Healthy and environmentally sustainable dietary behaviours among rural and urban Ugandan women of reproductive age in the context of the nutrition transition: a mixed methods study

By

Carolyn Imelda Auma

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The University of Sheffield
Faculty of Medicine, Dentistry and Health
School of Health and Related Research
Section of Public Health

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‘Far way in the sunshine are my highest aspirations. I may not reach them, but I can look up and see their beauty, believe in them, and try to follow where they lead’

(Louisa May Alcott)

PROJECT SUPERVISORS

Professor Michelle Holdsworth, School of Health and Related Research (University of Sheffield)

Dr Megan Blake, Department of Geography (University of Sheffield)

Dr Rebecca Pradeilles, School of Health and Related Research (University of Sheffield)

Fieldwork Advisor

Dr David Musoke, School of Public Health (Makerere University, Uganda)

DEDICATION

To my family, for keeping me going.

To my Sophia Alanna, you are my heartbeat.

To my Lord and Saviour Jesus Christ, apart from you I am nothing.

DECLARATION

I, Carolyn Imelda Auma hereby declare that this thesis is an original piece of work. No part of the work referred to in this thesis has been submitted in part or in entirety to any other university or institution of learning, other than the University of Sheffield, for the purpose of the award of an academic degree or any qualification of that sort.

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LIST OF CONFERENCES AND PUBLICATIONS

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Auma, C.I., Pradeilles, R., Blake, M., David, M. and Holdsworth, M. (2018). Oral Presentation. *Fieldwork Experiences from Uganda: A Novice Researcher's Foray into Photovoice*. Re-politicising Public Health: A Workshop for Early Career Ethnographers, King's College London, UK.

Auma, C.I., Pradeilles, R., Blake, M., David, M. and Holdsworth, M. (2018). Oral Presentation. *What Influences (un)Healthy and Environmentally (un)Sustainable Dietary Practices among Ugandan Women? A Qualitative Study using Photovoice.* Agriculture, Nutrition and Health (ANH) Academy Week and Conference, Accra, Ghana.

Auma, C.I., Pradeilles, R., Blake, M. and Holdsworth, M. (2018). Poster Presentation. *What do Ugandan Women Eat? A Health and Environmental Sustainability Perspective*. African Nutritional Epidemiology (ANEC) Conference, Addis Ababa, Ethiopia.

Auma, C.I., Pradeilles, R., Blake, M. and Holdsworth, M. (2018). Poster Presentation. *What do Ugandan Women Eat? A Snapshot of the Rural and Urban Dietary Landscape*. ScHARR PGR Conference, Sheffield, UK.

Auma, C.I., (2017). Poster Presentation. *Implications for Environmental Sustainability of Urbanisation and the Nutrition Transition: Perspectives from Rural and Urban Uganda*. Gratham Centre for Sustainable Futures Symposium, Sheffield, UK.

Publications

Auma, C.I., Pradeilles, R., Blake, M. and Holdsworth, M. (2019). What Can Dietary Patterns Tell Us about the Nutrition Transition and Environmental Sustainability of Diets in Uganda? *Nutrients*, 11(2), 342.

Nutritional Adequacy and Environmental Impact of the Dietary Intake of Rural and Urban Ugandan Women in Kampala and Wakiso.
Target Journal: Sustainability (In Preparation)

What Dietary Patterns and Dietary Typologies Exist Ugandan Women of Reproductive Age? An Exploratory Study in Urban Kampala and Rural Wakiso.
Target Journal: Nutrients (In Preparation)

Factors Influencing Dietary Practices of Ugandan Women of Reproductive Age: A Study of Four Dietary Typologies using Photovoice and Interviews.
Target Journal: Appetite (In Preparation)

ABSTRACT

Background: The aim of this mixed methods PhD was to explore the healthiness and environmental impact of the dietary behaviours of rural and urban Ugandan women of reproductive age (WRA) and identify factors influencing these behaviours.

Methods: In study one, principal component analysis was used to explore evidence for dietary transitions and describe Ugandan women's dietary patterns using secondary data. In study two, dietary data collected using a qualitative 24hr recall, were used to assess the healthiness and environmental impact of the dietary intake of WRA using nutrient profiling and greenhouse gas emission data. In study three, multiple correspondence analysis and cluster analysis were performed on data from study two to compare current dietary patterns with those from study one and categorise participants into dietary typologies. Study four established factors influencing women's dietary practices using Photovoice.

Findings: In study one, urban residency was associated with the '*transitioning, processed, low environmental impact*' (β=1.19 [1.06, 1.32]) and '*animal-based high environmental impact*' (β=0.45 [0.28, 0.61]) dietary patterns, but not with the '*plant-based low environmental impact*' pattern (β=-0.49 [-0.62, -0.37]). Some consistency was observed in dietary patterns identified from studies one and three. Study three identified four dietary typologies: '*urban, low-impact, early-stage transitioners*', '*urban, medium-impact, mid-stage transitioners*', '*rural, low-impact, early-stage transitioners*' and '*rural, low-impact, traditionalists*'. Study two suggested that urban and better educated WRA were more likely to consume healthy, lower impact foods. Study four identified convenience, meal balancing, perceptions, family, friends, food vendor reputation, availability and economic and physical access as key factors influencing dietary practices.

Conclusion: Ugandan WRA are experiencing early-mid stages in the nutrition transition. Family provides an avenue through which interventions aimed at impressing positive perceptions towards healthy and lower impact dietary practices can be targeted. Home gardens, urban farming and improved transportation can address challenges in availability and access to healthy, lower impact foods.

Key words: dietary patterns, dietary clusters, dietary practices, nutrient profiling, Photovoice, environmental sustainability, factors, women, Uganda

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ABBREVIATIONS AND ACRONYMS

CA	Cluster Analysis
CCC	Committee on Climate Change
EDNP	Energy-dense nutrient-poor
EU	European Union
FA	Field Assistant
FAO	Food and Agricultural Organisation of the United Nations
FGD	Focus Group Discussions
GHGE	Greenhouse Gas Emissions
HCA	Hierarchical Cluster Analysis
HES	Healthy and Environmentally Sustainable
HIC	High Income Countries
LCA	Life Cycle Analysis
LMIC	Low and Middle-Income Countries
MCA	Multiple Correspondence Analysis
NCDs	Non-communicable Diseases
NPA	National Planning Authority of Uganda
NR-NCDs	Nutrition-related Non-communicable Diseases
NT	Nutrition Transition
PCA	Principal Component Analysis
ScHARR	School of Health and Related Research
SES	Socioeconomic Status
SPSS	Statistical Package for the Social Sciences
SSA	sub-Saharan Africa
SSI	Semi-structured Interview
UBOS	Uganda Bureau of Statistics
UFCS	Uganda Food Consumption Survey
UK	United Kingdom
UN	United Nations

UNFPA	United Nations Population Fund
WCRF	World Cancer Research Fund
WHO	World Health Organization

GLOSSARY OF TERMS

Term	Definition
Dietary Behaviours	A term encompassing all aspects related to food choice, food consumption and dietary intake, including dietary patterns and practices (Stok et al., 2018).
Dietary Patterns	The various combinations of different foods, drinks and nutrients consumed in different amounts in the diet (Krebs-Smith, 2014).
Dietary Practices	Routinised behaviours around food and eating composed of several interconnected elements i.e. materials (e.g. food, cooking materials, structures, infrastructure), competence (e.g. food preparation skills) and meanings (understanding of social or cultural significance of food informed from past experience) (Reckwitz, 2002; Shove et al., 2012).
Eating Event	Food and drink consumed at one single point in time, including the 'situationally' in which that consumption occurred (Anderssen et al., 2003; Jastran et al., 2009). Eating events and eating occasions are used interchangeably in this thesis.
EquityTool	Short country-specific questionnaire used as a tool to assess the relative wealth of people by comparing their wealth to that of the national or urban population (Metrics for Management, 2016).
Food choice	This consists of factors and events that precede actual food consumption through the mouth, for example intentions, food purchasing and preparation (Stok et al., 2018).
Transition	The points at which an individuals' roles or statuses change. While transitions generally lead to minor changes in social practices (e.g. dietary practices), some transitions can become turning points that result in new trajectories in dietary practices and therefore dietary behaviours (Devine, 2005; Sobal et al., 2006).

ORGANISATION OF THE THESIS

Chapter 1 comprises a narrative literature review that highlights the three major subject areas that frame this PhD thesis, i.e. the nutrition transition, environmental impact of diets and healthiness of diets. Within the narrative literature review is interspersed a contextual background of the case study country, Uganda, a low-income sub-Saharan African (SSA) country. This chapter also highlights the socioecological framework model and the social practice theory that underpin the research. Following an overview of the literature and theoretical underpinnings, the chapter presents the research gaps identified, research questions arising from these, and research objectives through which the research questions are addressed. The rationale for carrying out this PhD research is also presented in this chapter.

Chapter 2 provides the researcher's epistemological position that informed the way in which this PhD research was carried out. The mixed methods approach adopted in this PhD is also presented. A summary of the different studies undertaken to answer research questions, and therefore meet the research objectives, identified in chapter one, is provided in this chapter.

Chapter 3 (study one) describes the principal component analysis (PCA) that was undertaken (i) to describe the dietary patterns of rural and urban Ugandan WRA using nationally representative dietary data from the Uganda Food Consumption Survey (UFCS) and (ii) to explore evidence for dietary transitions. The secondary dataset used, sampling method, data collection methods and steps undertaken in the PCA are described. Findings resulting from PCA are presented along with a discussion of the main findings from the study. Implications for policy and practice, resulting from the findings are highlighted.

Chapter 4 (study two) describes the nutrient profiling and environmental impact assessment that were carried out to assess the healthiness and environmental impact of the diets of a sample of rural and urban Ugandan WRA and explore the relationship between these and aspects of the eating practice. The methods used and findings are presented in this chapter. Implications for policy and practice, resulting from the findings are also highlighted.

Chapter 5 (study three) presents the multiple correspondence analysis and cluster analysis that were performed (i) to establish the current dietary patterns of rural and urban Ugandan WRA (which were compared with those obtained in study one) and (ii) to categorise rural and urban Ugandan WRA with similar dietary intakes into dietary typologies. The methods used, findings and implications for policy and practice are presented.

In Chapter 6 (study four), the Photovoice methodology, which was undertaken to explore individual-level and environmental-level factors that influence the dietary practices of rural and urban Ugandan WRA is presented. The methods used and findings are presented in this chapter. Implications for policy and practice, resulting from the findings are also highlighted.

In Chapter 7, the quantitative and qualitative studies undertaken in this mixed methods PhD are integrated within the context of the narrative literature review. By drawing on findings from similar studies in low and middle-income country (LMIC) contexts, this chapter highlights the contribution of this PhD thesis to the wider literature on healthy and environmentally sustainable diets in LMICs. Implications for policy and practice of the PhD findings are also presented.

1 CHAPTER ONE: LITERATURE REVIEW

This chapter gives an overview of the nutrition transition and the relationship between the dietary changes associated with the nutrition transition, health and environmental sustainability. The chapter first provides the scope for urbanisation, to provide context to the nutrition transition. Within this, a snapshot of urbanisation in the case-study country (Uganda) is provided, in comparison to regional and global trends. Next, the chapter presents the interrelationship between the nutrition transition, health and environmental sustainability. Following this, an overview of the theoretical perspective(s) that framed the research is described. The chapter concludes with a summary of the research gaps identified, and the research questions and research objectives that will be addressed in this thesis.

1.1 Urbanisation

Urbanisation is a shift in the population gradient between rural and urban areas fuelled by rural to urban migration, a reclassification of rural areas into urban areas and a natural increase in inherently urban populations, among other factors. Urbanisation is rising globally, with figures estimating that by 2030 about 5 billion people worldwide will reside in urban areas (UNFPA, 2007), i.e. approximately 60% of the global populace will be classified as urban dwellers, up from 54% in 2015; which could further increase to 66% by 2050 (UN, 2014; WHO, 2016). According to the United Nations (UN), more than 90% of future urbanisation is expected to occur in LMIC, such that by 2050 more than one in two Africans will live in urban areas; although these populations are currently described as largely rural (UNFPA, 2007; UN, 2014). To illustrate the scale of future urbanisation expected in SSA, the same UN report estimated that between 2014 and 2050, Nigeria's urban population would increase by 212 million people, an increase outpaced only by India and China (UN, 2014).

Although Uganda's most recent National Population and Housing Census reported that approximately 27 million people out of Uganda's 34.6 million-large population reside in rural areas, there are clear indications that Uganda's urban population is rapidly growing (UBOS, 2016). The World Bank, for example, estimates that given Uganda's current annual population growth rate of 4.5%, the urban population is set to exceed 20 million, from the current 7.4 million by 2040 (World Bank, 2015). Furthermore, Dorosh and Thurlow (2014) postulate that future urbanisation in Uganda will be driven, in part, by rural to urban migration, through which people annually populate Uganda's major cities [1] from smaller towns and rural areas. Additionally, the Uganda Bureau of Statistics (UBOS) in their 2014 report highlighted that urbanisation in Uganda could be partially attributed to the creation of new districts (112 from 80) (UBOS, 2014). This resulted in the conversion of many new administrative areas into town councils and town boards, which qualify as urban

[1] Kampala, Entebbe and Mukono

areas (UBOS, 2014). While Uganda's capital city, Kampala, currently houses 31% of the total urban population, the rest of Uganda's urban populace reside in 27 countrywide urban establishments, each having a population of at least 50,000 (World Bank, 2015; UBOS, 2016).

Urbanisation has been closely associated with development (Delislé, 1990) and therefore it is a top priority in Uganda's future development plans according to the Uganda National Planning Authority (NPA) (NPA, 2015). Their vision for Uganda discusses the Ugandan government's commitment towards growing the Ugandan economy from low-income to a middle-income country by 2040 (NPA, 2015). As part of this effort, one regional city has been planned for each of Uganda's four geographical (and ethnically diverse) regions in addition to five strategic cities nationwide (NPA, 2015). This, coupled with the increasing growth of smaller Ugandan towns in Uganda's urban landscape reported by some authors (Dorosh and Thurlow, 2014; World Bank, 2015) would suggest that the country is at the cusp of a future urbanisation boom.

Pertinent to public health nutrition, and the wider nutrition field, is the relationship between urbanisation and health through a phenomenon called the nutrition transition. Having defined urbanisation in the previous section, the next section now turns to the relationship between urbanisation and the nutrition transition.

1.2 The Nutrition Transition

The nutrition transition (abbreviated hereafter as NT) is a population-wide change in dietary patterns, nutrient intakes and physical activity resulting from acculturation, economic, political and social development and the adoption of 'modernised' lifestyles concomitant with urbanisation (Popkin, 2001; Amuna and Zotor, 2008; Vorster et al., 2011). Delislé (1990) argues that with urbanisation comes varying degrees of 'modernisation' and 'westernisation', which can have consequences for dietary habits. To this end, Ebrahim and Smeeth (2005) and Tilman and Clark (2014) identify urbanisation and the increasing incomes resulting thereof, as a significant influence in the so-called 'westernisation' of dietary habits and lifestyles.

Popkin (2002a) proposes a framework, which illustrates that change in dietary practices, consonant with the NT, occurs through a five-stage process. The first two stages, i.e. 'collecting food' and 'famine' are precursors to the actual NT (Popkin, 2006). The collecting food phase (stage one) is characterised by dietary patterns that are plant-based and primarily revolve around varied, carbohydrate-based foods, coupled with intake of low-fat wild animals (Popkin, 2002a; Popkin, 2006). The famine phase (stage two) is characterised by a less varied, cereal-rich diet and increasing food scarcity (Popkin, 2002a; Popkin, 2006). The later three later stages shown in Figure 1.1 are typically characteristic of the NT.

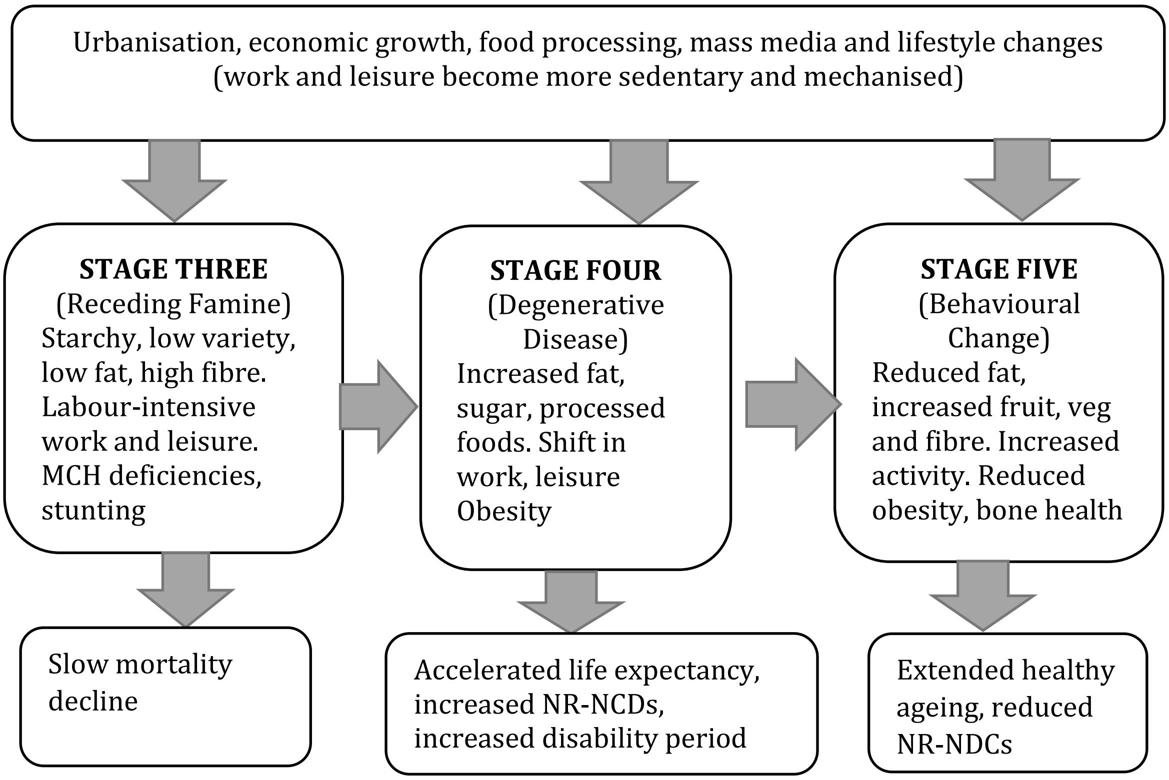

Figure 1.1: Stages in the Nutrition Transition (adopted from Popkin, 2002a)

In stage three (receding famine), intake of fibre is still high although diet variety is still somewhat low (Figure 1.1). Stage four (degenerative disease) is characterised by increased intake of sugar, fat and processed foods (Figure 1.1). The fifth stage (behavioural change) is characterised by increased intake of fruit, vegetables and dietary fibre (Figure 1.1).

The NT is not a new phenomenon, having already firmly rooted itself in high-income countries (HIC). However, Popkin et al. (2012) argue that the NT, i.e. stages three and four, is rapidly taking hold in LMIC in Africa, Asia, the Middle East and Latin America. Moreover, in a much earlier paper, Popkin (2002b) proposed that the NT in LMIC, unlike that observed in HIC, is occurring more rapidly and at lower socioeconomic levels. Findings from research conducted in China illustrate the NT in LMIC. Popkin (1999a), demonstrated that the urban Chinese diet was not only increasing in diversity but was increasingly adopting more ‘westernised’ aspects, i.e. increased refined carbohydrates, meat and edible oil and fat intake coupled with low dietary fibre intake. This is typically characteristic of stages three-four of the NT (Figure 1). Using longitudinal data from the 1989, 1991 and 1993 China Health and Nutrition Surveys (CHNS), the author demonstrated that the ‘traditional’ low-fat Chinese diet was losing relevance as the ‘westernised’ diet gained more prominence among high-income urban populations compared with rural and low-income urban populations. These trends, however, might change following the Chinese government’s recent plan to reduce meat consumption by half (CNS, 2016). This would move China to the behavioural change (phase five) of the NT (Figure 1). Various other authors have shown similar trends in the NT in Mexico and Brazil (Rivera et al., 2004; Perez-Ferrer et al., 2018).

While the NT in China is undisputed, from a regional perspective, the NT in SSA is contentious. While the bulk of research to-date is indicative of some dietary change in SSA, some authors disagree that the NT is underway. For example, Bosu (2015) reported that the total per capita dietary energy supply and dietary composition in West Africa is not suggestive of any NT at the national level (Bosu, 2015). Evidence from other authors, however, indicates that the NT in SSA appears to be following a similar pattern as in China, i.e. rapidly advancing from stage three to four (Figure 1) (Popkin, 2004; Abrahams et al., 2011). For example, the NT in South Africa has been well documented (Vorster et al., 2005; Steyn et al., 2012), while Steyn et al. (2012) found evidence that Kenyan and South African women, although from different geographical regions, were experiencing similar stages in the NT. Another study, which looked at changes in consumption of healthy and unhealthy food items [2] globally, reported a general reduction in vegetable, trans-fat, unprocessed meat and wholegrain consumption in most regions, accompanied by a general increase in fruit, milk, sugar-sweetened beverages and processed meat consumption between 1990 and 2013 (Masters, 2016). However, while all other regions in the period under study saw an increase in the consumption of nuts and seeds, SSA particularly reported a decline in their consumption; as well as a reduction in fish and seafood (Masters, 2016).

In East Africa, where Uganda is located, Raschke and Cheema (2007) and Byaruhanga and Opedun (2008) in part substantiate propositions about the NT taking hold. The authors both reported a dietary transition in East African countries from as early as colonial times. Further to this, a cross-sectional study based on national food consumption data (Abrahams et al., 2011) established that Uganda was experiencing the early stages of the NT, although the authors made no conclusions on the extent to which these findings varied between rural and urban areas. Nevertheless, an important conclusion drawn by the author was that in 3-5 years, following the paper's publication, Uganda could be expected to move into later stages of the NT if food consumption trends did not change (Abrahams et al., 2011).

More recently, a cross-sectional study by Imamura et al. (2015) reported that although the diet of adult Ugandan men and women had improved in recent decades (1990-2010) in terms of increased consumption of healthy foods, the consumption of unhealthy foods had increased even more significantly. In the same year, another study on dietary changes between 1990-2010, demonstrated that, based on FAO food balance data, in 2010 Ugandan adults older than 20 years of age, showed higher

[2] Unhealthy food items included trans-fat, sodium, sugar-sweetened beverages, red meat and processed meat while healthy items included fruits, vegetables, seafood omega 3 fats, milk, nuts and seeds, poly-unsaturated fatty acids and fibre (Masters 2016).

availability of fruit, nuts and seeds, seafood, unprocessed red meat and processed red meat and lower consumption of vegetables relative to the regional average (Micha et al., 2015). The same study reported that wholegrain consumption among Ugandan adults was approximately 85% lower than the regional average, which the authors partially attributed to the increasing replacement of traditional cereals with refined cereals (Micha et al., 2015). Although these findings are suggestive of the NT in Uganda, it must be stressed that these findings are based on FAO food balance sheet data that are at best reflective of food supply and availability but not actual food distribution and consumption (FAO, 2001).

While a country could be described as undergoing the NT, different locations, e.g. rural and urban within the same country might be at different stages in the NT (Abrahams et al., 2011; Steyn et al., 2012). Popkin (1999b) proposes that this rural-urban dietary divide is more apparent in LMIC than HIC due to better food distribution in HIC, reducing dietary inequality compared with LMIC (Popkin, 1999). It should be noted, however, that better food distribution does not necessarily equate to consumption. Regardless of developmental context, the consensus is that because urban residents have increased and better access to a wider diversity of foods, they are more likely to consume a higher proportion of low-fibre grains, saturated fat, sugar, animal products and ultra-processed foods (Popkin and Bisgrove, 1988; Popkin, 1999; Abrahams et al., 2011; Popkin et al., 2012). Urbanites are also more likely to eat out (Popkin and Bisgrove, 1988; Popkin et al., 2012). Data from Uganda, as early as the 1970s, observed differences in rural and urban consumption, with urban residents consuming more imported refined cereals and carbonated, sweetened beverages and fewer traditional staples than their rural counterparts (Oltersdorf, 1971). More recently, it has been suggested that these differences may still exist (Benson et al. 2008, Haggblade and Dewina, 2010; Pomeroy and D'Agostino, 2014). This is reinforced by findings from a study by Tschirley and colleagues, using household food expenditure data from Uganda, Ethiopia, Mozambique, Tanzania and South Africa. The authors reported that while the share of the food budget spent on processed food in these countries in 2010 was 40.6%, urban households spent a higher proportion of their food budgets on processed food than did rural households (64.2% vs. 30.6%) (Tschirley et al., 2015). Additionally, urban households spent a larger proportion of their food budget on highly processed food, e.g. vegetable oils, canned fruit and fish, bread, biscuits and food away from home, compared with rural households (38.3% vs. 14.3%) (Tschirley et al., 2015). The authors further projected that the proportions of household expenditures spent on processed foods in these countries would increase by 2040 as these countries' economies grow. Important to note, however, is that while household expenditure provides a general snapshot of availability, it does little in the way of elucidating on actual food consumption patterns within the household, i.e. who eats what, when and how much.

The following section summarises the literature on the possible health-related impacts of NT-related dietary changes. This is followed by potential implications of these dietary changes for environmental sustainability.

1.2.1. Health Implications of Dietary Changes Associated with the Nutrition Transition

Gill et al. (2015) propose that some dietary changes associated with the NT could be beneficial to nutritionally vulnerable populations. When such populations have access to diversified diets that are more affordable, they are more likely to meet their nutritional needs (Gill et al., 2015). This is particularly important for those nutrients that are deficient in some foods, such as vitamin B12. In these instances, a moderate increase in, for example, eggs, fish, meat and dairy products intake could provide high-biological value protein and important micronutrients like haem-iron, vitamin B12, and zinc (Bouvard et al., 2015; Gill et al., 2015), thereby preventing micronutrient deficiency while meeting macronutrient requirements.

Despite its potential benefits to human health, however, many authors emphasise the association between the NT and health through nutrition-related non-communicable diseases (NR-NCDs) (Ebrahim and Smeeth, 2005; Vorster et al., 2011; Islam et al., 2014; Tilman and Clark, 2014). Non-communicable diseases (NCDs), e.g. cardiovascular diseases, cancers and type 2 diabetes, are chronic diseases that are largely associated with lifestyle factors, such as tobacco use, unhealthy diets, inadequate physical activity and excessive alcohol use, which are seen as 'inescapable' by-products of economic growth, rapid urbanisation and 'westernisation' lifestyles (Dalal et al., 2011; WHO, 2011). NR-NCDs are a sub-set of NCDs primarily associated with unhealthy diets and inadequate physical activity.

Islam et al. (2014) highlight that most deaths worldwide can be attributed to NCDs. To this end, the World Health Organization (WHO) has reported an increase in the number of NCD-related deaths in every global region since 2000, with nearly 75% of these deaths in 2012 occurring in LMIC (WHO, 2014). This is corroborated by the 2013 Global Burden of Disease Study (Naghavi et al., 2015), which states that most countries worldwide have seen a major shift away from communicable diseases towards increased NCD-related deaths. This shift in disease burden from communicable to NCDs, termed the epidemiological transition, occurs in tandem with the demographic transition, i.e. reduced mortality and low birth rate and occurs in parallel with the NT. The epidemiological transition in LMIC including SSA, presents a future public health crisis unless averted (Dalal et al., 2011; Naghavi and Forousanfer, 2013). Moreover, unlike previously observed in HIC, NCDs are no longer a reserve for the affluent, but are now increasingly prevalent among the poor in LMIC (Dalal et al., 2011). In LMIC, NCDs kill at a younger age compared with HIC, presenting a potential problem for economic growth. This is exacerbated by the fact that in LMIC contexts, there is a vicious cycle at play. A lack of resources exposes people to risk factors for NR-NCDs, e.g. eating cheaper energy-dense, nutrient-poor (EDNP) foods leading to NR-NCDs, which then drives individuals and households into poverty as they strive to meet the costs associated with treating and managing these chronic diseases (WHO, 2011). Evidence from Uganda indicates that NCDs are increasing in prevalence because of unhealthy lifestyles, increasingly ageing populations and metabolic side effects from prolonged use of antiretroviral drugs (ARVs) in the management of HIV/AIDS (UBOS, 2014). Moreover, wealthier Ugandans are almost twice as likely to develop NCDs compared with poorer Ugandans (UBOS, 2014). Indeed, recent figures from the NPA estimated that almost 50% of adults in Kampala, the capital, were overweight or obese compared with only 1% in Karamoja, the poorest region (NPA, 2015).

Although research indicates that many SSA countries have already entered the NT, in SSA, women between 25–44 years are more vulnerable to overweight and obesity, which are consonant with the NT (Mbochi et al., 2012; Steyn and Mchiza, 2014). Indeed, in settings undergoing the NT, a gender divide exists in the prevalence of overweight and obesity (Hansford, 2010), i.e. low-income women are particularly vulnerable to overweight or obesity. In Uganda, the literature suggests that NR-NCDs, e.g. type 2 diabetes, obesity and overweight disproportionately affect WRA (15–49 years). Findings from a national survey found that approximately 19% of Ugandan WRA were either overweight or obese, with the prevalence rising with education and wealth (NPA, 2015). Conversely, the findings from the same survey estimated that only 5% of men within the same age group were either overweight or obese (NPA, 2015). Furthermore, a study that used data from a WHO STEPwise Approach to Surveillance (STEPS) survey estimated that although 29.4% of Ugandan adults (18-69 years) had raised blood pressure there was no significant difference between male and female or rural and urban prevalence (Guwatudde et al., 2015). Importantly, findings from the same WHO STEPS survey suggest that adult Ugandans are highly physically active, based on the WHO recommendations for physical activity for health (GoU/WHO/UNDP/World Diabetes Foundation, 2016). This suggests that diet, and not physical activity, could be the most important modifiable factor influencing the prevalence of NR-NCDs among Ugandan WRA. What is unknown, however, is how women's physical, social and cultural environments influence diets.

The aforementioned higher prevalence of obesity and some NR-NCDs among Ugandan WRA is counterintuitive, given that women are commonly referred to as the 'gate keepers' of food and nutrition security within the household (Byaruhanga and Opedun, 2008). This, coupled with the high prevalence of under-nutrition and vitamin A and iron deficiency anaemia (GoU, 2011), makes WRA particularly nutritionally vulnerable. The health and nutritional status of WRA is of interest in public health nutrition since it has been proposed that a mothers' nutritional status pre- and during pregnancy profoundly influences that of their children even later in adulthood (Barker, 2004). Moreover, the fact that many pregnancies in Uganda are unplanned, e.g. about 50% in 2013 (Hussain, 2013) highlights the importance of achieving good nutritional status among this population sub-group in the event of unforeseen pregnancy. The focus on WRA is important given that, adolescence (15-19 years) is a particularly vulnerable period of tremendous physical, behavioural and physiological changes (WHO, 2005; del Mar Bibiloni et al., 2013). Because adolescents have a heightened curiosity, they are keen to try new ideas and express their independence, such as by changing their dietary behaviours (WHO, 2005). Therefore, while adolescence presents an opportunity to correct some nutritional problems that might have originated in childhood, it is a precarious stage because there is a strong possibility that dietary behaviours developed at this stage may last into adulthood (WHO, 2005). On the other hand, adulthood is characterised by various transitions, turning points and events, e.g. employment, marriage and parenthood that could result in changes in dietary behaviours (Devine, 2005; Sobal et al., 2006; Paddock, 2015). Lastly, the fact that Ugandan women, like those in many SSA contexts, are responsible for food-related activities within the household, suggests that ensuring that they have healthy and sustainable diets could have positive impacts on diets of other household members.

The next section highlights the implications of NT-related dietary changes for environmental sustainability.

1.2.3 Environmental Sustainability Implications of Dietary Changes Associated with the Nutrition Transition

Sustainability is a complex, multifaceted concept as highlighted by the Brundtland Report, which stressed the three-fold components that underpin sustainable development, i.e. environment, economy and society (Brundtland, 1987). This was reiterated at the Johannesburg 2002 World Summit on Sustainable Development. At this conference, delegates made the following declaration:

> "*…assumed a collective responsibility towards advancing and strengthening the interdependent and mutually reinforcing pillars of sustainable development – economic development, social development and environmental protection – at the local, national, regional and global levels*" (UN, 2002: p1)

Notwithstanding this complexity, Garnett (2014a) states that sometimes sustainability focuses only on the environmental dimension. This is the approach taken by the bulk of current food and non-food related sustainability research. The focus in food-related research on '*sustainability as the environment*' is unsurprising given recent evidence that food production accounts for up to a third of greenhouse gas emissions[3] (GHGE) in HIC and is the leading cause of forest-cover loss, land use

[3] Greenhouse gases are anthropogenic gases that have been implicated in global warming, e.g. methane (CH_4), carbon dioxide (CO_2) and nitrogen dioxide (N_2O)

change, biodiversity loss and water pollution globally (Garnett, 2014a; 2014b; Bailey and Harper, 2015). Additionally, food production uses more than 50% and 90% of the total fresh water in HIC and LMIC respectively (Bailey and Harper, 2015). Furthermore, given the inefficiency of the current global food system, vast amounts of food waste along the food chain translate into unnecessary environmental expense as the resources and environmental cost incurred in its production is wasted (Macdiarmid, 2013; Lawrence et al., 2015).

Evidence suggests that within the food production chain not all sectors have the same impact on the environment. It has been argued that the livestock industry contributes more towards GHGE than the transport sector (air, land and marine) (Bailey and Harper, 2015; Bajželj et al., 2015; Willett et al., 2019). This has generated the notion that livestock-based diets are generally more environmentally destructive than plant-based diets (Macdiarmid, 2013; Willett et al., 2019). This presents a challenge, given that rising global incomes, commensurate with urbanisation, generally translate into increased demand for more varied and animal-rich diets (Bene et al., 2015). To this end, Tilman and Clark (2014) postulate that by 2050, if global diets increasingly incorporate more animal-based foods, the food chain will contribute towards an estimated 80% of agricultural GHGE. Moreover, a 2011 Foresight report projected that the share of GHGE among LMIC is set to increase depending on how their per capita dietary practices converge towards the 'westernised' dietary pattern that is congruent with the NT and urbanisation (Foresight, 2011).

It has also been argued that aside from increased environmental impact (GHGE) that could result from increasing demand for animal-source protein, a potentially complex food security conundrum in which grains, e.g. wheat, barley, maize and soya are produced to feed intensively-reared animals at the expense of human needs (Foresight, 2011; Bajželj et al., 2015). Vanham et al. (2013) have already described current food consumption trends in HIC as unhealthy and unsustainable. In these countries, animal protein consumption levels are twice or sometimes three times the dietary recommendations (Vanham et al., 2013). This increases the likelihood of NR-NCDS, e.g. colorectal cancer (Aston et al., 2012), while also negatively affecting the environment through increased GHGE (Bajželj et al., 2015). In SSA, therefore, the dietary transition towards 'westernised' diets, characteristic of many HIC, although could be beneficial for health particularly among rural populations where animal product consumption is low, presents a looming environmental sustainability and health concern. Moreover, if sustainability is considered in its entirety, it is fair to propose that this dietary transition could have wider effects than on health and environment, but could have knock-off impacts on other areas, such as ethics, social well-being and economic development (Garnett, 2014a). This could explain why Tilman and Clark (2014) describe the global dietary transition as one of the greatest challenges facing humanity, owing to its direct effects on both health and the environment.

Healthy and environmentally sustainable (HES) diets are proposed as a possible solution to this diet-health-environment conundrum (Willett et al., 2019). The reported health benefits of HES diets include a reduction in the risk of developing NR-NCDs while keeping environmental impact within acceptable limits (Scarborough et al., 2012; Payne et al., 2016a). Health attributes of HES are largely attributable to a reduction in saturated fat, cholesterol and sodium intake, coupled with increased intakes of health-promoting fruit, vegetables and other plant-based foods, while still meeting population-specific energy requirements (Payne et al., 2016a). Various authors (Garnett and Strong, 2013; Garnett, 2014a; Auestad and Fulgoni, 2015; Payne et al., 2016a; Willett et al., 2019) have extolled the potential benefits of HES diets, however, there is as yet no consensus on its practicality to the average consumer, due to the complex nature of sustainability (Lukas et al., 2013; Macdiarmid, 2013). It is therefore imperative to first gain an in-depth understanding of what HES diets look like before they are incorporated into public health policies. The Food and Agricultural Organisation (FAO) have defined sustainable diets as:

> ‘’*Sustainable diets have low environmental impact and contribute to food and nutrition security and healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy, while optimizing natural and human resources*’’ (FAO, 2010: p7)

Further to this, several HES dietary practices have been proposed by various authors, including reducing food waste, eating local and seasonal, reducing sugar, palm oil, processed and unprocessed red meat and consuming a varied diet based on wholegrain, legumes and fresh roots, tubers, fruit and vegetables (Bailey and Harper, 2015; Garnett et al., 2015). Additionally, despite the apparent murkiness around HES diets, there appears to be a consensus that policy initiatives geared towards promoting these diets should be context-specific. For example, policies in HIC should focus on reducing over-consumption (Garnett et al., 2015). For LMIC, many of which are still yet to address challenges of under-nutrition and micronutrient deficiency, guidelines for HES from HIC may have limited transferability. In such LMIC contexts, increased consumption of animal products may be necessary (Bajželj et al., 2015; Gill et al., 2015) to offset the nutritional inadequacy of the diets of some population sub-groups, such as WRA, growing children and the urban-poor. This highlights the importance of balance between health and environmental concerns in as far as HES diets are concerned.

As highlighted in this section, HES diets must be nutritionally adequate. In order to determine the nutritional adequacy (healthiness) of such diets, information on dietary data is required. The next section describes the methods used to collect dietary intake data in the field of nutrition. Following this is a description of methods used to assess the nutritional adequacy of diets is provided. Lastly, a summary of methods used in the assessment of the nutritional adequacy (healthiness) of HES diets is presented.

1.3 Estimating the Dietary Intake of Individuals

Dietary intake is estimated using a variety of laboratory and field dietary assessment methods (Rutishauser, 2005). Laboratory methods make use of biomarkers as a proxy for actual nutrient intakes and are usually physically intrusive, such as in the case of blood and tissue assays to determine micronutrients (Rutishauser, 2005; Shim et al., 2014). Although laboratory methods are often termed as objective dietary assessment methods, they are generally more expensive and require sophisticated equipment and expertise. For these reasons, they are rarely used in LMIC (Gibson, 2005; Rutishauser, 2005; Shim et al., 2014). In LMIC contexts, as well as in most HIC, field dietary assessment methods are commonly used because they are less intrusive and less expensive. A variety of field dietary assessment methods exist, e.g. food records, food frequency questionnaires (FFQs) and dietary recalls (Thompson and Byers, 1994). Field dietary assessment methods are either retrospective (capturing past dietary intake), e.g. 24-hour recall, diet history and FFQ or prospective (capturing current dietary intake), e.g. menu record and estimated and weighted food records (Rutishauser, 2005).

In prospective dietary assessment methods, participants are asked to keep a detailed account of all foods and drink they consume over a given time period. Prospective dietary assessment methods are more likely to give an accurate picture of an individual's actual dietary intake than retrospective methods (Gibson, 2005; Rutishauser, 2005). Notwithstanding, one major limitation of these methods is that depending on the length of time for which participants are engaged in data collection, they may not provide an actual picture of habitual dietary intake due to their high respondent burden and time-consuming nature that could influence the reporting of foods (Thompson and Byers, 1994; Gibson, 2005; Rutishauser, 2005). The high respondent burden means there is a likelihood that participants might misestimate dietary intakes where weighing or estimation is required. Another limitation of prospective dietary assessments is the likelihood that participants might alter their dietary intake for the period of data collection. Lastly, these methods require participants to be literate, i.e. read instructions, record foods consumed and estimate or weigh foods accurately (Thompson and Subar, 2013). This means that such methods have limited applicability in contexts with high illiteracy levels, e.g. rural areas in many LMIC.

In retrospective dietary assessment methods, individuals are asked to recall all food and drink consumed over varying periods of time. These methods are either self- or interviewer-administered. Two of the commonest retrospective dietary assessment methods used are the FFQ and the 24hr dietary recall. In FFQs, individuals are asked to recall the frequency with which they have consumed certain food items of food groups, from a pre-determined list, over different time periods, up to 1 year (Thompson and Byers, 1994; Gibson, 2005; Thompson and Subar, 2013). The advantage of the FFQ is that it has less respondent burden and is less likely to alter dietary behaviour since it is a recall of past intake (Thompson and Byers, 1994). Additionally, because it is relatively cheap to administer, the FFQ is often used for population-level studies (Thompson and Subar, 2013). The main limitation of the FFQ is its heavy reliance on respondent recall, which can be problematic if the recall period is too long (Thompson and Byers, 1994; Thompson and Subar, 2013). Additionally, this method, when self-administered, requires respondents to be literate (Thompson and Byers, 1994). Furthermore, although the FFQ offers the possibility of capturing habitual dietary intake, this requires a context-specific and comprehensive food list (Thompson and Subar, 2013). This can be problematic in the case of seasonal or wild foods or in contexts where data on types of food consumed are scarce, e.g. LMIC.

The quantitative 24hr dietary recall is the most common retrospective dietary recall methods used in the field of nutrition (Rutishauser, 2005; Shim et al., 2014). The 24hr recall is used frequently because it is cheap, relatively easy to administer, less physically intrusive, does not depend on literacy and has low respondent burden (Gibson, 2005; Rutishauser, 2005; Thompson and Subar, 2013). This makes it particularly applicable to LMIC, such as Uganda, in which resources are limited, and literacy levels might be low. Additionally, the short recall period of the 24hr recall reduces the likelihood of recall bias (Rutishauser, 2005). In the 24hr recall method, the participant is asked to recall and describe in detail all food and drink they consumed in the 24 hours preceding the interview (Rutishauser, 2005; Thompson and Subar, 2013; Shim et al., 2014). While the 24hr recall can provide data on actual dietary intake over the 24-hour period, it is limited in that it does little to provide an estimate of habitual dietary intake (Rutishauser, 2005; Shim et al., 2014). To elicit information on habitual intake, authors propose a repeat 24-hour recall carried out over two or more non-consecutive days, including one weekend day, to account for within week variation (Gibson, 2005; Rutishauser, 2005). Other limitations of the 24-hour recall are that it is highly dependent on the interviewer's skill to prompt recall is prone to interviewer bias and can be time-consuming (Shim et al., 2014). Lastly, since the 24hr recall requires an estimation of quantities consumed, it is also prone to social desirability bias (Shim et al., 2014).

The 24hr recall method is quantitative in nature, i.e. estimating amounts of foods consumed, however, a variation of the method in which quantities of food or drink consumed are not estimated, known as a 'qualitative 24hr recall' can be used (Webster-Gandy et al., 2012). The 'qualitative 24hr recall method' is conducted in the same way as the conventional 24hr recall, therefore it provides the same advantages described previously. However, the method also provides the allowance to explore contextual dimensions around dietary behaviours related to each of eating events in the recall period, e.g. length of eating occasion, place of eating occasion. It is for these reasons, as well as those highlighted previously regarding the strengths of the quantitative 24hr recall method, that the qualitative 24hr recall method was used in this PhD.

The next section describes methods used in the assessment of the nutritional adequacy of dietary intake.

1.4 How is the Nutritional Adequacy of Diets Assessed?

In the field of nutrition, the nutritional adequacy (healthiness) of diets has conventionally been assessed through the measurement of health outcomes from single foods and (or) individual nutrient intakes (Newby et al., 2003). In their 2014 paper, de Carvalho and colleagues highlight why this approach may be short sighted. The authors argue that owing to the complexity of the relationship between diet and health, it is inadequate to attribute health outcomes to a single dietary component. To this end, some authors have proposed that looking at diets in terms of dietary patterns may have more relevance for public health in so far as nutrition education is concerned (Crozier et al., 2006; Northstone et al., 2014). To this end, Crozier et al. (2014) argue that because different foods are frequently eaten together, it is difficult to extract the effect of a singular food or nutrient on health. Some authors (Hearty and Gibney, 2009; Smith et al., 2013) propose that looking at diet through a dietary pattern lens offers a more holistic and perspective of actual dietary practices in everyday life, as it sheds light on which foods are eaten together. de Carvalho et al. (2014) propose that this might be because such dietary patterns are more reflective of food choices, as a product of the individual's interaction with a myriad individual-level and environmental influences.

The dietary pattern approach capitalises on collinearity, i.e. high correlation between different foods that are consumed together (Crozier et al., 2006). The assessment of nutritional adequacy of diets based on dietary patterns is carried out using two main approaches, i.e. *a priori* and *a posteriori* (Hoffmann et al., 2004; Keding et al., 2011). Both *a priori* and *a posteriori* approaches have been used in the exploration of nutritional adequacy of diets in various contexts. The *a priori* approach, also called the hypothesis-driven approach, involves the use of measures like indices or diet-quality scores. Examples of such indices or scores include the Healthy Eating Index (HEI) (Kennedy et al., 1995), the Diet Quality Index International (DQI-I) (Kim et al., 2003) and the Dietary Diversity Score (DDS) (FAO and FHI360, 2016), among others. These indices or scores are based on pre-established recommended dietary patterns, e.g. Mediterranean diet or evidence-based dietary guidelines (Hoffman et al., 2004; Keding et al., 2011). The *a posteriori* approaches (data-driven approach), on the other hand, is more exploratory in nature. This approach involves the generation of dietary patterns using data available at the time of a study (Hoffmann et al., 2004). The most common *a posteriori* methods used in nutrition include factor analysis (FA), principal component analysis (PCA) and cluster analysis (CA) (Hoffman et al., 2004; Keding et al., 2011; Lim et al., 2014). More recently, some authors have explored the use of other methods, e.g. reduced rank regression (RRR) (DiBello et al., 2008; Frank et al., 2015) and multiple correspondence analysis (MCA) (Guinot et al., 2001; Krieger et al., 2018).

The next section provides a brief description of common *a posteriori* (data-driven) methods used in nutrition. Following this, a brief description of hypothesis-driven methods is presented.

1.4.1 Data-Driven (*A posteriori*) Approaches to the Assessment of the Nutritional Adequacy of Diets

As previously, stated, commonly used (*a posteriori*) data-driven methods in diet quality assessment include principal component analysis (PCA), factor analysis (FA), and cluster analysis (CA). More recently, less common methods like multiple correspondence analysis (MCA) and reduced rank regression (RRR) have been used. Regardless of the analysis method, the underlying principle of data-driven methods is data reduction.

Northstone et al. (2014) describe principal component analysis (PCA) as a 'powerful' dietary pattern analysis method. In PCA, dietary data is reduced into smaller subsets (principal components) based on the correlation between the different input variables (food items or food groups) (Northstone et al., 2014). Each resulting principal component describes a unique dietary pattern, explaining as much of the variation in the dietary data as possible (Smith et al., 2013). The dietary patterns described by each principal component are interpreted based on factor loadings, which are the correlations between the principal component and each input variable. In most of the literature, factor loadings with magnitude of at least ±0.2 are considered in describing dietary patterns (Annan et al., 2015; Mayen et al., 2016). To this end, large positive or large negative factor loadings indicate food items or food groups that are important in describing that principal component (dietary pattern). Since the principal components formed from PCA are "*linear combinations of the input variables*'', they are still reflective of the entire dietary data set (Smith et al., 2013). These linear combinations allow for the computation of a score for each participant, in the dataset, on each principal component (Smith et al., 2013). The higher the total score, the more likely this principal component, and thus dietary pattern, represents an individual's actual diet (Smith et al., 2013). The strength of PCA is that it is reflective of the correlations among various foods or food groups (Marchioni et al., 2005; Northstone et al., 2014) within the data. While PCA has been used to explore the nutritional adequacy of the diets of children, adolescents and adults in in HIC, its use in LMIC, particularly in SSA remains limited, although a few authors have employed the method. For example, PCA has been used in exploring the nutritional adequacy of the diets of HIV+ and HIV- adults in South Africa (Annan et al., 2015); adults in Benin (Becquey et al., 2010); rural women in Tanzania (Keding et al., 2011) and more recently, adults in the Seychelles (Mayen et al., 2016).

Factor analysis (FA) is sometimes referred to as PCA. The goal of FA, like PCA, is to reduce a large dataset into fewer non-correlated groupings called factors by taking advantage of the correlation between input variables (Marchioni et al., 2005). Much like PCA, the factors formed from FA are referred to as dietary patterns and are still reflective of the entire data set. By performing FA on dietary data, the underlying structures within the initial data matrix can be identified and a measurement of the adequacy of the diet can then be obtained (Marchioni et al., 2005; Bojorquez et al., 2015). FA, like PCA, offers the advantage of considering the diet in its entirety. FA can be either confirmatory or exploratory, each of which is suited to answering different research questions (Marchioni et al., 2005). When the researcher is unsure of the number and nature of factors (dietary patterns) to expect from the dietary data, exploratory FA is ideal (Marchioni et al., 2005). In instances where the researcher knows beforehand how many factors to expect, confirmatory FA acts as a proof of sorts (Marchioni et al., 2005). Although exploratory FA has been used in various contexts to explore dietary patterns among adults and adolescents, e.g. Bojorquez et al. (2015) in the USA and Venekaiah et al. (2011) and (2015) in India, its use in SSA is limited.

Multiple correspondence analysis (MCA) is a relatively new, robust multivariate analysis technique used in the analysis of non-parametric data (Aounallah-Shkiri et al., 2011; Hair et al., 2014). MCA is one of many descriptive methods (Costa et al., 2013). However, while other descriptive multivariate techniques like PCA and FA (described previously) are used in the analysis of continuous data, MCA allows for the exploration of non-linear relationships in categorical data (Guinot et al., 2001; Hair et al., 2014; Mori et al., 2016). Mori et al. (2016) write that MCA performs a similar function to PCA by summarising a large dataset into smaller components, thus, MCA is sometimes described as an extension of PCA for categorical variables (Mori et al., 2016). To this end, Guinot et al. (2001) write that MCA essentially becomes like PCA when all variables involved in the analysis are binary in nature. MCA is unique from other descriptive methods in that it allows for the formation of maps on which the proximities between subjects (participants) and the variables categories input in the analysis can be observed (Guinot et al., 2001; Hair et al., 2014). MCA is largely exploratory in nature and is advantageous in that it does not require that many of the assumptions required in other multivariate techniques are fulfilled, e.g. sample size requirements (Aounallah-Shkiri et al., 2011; Costa et al., 2013; Hair et al., 2014; Di Franco, 2016). The descriptive components (dimensions, typologies, principal components) produced at the end of the MCA are what become the dietary patterns (Guinot et al., 2001; Aounallah-Shkiri et al., 2011).

Cluster analysis (CA) is a data-driven descriptive multivariate analytical technique (Conti et al., 2004; Reedy et al., 2010; Green et al., 2015a). CA allows for the meaningful aggregation, into groups (clusters), of individuals based on their characteristics (Conti et al., 2004; Hair et al., 2014; Green et al., 2015a). At its core, CA takes advantage of both similarities between individuals within a cluster and differences between individuals across different clusters (Hair et al., 2014). This means that while the individuals constituting each cluster bear similarities with each other, they are different from individuals belonging to other clusters (Hair et al., 2014; Sarstedt and Mooi, 2014). Reedy et al. (2010) propose that large clusters are suggestive of traits shared by many cases (participants) while small clusters are indicative of traits shared by only a few, who might be considered outliers. It has been argued that CA and FA are similar, the main difference being that while ''*CA groups together individuals or cases based on proximity, FA or PCA groups together variables based on correlation*'' (Hair et al., 2014 p418). CA methods are either hierarchical or non-hierarchical. Examples of hierarchical cluster analysis methods include hierarchical clustering while non-hierarchical methods include K-means clustering and two-step clustering (Hair et al., 2014). The K-means is a group of non-hierarchical clustering methods that can be used for large datasets. In K-means, the researcher has an idea of how many clusters to expect and defines this in the cluster solution. According to Hair et al. (2014), in this method the clustering algorithms work by partitioning observations (cases) into a pre-determined number of clusters and then iteratively reassigning observations until some numeric goal related to cluster distinctiveness is met. In many studies, the K-means cluster analysis is used as a follow-up step, to refine or optimise clusters, following a hierarchical cluster analysis (Everitt et al., 2001). Two-step clustering is a quick clustering method that can handle large data sets that would take much longer using hierarchical cluster methods. In two-step cluster analysis, an adequate number of groups of individuals are first identified by running pre-clustering and then using non-hierarchical methods, individuals are classified into these groups (Hair et al., 2014). As such, this method is sometimes defined as some sort of hybrid between the K-means and hierarchical clustering methods.

Hierarchical cluster analysis (HCA) is one of the commonest methods of cluster analysis (Everitt et al., 2001; Hair et al., 2014). In HCA, individuals are clustered together using either agglomerative or divisive procedures (Hair et al., 2014). In agglomerative hierarchical clustering, every individual in the dataset begins as a singular cluster on its own (Hair et al., 2014). Subsequently, these small clusters are grouped together in pairs, according to how similar they are, resulting in a smaller number of agglomerate clusters until finally, all cases are grouped into one large cluster (Hair et al., 2014; Sarstedt and Mooi, 2014). Individuals that are more similar are paired during the first stages of the HCA, with less similar individuals being added to the clusters at later stages, i.e. the two most similar individuals are first grouped, at the bottom of the hierarchy, then subsequently clusters are added at higher levels of the hierarchy (Hair et al., 2014; Sarstedt and Mooi, 2014). On the other hand, the divisive method of HCA begins with all cases belonging to one large cluster. This cluster is divided into two, based on the most dissimilar cases (Hair et al., 2014). The new clusters formed are further split into two, in a step-wise process, until only single-member clusters are formed, i.e. each case (individual) is its own cluster. The divisive method is essentially the opposite of the agglomerative method (Hair et al. 2014). The final number of clusters produced by HCA is the number of individuals or cases (n) less one (n-1), e.g. a sample of 100 participants would result in 99 clusters (100 - 1) (Hair et al., 2014). HCA is relatively simple and fast and allows for the formation of a tree-like structure of clusters, called a dendrogram. The dendrogram is a graphical representation of the stages at which different cases were grouped together into different clusters (Hair et al., 2014; Sarstedt and Mooi, 2014). While HCA can be used in the analysis of relatively small datasets, it is not amenable to large sample sizes (Hair et al., 2014).

While all the methods described above are all multivariate data reduction techniques, differences exist between them. In CA, individuals are agglomerated into dietary clusters (sometimes referred to as dietary patterns) based how similar they are in what they eat (Hearty and Gibney, 2009). The resulting dietary clusters are mutually exclusive, i.e. each individual present in the dataset can belong to only one cluster (Hearty and Gibney 2009). In PCA, FA and MCA, on the other hand, each participant receives a score that is reflective of the extent to which they adhere to each of the resulting dietary patterns (Guinot et al., 2001; Hearty and Gibney, 2009).

The advantage of *a posteriori* methods over *a priori* methods is that they do not pre-suppose that certain dietary patterns exist and therefore allow for the identification of emerging dietary patterns, i.e. the data speaks for itself. Additionally, data-driven approaches do not require the availability of dietary guidelines or recommendations, making them particularly suitable to LMIC contexts, which might lack these. Despite the strengths of these data-driven methods, however, they are not without limitations, which might affect the validity of the resulting findings (Imamura and Jacques, 2011). Firstly, data-driven approaches often result in dietary patterns that may not be directly reflective of dietary recommendations and therefore might be difficult for the public to interpret (McNaughton et al., 2008). From a methodological point of view, because PCA, MCA, FA and CA require a researcher to use self-judgement at several stages, e.g. interpreting dietary patterns and choosing which factors, principal components, dimensions or clusters to retain, there is a possibility of introducing bias (Marchioni et al., 2005). To overcome this, Imamura and Jacques (2011) propose comparing dietary patterns resulting from two data reduction methods on the same dataset as one way of assessing the validity of the findings from one method. Furthermore, because dietary intake data is used in the generation of dietary patterns, the resulting findings are only as good as the quality of the dietary intake data, which quality depends on the methods used in data collection, that are themselves not without limitations. An awareness of these limitations is therefore necessary in interpreting results obtained using these methods.

The next section presents *a priori* (hypothesis-driven) methods used in the assessment of the nutritional adequacy of diets.

1.4.2 Hypothesis-Driven (*A priori*) Approaches to the Assessment of the Nutritional Adequacy of Diets

As highlighted earlier, hypothesis-driven approaches make use of scores and indices, which assess the quality of the overall diet. A vast number of hypothesis-driven methods exist, some of which are population-specific while others can be applied to various populations.

The Diet Quality Index (DQI) was developed to measure diet quality based on United States (US) dietary recommendations (Patterson et al., 1994). When it was first proposed, the DQI assessed the quality of the diet based on the intake of eight food and nutrient groups, i.e. legumes and grains, fruit and vegetables, protein, calcium, total fat, saturated fat, dietary cholesterol and sodium (Patterson et al., 1994; Newby et al., 2003; de Carvalho et al., 2014). Individuals' diets received a score ranging from 0-16 depending on their intakes for the eight food and nutrient groups (Patterson et al., 1994). A score of zero (lowest) was representative of the best quality diet, while a score of 16 (highest) was indicative of the poorest quality diet (Patterson et al., 1994). The DQI was then updated to the Diet Quality Index Revised (DQI-R) to reflect aspects of diet quality not captured by the original DQI, i.e. moderation, diversity (variety) and proportionality (Haines et al., 1999; Newby et al., 2003; de Carvalho et al., 2014). The changes to the DQI reflected changes to the American Food Guide Pyramid and Dietary Reference Intakes (DRI) (Haines et al., 1999; Newby et al., 2003; de Carvalho et al., 2014). The DQI-R includes 10 components, i.e. eight food and nutrient groups (fruit, vegetables, grains, calcium, iron, total fat, saturated fat, and dietary cholesterol), one dietary moderation score and one dietary diversity score (Haines et al., 1999; Newby et al., 2003). The dietary moderation score captures intake of discretionary fat, added sugar, sodium and alcohol (Haines et al., 1999). Each of the components is scored on a scale from 0-10, such that the final DQI-R score varies from zero to 100 (Haines et al., 1999; Newby et al., 2003). The lower the score on the DQI-R, the poorer the quality of the diet.

The Healthy Eating Index (HEI) is one of the most frequently used measures of diet quality (Krebs-Smith et al., 2018). The HEI was developed to assess the quality of the diets of Americans based on their adherence to the United States Department of Agriculture (USDA)'s recommended dietary guidelines (Kennedy et al., 1995). The original HEI was based on the intake of five food and nutrient groups (fruit, vegetables, dairy, meat and grains), four nutrients to limit (total fat, saturated fat, sodium and dietary cholesterol) and diet variety (Kennedy et al., 1995; de Carvalho et al., 2014). Diet quality was assessed based on the intakes of these 10 components, each on a scale of 0-10; a higher score was reflective of a diet of better quality that adhered to dietary recommendations (Kennedy et al., 1995). Since its inception, the HEI is revised every five years to reflect changes in the USDA dietary recommendations (de Carvalho et al., 2014). The latest HEI, the HEI-2015 was released based on the 2015-2020 Dietary Guidelines for Americans (DGA) and scores the quality of the diet based on adequacy and moderation (Krebs-Smith et al., 2018). Diet adequacy is based on intake of fruit, vegetables, protein foods, grains, dairy and fat, each scored on a scale from 0-10 (Krebs-Smith et al., 2018). Moderation is based on intake of refined grains, sodium and empty calories (solid fats, alcohol, added sugar and saturated fat) (Krebs-Smith et al., 2018). A higher score on the HEI denotes a diet of better quality (Kant, 1996; Kennedy et al., 1995; de Carvalho et al., 2014).

Although they have been extensively used, diet quality assessment tools highlighted above were developed for American populations. Such measures of diet quality therefore have limited applicability in LMIC contexts, especially those undergoing dietary changes associated with the NT (de Carvalho et al., 2014). To this end, an alternative index, the Diet Quality Index International (DQI-I) was first proposed for use in LMIC by Kim et al. (2003). The DQI-I was developed to allow for comparisons in diet quality between and within countries, by capturing information on both over nutrition and undernutrition (Kim et al., 2003, de Carvalho et al., 2014). Therefore, the DQI-I is particularly useful in assessing diet adequacy in populations in which the double burden of malnutrition exists (Kim et al., 2003). The DQI-I collects information on four components of the overall diet, i.e. variety, adequacy, moderation and overall balance (Kim et al., 2003). Diet variety is scored on a scale from 0-20 based on two aspects, i.e. overall variety and variety within protein sources (Kim et al., 2003). Diet adequacy is scored on a scale from 0-40 based on the intake of eight food and nutrient groups, i.e. fruit, vegetables, grains, fibre, protein, iron, calcium and vitamin C (Kim et al., 2003; de Carvalho et al., 2014). On the other hand, moderation is assessed on a 0-30-point scale based on intake of total fat, saturated fat, dietary cholesterol, sodium and empty-calorie foods (Kim et al. 2003). Lastly, the overall balance of the diet is gauged on a 0-10-point scale based on the macronutrient balance (ratio of energy from carbohydrate to protein to fat) and fatty acid ratio (PUFA: MUFA: SFA[4]) (Kim et al., 2003). Like the DQI-R, the DQI-I ranges from zero (poorest quality diet) to 100 (highest quality diet) (Kim et al., 2003). Despite its applicability for transitioning LMIC and the potential for cross-country comparisons offered by the DQI-I, its usability is limited by the numerous variables, i.e. variety, adequacy, moderation and overall balance required to compute a single score for diet quality (de Carvalho et al., 2014).

Apart from the DQI-I, other diet quality scores that have applicability in LMIC include the nutrient value score (NVS) and the more commonly used dietary diversity score (DDS). In these contexts, the DDS is used as a proxy for the nutrient adequacy of diets (coverage of basic requirements for macro and micronutrients) at both household and individual level (FAO, 2013). While the household dietary diversity (HDDS) is

[4] PUFA (poly-unsaturated fatty acids), MUFA (mono-unsaturated fatty acids), SFA (saturated fatty acids)

based on the intake of 12 food groups[5], the women's dietary diversity score (WDDS) assesses how many out of a pre-determined set of nine food groups[6] are consumed (FAO, 2013; FAO and FHI360, 2016). The final HDDS ranges from zero (poor quality diet) to 12 (good quality diet), while the WDDS ranges from zero (poor quality diet) to nine (good quality diet) (FAO, 2013). The minimum dietary diversity score for WRA (MDD-W), on the other hand, assesses whether at least five out of a pre-determined list of 10 food groups are consumed by WRA (FAO and FHI360, 2016). The 10 food groups include grains, white roots and tubers and plantain; pulses (beans, peas and lentils); nuts and seeds; dairy; eggs; meat, poultry and fish; dark-green leafy vegetables; other vitamin-A rich vegetables and fruit; other vegetables; other fruit (FAO, 2013). The MDD-W score ranges from zero (poorest diet) to 10 (good quality diet). While the HDDS is more reflective of whether households have economic access to a diet that provided adequate dietary energy, the WDDS and WDD-M measure one aspect of diet quality, i.e. micronutrient adequacy (FAO and FHI360, 2016).

While Walls et al. (2018) argue that it is not appropriate measure for dietary changes associated with the NT, the DDS has been used to assess the NT in SSA. In these studies, a more diverse diet is not taken as one that is necessarily healthy, and depending on food groups used in computing the DDS, could be indicative of a less healthy diet characteristic of the NT (Keding et al., 2012). For example, Steyn et al. (2012) used the DDS, based on nine food groups[7], to compare the extent of the NT among rural and urban Kenyan and South African women. In their study, the authors hypothesised that a higher DDS was associated with later stages in the NT. Findings from the study indicated that Kenyan and South African women were at the same stage in the NT given the similarity in DDS among women in both countries. More recently, the DDS was used to explore differences in the NT among Indian, Peruvian, Ethiopian and Vietnamese adolescents based on dietary data collected between 2006 and 2013 (Aurino et al., 2016). The authors demonstrated evidence of significant increases in DDS among these adolescents using a DDS based on seven food groups[8] and added sugar (Aurino et al., 2016). The changes in DDS were driven mainly by increased consumption of pulses, legumes and nuts, meat and fish, eggs, dairy products and added sugar (Aurino et al., 2016). Findings from this study corroborate those from a study in rural Burkina Faso in which higher DDS, based on 14 food groups[9], was associated with the consumption of markers of the NT, i.e. energy-dense

[5] cereals, white roots and tubers, vegetables, fruits, meat, eggs, fish and other seafood, legumes, nuts and seeds, milk and milk products, oils and fats, sweets and spices, condiments and beverages (FAO, 2013; FAO and FHI360, 2016)

[6] starchy staples, dark-green leafy vegetables, other vitamin-A rich fruits and vegetables, other fruits and vegetables, organ meats, meat and fish, legumes, nuts and seeds and milk and milk products (FAO, 2013; FAO and FHI360, 2016)

[7] Cereals, roots and tubers, vitamin A rich fruits and vegetables, non-vitamin A rich (other) fruit, non-vitamin A rich (other) vegetables, legumes and nuts, meat, poultry and fish, fats and oils, dairy, eggs (Steyn et al. 2012)

[8] Grain, roots and tubers, fruit and vegetables, meat and fish, eggs, pulses, legumes and nuts, milk and dairy products and foods cooked in oil (Aurino et al. 2016)

[9] Condiments, cereals, green leafy vegetables, other vegetables, oils and fat, fish and seafood, pulses and nuts, meat, sugar, fruit, roots and tubers, drinks and miscellaneous, milk and dairy products, eggs (Savy et al. 2005)

food groups, such as sugar and fats and oils (Savy et al., 2005). Given differences in the number of food groups used in computing the DDS in different contexts, it comes as no surprise that Savy et al. (2007) propose that dietary diversity is an insufficient identifier for women at risk of both under and overweight (dual burden of malnutrition). However, some authors in middle-income contexts have demonstrated that women with lower dietary diversity are at a higher risk for overweight (Azadbakht and Esmaillzadeh, 2010; Bezerra and Sichieri, 2011).

The methods described above are mostly used to assess the nutritional adequacy of diets at the population level, however, more recently, nutrient profiling has been used to rank individual foods based on their healthiness (Drewnowski and Fulgoni, 2008; Drewnowski et al., 2009; Fulgoni et al., 2009; Poon et al., 2018). While it is generally believed that there is no such thing as healthy food (only healthy diets), the results from nutrient profiling of foods can be used in various ways, e.g. regulation, food labelling (Rayner, 2017; Poon et al., 2018). Because nutrient profiling uses pre-existing data on the nutritional composition of foods, and nutrient profiling models are validated against diet quality indices, nutrient profiling is described in this PhD thesis under hypothesis-driven approaches to diet quality assessment.

Like diet quality indices or scores, many different nutrient profiling models exist, e.g. the French SAIN: LIM model (Darmon et al., 2009), the American Nutrient Rich Foods (NRF) models (Drewnowski, 2017) and the UK Ofcom model (Payne et al., 2016a). The bulk of nutrient profiling models, however, have not been validated (Poon et al., 2018). The Ofcom model was developed in 2005 by the UK Food Standards Agency (FSA) to streamline the advertising of foods to children younger than 16 years (Department of Health, 2011; Poon et al., 2018). The model computes a score based on the amounts of nutrient or food groups to encourage, (fruit, vegetables and nuts, fibre and protein) and nutrients to limit (energy, saturated fat, sodium and total sugar) contained in 100g of a food item (Department of Health, 2011; Poon et al., 2018). The lower the score on the Ofcom nutrient profiling model, the healthier the food or beverage (Department of Health, 2011; Poon et al., 2018). The SAIN: LIM model, on the other hand, was developed by the French Foods Standards Agency to guide the labelling of foods with health or nutritional claims (Darmon et al., 2009; Darmon et al., 2017; Tharrey et al., 2017; Maillot et al., 2018). The most basic SAIN: LIM model ranks individual foods based on a composite score that incorporates nutrient to encourage (SAIN), i.e. protein, fibre, vitamin C, calcium and iron and nutrients to limit (LIM), i.e. sodium, saturated fat and added sugar contained in 100g or 100kcal of the food (Darmon et al., 2018; Tharrey et al., 2017; Maillot et al., 2018). The SAIN: LIM model has recently been updated to the SENS model. The SENS model is based on the same principle, i.e. nutrients to encourage and limit (Darmon et al., 2018; Tharrey et al., 2017; Maillot et al., 2018). However, with the new SENS model, new food categories and sub-categories were introduced, e.g. beverages (vitamin C and proportion of fruit and vegetables), added fat (α-linoleic acid and MUFA) and other dairy foods (Darmon et al., 2018; Tharrey et al., 2017; Maillot et al., 2018). Additionally, the number of nutrients were reduced (e.g. iron was removed and calcium used for only dairy foods, free sugar replaced added sugar), weightings for nutrient groups were introduced and French dietary recommendations were replaced with European dietary recommendations (Darmon et al., 2018; Tharrey et al., 2017; Maillot et al., 2018).

The nutrient rich foods (NRFn.3) family of models was developed based on the UDSA dietary recommendations (Drewnowski and Fulgoni, 2008). Although there are numerous iterations of the NRFn.3 models, like other nutrient profiling models described previously, all variations incorporate a combination of 'positive' nutrients to encourage and 'negative' nutrients to limit (Drewnowski, 2010). In the NRFn.3 profiling model, the number of nutrients to encourage can range anywhere from six to 15 while the number of nutrients to limit is always three (Drewnowski, 2009; Drewnowski and Fulgoni, 2014). Of all NRFn.3 models, however, only the NRF9.3 model has been validated against the previously described Healthy Eating Index (Fulgoni et al., 2009; Drewnowski and Fulgoni, 2014; Drewnowski et al., 2017). As such, the NRF9.3 is one of the most common nutrient profiling models used. The NRF9.3 model, computes a score based on nine nutrients to encourage (protein, dietary fibre, calcium, magnesium, potassium, iron, vitamin A, vitamin C and vitamin E) and three nutrients to discourage (saturated fat, sodium and added sugar) per 100g or 100kcal of food (Drewnowski and Fulgoni, 2014). The algorithm for the NRF9.3 model is the difference between the unweighted sum of percent daily values(%DV) for the nine nutrients to encourage and the sum of the %DV of the three nutrients to limit (Drewnowski et al., 2017; van Dooren et al., 2017). To prevent foods that are particularly high in one nutrient to encourage influencing the final score, the %DV of nutrients to encourage can be capped at 100% (Drewnowski, 2017; van Dooren et al., 2017).

The main strength of *a priori* approaches to diet quality assessment lies in the fact that they are based on existing knowledge of healthy diets and so can therefore be used to monitor population-level compliance with dietary recommendations (McNaughton et al., 2008). The main disadvantage of *a priori* approaches, on the other hand, is the fact that they often rely on evidence-based knowledge of healthy dietary patterns (McNaughton et al., 2008) and as such might have limited applicability in LMIC contexts, in which such evidence is scarce or non-existent.

The following section highlights how nutritional adequacy of HES is assessed.

1.4.3 Assessing the Nutritional Adequacy of HES Diets

Most research on HES diets is based on HIC contexts. Some literature has described pre-existing healthy dietary patterns as HES, such as the Mediterranean dietary pattern, which is a traditional plant-based diet characterised by high intakes of fruits, vegetables and nuts, moderate consumption of fish and olive oil and low intake of red meat and EDNP foods (FAO, 2010; Dernini and Berry, 2015). Overall, the nutritional adequacy of HES in HIC has been assessed using a variety of *a priori*, and to a lesser extent, *a posteriori* methods. In some instances, the nutritional adequacy of HES diets has been assessed using diet scores and indices (hypothesis-driven methods). For example, Masset et al. (2014) used the PANdiet score in a French study, while a composite score based on the mean adequacy ratio (MAR), mean energy ratio (MER) and energy density (ED) was used by other authors (Vieux et al., 2011; 2013; Perignon et al., 2016; Walker et al., 2018). In other studies, the nutritional adequacy of HES has been estimated using various versions of the previously described NRFn.3 nutrient profiling model (Smedman et al., 2010; Doran Browne et al., 2015; Drewnowski et al., 2015; van Dooren et al., 2018).

In other instances, the nutritional adequacy of HES diets were inferred from existing literature on nutritional composition of foods and dietary recommendations. In these situations, theoretical HES diets, which aligned with country-specific, evidence-based dietary recommendations, were either proposed or modelled based on constraints set for nutritional composition of foods and environmental impact estimates. For example, Bere and Brug (2009) described a HES based on the nutritional properties of traditional, local, seasonal foods that could meet Nordic dietary recommendations. In other instances, authors went beyond simply describing, by formulating HES diets using various mathematical modelling approaches. For example, Macdiarmid et al. (2013), Wilson et al. (2013) and van Dooren et al. (2014) used linear programming to model HES diets in the UK, USA and the Netherlands, respectively. In another study, interval goal programming was used to formulate a HES diet for Spanish school-going children (Ribal et al., 2015). To ensure that the modelled HES diets were both nutritionally adequate and culturally-appropriate and nutritionally-adequate, well-established traditional diets like the Mediterranean Diet, New Nordic Diet (adapted from the Nordic Diet), and the Dutch Low Lands Diet were sometimes used as building blocks for the diets. In most cases HES diets are modelled based on country-specific or region-specific dietary guidelines (Friel et al., 2013; Hendrie et al., 2014; van Dooren et al., 2014; van Dooren and Aiking, 2015), possibly limiting their applicability in the wider global context. In other instances, HES diets are modelled based on global dietary guidelines like the WHO recommendations (Green et al., 2015b), World Cancer Research Fund (WCRF) recommendations (Wolf et al., 2011) or the Committee on Climate Change (CCC) recommendations (Scarborough et al., 2012), possibly enhancing their applicability in different contexts. However, only Wilson et al. (2013) explicitly suggested that the HES diets that they modelled might have some global adaptability beyond the New Zealand context, since the foods used in the optimization model were globally available, although availability does not necessarily imply accessibility and utilisation.

The next section describes the assessment of the environmental impact of dietary intake. First, a description of methods used in estimating the environmental impact of diets is presented, followed with a summary of the methods used to assess the environmental impact of HES diets.

1.5 How is the Environmental Impact of Diets Assessed?

Since most research has investigated the sustainability of diets from an environmental perspective, there is a growing body of literature on estimating the environmental impact of diets using a variety of methods. The environmental impact of foods (and therefore the diets that they constitute) has mostly been estimated using the Lifecycle Assessment (LCA) method (Roy et al., 2009; Jones et al., 2016; Gonzalez-Garcia et al., 2018; Batlle-Bayer et al., 2019). To a lesser extent, other methods, such as environmentally extended input-output models have been used in HIC (Tukker et al., 2011; Wolf et al. 2011; Hendrie et al., 2014).

The LCA method maps all the stages that a food product goes through, from 'cradle to grave' or 'farm to fork', i.e. primary production to final consumption (Jones et al., 2016; Gonzalez-Garcia et al., 2018). According to guidelines formulated by the International Standards Organisation (ISO), the stages or phases considered in a typical food LCA include goal definition and scope (phase one), inventory analysis (phase two), lifecycle impact assessment (phase three) and interpretation (phase four) (ISO, 2006). The goal definition and scope (phase one) involves defining the purpose of the study, functional unit (FU), system boundaries and assumptions (ISO, 2006; Roy et al., 2009). The FU is the reference unit that will be considered for the LCA and is more commonly expressed in terms of weight (Roy et al., 2009), e.g. 1kg of beef or 1 tonne of cassava. More recently, some LCA studies also consider nutritional units (100kcal) and area under cultivation (hectares) (Roy et al., 2009). The FU used depends on the aim of the study, for example, to compare the environmental impact of a food product produced under different production systems the weight of product could be used as the basis (Roy et al., 2009). The system boundary includes the stages the food product goes through that will be considered for the purposes of the LCA (Roy et al., 2009), e.g. production, primary processing, transportation to industry, processing. While some LCA studies will consider all stages from cradle to grave, some studies will only consider some stages of food production (Hellweg and Canals, 2014). The environmental impact metric that is used in the LCA, e.g. GHGE, water footprint, land use, is also decided as part of what constitutes the system boundary. In most LCA studies, the carbon footprint, gleaned from the GHGE, is used as a measure of the environmental impact as it *"reflects broad scientific and social awareness on the reduction of GHG emissions aiming to counteract the effects of climate change"* (Gonzalez-Garcia et al., 2018: p79). Roy et al. (2009) postulate that the first phase (goal definition and scope) is perhaps the most important step in the LCA because the analysis is dependent on what is defined in this step.

Inventory analysis (phase two) involves outlining all inputs and outputs from all processes defined in the first phase (Roy et al., 2009; Jones et al., 2016). For example, in an LCA study of beef, the inputs can include water and energy (heat or electricity) used in running different process along the lifecycle, and raw materials, such as hay fed to beef cattle. The outputs, on the other hand can include the beef that is produced and the carbon dioxide, methane, nitrous oxide emissions incurred at the different stages along the lifecycle. Environmental impacts incurred at different stages collectively provide an estimate of the environmental impact for that food product (Jones et al., 2016). The inventory analysis is often the longest and most labour-intensive phase of the LCA, as it involves collecting and collating extensive quantities of data from various sources (Roy et al., 2009). To counteract this, most LCA studies make use of existent databases (Roy et al., 2009). In lifecycle impact assessment (phase three), the emissions and input use from the inventory analysis are grouped into different categories (Roy et al., 2009). Impact categories include eutrophication potential[10], land use, water use and global warming potential (GWP), which is gleaned from data on GHGE, among others (Roy et al., 2009). The final phase of the LCA (interpretation) involves a discussion of the results from the second and third phases (inventory analysis and lifecycle impact assessment) to draw conclusions about the environmental impact of the food product (Roy et al., 2009). In this phase, sensitivity or uncertainty analysis are sometimes carried out to assess the robustness of findings (Hellweg and Canals, 2014). In this phase, recommendations may also be made on the stages of the product's lifecycle that are most environmentally costly (Roy et al., 2009).

Although the LCA method is widely used to assess the environmental impact of diets, it is not without limitations. Firstly, LCA is time-consuming (Roy et al., 2009). Secondly, if data are missing or incomplete at any lifecycle stage, but especially at the inventory phase, e.g. emission of data for some foods means it might be necessary to make assumptions based on similar foods. Additionally, although environmental cost is incurred at all points along the product's lifecycle (Macdiarmid, 2013), many studies inadequately account for the impacts of postharvest losses, food transportation (from farm to fork), and consumer storage (refrigeration). Lastly, the LCA method can be highly context specific because the food production systems vary between countries and seven within countries. This means that environmental impacts for the same product across and within different countries may not necessarily be directly comparable. Nevertheless, LCA remains the most widely used method for assessing the environmental impact of a product for which a standardised, systematic protocol exists (ISO, 2006; Gonzalez-Garcia et al., 2018). While LCA is the most widely used method of environmental impact assessment, these limitations should be taken into consideration when using and interpreting such data.

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[10] Eutrophication potential is a measure of nitrogen and phosphorus (kg PO43- equivalents) present in waterways that can lead to excessive algae growth and decay resulting in oxygen depletion and loss of marine life (Webb et al. 2013).

1.5.1 Assessing the Environmental Impact of HES Diets

The focus of measuring the environmental sustainability of HES diets has been on the quantification of the carbon footprint (GHGE) of foods that comprise these diets. In some studies, estimates of GHGE of individual food items, of interest to the HES debate, are obtained by carrying out a LCA using the steps previously descibed in section 1.5. In most cases, however, when HES diets are viewed as a composite of many foods, the environmental impacts of diets are based on the GHGE of individual foods obtained from secondary data compiled using the LCA method (Baroni et al., 2007; Berness-Lee et al., 2012; Temme et al., 2015; van Dooren and Aiking, 2015). In these contexts, region-specific or country-specific databases are used, such as data from supermarkets (Vieux et al., 2013; Masset et al., 2014).

Important to note is that minimal attention has been given to other measures of environmental impact, like biodiversity loss, water footprint and land use impact, with only a few papers reporting these measures (Vanham, 2013; Vanham et al., 2013; van Dooren et al., 2014; Vanham and Bidoglio, 2014a;2014b; van Dooren and Aiking, 2015). This could be due to both a lack of data and a dearth of well-defined, systematic assessment methodologies for these environmental impact indices. Furthermore, this could also be attributed to the fact that biodiversity loss or water use is more salient in LMIC, and not HIC, in which most research on HES diets has been carried out.

The next section highlights some critiques of healthy and environmentally sustainable diets.

1.6 Limitations of Healthy and Environmentally Sustainable Diets

The environmental impact of HES diets has primarily been inferred from GHGE estimates. Since ruminant animals reportedly have a higher GHGE than poultry and plant foods, most HES diets are primarily plant-based, incorporating variations of reduced amounts of processed and unprocessed red meat, dairy, fish and poultry. This is the point of intersection between theoretical (modelled) and actual HES diets, such as the Mediterranean dietary pattern. The reduced amounts of meat in HES diets possibly explains why vegetarianism or veganism are salient themes in the literature on HES diets (see Baroni et al., 2007; Aston et al., 2012; Berness-Lee et al., 2012; Vanham, 2013; Vanham et al., 2013; van Dooren et al., 2014; Vanham and Bidoglio, 2014a;2014b). In most modelled HES diets, meat and (or) milk and dairy products are substituted with various plant-based foods products, including tofu, pulses and nuts. To a lesser extent, soya drinks and EDNP foods, e.g. soft drinks and sugary snacks are used to meet the energy requirements of populations in these modelled diets (Green et al., 2015b; Hendrie et al., 2015).

It comes as no surprise that whereas the literature largely suggests that there are health benefits to HES diets, there are some contradictions (Vieux et al., 2013). While van Dooren et al. (2014) propose that diets that include a moderate amount of meat are less detrimental to environmental sustainability, Werner et al. (2014) argue that reducing dairy in the diet neither mitigates environmental impact nor benefits health because such diets are nutritionally inadequate. Additionally, inadequate zinc and vitamin B1 intakes for girls on the HES dietary pattern have been reported (Temme et al., 2011), although intakes of iron and fibre improved with this same HES diet. Furthermore, Hallström et al. (2014) found evidence that two modelled HES diets provided inadequate amounts of iron to meet the requirements of adult women. Therefore, while HES diets might be beneficial, inconsistencies in the accrued health benefits relative to environmental impact might pose a significant challenge to consumer adoption. Further to this, Macdiarmid (2013) writes of the challenge in changing well-established dietary practices due to the strength of psychosocial and cultural factors, such as the pleasure associated with eating meat, the belief that a meal devoid of meat is incomplete and the sociocultural meanings attached to meat and animals in general.

As highlighted in section 1.4.3 of this thesis, the nutritional adequacy of modelled (theoretical) HES diets is ensured by fitting these diets within constraints for dietary recommendations. In many of these studies, however, the number of foods comprising the modelled HES diet reduces with increasing constraints for either nutritional adequacy or environmental impact. This means that while such theoretical HES diets might provide a framework for actual HES diets, the question of whether such diets, although they are nutritionally adequate, are realistic in a real-world scenario remains doubtful. Furthermore, since most papers have used only one impact indicator (GHGE) as a measure of environmental impact of HES diets, it is unclear whether these proposed diets would still be considered HES if all environmental impact measures were considered in combination. For example, changing current US consumption patterns towards the USDA dietary recommendations would increase energy use, GHGE and blue water footprint from baseline values (Tom et al., 2015).

To ensure that HES diets are culturally identifiable, well-established traditional diets are often used as building blocks for the modelled diets. However, despite attempts to make HES as culturally acceptable as possible, there is limited information on the social aspects of HES diets. This has been emphasised in a review by Auestad and Fulgoni (2015) that highlights the relevance for a comprehensive assessment of the environmental, social, and economic impacts of such HES diets. Where attempts have been made to incorporate social and economic aspects of HES diets, the focus has been on price comparison. In these studies, finding suggest that HES diets are relatively cheaper than current diets (Berness-Lee et al., 2012; Wilson et al., 2013), although this is not always the case (Vieux et al., 2013).

Lastly, most research on HES diets has been conducted in HIC, meaning such diets have limited generalisability to LMIC contexts. For example, while ruminant meat is seen as having high GHGE, it cannot be said that the environmental impact of meat produced by pastoralists in Eastern parts of SSA is akin to that of intensively reared meat in most HIC. In fact, Herrero and colleagues, in a 2013 study, proposed that SSA beef cattle produced higher GHGE (methane and nitrous oxide) compared with cattle from HIC due to lower feed efficiency (Herrero et al., 2013). A lack of research from LMIC could also explain why there is little mention of wild foods and other nutritionally-rich 'neglected plants' (Baldermann et al., 2016) or alternative protein sources in the HES diet discourse, except for some mention of insects (Payne et al., 2016b) and kangaroo meat (Friel et al., 2015). It is possible that this was the case because most HES diets are modelled based on dietary intakes in HIC, probably, as a proxy for acceptability.

The previous sections of this thesis have highlighted possible implications of the dietary changes associated with the NT for health and environmental sustainability and described HES diets as a possible solution. In order to encourage consumption towards HES diets, it is imperative to first gain an understanding of why they eat what they eat. The following section highlights the theoretical perspectives that seek to understand why people eat what they eat.

1.7 Dietary Practices: Influences and Drivers

Food choice and therefore dietary behaviour is the product of a myriad of interrelated economic, social, cultural, physiological, nutritional and psychological factors (Shepherd, 1999; Story et al., 2008; Tilman and Clark, 2014). To understand dietary practices, several models and theories have been proposed by various authors, including Randall and Sanjur (1981)'s factors influencing food preferences model; Furst et al. (1999)'s food choice process model; and Shepherd (1999)'s factors affecting food choice, among others. These models borrow from various disciplines, including psychology, economics and sociology, to explain what influences dietary behaviour.

Shepherd (1999) describes earlier food choice models as only inventories of the likely influences on food choice. The author argues that these models, while useful, are limited in that they neither provide the key mechanisms of action involved in dietary practices, nor quantify the relative importance of the different factors (Shepherd, 1999). Furthermore, many of these models do not show the interrelatedness between the various factors involved although they are useful in suggesting the variables one might consider in research exploring food choice and dietary behaviours (Shepherd, 1999). Therefore, there has been a tendency for research in dietary behaviours to focus on singular aspects of the different models, which does not align with the public health systems approach to mitigating public health challenges. The systems thinking approach emphasises an understanding of the interconnectedness and relationships between different parts of the whole and their relationship with the whole, often understood within the context of an even wider whole (Trochim, 2006). The public health systems approach recognises that owing to the complexity of most public health challenges, they cannot be fully understood from single-level analysis (Story et al., 2008), e.g. in the case of dietary behaviours, focusing only on individual-level factors. This highlights the need for models that capture the complexity of multi-dimensional factors at play in as far as influences on dietary behaviours is concerned.

Models that are more holistic have emerged recently. These models aim to capture the complexity of dietary behaviours. The socioecological model offers a more comprehensive perspective by borrowing from the epidemiological triad model commonly used in infectious disease research (Egger and Swinburn, 1997). One such model is Story et al. (2008)'s socioecological framework model of the factors influencing healthy food behaviour.

1.7.1 The Socioecological Framework Model

According to the broader ecological approach, health behaviour is influenced by inter- and intra-individual level factors (Robinson, 2008). Story et al.'s 2008 socioecological framework model (Figure 1.2) distils these inter-and intra-individual levels of influence to the individual (inter) and the social, physical, and macro-level environments (intra), which have both exacting and indirect impacts on dietary behaviours (Figure 1.2). According to Story et al. (2008) and Robinson (2008), individual-level factors are traits specific to a person, e.g. socio-demographic characteristics, beliefs, perceptions, tastes and preferences, nutritional knowledge, skills, and biological factors.

Beyond the individual, are the social, macro and physical environments, which are collectively, refer to as environmental-level factors. All individuals reside within an environment, which according to Swinburn and Egger (2002) poses a significant influence on dietary practices. Bilman et al. (2017), in their paper, highlight the influence of such environmental-level factors on dietary practices, and therefore, on possibly facilitating dietary transitions. The authors propose that signals outside of individuals, i.e. within their social, cultural and physical food environments prompt individuals to start or stop eating and influence what and how much to eat and drink, sometimes even overriding the body's inbuilt appetite-control mechanisms, potentially contributing to overconsumption (Bilman et al., 2017).

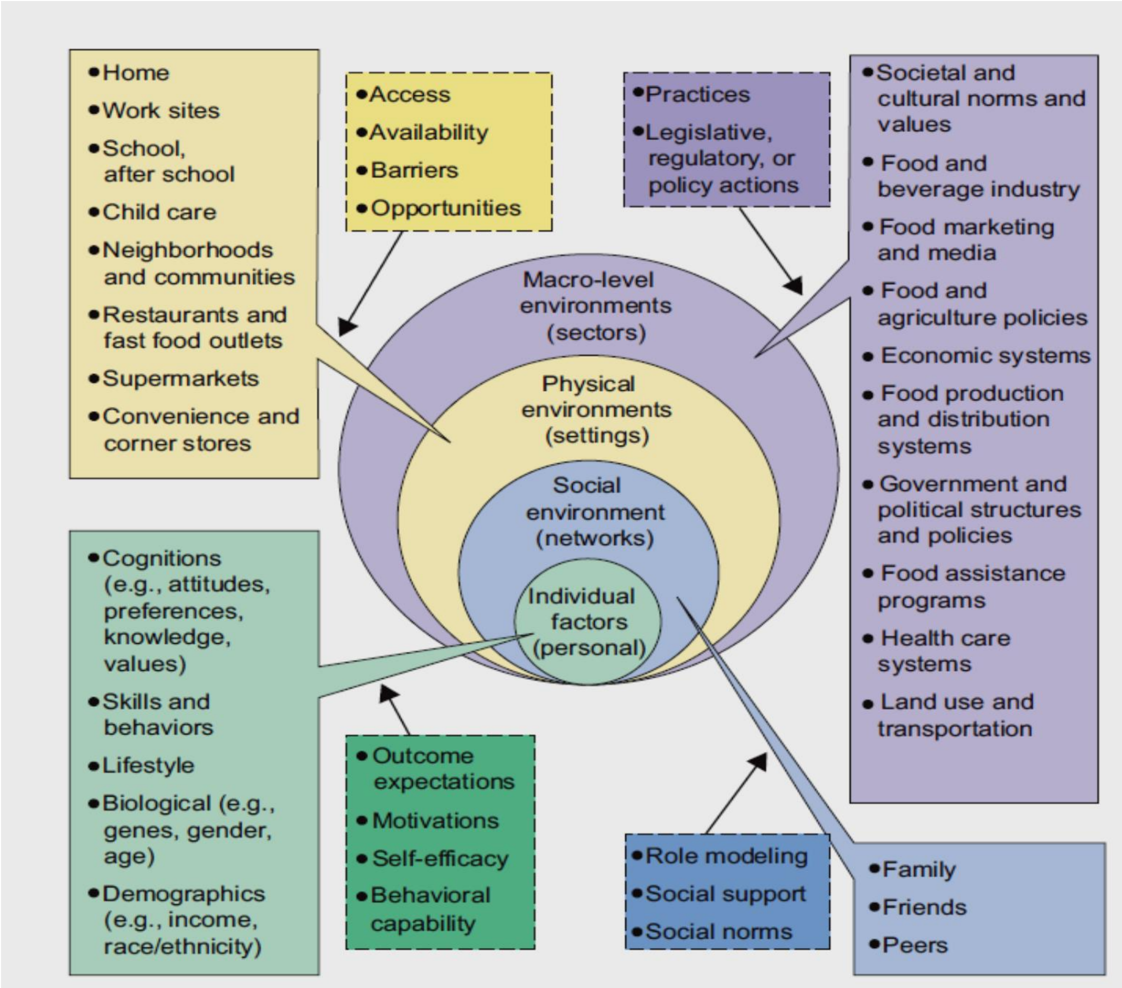

Figure 1.2: A socioecological framework model depicting the multiple influences on what people eat (Story et al., 2008)

The social environment includes interactions with family, friends, and other social networks (Figure 1.2). The social environment may influence dietary practice through some mechanisms, i.e. providing a supportive environment in which certain dietary practices thrive over others, role modelling and establishing social norms (Story et al., 2008). To this end, Swinburn and Egger (2002) cite the home environment and the relationships therein, as the most fundamental setting in shaping children and adolescent's dietary practices. Within the home environment, not only do parents act as role models on what is acceptable or unacceptable to eat, but also family eating practices developed within the home, e.g. eating while watching TV vs. eating at table are likely to be perpetuated later into adulthood (Swinburn and Egger, 2002). The same can said of other environments in which social relationships are enacted, e.g. the workplace and school. The direct influence of the social environment on dietary practices can also be seen in the phenomenon described as the 'social facilitation of eating' in which people are found to eat more food in company of friends, relatives and family. Barnett and Casper (2001) propose that because social environments are a product of factors both within and without the wider environment, the social environment can change over time as these factors change.

The physical environment on the other hand encompasses the various places at which food is eaten or provisioned, e.g. home, work, school, restaurants (Figure 1.2). The physical food environment influences food availability, physical access and economic access thereby providing barriers and opportunities to certain dietary practices (Swinburn and Egger, 2002; Story et al., 2008). The physical and social environments to which one is exposed are closely linked because the interactions that characterise an individual's social environment take place within the context of the physical environment (Bernett and Casper, 2001; Story et al., 2008). Beyond the individual-level and physical and social environments, the macro-level environment operates at the population level (Figure 1.2). The macro-level environment includes aspects like food production, food distribution systems, branding and marketing, agricultural and trade policies, food market pricing structures and the wider context-specific social norms (Story et al., 2008). Macro-level factors are often beyond the direct control of the individual as they are enforced by national-level policies (Story et al., 2008).

While the socioecological model does not remove from the importance of individual-level factors in understanding dietary behaviours, it highlights the crucial fact that food choices, and therefore dietary behaviours are embedded within the different contextual layers that are reflective of the dynamic, multi-faceted complexity of daily life. Indeed, several authors have pointed out that eating is a social practice that develops alongside interpersonal relationships and everyday interactions in social spaces, e.g. school, the work and family (Delormier et al., 2009; Wills et al., 2011; Paddock, 2015). In order to propose recommendations that can effectively encourage more HES dietary behaviours, it is paramount to understand both individual and environmental-level influences on dietary practices.

More recently, Gissing et al. (2017) produced an adaptation of Story et al. (2008)'s socioecological model to explain determinants of dietary behaviour among urban African women. The authors conducted a systematic review that built on Story et al. (2008)'s model by highlighting determinants of dietary behaviour that were specific to the urban SSA context. Furthermore, while it was found that most research on dietary behaviour among urban SSA women focused on individual-level factors, Gissing et al. (2017) stressed the gap in data on the social, physical and macro-environment factors that influence the dietary behaviours among these women. That Story et al.'s model (Figure 1.2) emphases the multi-level factors that influence dietary behaviour makes it an appropriate model on which to frame this PhD. Therefore, by taking an ecological perspective to dietary behaviours, the various factors operating at the many different levels of influence and the linkages between these factors are explored in this PhD, painting a holistic picture of dietary behaviours among Ugandan WRA.

However, while the socioecological model goes further than earlier food choice models by emphasising the importance of environmental-level factors in dietary behaviours, it does little to elucidate on the exact mechanisms through which all these factors interact to result in changes in dietary behaviours. This is where social practice theory, described in the following section, is useful.

1.7.2. Social Practice Theory

Interventions targeting unhealthy practices have traditionally focused either solely on individual or on contextual theoretical perspectives in which individual agency is prioritised (Shove et al., 2012). This is the basis for behavioural change theories, which have dominated public health nutrition. According to Shove et al. (2012), behavioural change theories, such as the Health Belief Model (Janz et al. 1974), Social Cognitive Theory (Bandura, 1986) and the Theory of Planned Behaviour (TPB) (Ajzen, 1991) are based on natural laws which postulate that the process of change in practice is causational. These models assume that individuals have an array of choices, within the environments in which they reside, and make logical decisions following a rational deliberation of all the possibilities (Delormier et al., 2009). This, though may be true in some instances, undervalues the extent to which social practices like dietary practices are interwoven into the fabric of daily life and the extent to which meanings and competence are formed and re-enacted in the process of doing these practices (Delormier et al., 2009; Shove et al., 2012). It is well known that food decisions, and therefore dietary practices, are not always a product of rational decision-making but can be produced by the habitual, patterned and routinised ways in which life is lived out (Blue et al., 2016). The result is that theories and models like the TPB are better at predicting intention rather than practice, and yet the challenges encountered in overturning unhealthy practices go beyond a lack of self-will on the part of the individual. Practices are also culmination of social, cultural and material factors that are combined in various ways to deeply entrench such practices (Paddock, 2015). An appreciation of how dietary practices fit into daily life is therefore fundamental to understanding how people join and defect from certain dietary practices (Blue et al., 2016). Incorporating a practice-oriented approach, to this PhD research, in addition to Story et al. 's socioecological model, is fundamental to understanding the mechanisms through which different dietary practices, resulting from various repeated eating events, might arise and change among Ugandan WRA.

Practice theory has been proposed as an appropriate theoretical approach towards understanding public health challenges, particularly where consumption of some form is concerned (Blue et al., 2016; Warde, 2016). Having their origins in the works of authors like Anthony Giddens and Pierre Bourdieu, among others, practice theories take the focus of inquiry on the life of the social practice rather than solely focusing on the participants engaged in them (Warde, 2014; Blue et al., 2016). Because practice theories, recognise that the process of change is emergent, they are a suitable theoretical orientation to explore scenarios in which change occurs gradually and is a product of historical and cultural context, e.g. dietary practice (Shove et al., 2012; Warde, 2016). A simplified version of practice theory defines social practices as routinised behaviours composed of several interconnected elements, i.e. materials (such as objects, structures, infrastructure and consumer goods); competence (practical know-how and skills) and meanings (understanding of social significance of social practice based on past experiences of participation) (Reckwitz 2002; Shove et al., 2012). Practices are born when the elements of which they are comprised are linked together (Shove et al., 2012; Blue et al., 2016). This means that new and innovative combinations of different practice elements can result in entirely new practices or modified ways of doing old practices e.g. traditional vs transitional vs modern dietary practices (Shove et al., 2012).

The elements of which practices are comprised (as proposed by practice theories) are reflective of the multi-level influences captured by Story et al. (2008)'s model (Figure 2). Therefore, both the socioecological framework model and practice theories seek to understand dietary practice from a more holistic perspective. However, while the ecological framework model conceptualises the drivers of dietary practice, borrowing from a practice-oriented approach plays a supplementary role by pointing towards the mechanisms by which these influences (the elements of which dietary practice is comprised) evolve, mutually shape and hinder each other to result in observed dietary practices.

In understanding how dietary practices change, it is also important to consider the temporalities of eating practices, such as tempo, peridocity and synchronisation. Tempo refers to the length of time it may require to complete an eating event, which depends on the context in which said eating practice is carried out and with whom. For example, an eating event taken alone or at a fastfood estbalishment may be short and harried, while that taken in the company of others would usually take longer (Southerton et al., 2006). Peridoicity refers to the notion that certain foods are associated with certain times of the day, e.g. breakfast, lunch or dinner (Southerton et al., 2006). Peridocity is culture-dependent, i.e. what might pass for breakfast food in one culture or country might pass for lunch in another (Southerton et al., 2006). Lastly, synchronisation pertains to what other activities or practices might occur at the same time as an eating event (Southerton et al., 2006), e.g. socialising, working, childcare. Synchronisation therefore depends on the physical environment in which the eating event occurs, as well as who might be present at the time.

By taking dietary practices (one aspect of dietary behaviour) as a unit of inquiry and analysis (Paddock, 2015), this research examines their reproduction and transformation in the everyday lives of Ugandan WRA. This not only provides an understanding, of women's dietary practices, but also highlights possible ways through which these dietary practices might remain the same or change over space and time (Blue et al., 2016). By using a socioecological approach, supplemented by a practice-oriented approach, this PhD research explores whether (and by what process) the tangible and intangible elements of dietary practice have or have not undergone transformation over time within rural and urban contexts.

1.8 Study Rationale

Recent studies have highlighted that dietary shifts from more traditional, less processed, plant-based diets towards more 'modern' diets high in sugar, saturated fat and processed foods, are now taking place in both rural and urban SSA and Uganda specifically (Steyn et al., 2012; Tschirley et al., 2015; Masters, 2016). In SSA, as with many LMIC, women are more vulnerable to overweight and obesity, which are associated with the dietary change characteristic of the NT (Hansford, 2010). These dietary changes have implications for both health and environmental sustainability. Evidence from HIC indicates that such diets, consonant with the NT, are associated with increased risk for NR-NCDs and have higher environmental impact (GHGE). This presents a complex public health problem for Uganda, which is already grappling with high prevalence of infectious disease and micronutrient deficiencies. This triple burden of disease could exert additional strain on the country's already fragile public health system. Environmental impacts brought on by production to meet increased demand for 'westernised diets' could also be detrimental to Uganda, which is already feeling the effects of climate change (Magrath, 2008) and yet is largely dependent on agriculture economically. As discussed in this chapter, the macro, social, cultural and physical environments in which individuals live can have an influence on their dietary practices (Barnett and Casper, 2001; Swinburn and Egger, 2002; Story et al., 2008; Bilman et al., 2017). This contextual influence goes beyond just what people eat and drink but also encompasses how they source and prepare food, as well as how, where, how and with whom they eat.

Despite established and emerging evidence from many HIC on the impacts of so-called 'westernised diets', for both health and environmental sustainability, few studies in LMIC have attempted to understand the nature of dietary changes that might exist among their populations. Furthermore, research in LMIC contexts on the influences behind dietary practices that look beyond the individual-level is limited. The findings that this PhD generates on healthy and environmentally dietary behaviours among rural and urban Ugandan WRA will inform public health nutrition practitioners of these dietary changes and provide a starting point for debate among those involved in local and regional public health nutrition policy.

1.9 Identification of Gaps in the Literature

In Uganda, although the debate on dietary changes and associated implications for health and environmental sustainability has recently gained ground, data in this area are still scant. The following research gaps have been identified:

i. What is the healthiness and environmental impact of dietary behaviours of Ugandan WRA?

ii. Do dietary behaviours differ between rural and urban Ugandan WRA as has been postulated by nutrition transition theory? If, so, what nature do these differences take?
iii. What factors influence dietary practices among rural and urban Ugandan WRA?
iv. Do these factors identified in (iii) above vary between rural and urban contexts?

1.10 Research Questions, Aim and Objectives

1.10.1 Research Aim

The overall aim of this PhD was to assess the healthiness and environmental impact of the dietary behaviours of rural and urban Ugandan WRA and identify the individual-level and environmental-level factors influencing these dietary behaviours.

1.10.2 Research Questions

The following research questions (Figure 3) were identified from the research gaps.

i. What is the healthiness and environmental impact of the dietary behaviours of rural and urban WRA?
ii. How do dietary behaviours differ between rural and urban Ugandan WRA in terms of healthiness and environmental impact?
iii. How do factors at the individual-level and the environmental-level perpetuate the dietary behaviours of Ugandan WRA?

1.10.3 Research Objectives

The following research objectives were identified from the research questions:

i. To establish the dietary patterns of rural and urban Ugandan WRA.
ii. To explore evidence for dietary transitions among Ugandan WRA using differences in urban and rural dietary intake.
iii. To assess the healthiness and environmental impact of the dietary intake of rural and urban Ugandan WRA.
iv. To categorise rural and urban Ugandan WRA with similar dietary profiles into dietary typologies with respect to healthiness and environmental impact.
v. To establish individual-level and environmental-level factors that influence the dietary practices of rural and urban Ugandan WRA.

The research questions, research aim and research objectives that frame this PhD thesis are summarised in the PhD Research Framework in Figure 1.3. Proposed methods (Figure 1.3) are described in the following chapter of this PhD thesis.

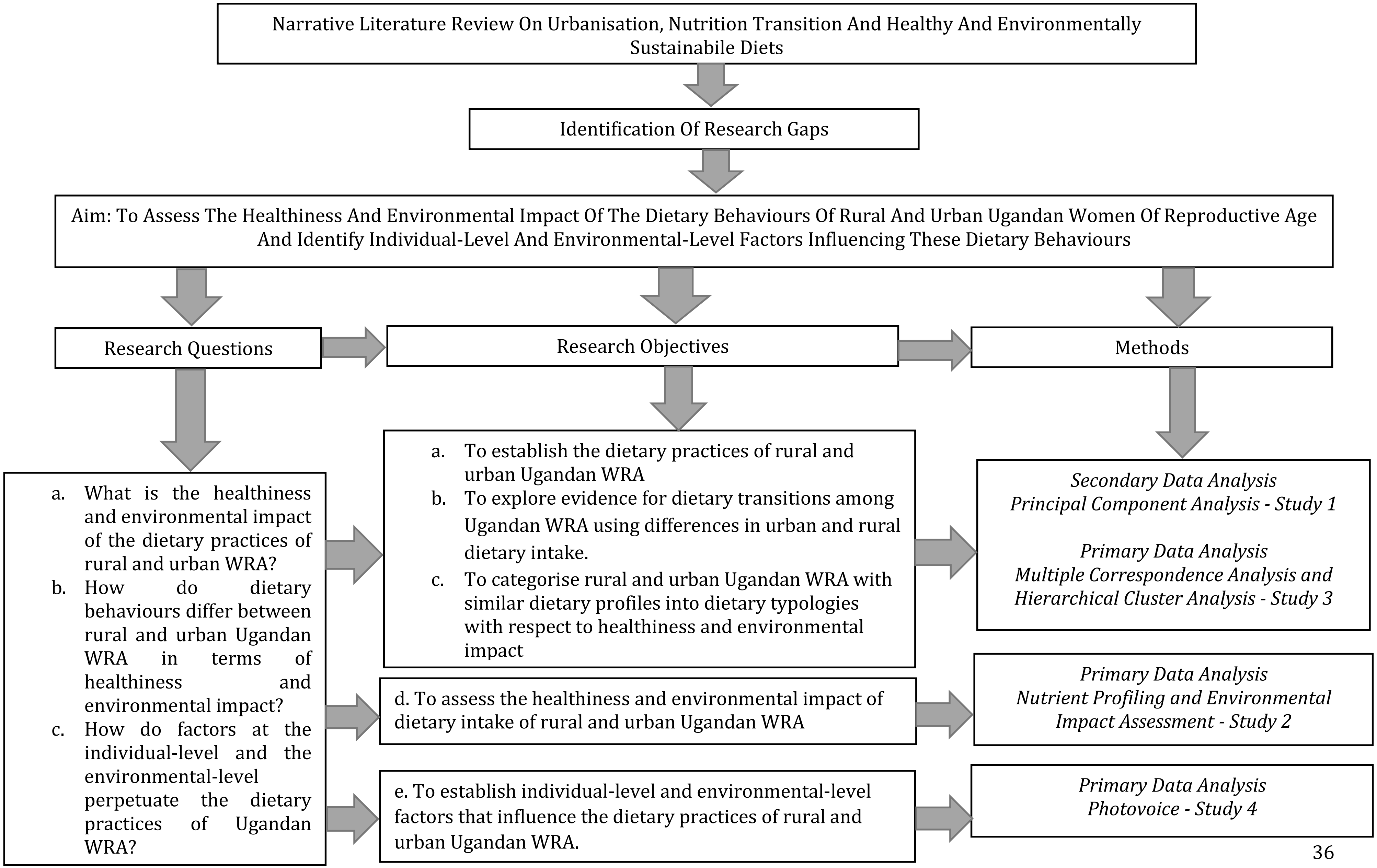

Figure 1.3: PhD Research Framework

2 CHAPTER TWO: METHODOLOGY

This chapter provides a description of the methods employed in the four studies undertaken in this mixed methods PhD, which aimed to assess the healthiness and environmental impact of the dietary behaviours of rural and urban Ugandan women of reproductive age and identify the individual-level and environmental-level factors that influence these dietary behaviours. First, a description of the researcher's epistemological position is highlighted followed by a description and justification of the mixed method approach used.

2.1 Epistemology and Ontology

Qualitative research has traditionally been approached from a constructivist world-view and quantitative research from a positivist or post-positivist epistemological perspective (Draper, 2004; Creswell, 2009; Feilzer, 2010). The constructivist postulates that there is no one truth, i.e. truth is fluid and varies depending on people's subjective perceptions, values and beliefs (Creswell, 2003; Draper, 2004), and as such, uses qualitative research methods that allow these views to come to the fore. On the other hand, the positivist seeks to find objective truths using quantitative methods that collect empirical data by measuring and quantifying (Creswell, 2003; Draper, 2004). In the scientific literature, most studies in nutrition have been approached from either a strictly quantitative or a qualitative perspective. More recently, as in this PhD thesis, it has become necessary for researchers to use a combination of qualitative and quantitative methods (mixed methods) to answer research questions. Feilzer (2010) writes that the mixed methods approach worldview neither falls neatly within the positivist nor constructivist paradigms but adopts an entirely different paradigm called 'pragmatism'. By adopting pluralistic approaches to answer questions, pragmatism seeks to provide deeper understanding of social phenomena (Creswell, 2003). Therefore, rather than being immersed in which philosophical position to situate my research, I adopted a pragmatic epistemological position, by considering what methods would be most suited to answering the research questions summarised (section 1.10.2), bearing in mind the strengths and limitations of each method and the complementarity offered by mixing them.

The next section highlights the mixed methods approach used in this PhD.

2.2 The Mixed Methods Approach

The mixed methods approach involves the use of a combination of two or more qualitative methods within the same study, or more commonly, the use of a combination of quantitative and qualitative methods in the same study (Ritchie and Ormston, 2014). Since it involves the collection and analysis of both quantitative and qualitative data, such mixed methods studies often require expertise in both research traditions and can be taxing in terms of time and resources (McKim, 2017). Nevertheless, mixed methods studies are gaining popularity in scientific research as they offer a number of advantages.

Firstly, using the mixed methods approach offers a more detailed and broader understanding of the phenomenon under study (Creswell, 2009; McKim, 2017). This is particularly important for topics that are multi-dimensional in nature, e.g. dietary behaviour as in this PhD. Furthermore, the mixed methods approach offers the ability of multiple methods complementing the weaknesses or limitations of each other (Creswell, 2003; 2009; McKim, 2017). For example, in this PhD, while questions on what people eat could adequately be addressed using quantitative methods, questions on what influences dietary behaviours were better approached qualitatively, as these are embedded in people's narratives of everyday life. Moreover, the fact that healthy and environmental sustainable diets is a relatively new field necessitates any forthcoming research in this area to address research gaps regarding both numbers and narratives. The breadth and depth of data arising from the use of both quantitative and qualitative methods in this PhD, provides comprehensive and holistic insight into healthy and environmentally sustainable dietary behaviours, among rural and urban Ugandan WRA.

A number of mixed methods study designs or typologies exist (Creswell et al., 2008; Creswell, 2009; Tashakori and Teddle, 2010). The nomenclature of mixed methods study design depends on implementation (whether the quantitative study takes place before the qualitative and vice versa or at the same time), priority (whether the quantitative and qualitative arms have different or equal importance in the study), integration (at which point the different components are brought together) and whether or not the research is hinged on a theoretical perspective (Creswell et al., 2008). To this end, Creswell et al. (2008) propose six mixed method study designs, i.e. sequential explanatory, sequential exploratory, sequential transformative, concurrent triangulation, concurrent nested and concurrent transformative. In sequential mixed methods study designs, data collection and analysis for one component follows the completion of the other, while in concurrent study designs, data collection and analysis for both components (quantitative and qualitative) occur at the same time. For example, in the convergent parallel mixed methods design, the quantitative and qualitative arms of the study occur at the same time, i.e. data are collected, analysed separately and then findings brought together (Creswell et al., 2008; Creswell, 2009). In the sequential exploratory mixed methods design, qualitative data is first collected and analysed and following this, the quantitative arm of the study is conducted (Creswell et al., 2008; Creswell, 2009). In the sequential explanatory mixed methods study design, the quantitative component of the study is conducted first and the results from this are used to plan or build the subsequent qualitative study (Creswell, 2009). In this mixed methods design, the quantitative findings guide the researcher on which participants to include in the qualitative study and what kinds of questions to explore (Creswell et al., 2008; Creswell, 2009). In so doing, the qualitative arm of the study helps explain the observations from the quantitative study (Creswell et al., 2008; Creswell, 2009). The sequential explanatory mixed methods study design is straightforward and easier to implement since steps fall into clear, separate stages (Creswell et al., 2008). This makes the sequential explanatory mixed methods study design particularly useful for the novice mixed methods researcher, or the researcher more conversant in quantitative research, such as the lead researcher for this PhD thesis (Creswell et al., 2008). To this end, this PhD research employed such a sequential explanatory mixed methods design.

As proposed by Creswell (2009), this mixed methods research was carried out as follows (Figure 2.1). Following a review of the literature, the quantitative PCA was conducted in study one to describe the dietary patterns of rural and urban Ugandan WRA and explore evidence for dietary transitions, using secondary data, i.e. nationally representative dietary dataset, collected in 2008 using a quantitative 24hr recall (Figure 2.1). As highlighted previously, the research questions in this PhD necessitated the exploration of the dietary behaviours of Ugandan WRA from both a healthiness and environmental sustainability angle. PCA was deemed appropriate for study one considering that Ugandan dietary recommendations were non-existent, therefore, an *a priori* method of diet quality assessment would have been inappropriate. Furthermore, given that the study was exploratory in nature, i.e. it was unknown what dietary patterns existed or how many dietary patterns to expect, PCA was deemed appropriate for study one, as it is exploratory in nature. By taking advantage of the inherent collinearity between the different foods and food groups consumed by WRA during the 2008 Uganda Food Consumption Survey (UFCS), an understanding of the foods and food groups that are consumed together in the different dietary patterns was obtained. Chapter 3 presents details of methods used and findings from study one.

Following study one, primary dietary data were collected from a smaller group of rural and urban Ugandan WRA using a single qualitative 24hr recall administered through semi-structured interviews. The qualitative 24hr recall method used in this study was different to that used in study one in that no quantities of foods consumed were obtained. Using this dietary data obtained, in study two, the healthiness and environmental impact of the dietary intake of these WRA were estimated using two quantitative methods, i.e. nutrient profiling and environmental impact assessment (GHGE) (Figure 2.1). In so doing, study two provided an objective measure of the healthiness and environmental impact of the dietary behaviours of WRA. This complemented findings from other diet quality assessment methods used in this PhD, i.e. PCA, MCA and CA, which are often criticised for their subjectivity. Findings from study two also provided more insight into the dietary behaviours of rural and urban Ugandan WRA by providing data on the relationships between foods consumed and aspects of dietary practice, i.e. tempo (length of eating event), periodicity (when eating event took place) and synchronisation (where eating event took place). Chapter 4 presents detailed methods and findings from study two.

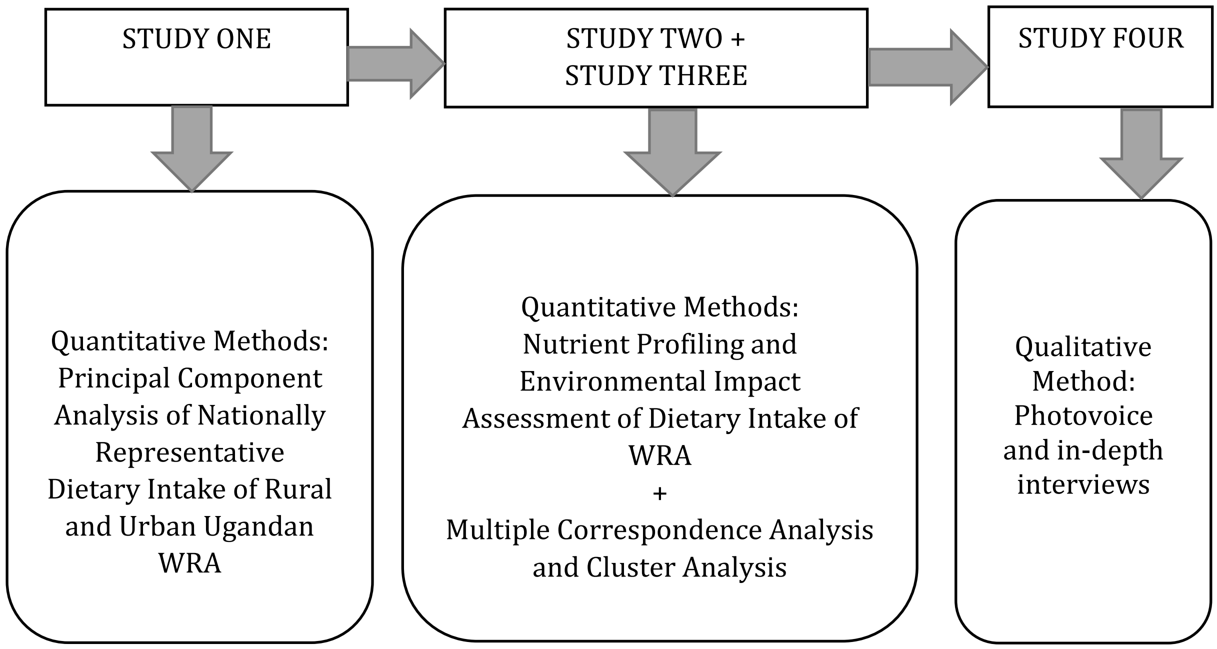

Figure 2.1: Sequential Explanatory Mixed Methods Study Design used in the PhD

The same primary dietary data collected study two were used in study three to identify existing dietary patterns among study participants using multiple correspondence analysis (MCA) (Figure 2.1). MCA was chosen as an appropriate method for dietary pattern analysis since it is a similar method to PCA, but is suited to categorical data, such as that collected for study three (dietary data that is not quantified). The use of MCA allowed for comparability between dietary patterns emerging from study three with those from study one. Comparison of dietary patterns between the two studies was necessary given that dietary data used in study one and study three were collected ten years apart (2008 vs 2018). Following this, participants were categorised into dietary typologies, based on similarities in their dietary intake, using the cluster analysis (CA). The dietary typologies resulting from CA in study three provided the basis for exploring factors influencing dietary behaviours among study participants in study four. The methods used in study three (MCA and CA) were informed by the methods and findings from study one and study two. For example, food groups used in the MCA and CA were based on those used in PCA in study one and were informed from the findings of study two. Detailed methods and findings from study three are presented in Chapter 5.

In study four, using Photovoice (PV), a qualitative participatory method of inquiry, the factors influencing the dietary behaviours of a subset of study participants from studies two and three were explored (Figure 2.1). As highlighted previously, the dietary typologies resulting from study three formed a basis for comparison in the factors identified among the study participants (Figure 2.1). PV aims to illuminate voices, ideas and conversations of often-marginalised groups, e.g. women, thus empowering them (Wang and Burris, 1997; Wang and Redwood-Jones, 2001; Sutton-Brown, 2014). By placing cameras in their hands and allowing them to take photographs, PV also aims to make participants feel more involved in the research process (Sutton-Brown, 2014). Additionally, by capturing images, participants that might otherwise have been unable to answer questions that explore their feelings and concerns, are able to express themselves (Sutton-Brown, 2014). It was for these reasons that PV, and not conventional qualitative methods such as interviews and focus-group discussions (FGD), was used in this PhD. Detailed methods and findings from this study are presented in Chapter 6.

As highlighted in Figure 1.3 and Figure 2.1, by addressing different research objectives (section 1.10.2), all four studies consequently met the research aim. Findings from studies one, two and three supplemented and complemented each other to provide a comprehensive picture of dietary behaviours among rural and urban Ugandan WRA, while those from study four provided an understanding of factors that influenced the dietary behaviours observed in the quantitative studies.

The ethical considerations for each of the four studies is highlighted in the next section.

2.3 Ethical Considerations and Participant Confidentiality

The ethical clearance procedures and participant confidentiality four all four studies in this mixed methods PhD are highlighted in this section. Since this was a mixed methods PhD, ethical clearance obtained for one study often meant ethical clearance was obtained for subsequent studies. All ethics approval documents are attached in Appendix n.

Principal Component Analysis – Study One
Ethical Considerations

Ethical clearance for the UFCS, the dataset used in study one was obtained from the Ugandan National Council for Science and Technology (UNCST) on 30 April 2008 and from the AED Research Integrity Department in Washington, DC on 5 January 2008 (Harvey et al. 2010; Kyamuhangire et al. 2013). For the use of the dietary data from the UFCS in this study, ethical clearance was obtained from the University of Sheffield School of Health and Related Research (ScHARR) Ethics Committee on 28 September 2016 (see Appendix 1).

Nutrient Profiling and Environmental Impact Assessment – Study Two
Ethical Considerations

Ethical clearance for study two was obtained from the Makerere University School of Public Health Higher Degrees Research and Ethics Committee (HDREC) on 27 July 2017 (Protocol no. 495) and the Uganda National Council for Science and Technology (UNCST) on 26 September 2017 (Protocol no. HS111ES) (see Appendix 2 and 3). These were approved by the University of Sheffield's Research Information Systems (RIS) Alternative Ethics Application in September 2017.

Informed Consent, Participant Confidentiality and Privacy

Informed consent was obtained from study participants before data collection (24hr recall). Participants did this by signing an informed consent form before interviews commenced. For participants younger than 18 years, consent was first sought from parents or guardians and then assent sought from the respective participants before interviews commenced. At the point of obtaining informed consent participants were informed of what their participation would entail, what kinds of data would be collected, the purpose of the research and any compensation they would receive for partipation. At all stages of the data collection process, participants were informed that they could leave the study at any point if they felt like without explaining why and with no negative consequences. Participants were also given the opportunity to ask questions about anything that was unclear regarding the research. Urban participants and rural participants that lived in Nakawuka parish received a 5,000 Uganda shilling (UGX) (approximately 1GBP) transport refund at the end of the 24hr recall interview. Those living in the more distant rural Bulwanyi parish received a 10,000 UGX (approximately 2GBP) transport refund. All interviews (24hr recall interviews) were audio recorded and audio recordings were entered onto an encrypted laptop at the end of each data collection day. Data were backed up on an encrypted external storage device during the fieldwork. Data were also uploaded on the researcher's U drive hosted at the University of Sheffield. Participants' data was anonymised by attaching a random ID number to each participant. Data collected in this study was treated with the utmost confidentiality and was not shared with other parties, except for the PhD research supervisors. All interview recordings were kept on an encrypted laptop that only the researcher had access to. Signed consent and assent forms were kept in a locked cabinet to which only the researcher had access. Informed consent and assent forms are in attached Appendix 4-7.

Multiple Correspondence Analysis and Hierarchical Cluster Analysis – Study Three

Participants that took part in study three were taken from those that took part in study two. Ethical clearance, informed consent and participant cofidentiality are described in sufficient detail under procedures followed for study two.

Photovoice – Study Four

Ethical Considerations

Participants for this study were drawn from those that took part in studies two and three. Ethical clearance for this study are described under procedures for study two.

Informed Consent, Participant Confidentiality and Privacy

The same participants that participated in this study took part in studies two and three and had previously given informed consent at that point of the 24hr recall interviews. Notwithstanding, it was important to get participants' consent before they took part in the Photovoice (PV) interviews. Therefore, informed consent was obtained from participants again before data collection for PV commenced. Participants were informed of what the PV study would entail, including what their participation would entail, what kinds of data would be collected, the purpose of the research and any compensation they would receive for partipation. Participants signed an informed consent form before the interviews commenced. For participants younger than 18 years, consent was again sought from parents or guardians and then assent was sought from the respective participants before interviews commenced. Prior to the in-depth interviews, participants signed another informed consent or informed assent form to show their willingness to participate in the PV interview (see Appendix 8-11) and an 'acknowledgment and release' form (see Appendix 12-13) allowing the researcher to use their photographs in the interview and in future research activities.

At all stages of the study, participants were informed that they could leave the study at any point without explaining why and with no negative consequences. All semi-structured interviews were audio recorded and all data (audio recordings and interview transcripts) were entered onto an encrypted laptop at the end of each data collection day. Data were backed up on an encrypted external storage device during the fieldwork. Data were also uploaded on the researcher's U drive hosted at the University of Sheffield. Study participants' data was anonymised by attaching a random ID number to each participant. Data collected in this study was treated with the utmost confidentiality (according to Makerere University School of Public Health IRB guidelines) and was not shared with other parties, except for the PhD research supervisors when necessary. Interview recordings were kept on an encrypted laptop to which only the researcher had access. Signed consent and assent forms were kept in a locked cabinet to which only the researcher had access. As with studies two and three, urban participants received a 5,000 UGX transport refund at the end of the PV training and following the in-depth, interviews. Likewise, rural participants that lived in Nakawuka parish received a 5,000 UGX transport refund while those who lived in Bulwanyi parish received a 10,000 UGX transport refund. All PV participants received a 5,000 UGX mobile phone voucher so that they could contact the researcher or field assistants for advice during the photography period.

The next chapter details the PCA that was undertaken to explore evidence for dietary transitions and to describe the dietary patterns of rural and urban Ugandan women of reproductive age using secondary data from the 2008 UFCS.

3 CHAPTER THREE: DIETARY PATTERNS AMONG RURAL AND URBAN UGANDAN WRA (STUDY ONE)

As mentioned in the previous chapter, in study one, PCA was undertaken on nationally representative dietary data to describe the dietary patterns of Ugandan WRA and explore evidence for dietary transition. This chapter presents the steps undertaken in the PCA and the resulting findings. First, a description of the dataset used in the study, the 2008 Uganda Food Consumption Survey (UFCS) is presented. Following this, a description of the study setting for the UFCS and sampling method employed is highlighted. Next, a detailed description of the steps involved in the PCA is presented, followed by key findings. This chapter concludes with a discussion of the findings and highlights possible implications of findings for policy and practice. Study one has been published (Auma et al. 2019).

3.1. The 2008 Uganda Food Consumption Survey: Study Setting, Participants and Data Collection

The 2008 UFCS was a cross-sectional dietary survey undertaken in 2008 in rural and urban Uganda (Harvey et al., 2010). The UFCS, which followed from a baseline study that assessed the prevalence of vitamin A deficiency in Eastern Uganda, was carried out to provide evidence on the need and potential for food fortification programmes to mitigate micronutrient deficiencies in Uganda (Harvey et al., 2010).

3.1.1 Study Setting

The 2008 UFCS took place in three diverse geographical regions, i.e. Northern, Southwestern and Kampala City Region (Kampala District), collectively representing rural and urban Uganda.

3.1.2 Sampling

Participants were sampled using the multi-stage random sampling method described in detail elsewhere (Harvey et al., 2010; Kyamuhangire et al., 2013). First, three geographical regions were purposively sampled, i.e. Kampala City Council (KCC) and the rural Northern and Southwestern regions (Harvey et al., 2010). From Kampala City Council, two divisions were randomly sampled while four districts were randomly sampled from the Northern (n=2) and Southwestern regions (n=2) after excluding those districts considered unsafe or unreachable (Harvey et al., 2010). From each of the four rural districts, two sub-countries were randomly sampled resulting in eight rural sub-counties (Harvey et al., 2010).

Study participants were subsequently sampled from the two divisions in KCC and the eight sub-counties in the Northern and Southwestern regions using multi-stage cluster sampling. First 'enumeration areas' (EAs) or clusters were sampled with probability proportional to size (Harvey et al., 2010). Boundaries for these EAs or clusters were based on the 2002 UBOS Population and Housing Census (Harvey et al., 2010). Large clusters containing more than 150 households were sub-divided and only one sub-cluster was randomly chosen (Harvey et al., 2010). Following this, households within each sampled clusters were randomly selected from a comprehensive list of all eligible households in the cluster (Harvey et al., 2010). Eligible households were those identified, by local area leaders, as those having at least one woman of reproductive age (15-49 years) and one child aged 6-23 months resided prior to data collection (Harvey et al., 2010). In households where more than one eligible woman or child resided, the final participant who participated in the survey was randomly chosen from all potential participants within that household (Harvey et al., 2010). Sampling yielded a total of 957 WRA; 314 in urban Kampala, 322 in rural Southwestern and 321 in rural Northern Uganda (Harvey et al., 2010; Kyamuhangire et al., 2013).

3.1.3 Data Collection

Data collected during the UFCS included independent and dependent variables. Independent variables included information on participants' place of residence (urban vs rural), age, education, socioeconomic status, marital status, religion, occupation, relationship to household head, livelihood of household head and household food production (Harvey et al., 2010; Kyamuhangire et al., 2013). Details of the survey participants' socio-economic and demographic characteristics have been detailed elsewhere (Harvey et al., 2010; Kyamuhangire et al., 2013) and are summarised in the section 3.4.1 of this thesis. At the time of this PhD study, data on the socio-demographic variables, except for participant place of residence, were unavailable and were therefore not included in any of the analyses.

The dependent variables included dietary intake and household expenditure data (Harvey et al., 2010). Dietary intake data in terms of individual dietary intake were collected from all 957 women using a single quantitative 24-hour recall method with a context-specific questionnaire (Harvey et al., 2010). The multi-pass method was used to prompt recall and ensure participants recounted, as accurately as possible, all foods and drinks that they consumed the day before the interview (Harvey et al., 2010). The multiple pass 24-hour recall was organised into a four-step process. In the first step, participants listed all food and drink (including snacks) that they ate just after they or their 6-23 month-old child woke up until just before they went to bed (Harvey et al., 2010). The second step involved participants providing a detailed description of each food item, they listed at the first instance, including ingredients and food preparation methods, following the promptings of the trained data collectors (Harvey et al., 2010). Next participants estimated the amounts of each food, drink or snacks they ate. Lastly, with the aid of food picture charts, participants and the trained data collectors went through the dietary intake to ensure correctness of the dietary recall (Harvey et al., 2010; Kyamuhangire et al., 2013).

Data collection tools (questionnaire) were translated into the local languages commonly used in the different regions that were sampled for the survey. Trained data collectors fluent in these local languages carried out the 24hr recall interviews, each of which lasted

2-3 hours (Harvey et al., 2010). Most data collectors were graduates of Food Science and Technology or Human Nutrition from Makerere University that had participated in previous surveys (Harvey et al., 2010). Prior to data collection, all recruited data collectors participated in a two and a half-week training course on the use of the data collection tools and the interviewing techniques at Makerere University's Department of Food Science and Technology (Harvey et al., 2010). Following this, pilot interviews were carried out in one urban and one rural cluster and adjustments made to the data collection tools, sampling methodology and interview method as necessary (Harvey et al., 2010).

Data collection in Kampala (urban) and Southwestern Uganda (rural) took place between May and September 2008 while that in the Northern region (rural) took place between August and September 2008 (Kyamuhangire et al., 2013). During data collection, data were double entered using Census and Survey Processing Programme (CSPRO) Version 3.3.002 (Harvey et al., 2010). In each of the survey regions, 10% of the sampled households participated in a repeat 24-hour recall exercise on a non-consecutive day (Harvey et al., 2010; Kyamuhangire et al., 2013). Data from these repeat 24hr recalls were used to estimate the distribution of usual nutrient intakes and therefore account for variations in dietary intake between weekdays and weekend days (Harvey et al., 2010; Kyamuhangire et al., 2013).

The next section describes the steps involved in the PCA.

3.2 Steps Undertaken in the Principal Component Analysis

The steps involved in dietary pattern analysis using PCA are data cleaning and management; classification of food items into food groups; principal component analysis; rotation of principal components; selection and interpretation of components to be retained; and finally, labelling of each component (Yong and Pearce, 2013). The next section describes each of these steps, as carried out in this study:

3.2.1 Data Cleaning and Management

Although data for the UFCS were collected from 957 participants, data used in the present study were from 955 participants as this is what was available at the time of the study. The dataset obtained contained 24hr dietary intake data in the long format. Before PCA was performed, the dataset was converted into the wide format as follows. First, using the merge function in SPSS, the total intake in grams for all individual food items consumed by each participant were obtained by adding up the intakes in grams for any food items consumed by that participant more than once in the course of the 24hr period. This was performed for all study participants (n=955). Once this was completed, the resulting dataset contained one total intake in grams for each individual food item consumed by each participant over the 24h period in long format. Data were then reorganised into the wide format, using the transform function in SPSS, to facilitate the recoding of individual food items into PCA food groups.

3.2.2 Classification of Food Items into Food Groups

In PCA, input variables can take on two forms, i.e. individual food items consumed by participants or food groups that are constituted by merging individual food items from participants' dietary intake data. For a robust analysis, Comrey and Lee (1992) propose that each input variable should have a minimum of 5-10 observations within the dataset, i.e. should be consumed by 5-10 participants at the minimum. Additionally, Yong and Pearce (2013) suggest a 10:1 ratio between participants and input variables used in the PCA. It was on this basis that food groups, and not individual food items, were used as input variables for this study. Food groups used in the analysis were the result of an agglomeration of the unique food items reported in the UFCS dataset.

To obtain a list of unique food items from the UFCS dataset, a copy of the dataset in long format was converted from SPSS into Microsoft Excel format. Then, a listing of all the food items reported by participants were extracted from the spreadsheet. From this listing, duplicate food items were removed leaving 537 unique food items. Food items from the dataset were then clustered together to formulate food groups. As a starting point in formulating food groups, references were made to food groups conventionally cited in the nutrition literature, e.g. legumes, roots, tubers and plantain (FAO, 2013). Some of these conventional food groups were then further split into 35 smaller food groupings (Table 3.1) based on several factors. These included the researcher's knowledge of culinary use of the respective food item(s) in the Ugandan context, the nutritional and environmental impact attributes of the food items and whether the food item(s) could be regarded as part of a traditional Ugandan diet. This resulted in, for example, food groups such as traditional vegetables and non-traditional vegetables in place of vegetables, and traditional fats, oils and spreads and non-traditional fats, oils and spreads in place of fats and oils (Table 3.1).

Table 3.1: Food Groups used in Principal Component Analysis of the Dietary Intake of Rural and Urban Ugandan WRA (n=955)

Food Group used in PCA	Food Items Consumed by WRA in the 2008 UFCS
Red meat	Beef, Goat meat, Pork
Chicken	Chicken
Fish	Nile tilapia, Nile perch, mukene[11], nkejje[12], semutundu[13]
Organ meats	Tripe, liver, chicken gizzards, mulokonyi[14]
Bread and Buns	White, yellow or brown bread, buns
Sugar and Sweeteners	White sugar, brown sugar, sugarcane, honey
Insects	Grasshoppers, white ants, bee larvae
Alcohol	Bottled beer, bottled wine, traditional beers and crude gin
Sugar-sweetened beverages	Homemade fruit juice with added sugar, soda, packaged fruit juices and sugar-sweetened drinks

[11] Lake Victoria sardine
[12] Small pelagic fish species
[13] Cat fish
[14] Cow hooves

Fresh fruit and unsweetened fruit juice	Orange, pineapple, mango, guava, raspberries, 'nsaali', menvu[15], bogoya[16], passion fruit, papaya, guava, lemon, jackfruit, empafu[17] tangerine, watermelon, unsweetened fruit juice
Traditional fats, oils and spreads	Shea nut butter, omuzigo omuganda[18], groundnut paste, sesame paste, groundnut and sesame paste
Non-traditional fats, oils and spreads	Vegetable oil, margarine, hydrogenated vegetable cooking fat
Traditional vegetables boiled	Nakatti[19], spider plant, doodo[20], pumpkin leaves, malakwang[21], cow pea leaves, bean leaves, entula[22], okra fruit, okra leaves, pumpkin, ensusuti and alayo[23] (cooked by boiling, steaming or eaten raw)
Traditional vegetables fried	Nakatti, spider plant, doodo, pumpkin leaves, malakwang, cow pea leaves, bean leaves, entula, okra fruit, okra leaves, pumpkin, ensusuti and alayo (cooked by frying with oil)
Non-traditional vegetables boiled	Tomatoes, chilli, cucumber, onions, garlic, avocado, carrots, green bell peppers, sukuma wiki[24]' (collard greens), French beans, cabbage (cooked by boiling, steaming or eaten raw)
Non-traditional vegetables fried	Tomatoes, chilli, cucumber, onions, garlic, avocado, carrots, green bell peppers, sukuma wiki, French beans, cabbage (cooked by frying with oil)
Rice and pasta	White rice, brown rice, spaghetti, macaroni
Traditional cereals (boiled)	Maize atap, millet atap, sorghum atap, sorghum:cassava (2:1) atap[25]' (cooked by boiling or steaming)
Traditional cereals (fried)	Popcorn, hard corn, roasted maize (cooked with oil added or roasted)
Matooke	Matooke[26]
Sweets	Biscuits, candies, kabalagala[27], gulusa[28], doughnuts, mandazi[29], half cake, cake.
Katogo	Katogo[30], nyoyo[31]
Legumes	Nambaale[32], yellow bean, white bean, black bean, kidney bean, adzuki bean, bean sauce, field pea, cowpea, pigeon pea, agira[33]
Groundnut sauce	Groundnut sauce, raw pounded groundnuts, sesame seed sauce
Soups	Bean soup, beef soup, goat soup, chicken soup, pork soup, fish soup, tomato soup

[15] Small dessert banana
[16] Big sweet bananas
[17] Ugandan olives
[18] Cow ghee
[19] African night shade (dark green leafy vegetable)
[20] Amaranth spp. (dark green leafy vegetable)
[21] Hibiscus spp. (dark green leafy vegetable)
[22] Garden egg
[23] Dark green leafy vegetables
[24] Collard greens
[25] Traditional staple, resembling polenta in appearance, made by boiling various cereals in water
[26] Traditional staple made from boiled or steamed cooking bananas
[27] Traditional deep-fried Ugandan pancakes made from cassava flour and over-ripe small dessert bananas
[28] Traditional Ugandan sweets
[29] A form of fried bread made primarily from wheat flour, sugar, water and vegetable oil or margarine
[30] Traditional dish made from various combinations of yam, matooke, potatoes, sweet potatoes, legumes, and vegetables in one dish
[31] Traditional dish made from dried maize and beans
[32] Cranberry bean
[33] Traditional sauce made from boiling skinless beans in water

Eggs	Omelette, boiled egg, fried egg
Chapatti	Chapatti
Savoury snacks	Samosas, rice balls[34]
Porridge	Soya porridge, maize porridge, millet porridge, TASO porridge, sorghum porridge, enturire[35]
Fast food	Chips, chaps, chips and liver, sausages, rolex[36]
Milk and milk products	Fresh milk, boiled milk, yoghurt, milk tea, eshabwe[37], sour milk
Tea	Unsweetened black tea, unsweetened black coffee
Nuts and seeds	Pumpkin seeds, sunflower seeds, roasted groundnut seeds, roasted sesame seeds
Boiled roots and tubers	Yam, sweet potato, irish potato[38], cocoyam, cassava, cassava: maize atap, cassava atap (cooked by boiling, steaming or eaten raw)
Fried roots and tubers	Sweet potato, cassava (cooked by shallow or deep frying)

Data on the nutrient content of food items were obtained from the HarvestPlus Uganda Food Composition Table (Hotz et al., 2012) and the Tanzania Food Composition Tables (Lukmanji et al., 2008). For foods not in these two composition tables, data were gleaned from the wider nutrition literature. Data on the culinary use of food items was based on the researcher's own knowledge of the local context, while data on the 'traditionality' of food items were obtained from Ugandan food consumption literature during pre-colonial and colonial times (Callanan, 1926; Courcy-Ireland et al., 1937; GoU, 1945; Ruttishauser, 1963; Oltersdorf, 1971; Goode, 1989; Raschke et al., 2007). This was supplemented with the researcher's own anecdotal knowledge of traditional Ugandan foods. As detailed in Auma et al. (2018) each of the 35 food groups were labelled as low, medium or high impact depending on whether the food items that constituted them were low, medium or high impact. To this end, low impact food items had GHGE <4 kgCO2eq per kg of product, medium impact had GHGE between 4–7 kgCO2eq per kg of product while those >7 kgCO2eq per kg of product were classified as high impact foods (Auma et al., 2019). Data on environmental impacts of food items were gleaned from published literature, primarily from HIC (Macdiarmid et al., 2012; Bailey and Harper, 2015; Bajzelj et al., 2015; Reynolds et al., 2015; Clune et al., 2017). A detailed list of the 35 PCA food groups and rationale for grouping is presented in Appendix 14.

For each of the 35 food groups formed (Table 3.1), intake in grams for each participant was computed by collating participants' intake (grams) for the different food items constituting each respective food group that they consumed in the 24h period. This was performed using the compute function in SPSS. Before PCA was performed, the intake in

[34] A deep-fried snack comprising of rice encased in a wheat flour-based batter
[35] Fermented millet or sorghum porridge
[36] Popular Ugandan street food consisting of fresh vegetables, fried eggs and other ingredients like sausages, beef, and pork wrapped in a chapatti.
[37] A kind of clarified butter commonly used as condiment by the Ankole people. It is usually reserved for special occasions, e.g. traditional weddings
[38] In Uganda, potatoes are referred to as irish potatoes differentiating them from sweet potatoes

grams for each food group for each participant was standardised (normalised to z-scores). This accounted for portion size effect since different foods are eaten in different quantities or portions (Sodjinou et al., 2009). This resulted in a dataset with normalised intakes (mean 0 and standard deviation 1), in place of a dataset with intake in grams. Using the ±6SD threshold, possible outliers were identified from the normalised intakes (Crozier et al., 2006). For those intakes that were identified as possible outliers (> ±6SD), the amount in grams for that food group and all other food groups consumed by that participant were scrutinised for plausibility, based on the researcher's knowledge of the local context (Auma et al., 2019). Intakes for individual food groups that were deemed biologically implausible were removed, but not the individual's entire dietary intake for the 24-hour period (Auma et al., 2019). For example, participant 102102010106's intake of rice and pasta (1087 grams) was identified as an outlier (6.47459SD). This intake was therefore removed from the dataset before analysis, but not the participant's intakes of the 8 other food groups they consumed (sugar, bread, milk, tea, fresh fruit, boiled non-traditional vegetables, boiled traditional cereals and legumes). When PCA was performed, the removed implausible intake was treated as 'data missing' for only that food group but not for all other food groups consumed by the participant. Intakes flagged as possible outliers that were deemed plausible based on context, were left in the dataset. For example, participant 307202085119's intake of fried non-traditional vegetables (283.02 gram) although flagged as an outlier (7.19740SD) was left in the dataset as it was deemed plausible. This was due to the fact that this was a rural participant that consumed only 7 (fresh fruit, fried non-traditional vegetables, boiled roots and tubers, boiled traditional cereals, fried traditional cereals, legumes and matooke) out of the 35 food groups, which were all within ±6SD except for fried non-traditional vegetables.

Once all participants' intakes were checked, PCA was performed with the normalised intakes for the food groups entered as the input variables. Although some authors have used gram intake for the food groups as the PCA input variables, in this study, both types of input variables resulted in the same output.

3.2.3 Running the PCA, Rotation, Selection and Interpretation of Principal Components

PCA was run in SPSS using the principal components function with missing cases excluded pairwise to account for implausible intakes that were removed during data cleaning (Auma et al., 2019). Excluding missing cases pairwise, unlike excluding missing cases listwise, ensures that missing intakes are accounted for without excluding the participant altogether from the analysis. Once PCA was performed, varimax rotation with Kaizer normalisation was used to aid in interpretation of principal components (Smith et al., 2013).

The choice of principal components (dietary patterns) to retain was based on statistical information, i.e. scree plot of eigenvalues > 1.0 and interpretability (Smith et al., 2013). The scree plot of eigenvalues shows the proportion of the variance explained by the first component and then the additional variance explained by the second, third, fourth principal components and so on. Figure 2.1 shows the scree plot of eigenvalues from this study. Although many components had eigenvalues >1.0 (Figure 3.1) only the first four principal components, accounting for 23.6% of variance in dietary intake, were retained based on interpretability.

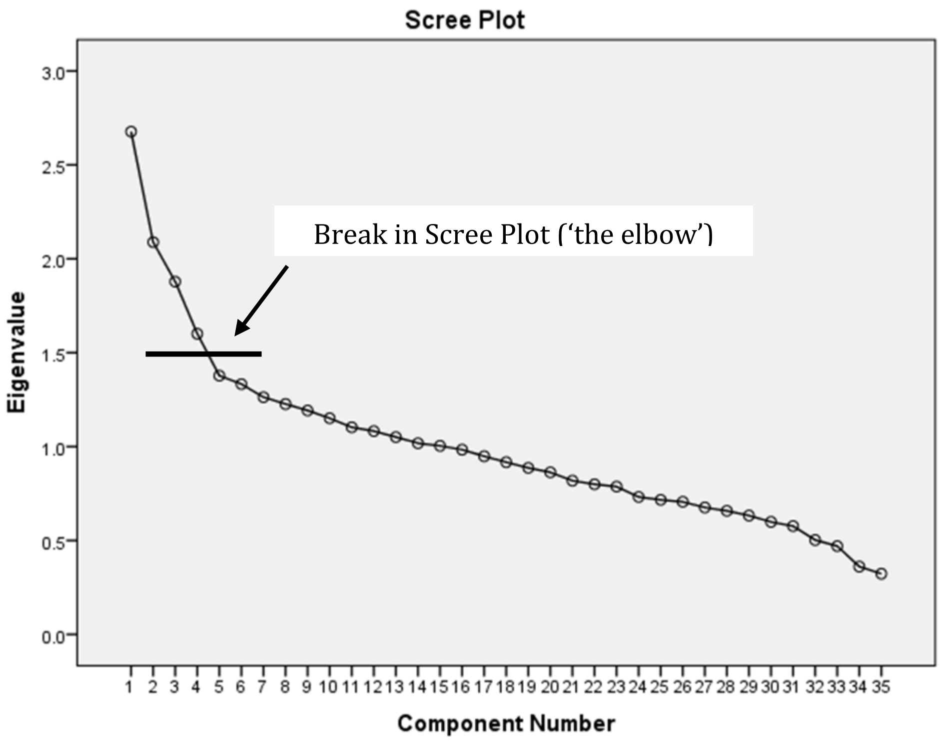

Figure 3.1: Scree plot of Eigenvalues from PCA of Ugandan Women's Dietary Intake

In interpreting and labelling the retained principal components, factor loadings with a magnitude of at least ±0.2 were considered to load either highly positively or highly negatively on each principal component (Smith et al., 2013; Annan et al., 2015). The retained principal components were labelled as dietary patterns. This was based on the food groups with which the principal components were negatively or positively associated. In this way, the labelling of the dietary patterns was reflective of the mix of food groups associated with it. Details on the labelling of food groups with respect to environmental impact have been published previously (Auma et al., 2019). As described in Auma et al. (2019) for each dietary pattern, a count of the total number of food groups that loaded positively and negatively at each environmental impact level (low, medium, high) was obtained. The difference between the total number of positive and total number of negative counts at each environmental impact level was then computed for each dietary pattern (Auma et al., 2019). The environmental impact category (low, medium, high) with the largest difference of the three was taken as the environmental impact category representative of that dietary pattern, and the dietary pattern was labelled as such (Auma et al., 2019). When a dietary pattern showed an equal difference for more than one environmental impact category, the final decision on labelling depended on the environmental impact category of the food group that had the highest positive factor loading on that dietary pattern (Auma et al., 2019). Dietary patterns were also labelled depending on whether food categories of which thet were comprised were modern or part of the traditional Ugandan diet. Labelling of the dietary patterns is discussed in more detail in the findings section of this chapter (section 3.4.3).

3.3 Data Analysis

To test the relationship between participants' place of residence and the resulting dietary patterns, bootstrap linear regression analysis was undertaken. Bootstrap regression is a robust regression method suitable for use when not all assumptions for a linear regression (independence of residuals, linearity of relationships, and normality of residuals and that the variance of residuals does not differ by predicted values, i.e. homoscedasticity) are met (Field, 2013). When the assumptions for all the linear regression were checked against the dataset, it was found that the data met the assumptions for independence of residuals. Although the histograms of the residuals showed that the residuals were approximately normal, the standardised P-P plots showed evidence of some skew. However, because of the large sample size (n=955), it was assumed that the bootstrap regression was robust to the skew and the heteroscedasticity of the data. When running the bootstrap linear regression, the rural group was taken as the reference category and was denoted as 0 (urban = 1). The relationships between the resulting dietary patterns and the sociodemographic characteristics of the participants was not tested because sociodemographic data were unavailable at the time of this study.

Data analyses (PCA and bootstrap linear regression analysis) were performed using SPSS Version 23 (SPSS Statistics, IBM, New York).

3.4 Findings

Although survey dietary data were collected from 957 participants (section 3.2.1), the findings presented in this chapter, except for the sociodemographic characteristics, are based on dietary intake data of 955 participants, which were available at the time of this study.

3.4.1 Characteristics of Study Participants

Sociodemographic characteristics of study participants in the UFCS (n=957) have been presented previously (Harvey et al., 2010; Kyamuhangire et al., 2013). These characteristics are summarised in Table 2.2. As highlighted in Table 2.2, most study participants were younger than 35 years of age. Most participants were either married or cohabiting, although the proportion was slightly higher among rural participants (9 in 10 vs 8 in 10) (Table 2.2). Rural participants achieved a higher level of education compared with their urban counterparts were, i.e. more than 9 in 10 urban women were educated up to at least the primary level compared with about 7 in 10 rural women.

Table 3.2: Sociodemographic Characteristics of Rural and Urban Ugandan WRA (n=957) from the 2008 UFCS

	Urban Uganda (n=314)		Rural Uganda (n=643)	
Characteristics	n	%	n	%
Age (years)				
15-24	125	39.8	195	30.3
25-34	156	49.7	275	42.8
35-49	32	10.2	164	25.5
Marital Status				
Married (or cohabiting)	273	86.9	585	91
Single[39]	41	13.1	60	9.3
Highest Level of Schooling Completed				
Informal	24	7.6	144	22.4
Primary	123	39.2	395	61.4
Secondary	146	46.5	59	9.2
Post-secondary	21	6.7	10	1.6
Do not know	1	0.3	36	5.6
Socioeconomic Status[40]				
1 (Lowest Quintile)	53	16.9	241	37.5
2	3	1.0	174	27.1
3	22	7.0	119	18.5
4	63	20.1	106	16.5
5 (Highest Quintile)	176	56.1	3	0.5
Occupation	(n=111)		(n=177)	
Farming	0	0	115	65
Trader	43	38.7	12	6.8
Civil servant	3	2.7	11	6.2
Other private employment	24	21.6	21	11.9
Artisan	1	0.9	0	0
Food service	13	11.7	5	2.8
Other service industry	26	23.4	16	9.0

(adapted from Harvey et al. 2010 and Kyamuhangire et al. 2013)

Urban women were mostly within the two highest wealth quintiles (Table 3.2) while most rural women were within the two lowest wealth quintiles (Table 2.2). This suggests that urban women were more affluent than their rural counterparts were. While rural women were more involved in farming, urban women were more involved in trade and other private employment (Table 3.2).

3.4.2 Dietary Intake Estimates for Rural and Urban Ugandan WRA

Table 3.3 shows the median consumption in grams, in the past 24 hours preceding the UFCS, of the 35 food groups that were used as input variables in the PCA. Findings indicate that among this sample of Ugandan WRA, there was low median consumption (<50grams/day) of non-traditional fats, oils and spreads, insects, eggs, fish, savoury snacks and sweets (Table 3.3). On the other hand, the median consumption of mostly

[39] Includes participants who were never married, widowed, separated or divorced
[40] Generated using tool based on 2006 wealth index

plant-based food groups (rice and pasta, tea, sugary drinks, groundnut sauce, boiled traditional vegetables, boiled roots and tubers, matooke, legumes, boiled traditional cereals and katogo) as well as traditional fats, oils and spreads, milk and milk products, and alcoholic beverages was high (>200grams/day) (Table 3.3). Moderately high consumption (50 - 200grams/day) was observed for all other food groups, including some that can be considered as characteristic of transitioning dietary practices, i.e. red meat, chicken, fried roots and tubers, fried traditional cereals, fast food, sugar, bread and buns, chapatti and fried traditional vegetables and fried non-traditional vegetables (Table 3.3). These findings are indicative of a higher consumption of plant-based food groups among both rural and urban Ugandan WRA compared with animal-based foods. Similar results were obtained when medians were computed with outlier intakes removed.

Table 3.2: Median Food Intake (g/day) for 35 PCA Food Group consumed by Rural and Urban WRA (n=955)

Food Group	Median (IQR) (n=955)	Median (IQR) (urban, n=313)	Median (IQR) (rural, n=642)
Red Meat	73.4 (51.5, 114.6)	72.3 (51.2, 112.8)	79.2 (52.0, 126.8)
Organ Meats	49.3 (41.1, 70.6)	49.4 (42.4, 75.9)	49.3 (47.3, 49.8)
Chicken	70.1 (48.0, 94.2)	61.8 (47.1, 93.8)	75.2 (53.3, 94.2)
Fish	45.5 (30.2, 76.4)	45.2 (24.4, 80.6)	47.1 (33.6, 73.1)
Insects	37.6 (28.8, 110.6)	18.3 (18.3, 18.3)	44.8 (30.4, 132.6)
Sugar and Honey	68.2 (40.3, 124.7)	58.2 (37.8, 108.2)	80.2 (45.9, 137.7)
Bread and buns	69.6 (40.6, 83.2)	72.2 (40.6, 83.2)	41.6 (37.4, 74.8)
Chapatti	59.6 (59.6, 64.7)	59.6 (59.6, 79.1)	59.6 (45.7, 59.6)
Eggs	47.5 (31.3, 74.0)	47.5 (42.7, 85.5)	41.3 (38.9, 64.4)
Rice and Pasta	338.0 (209.0, 431.0)	282.0 (211.0, 421.8)	378.0 (174.5, 468.5)
Traditional Fats, Oils and Spreads	114.9 (28.0, 253.8)	30.9 (18.3, 250.0)	144.0 (44.4, 274.5)
Non-traditional Fats, Oils and Spreads	49.5 (27.5, 83.3)	41.6 (20.8, 62.5)	62.5 (41.6, 108.0)
Milk and milk products	498.0 (400.0, 860.0)	485.0 (400.0, 640.0)	567.6 (404.5, 965.0)
Alcoholic drinks	485.5 (255.6, 519.7)	497.3 (485.5, 971.0)	292.0 (144.6, 411.9)
Porridge	439.8 (306.8, 749.6)	380.9 (231.5, 798.3),	449.8 (352.4, 749.6)
Savoury Snacks	32.0 (15.6, 56.6)	31.8 (15.5, 49.4)	126.0 (126.0, 126.0)
Sugary Drinks	294.0 (271.2, 365.1)	294.0 (258.5, 365.1)	294.0 (294.0, 367.5)
Tea	460.0 (400.0, 770.0)	490.0 (410, 800.0)	450.0 (400.0, 650.0)
Soups	163.2 (109.9, 240.0)	151.2 (96.0, 249.7)	168.0 (115.2, 234.8)
Nuts and Seeds	58.4 (30.3, 90.9)	43.2 (26.7, 77.0)	62.1 (31.9, 92.7)
Groundnut Sauce	218.4 (114.8, 364.0)	166.4 (80.1, 254.8)	307.0 (200.2, 478.7)
Fast Food	161.7 (97.2, 193.2)	161.7 (97.2, 193.2)	0.0 (0.0, 0.0)
Fresh Fruit and Unsweetened Fruit Juice	154.2 (76.8, 305.7)	102.3 (52.2, 202.6)	202.5 (99.6, 380.1)
Traditional Vegetables (Boiled)	215.4 (114.7, 402.2)	131.4 (63.3, 243.0)	241.2 (131.4, 433.6)
Traditional Vegetables (Fried)	188.7 (62.7, 331.2)	62.5 (24.1, 90.5)	267.3 (129.0, 380.0)
Non-traditional Vegetables (Fried)	134.9 (59.8, 187.6)	57.3 (45.4, 171.3)	142.7 (109.3, 213.1)
Non-traditional Vegetables (Boiled)	146.9 (77.9, 308.2)	130.9 (77.5, 258.1)	166.4 (78.1, 319.6)
Roots and Tubers (Boiled)	322.0 (165.5, 593.1)	189.4 (90.8, 384.0)	363.0 (192.4, 663.9)
Roots and Tubers (Fried)	94.4 (67.4, 189.3)	86.5 (62.4, 147.0)	209.7 (129.6, 437.8)
Katogo	485.7 (317.8, 730.0)	408.7 (238.0, 602.8)	520.4 (380.6, 872.9)

Food Group	Median (IQR) (n=955)	Median (IQR) (urban, n=313)	Median (IQR) (rural, n=642)
Traditional Cereals (Boiled)	495.3 (302.1, 771.0)	378.0 (193.5, 550.8)	554.4 (362.3, 855.5)
Traditional Cereals (Fried)	135.7 (91.8, 258.2)	67.9 (61.2, 122.5)	183.7 (122.5, 271.5)
Legumes	410.6 (254.4, 635.0)	335.8 (202.0, 500.0)	437.1 (284.9, 683.1)
Matooke	696.0 (448.0, 1172.5)	568.0 (385.4, 838.5)	1024.1 (595.3, 1557.7)
Sweets	42.0 (29.2, 68.4)	41.9 (29.2, 63.6)	50.2 (20.0, 124.4)

3.4.3 Dietary Patterns Resulting from PCA

The findings in this section have previously been published in Auma et al. (2019). As highlighted in section 3.2, PCA led to the identification and retention of four principal components that collectively explained 23.6% of the variance in dietary intake among this sample of Ugandan WRA. Principal components were retained based on statistical information (eigenvalue >1.0) and interpretability. Retained principal components are presented in Table 3.4. High positive factor loadings (≥+0.20) are highlighted in yellow while high negative factor loadings (≤-0.20) are highlighted in blue (Table 3.4).

The first principal component (Table 3.4) explained 7.6% of the variance in food intake among these participants and had only positive factor loadings above 0.20. It was characterised by high intake of fish, traditional fats, oils and spreads, non-traditional fats, oils and spreads, nuts and seeds, boiled traditional vegetables and boiled traditional cereals (Table 3.4). This component was characterised by high fat food groups of mostly medium environmental impact and was therefore labelled the '*traditional, high fat, medium environmental impact*' dietary pattern (Auma et al., 2019).

Table 3.3: Dietary Patterns among Rural and Urban WRA (n=955)

Principal Component	1	2	3	4
Dietary Pattern	'Traditional, high fat, medium environmental impact'	'Transitioning, processed, low environmental impact'	'Plant-based, low environmental impact'	'Animal-based, high environmental impact'
PCA Food Group				
Red meat	-0.01	0.18	-0.05	0.73
Organ meats	-0.07	-0.07	0.02	0.59
Chicken	-0.01	-0.06	0.12	0.21
Fish	0.71	0.16	-0.06	0.07
Insects	0.01	0.01	-0.12	-0.10
Sugar and Sweeteners	0.14	0.56	0.13	0.04
Bread and Buns	0.11	0.66	-0.15	0.14
Chapatti	0.05	0.12	-0.14	-0.02
Eggs	0.01	0.15	0.05	0.03
Rice and pasta	-0.03	0.55	-0.05	0.08
Traditional fats, oils and spreads	0.29	-0.20	-0.05	-0.00
Non-traditional fats, oils and spreads	0.75	0.07	0.01	-0.05
Milk	0.04	0.09	0.02	0.05
Alcoholic drinks	0.03	-0.07	-0.04	-0.01
Porridge	-0.02	-0.01	-0.06	0.04
Savoury Snacks	-0.03	0.03	-0.02	0.17
Sugary Drinks	-0.04	-0.06	-0.06	0.02
Soups	0.02	0.11	-0.02	0.78
Tea	-0.36	0.53	0.17	0.08
Nuts and seeds	0.30	-0.13	-0.04	-0.02
Groundnut sauce	-0.10	0.16	-0.03	-0.09

Fast food	0.05	-0.05	0.04	-0.11
Fresh fruit	0.09	0.13	0.66	0.01
Traditional vegetables (boiled)	0.27	-0.33	-0.18	-0.11
Traditional vegetables (fried)	0.00	-0.08	-0.06	-0.02
Non-traditional vegetables (fried)	0.08	-0.03	0.08	-0.01
Non-traditional vegetables (boiled)	0.49	0.02	0.34	-0.07
Roots and tubers (boiled)	-0.14	-0.10	0.64	-0.06
Roots and tubers (fried)	0.00	0.05	0.01	-0.01
Katogo	-0.07	0.01	0.12	-0.06
Traditional cereals (boiled)	0.41	-0.23	-0.29	-0.05
Traditional cereals (fried)	-0.05	-0.16	0.54	0.02
Legumes	-0.07	0.02	0.43	-0.22
Matooke	-0.13	-0.06	-0.05	0.16
Sweets	0.05	0.11	-0.10	-0.02
Eigenvalues	2.68	2.09	1.88	1.60
Variance explained (%)	7.65	5.97	5.37	4.57
Total variance explained (%)	23.56			
Positive factor loading		Negative factor loading		

Factor loadings of at least ±0.2 used in interpreting and labelling dietary patterns (adopted from Auma et al., 2019)

The second principal component explained 6.0% of the variance in food intake (Table 3.4) and had high positive factor loading for tea, sugar and honey, bread and buns and rice and pasta and high negative factor loading on boiled traditional vegetables, boiled traditional cereals and traditional fats, oils and spreads (Table 3.4). This principal component was characterised by low environmental impact food groups that are not typical of the traditional Ugandan diet but have been highlighted in the nutrition transition discourse as suggestive of dietary transitions, e.g. rice and pasta, bread and buns (refined carbohydrates). This principal component was therefore labelled the '*transitioning, processed, low environmental impact*' dietary pattern. The third principal component explained 5.4% of the variance in food intake and was characterised by high consumption of fresh fruit and unsweetened fruit juice, boiled non-traditional vegetables, boiled roots and tubers, fried traditional cereals and legumes (Table 3.4). The principal component also had high negative factor loading for boiled traditional cereals. This dietary pattern seemed to reflect a mix of both traditional and non-traditional low environmental impact plant-based food groups. This principal component was therefore labelled the '*plant-based, low environmental impact*' dietary pattern (Auma et al., 2019).

The fourth principal component explained 4.6% of the variance in food intake. It had high positive factor loadings for red meat, organ meats, chicken and soups. Additionally, it had high negative factor loading on legumes (Table 3.4). This principal component, which was not associated with the consumption of any plant-based food groups, was labelled '*animal-based, high environmental impact*' dietary pattern since it was primarily characterised by high environmental impact food groups (Auma et al. 2019).

3.4.4 Relationship between Dietary Patterns and Place of Residence

Findings in this section have been previously published in Auma et al. (2019). From the bootstrap linear regression, findings suggest that a high fat, traditional diet of moderate environmental impact exists among both rural and urban WRA (Table 3.5). The '*transitioning, processed, low environmental impact*' dietary pattern was positively associated with urban residency (ß=1.19, 95%CI 1.06, 1.32) as was the '*animal-based, high environmental impact*' dietary pattern (ß=0.45, 95%CI 0.28, 0.61) (Table 3.5). On the other hand, the '*plant-based, low environmental impact*' dietary pattern was negatively associated with urban residency (β= -0.49, 95%CI -0.062, -0.037) (Table 3.5).

Table 2.4: Bootstrap Regression Results for Associations between Dietary Patterns and Residence

Dietary Pattern	ß-coefficient	95% CI	p-value
Traditional, high fat, medium environmental impact dietary pattern	0.10	-0.04, 0.22	0.19
Transitioning, processed, low environmental impact dietary pattern	1.19	1.06, 1.32	0.00**
Plant-based, low environmental impact dietary pattern	-0.49	-0.62, -0.37	0.00**
Animal-based, high environmental impact dietary pattern	0.45	0.28, 0.61	0.00**

**significant at 0.01 level (adopted from Auma et al. 2019)

3.5 Discussion

The objectives of this study were to describe the dietary patterns of Ugandan WRA and explore differences in urban and rural dietary intake as a proxy for dietary transition. Four dietary patterns were identified among this sample of rural and urban Ugandan WRA, i.e. the '*traditional, high fat, medium environmental impact*' dietary pattern; '*transitioning, processed, low environmental impact*' dietary pattern; '*plant-based, low environmental impact*' dietary pattern and '*animal-based, high environmental impact*' dietary pattern. These four dietary patterns collectively explained 23.6% of the variance in dietary intake among Ugandan WRA. The '*transitioning, processed, low environmental impact*' and '*animal-based, high environmental impact*' dietary patterns were positively associated with urban residency ($p<0.01$), while the '*plant-based, low environmental impact*' dietary pattern was negatively associated ($p<0.01$) with urban residency (Table 3.5).

Although the four dietary patterns accounted for less than half of the total variance in dietary intake among rural and urban WRA, similar findings have been found in other SSA contexts. For example, in a study among rural, urban and diaspora adult Ghanaians, three dietary patterns explained 29% of the variance in dietary intake (Galbete et al., 2017). The variance explained by the dietary patterns in this study, however, were contrary to a 2011 study among rural women in Tanzania in which five dietary patterns explained 67%

of the variance in dietary intake (Keding et al., 2011). They were also different from a 2015 South African study in which four dietary patterns explained 44% of the variance in dietary intake among adults (Annan et al., 2015). The number of variables input into PCA can influence the number of dietary patterns resulting from the study, and consequently, the variance accounted for by each dietary pattern (Smith, 2002). The larger the number of input variables (food groups), the lower the proportion of the variance explained by each principal component (Smith, 2002). The fact that, 35 PCA food groups were used in this study could explain why the total variance accounted for by the four retained principal component was less than that from other studies, in which 17 (Annan et al., 2015) and 12 input variables (Keding et al., 2011) were used. However, given that Uganda is composed of over 65 diverse ethnic groups, each with its own dietary practices (Amone, 2014), it was necessary to reflect this diversity by using a relatively large number of food groups. Moreover, a recent study on dietary intake among four diverse urban and peri-urban African settings including Uganda used a similar number of food groups to reflect the diversity in dietary intake among study participants (Holmes et al., 2018).

The '*traditional, high fat, medium environmental impact*' dietary pattern from this study was characterised by high intake of traditional and non-traditional fats, oils and spreads, fish, nuts and seeds, boiled traditional and non-traditional vegetables and boiled traditional cereals. While predominantly traditional, this dietary pattern could be reflective of the early stages of dietary transition, during which increases in consumption of inexpensive fats and oils are observed alongside the traditional dietary intake (Drewnowski, 2000; Keding et al., 2011). The '*traditional, high fat, medium environmental impact*' dietary pattern bears some similarity to the '*roots, tubers and plantain*' dietary pattern among Ghanaian adults, which was characterised by high intake of refined cereals, fruits, nuts and seeds, roots, tubers and plantain, banku and kenkey (fermented maize products), legumes and palm oil (Galbete et al., 2017). These two dietary patterns were also both not associated with urban residency. While similar however, the main difference between the two dietary patterns, is the high factor loading of refined cereals, roots, tubers and plantain and fruit on the '*roots, tubers and plantain*' dietary pattern (Galbete et al., 2017). Furthermore, unlike the '*traditional, high fat, medium environmental impact*' dietary pattern in this study, the '*roots, tubers and plantain*' dietary pattern in Ghana was also associated with being older (Galbete et al., 2017). Differences between these two dietary patterns could be explained by the fact that the Ghanaian sample included participants who were older that those used in this PhD study. Additionally, the Ghanaian sample included participants that resided in Europe. It is possible that this sample could therefore possibly have had participants that had more access to refined products compared to this study sample given that the Ugandan food processing industry is less well developed.

The '*transitioning, processed, low environmental impact*' dietary pattern is suggestive of the dietary changes associated with nutrition transition among urban Ugandan WRA.

This dietary pattern was different from the '*snacking*' pattern, a transitioning dietary pattern, obtained by Becquey et al. (2010) in a study among adults (20-65 years) in Ouagadougou. The '*snacking*' dietary pattern like the '*transitioning, processed, low environmental impact*' dietary pattern in this study were both characterised by high intake of sugar and were associated with urban participants. However, in addition to this, the '*snacking*' dietary pattern was characterised by high consumption of fried foods, vegetable source fats, sugar-sweetened beverages, cereals, sweetened drinks, other vegetables, milk and yoghurt, fresh fish, roots and tubers, non-fatty meats and poultry (Becquey et al., 2010) unlike the '*transitioning, processed, low environmental impact*' dietary pattern. The '*transitioning, processed, low environmental impact*' dietary pattern also differed from the '*rice, pasta, meat and fish*' dietary pattern (Galbete et al., 2017) that was characterised by high intake of dairy products, red meat, processed meat, eggs, legumes, rice and pasta, meaty mixed dishes, condiments and cakes and sweets. Notwithstanding, both dietary patterns were associated with urban residency. The '*transitioning, processed, low environmental impact*' dietary pattern was also similar to the '*processed*' dietary pattern in four urban and peri-urban African settings (Holmes et al., 2018), the main difference being the '*processed*' dietary pattern was also characterised by high processed animal products intake (Holmes et al., 2018). The differences between the two dietary patterns could be attributed to the fact our study had a larger, relatively less educated rural sample compared with the study by Holmes et al. (2018) who recruited a more highly educated urban sample.

On the other hand, the '*transitioning, processed, medium environmental impact*' had some similarities with the '*purchase*' dietary pattern in rural Tanzanian women characterised by high intake of bread or cake, tea and sugar (Keding et al., 2011). This suggests that urban Uganda WRA and rural Tanzanian women could be at a similar early-mid stage of dietary transition. These findings are consonant with Abrahams et al. (2011) and Tschirley et al. (2015) who found evidence that indicated that Uganda was experiencing the early stages of the NT. Furthermore, these findings, to some extent lend support to Popkin's hypothesis that urban areas experience dietary changes associated with the NT before rural areas. Although the transitioning dietary patterns in this study are somewhat different the 'westernised diet' typified as a hallmark of the nutrition transition by Popkin, Puoane and colleagues (2006) argue that because dietary change is gradual, it is not unexpected for urban dwellers to retain many attributes of their traditional dietary practices while incorporating new dietary practices. Similar findings have been found in other LMIC at similar stages of the NT (Puoane et al., 2006; Becquey et al., 2010; Keding et al., 2011). Furthermore, Keding et al. (2011) propose that the typical 'westernised diet' (high in saturated fat, added sugar, refined cereals, animal products and processed food) is typically observed at later stages of the NT (Keding et al., 2011).

The third principal component from this study, the '*plant-based, low environmental impact*' dietary pattern was characterised by a variety of plant-based food groups, i.e. boiled non-traditional vegetables, roots and tubers and fruit. A diverse, largely plant-based diet has been highlighted as ideal for from both health and environmental sustainability perspectives since these food groups are not only nutrient-dense and lower in calories but also tend to have GHGE, particularly when they are field-grown (Garnett et al., 2015; Clune et al., 2017; Willett et al., 2019). This is largely the situation in Uganda, i.e. most food is field-grown by numerous subsistence farmers. The fourth principal component from this study, the '*animal-based, high environmental impact*' dietary pattern had some similarities with the '*animal-based*' dietary pattern in a study among HIV+ and HIV- urban South African adults (Annan et al., 2015). Annan et al. (2015)'s '*animal-based*' and was characterised by high consumption of red meat, fish, chicken and dietary fat and low consumption of fruit and vegetables. In the same vein, the '*animal-based, high environmental impact*' dietary pattern was similar, to some extent, to the '*modernity*' pattern, which was classified as a marker of the dietary changes associated with the nutrition transition among Beninese adults in Ouagadougou. This dietary pattern was characterised by high consumption of eggs, non-fatty meats and poultry, fatty and processed meats and low consumption of cereals, nuts and seeds, beans and pulses and vitamin A-rich fruit and vegetables. The '*animal-based, high environmental impact*' dietary pattern was also much the same as the '*animal products*' dietary pattern among rural Tanzania women, which was also characterised by high factor loading on all animal products except fish (Keding et al., 2011).

Despite similarities between the four dietary patterns resulting from this study and those from similar SSA contexts, there were still some differences. For example, although classified as an East African country like Uganda, none of the three dietary patterns ('*snacks and drinks*', '*fruit and vegetables*' and '*fish and rice*') identified in a 2016 study among adults (25-64 years) in the Seychelles (Mayen et al., 2016) bore any similarities to any of those identified in this study. This could be attributed to the distinct cultural and geographical differences between Uganda and the Seychelles. For example, the '*fish and rice*' dietary pattern, which is traditionally typical of the Seychelles, (Mayen et al., 2016) is closely tied to the history and the coastal location of the Seychelles vs Ugandan, which is landlocked. Furthermore, the '*mixed*' dietary pattern, characterised by high intake whole grain cereal, sweet spreads, dairy products, coffee and tea, soda and juices, olive oil, margarine and condiments and low intake of palm oil and vegetarian mixed dishes, identified by Galbete et al. (2017) did not bear any similarities to any of the dietary patterns identified in this PhD study. This is probably because this '*mixed*' dietary was more associated with diaspora Ghanaians residing in Europe, which is a very different context to rural and urban Uganda.

While it can be argued that differences in dietary patterns between this study and other SSA countries highlights the strong influence of the physical and socio-cultural environments on dietary practices, it is pertinent to highlight that in some of these studies, dietary data were collected from population sub-groups different from that in this present study. For example, in some studies, older participants (compared to those in this PhD study) were considered (Galbete et al., 2017). Furthermore, while the present study included dietary intake data collected from only women, other studies considered dietary intakes from both men and women (Becquey et al., 2011; Annan et al., 2015; Mayen et al., 2016; Galbete et al., 2017; Holmes et al., 2018). The inclusion of both male and female dietary intakes in some of the studies could account, to some extent, for the differences in dietary patterns between their studies and this present one. This is particularly important where animal protein consumption is concerned. A 2005 study highlighted that many North American men associated meat consumption with masculinity and considered 'realness' of a meal based on its meat content (Sobal, 2005). In the same study, many males associated meatless diets with femininity (Sobal, 2005). Although it is unclear how pervasive such sentiments are among Ugandan men, the presence of food taboos that discourage meat consumption among females especially among many SSA rural communities could have played a role among the largely rural sample involved in this study. The lack of dietary intake data in this PhD study of similarly aged men, as the WRA could have influenced dietary patterns resulting from this study, and reduced, to some extent the comparability of the dietary patterns resulting from this study with others in the literature. Notwithstanding, in their study, Galbete et al. (2017) demonstrated no difference in dietary patterns between men and women, suggesting that male dietary intakes may not strongly affect overall resulting dietary patterns.

Lastly, in addition to the NT and culinary use, the literature on environmental impact of food items informed the formation of food groups used in the PCA in this study (section 3.2). This is means that in the present study, food items that might otherwise have been grouped similarly to food groups in other studies were grouped differently and vice versa. Since none of the studies in similar LMIC contexts approached dietary patterns through an environmental sustainability lens, this could possibly explain the many differences between dietary patterns observed in this study and those cited from the literature.

3.6 Methodological Challenges, Strengths and Limitations

This section presents the strengths and limitations of the present study including the methodological challenges.

3.6.1 Strengths and Limitations

To the author's knowledge, this is the first study to approach the dietary patterns of Ugandan WRA from a dietary transition and environmental impact perspective, using nationally representative data. This is one of the main strengths of the study. The relatively large sample size (n=955), generated using random sampling methods, and representing a diversity of ethnicities and socioeconomic groups, is another of the study's strengths. Dietary data for this study were generated from a sample that was disproportionately rural, which is a limitation. However, the sample was somewhat reflective of Uganda's unevenly distributed population given that approximately 20% of Ugandans live in urban areas while an estimated 70% of Ugandan WRA live in rural areas (World Bank, 2015; UBOS, 2017).

Dietary data used in this study were secondary data, i.e. not collected for the purpose of the present study; therefore, the researcher had little control over the quality of the dietary data. This was evidenced by the implausibility of some intakes (section 3.2.2). To account for this, the standardised z-scored were used in the PCA instead of gram intake, implausible intakes were removed and missing intakes were excluded pairwise from the PCA. Data used in this study were relatively old, having been collected in 2008. It is fair to assume that between the time of data collection and this study, dietary patterns could have changed. However, at the time of the study, the 2008 UFCS dataset was the most comprehensive dietary intake survey available, collected from a representative sample of Ugandan WRA in both rural and urban areas. Other dietary surveys have recently been carried out in Uganda, e.g. the WHO STEPS survey and the Africa/Harvard School of Public Health Partnership for Cohort Research and Training (PaCT) pilot study. These more recent surveys, however, have a different scope and depth compared with the 2008 UFCS used in this study. In the WHO STEPS survey, for example, data were collected on consumption of processed foods high in sodium, average number of days per week on which participants consumed fruit and vegetables, average number of vegetable servings consumed per day and proportion of participants that consumed less than five servings of fruit and vegetables per day (MoH, 2014). On the other hand, in the (PaCT) pilot study, dietary data were collected using food frequency questionnaires from only rural and peri-urban Ugandan men and women. Data on demographic and socioeconomic variables were unavailable at the time of this study. The researcher was therefore unable to explore associations between these variables and the resulting dietary patterns. Additionally, the cross-sectional nature of data used means that findings could not adequately depict dietary transition in action. This would have necessitated periodic dietary data collection and analysis, i.e. longitudinally.

3.6.2 Methodological Challenges

Dietary data used in this study were collected using the quantitative 24-hour recall method. The 24hr recall has been proposed as the best method to estimate dietary intakes in LMIC contexts, where resources and high levels if illiteracy might not allow for other methods e.g. food diaries. The 24hr recall is limited in that it is prone to recall bias and relies heavily on the skill of the interviewer to prompt participant's recall. To counteract this, trained data collectors were used for data collection during the UFCS (see section 3.1.3). The 24hr recall was conducted on one day which is another limitation given that dietary intakes vary between different days. However, as highlighted in section 3.1.3, to adjust for such variations in dietary intake, in each sampled region, repeat 24hr recall interviews were conducted on 10% of the sample on a non-consecutive day (Harvey et al., 2010; Kyamuhangire et al., 2013). Dietary data were collected between May and September possibly resulting in under-reporting in intakes for food crops that grow outside of the data collection period. This coupled with food aid in Northern Uganda at the time of data collection, could have resulted in over-estimation of intakes of food items especially among the rural sample, for example non-traditional fats, oils and spreads (vegetable oils), some pulses and cereals (Kyamuhangire et al., 2013). Lastly, the

24hr recall provides only a snapshot of dietary intake, reducing the likelihood that estimates resulting from the method are reflective of habitual dietary intakes. This should be considered in interpreting these findings.

Lastly, the subjectivity of many of the steps involved in PCA, i.e. creation of food groups, deciding how many principal components to retain and labelling and interpretation of retained principal components is another methodological limitation.

3.7 Implications for Policy and Practice

Ugandan WRA show a mixed dietary profile. While a medium-impact high fat dietary pattern is consumed by both urban and rural WRA, urban women showed a more diverse diet compared with rural participants. The first, second and fourth dietary patterns suggest that urban women could be at a more advanced (mid) stage of the NT, i.e. degenerative disease (stage 4 in Popkin's model, see section 1.2). The intake of food groups high in fat, coupled with many traditional food groups, provides evidence that rural Ugandan WRA could be experiencing less advanced (early) stage in the NT, i.e receding famine (stage 3 in Popkin's model, see section 1.2). Evidence from HIC has demonstrated that the so-called 'westernised dietary pattern', which bears some similarities with the '*transitioning, processed, low environmental impact*' dietary pattern in this study, is associated with increased risk for obesity and NR-NCDs (Auma et al., 2019). Furthermore, recent evidence suggests that this diet is linked with increased risk for high-risk Human Papillomavirus (hrHPV) infection and cervical cancer (Barchitta et al., 2018). Therefore, given the high prevalence of cervical cancer among Ugandan women (Nakisege et al., 2017), findings from this study are suggestive of an increased risk, among both rural and urban Ugandan WRA, for such diseases.

Future research will need to identify the factors that influence the dietary patterns in urban and rural contexts. Practitioners and policy makers will have to consider the differences in the dietary landscape between rural and urban Ugandan WRA in designing and implementing recommendations, policies and interventions that steer transitioning dietary practices towards healthy and environmentally sustainable dietary practices.

3.8 Chapter Summary

The objectives of study one was to describe the dietary patterns of Ugandan WRA and explore evidence for dietary transitions. Four dietary patterns emerged, i.e. the '*traditional, high fat, medium environmental impact*' dietary pattern, '*transitioning, processed, low environmental impact*' dietary pattern, '*plant-based, low environmental impact*' dietary pattern and '*animal-based, high environmental impact*' dietary pattern (Auma et al., 2019). Findings indicated that the '*transitioning, processed, low environmental impact*' and '*animal-based, high environmental impact*' dietary patterns were positively associated with urban residency, while the '*plant-based, low environmental impact*' dietary pattern was negatively associated with urban residency (Auma et al., 2019). Findings from this study also demonstrated that although rural and urban Ugandan WRA consume a diet that is plant-based, urban women are at a more advanced stage in the NT compared with rural women. Given that dietary data used in this study were more than 10 years old (collected in 2008) it cannot be ascertained whether these dietary patterns and differences in rural and urban dietary intake still exist. This limitation is addressed by study three (Chapter 5), for which primary dietary data were obtained from a sample of rural and urban WRA in 2018.

4 CHAPTER FOUR: HEALTHINESS AND ENVIRONMENTAL IMPACT OF THE DIETARY INTAKE OF RURAL AND URBAN UGANDAN WRA (STUDY TWO)

The objectives of study two were (i) to assess the healthiness and environmental impact of the dietary intake of rural and urban Ugandan WRA and (ii) to explore the relationship between dietary intake and aspects of the eating practice (i.e. tempo, periodicity and synchronisation). This chapter presents the methods and findings of the study. First, a description of the study setting, study participants, data collection and analysis methods used is provided. This is followed by a presentation of the key findings and implications for policy and practice.

4.1 Study Setting, Participants and Data Collection

4.1.1 Study Setting

This study was conducted in rural and urban Uganda. In urban Uganda, data collection was carried out in Kampala City, the largest urban setting in the country. Kampala City is in Kampala district in Central Uganda. Within Kampala City, study participants were recruited from Nakawa Division, one of five urban administrative councils in the city (NSDFU and ACTogether Uganda, undated). Nakawa Division[41] was purposively chosen as the urban study site because it is the most industrialised of all five divisions and houses residents across the socioeconomic spectrum, i.e. wealthier residents as well as the urban poor that live in densely populated informal urban settlements [42] (NSDFU and ACTogether Uganda, undated). The mix of neighbourhoods and livelihoods in Nakawa Division was deemed appropriate to provide a sample of WRA of low, middle and high socioeconomic status and livelihoods. Nakawa also houses a diversity of ethnicities, which it was anticipated, would further enrich the dataset. Furthermore, ease of access and ease of communication were other reasons why Nakawa division was chosen as the urban study site.

Data collection in rural Uganda was carried out in in Bulwanyi and Nakawuka parishes, located in Ssisa sub-county, Wakiso district in Central Uganda. In 2012, it was estimated that approximately 68,900 people lived in Ssisa sub-county (Musoke et al., 2015), although this figure was assumed to have risen at the time of data collection, given Uganda's relatively high population growth rate. Livelihoods in Ssisa sub-county are based on subsistence farming, small-scale trade, stone works, local brick manufacturing and sand mining (Musoke et al., 2016). According to the census data available at the time of data collection for the this study, Ssisa Sub County was classified as a rural population. However, although Ssisa is predominantly rural, it has pockets of urban and peri-urban areas (Musoke et al., 2015). Ssisa sub-county was purposively chosen as the rural study site given that it would allow the researcher to explore dietary behaviours along the urbanicity continuum, i.e. rural (Ssisa), peri-urban (Ssisa) and urban (Kampala). The area was also chosen as the rural study site due to the ease of access to study participants and

[41]Nakawa division encompasses Bugolobi, Bukoto, Butabika, Kiswa, Kiwaatule, Kulambiro, Kyambogo, Kyanja, Luzira, Mbuya, Mutungo, Naguru, Nabisunsa, Nakawa and Ntinda (LMCT, 2014)

[42]Banda, Bukoto I, Butabika, Kinawataka, Mambo Bado, Kisenyi and parts of Luzira and Naguru (LMCT, 2014)

the researcher's knowledge of the local language used in the area, which would facilitate easier data collection.

4.1.2 Sampling

Given the limited time and resources available to the researcher, a diverse sample of rural and urban Ugandan WRA was generated using the quota sampling technique. Quota sampling is a non-random sampling method, which although similar to stratified and purposive sampling, does not recruit a representative sample (Bowling, 2014; Yang and Banamah, 2014). Rather, the generated quota sample provides a breadth of perspectives because the researcher attempts to fill every possible quota (Marshall, 1996; Bowling, 2014; Bryman, 2016). It was for this reason that the quota sampling techique was used.

Prior to data collection, a quota sampling criterion, informed by the literature and research questions (Ritchie et al., 2014; Bryman, 2016) was produced. The sampling criteria considered were age (15-49 years) and socioeconomic status (low, mid and high). The importance of focusing on WRA (15-49 years) is highlighted in section 1.8 of this thesis. Socioeconomic status (SES) was taken as one of the sampling criterion variables because SES has been identified as a precursor to dietary transitions since increased incomes can result in increased economic access to a wider variety of foods (Amuna and Zotor, 2008). SES was determined using the EquityTool for Uganda, which is a short questionnaire-based, country-specific tool that ranks participants based on their wealth relative to that of either the urban or national population (Metrics for Management, 2016). The EquityTool used was based on the 2014/2015 Uganda Malaria Indicator Survey, as this was the version available at the time of data collection. By responding to the questionnaire, participants provided data on household assets, housing structure, water and sanitation, and based on their responses, were assigned to one of five wealth quintiles. The EquityTool produced two rankings (wealth quintiles) for each participant, i.e. based on the national and urban population. For rural participants the quintiles based on the national population were considered while for urban participants those based on urban population were considered. Participants in the two lowest wealth quintiles were considered as low SES, those in the 3rd quintile were mid-SES and those in the highest two quintiles were considered as high-SES participants. The EquityTool was administered using a tablet, as this quickened the process of data collection and screening of participants for eligibility based on SES.

To guide participant recruitment, a quota sampling matrix, based on the sampling criteria was developed prior to data collection (Table 4.1). At commencement of data collection, it was estimated that 54 participants would be recruited to the study (Table 4.1). The sample (n=54) was to be distributed within 18 quotas, with each quota having three representative participants (Table 4.1). Since this study was part of a mixed method PhD, it was envisaged that at the end of each qualitative 24hr recall interview (in this study), each participant would be asked if they were interested in participating in the subsequent

Photovoice exercise (study four). It was anticipated that from each of these quotas, at least one participant would express interest, and from these, one participant would be randomly chosen to participate in Photovoice (PV).

Table 4.1: Quota Sampling Matrix for Study Participants Showing Expected and Actual Sample Size

SES / Age group	Lowest SES (1st and 2nd quintile)		Middle SES (3rd quintile)		High SES (4th and 5th quintiles)		n
	Rural Uganda	Urban Uganda	Rural Uganda	Urban Uganda	Rural Uganda	Urban Uganda	
15-19y (Adolescence)	3 (n=3)	3 (n=7)	3 (n=3)	3 (n=3)	3 (n=3)	3 (n=5)	18 (24)
20-34y (Early adulthood)	3 (n=3)	3 (n=3)	3 (n=3)	3 (n=4)	3 (n=7)	3 (n=8)	18 (28)
35-49y (Mid adulthood)	3 (n=3)	3 (n=3)	3 (n=3)	3 (n=3)	3 (n=5)	3 (n=4)	18 (21)

Final quota sample size for participants recruited to the study is indicated in brackets

During data collection, however, sampling changes were made. Not all participants who participated in the qualitative 24-hr recall interview in this study, showed interest in participating in Photovoice (study four). This meant that at the point, during data collection, where the initial quota sample size (n=54) was achieved some quotas had none of their participants showing any interest in participating in PV, meaning that those quotas would not be represented in PV if the initial pre-determined sample size was maintained. Therefore, to ensure the breadth of experiences were captured in the subsequent PV exercise (study four), more participants were recruited to the present study, yielding a final quota sample size of 73 (n=33 rural; n=40 urban) (Table 4.1). This ensured that each quota had at least one participant who expressed interest in participating in PV (study four).

4.1.3 Sample Recruitment

The first study participants were recruited to the study with the aid of gatekeepers. In Kampala (urban), respondents were recruited through two gatekeepers: a local female community leader who resided in the middle-income Kisaasi-Kulambiro area of Nakawa Division; and an assistant parish priest at a local church, St. Jude Naggulu Parish, who introduced the researcher to members of the church youth group. From the church youth group, a youth group leader who later became a field assistant (FA) was identified. Through this FA, younger participants who resided within the local area (a low-income area with several informal urban settlements) were recruited. In Kampala, in addition to the study participants recruited through gatekeepers, a few initial high-SES participants were recruited through the researcher's own social networks.

In Wakiso (rural), participant recruitment was facilitated by two gatekeepers, who also acted as FAs and were well-respected community health mobilisers with extensive networks. Of the two, the FA from Nakawuka parish (HB) was assigned as the rural site coordinator because the researcher could easily communicate with him in English and he was more senior than the other FA. HB advised the researcher against the use of recruitment posters in the rural study site as this would make the researcher appear as an outright outsider and therefore less approachable to potential research participants. The gatekeepers, therefore, introduced the researcher to a few community members fitting the sampling criteria (see section 4.1.2) at the beginning of data collection. Once initial study participants were recruited in either context, the snowball sampling technique was employed to recruit subsequent participants. At the end of each interview, particularly at commencement of data collection, initial study participants were asked if they could suggest other participants, fitting the quota sampling criteria (Table 3.1) that they thought might be interested in participating in the study (Bowling, 2014; Bryman, 2016). In both study sites (Kampala and Wakiso), participant recruitment was often a balance between ease of access, ease of communication (language) and resources (cost and time).

4.1.4 Data Collection: Dietary Intake using the Qualitative 24hr Recall

Data were collected from participants using a single qualitative 24hr recall interview method. The recruited study participants (n=73) were asked to recall and describe all food and drink consumed inside or outside the home in the 24 hours preceding the interview, including any snack foods (Webster et al., 2012). Participants were, however, not asked to estimate quantities of food and drink consumed (Webster et al., 2012). To prompt recall, participants were interviewed using a modified multi-pass method (Gibson, 2005). To this end, participants were first asked to list all food and drink they consumed the day before the interview, right from the time they just woke up, until just before they went to sleep (Gibson, 2005). Following this, participants were asked to provide detailed description of each of the food and drink items they listed in the first step, including food preparation methods, e.g. where a participant mentioned egg, they were asked to clarify whether it was fried, boiled or poached. Next participants were asked follow-up questions on different aspects of each eating event, i.e. tempo, periodicity and synchronisation (Table 4.2).

Table 4.2: Tempo, Synchronisation and Periodicity of Eating Events

Variable	Description
Tempo	How long did each eating event take (approximate minutes or hours)?
Synchronisation	Where did each eating event take place?
	With whom did the respondent have each eating event?
Periodicity	At which time of the day did each eating event take place?

In the last step of the modified multi-pass, a recap of the dietary recall was read to the participant to check for accuracy and completeness (Gibson, 2005). Before the 24hr recall interview concluded, participants were asked if there was any food and drink, they might have consumed between the main meal times that they might have forgotten. This was particularly important in the rural setting, as many participants did not consider ‘snacks’ as ‘proper’ food and drink and so had often ommitted them during the recall.

The qualitative 24hr recall interviews were administered by the lead researcher with the assistance of FAs as translators using paper questionnaires. Interviews lasted between 20 minutes and 1.5 hours and were audio recorded for cross-checking, where necessary, before data analysis. Data collection interviews in Wakiso (rural) were conducted at the ‘Strengthening Community Health’ project office in Nakawuka parish, while those in Kampala (urban) were mostly conducted at the Our Lady and St. Jude Naguru Parish Church. A few interviews in Kampala were conducted at other locations, including participants’ homes and workplaces. In these instances, a FA was always present to ensure the researcher’s safety.

4.1.5 Piloting of Data Collection Methods

Prior to data collection, a piloting exercise was conducted in both study sites. Two participants were conveniently sampled for the piloting exercise, i.e. one in Kampala (urban) and another in Wakiso (rural). Both participants met the inclusion criteria that were used in recruiting actual study participants. Using the same modified multi-pass method as was used in the actual quaitative 24hr recall interviews, participants listed all food and drink they consumed the previous day. Participants also answered questions on tempo, synchronisation and periodicity of each eating event. Following this, participants were given an opportunity to provide any feedback they might have had on anything concerning the interview. Their suggestions, as well as the researcher’s own reflection on the pilot interview, were incorporated into subsequent interviews when actual data collection commenced. For example, it was observed that at times the pilot dietary recall did not strictly follow the sequence of steps in the multipass interview. In these instances participants offered information on aspects of dietary practice, e.g. meal timing at the point when they listed what they ate or drank. It was decided, therefore, that in order not to break the flow of subsequent interviews, the researcher, rather than insisting on following the interview sequence, would adjust the interview in response to participants’ narratives. The pilot interview in Kampala was carried out in English, while that in Wakiso was conducted in Luganda, the local language.

The next section describes the steps undertaken in the analysis of the healthiness and environmental sustainability of the dietary intake (foods consumed) by study participants (n=73). First, a description of the assessment of the environmental impact of the participants’ dietary intake is provided, followed by a description of the nutrient profiling methods used. The section concludes with a description of the methods used in the analysis of the relationship between aspects of the eating practice and study participants’ dietary intake.

4.2 Estimating the Environmental Impact of Participants' Dietary Intake

Greenhouse gas emissions (GHGE) were used as a proxy for environmental impact, as GHGE of foods have been shown to have a strong correlation with other environmental impacts of foods, including water footprint, land use, fossil energy use and ecological footprint (van Dooren et al., 2017; 2018). The GHGE associated with each of the unique food items consumed by study participants was estimated as gCO2eq per 100g of fresh food item. The method used to estimate the GHGE in this study was primarily adopted from Scarborough et al. (2014). This was supplemented with information from Wickramasinghe et al. (2016) and Perignon et al. (2016).

The steps in estimating the environmental impact of foods are described below. First a summary of the data management is provided. This is followed by a description of the data sources used for the GHGE of food items. Next, a detailed explanation of the steps involved in estimating the final environmental impact of the foods is provided.

4.2.1 Data Cleaning and Management

Data for all food and drink consumed in the 24 hours preceding the 24hr recall interview were collected separately for participants in Kampala (urban) and Wakiso (rural). Data were entered in two separate Microsoft Excel spreadsheets. In each spreadsheet, food names were first checked to ensure that the same food item did not have variations in spellings for different participants that might have made it appear as a different dish. Once this was complete, a list of all food items consumed from both Kampala and for Wakiso were entered in a new spreadsheet. Again, foods were checked for any variations in spellings for the same item, which might not have been identified at the first screening stage. Once this was complete, duplicates were removed from the combined list of food items, yielding a total of 203 unique foods. These 203 unique foods included individual-item foods and mixed dishes comprised of multiple ingredients.

Of the 203 individual food items, 202 were profiled for environmental impact. Only one food item, (powdered fruit-flavoured drink) was not profiled because information was unavailable from any of the GHGE data sources.

4.2.2 Sources of Data for GHGE

As highlighted in section 1.5, to estimate the environmental impact of food products, a life-cycle assessment (LCA) is usually carried out. LCA entails looking at the environmental footprint resulting from the different stages that a food product goes through from 'cradle to grave' (Andersson et al., 2014). The stages of the food product's lifecycle under consideration in the LCA constitute what is referred to as the system boundary. This system boundary encompasses anything from the farm production stage, transportation from farm to regional distribution centre (RDC), factory processing, transportation to retail centre, transportation from retail to consumer home, home storage, consumer cooking and food waste (Audsley et al., 2009).

Incorporating all the stages or processes that a food product might go through in its lifetime in the LCA is more likely to result in an accurate estimate of the environmental impact (GHGE) of the food product at the time of final consumption. However, several studies have reported that for most food products, the production stage (at the farm-level) accounts for the largest proportion (up to 65-85%) of the final product's GHGE (Audsley et al., 2009; Castane and Anton, 2017). This means that home transport and cooking contribute a small proportion of the GHGE related with foods. Additionally, the use of GHGE of production accounts for differences in calculations if the GHGE were calculated for quantities that change during the cooking process and it also accounts for differences in food waste in the home. Furthermore, data on context-specific conversion factors for cooking were unavailable for Uganda at the time of analysis, and remain unavailable to-date. Most studies base their cooking conversion factors on electricity, but electricity coverage in Uganda is low, therefore using international conversion factors would have resulted in misestimating GHGE. It is for these reasons that only production-level GHGE were considered in estimating the environmental impact of foods in this PhD, i.e. 'environmental impact of food production'. The environmental impacts of cooking processes (at home and industrially) were therefore unaccounted for in this PhD. A similar approach, where only the environmental impact of production has been used as a proxy of the environmental impact of food products, has been reported by previous studies (Doran-Browne et al., 2015; Walker et al., 2018). This approach has also been taken by Scarborough et al. (2014), which informed the methods used in this study.

The values for the environmental impact of production of food items (GHGE) for this study were obtained from previously published literature (Audsley et al., 2009; Clune et al., 2017), as primary data on GHGE for foods were unavailable for Uganda. Clune et al. (2017) is a systematic review of the environmental impact of food production, also termed the global warming potential (GWP[43]), which synthesised international studies using the 'farm to the regional distribution centre' (RDC) as the system boundary. GHGE were estimated using the LCA method as kgCO2eq per kg of fresh produce or per kg of boneless meat for animals (Clune et al., 2017). The GHGE from Clune et al.'s study were the primary source of GHGE data used in this study, since it incorporated findings from studies conducted throughout the world, including SSA. Where food items were unavailable, GHGE were obtained from Audsley et al. (2009), which used the same system boundary and units for estimating GHGE, including data from the UK, Europe and the rest of the world (RoW). When Audsley et al. (2009) was used, values from the RoW were used over UK and European values. For cassava, GHGE values were unavailable from both data sources, so they were estimated from a third study that estimated the environmental impact of cassava production in Nigeria (BMZ, 2013). The 'production stage' environmental impact of cassava, reported as t CO_2 e. per tonne of fresh root, was used.

[43] GWP is a cumulative value incorporating the main greenhouse gases, such as carbon dioxide, methane and nitrous oxide (Wickramasinghe et al. 2016; Clune et al. 2017)

The steps involved in estimating the environmental impact of foods are now described.

4.2.3 Steps in the GHGE Estimation

Estimating GHGE for Single Food Items

For single-item foods, such as fresh mango or pineapple, the GHGE per 100g was estimated by simply dividing the original value from Clune et al. (2017) or Audsley et al. (2009) by a factor of 10. For example, the GHGE of banana was 0.72 kg CO_2 e. per kg fresh banana. To obtain the environmental impact per 100gram, the value was divided by 10, giving a GHGE of 0.072 kg CO_2 e. per 100g. This value was then entered in the spreadsheet against the respective food item name. If the GHGE for a food item was unavailable, the average value for that food group was used (Wickramasinghe et al., 2016), e.g. for 'nakatti' (African spider plant) the GHGE for 'all field-grown vegetables' was used.

Estimating GHGE for Multiple-Ingredient Food Items (Mixed Dishes)

For multiple-ingredient foods (mixed dishes), recipes for each of these mixed dishes were obtained to estimate the proportions of different food items in the mixed dish (Scarborough et al., 2014; Perignon et al., 2016; Wickramasinghe et al., 2016). The 2011 Uganda Food Composition Table (UFCT) was used as the primary source for recipes for mixed dishes. If a mixed dish was unavailable in the UFCT, the Tanzania Food Composition Table (TFCT) was used. When the FCTs contained an exact description of the mixed dish described by participants, this information was used. However, because the mixed dishes were based on participants' 24hr recall and were not obtained from a standard, pre-filled FFQ, their descriptions often varied from the standard recipes in the FCTs. In these instances, adjustments were made to the closest possible standard recipe from the FCTs; for example, '*nakatti fried with vegetable oil*' did not exist in any of the FCTs. For this mixed dish, the proportions for '*nakatti w/wo onions, w/wo tomatoes and vegetable oil*' from the UFCT were used instead. However, while the proportions for both '*nakatti and vegetable oil*' were maintained from the original recipe, the proportions for onion and tomato were each assumed zero (0).

When the mixed dish or a close alternative was unavailable in either the UFCT or TFCT, a Google search was conducted, as recommended by Scarborough et al. (2014). Where possible the local name for the mixed dish was used to ensure that recipes were context-specific. Where no locally names mixed dishes were found, the English translation was used. Each time a Google search was performed, the first website (first hit) was used (Scarborough et al., 2014), except if a recipe lower than the first hit was Ugandan, Kenyan or Tanzanian, in which it was used instead to ensure it was more context-specific.

For each of the mixed dishes, the proportions of each of the foods constituting the mixed dish, out of the total weight of the mixed dish, were obtained. For the recipes obtained from the UFCT, ingredients' weights were not provided; only proportions out of 1 were provided, which were used. To obtain the proportions for ingredients in mixed dishes obtained from the TFCT and Google, the weight of each of the ingredients in the recipe was divided by the total weight of the mixed dish. Then GHGE for each ingredient (kg CO_2 e. per 100gram) was multiplied by its proportion in the mixed dish. In estimating the GHGE of the mixed dishes, a threshold of 90% (0.9) was applied. To this end, ingredients' proportions were considered from highest to lowest, and once the 0.9 mark was reached, the remaining ingredients were not included in the GHGE calculation for that mixed dish (Scarborough et al., 2014). This threshold ensured that smaller items with unknown GHGE, e.g. a pinch of salt, were removed (Scarborough et al., 2014). The GHGE of all the ingredients meeting the 90% threshold were then summed to provide an estimate of the GHGE of the entire mixed dish (Scarborough et al., 2014; Wickramasinghe et al., 2016).

To estimate the GHGE of fruit juices, the GHGE for the fruit of which it was comprised, was multiplied by a conversion factor to adjust for density (Scarborough et al., 2014).

Converting GHGE Estimates from Kilogram to Gram per 100g and 100kcal

Once GHGE for all foods in kg CO_2e. per 100gram was estimated, the values were multiplied by 1000 to convert the GHGE to g CO_2 e. per 100g in order to allow for comparison between GHGE and nutrient density on a similar scale. While GHGE can be estimated by weight (100g) or energy (100kcal), in this study, the environmental impact of foods were calculated based on weight ($GHGE_{100g}$) and not energy ($GHGE_{100kcal}$) given that people are generally more likely to eat or make food purchasing descisions by weight rather than in calorific terms. However, to allow for comparison of environmental impact (by weight and calories), the GHGE for each of the food items per 100gram were converted to $GHGE_{100kcal}$ by multiplying the GHGE per 100gram by 100 and dividing the result by the energy density of each respective food item. GHGE estimates for foods consumed by this sample of WRA are attached in Appendix 15.

The following section describes steps involved in assessing the healthiness of the foods consumed by participants in this study. First, a description of the data sources for nutrient content of foods used are provided, followed by the steps involved in the nutrient profiling.

4.3 Assessing the Healthiness of Participants' Dietary Intake

As mentioned in section 1.4 of this thesis, there are several ways of assessing the nutritional adequacy (healthiness) of entire diets. To assess the healthiness of the foods consumed by WRA in this study, nutrient profiling was conducted on the dietary intake data collected from all WRA (n=73).

As highlighted in section 1.4.2, various nutrient profiling models exist, e.g. SAIN: LIM, the Nutrient Rich Foods (NRFn.3) models and the Ofcom model. For this study, nutrient profiling was conducted using the NRFn.3 model proposed by Drewnowski and Fulgoni (2008; 2014). In studies that have looked at relationships between nutrient density and environmental impact of diets, as in this study, the NRF9.3 had been proposed as the most robust nutrient profiling model (van Dooren et al., 2017). Moreover, as highlighted in section 1.4.2 the model has been validated against the HEI. In this study, minor modifications were made to the NRF9.3 model. Although the NRF9.3 model was used as the starting point for the nutrient profiling exercise, given the high levels of micronutrient deficiency among WRA (see section 1.2.1), two additional nutrients were added such that the final model included 11 nutrients to encourage and three nutrients to limit. Moreover, Drewnowski (2017) proposes that adding additional nutrients to encourage to the NRF9.3 model does not make any difference to the nutrient profiling model. Therefore, the use of the NRF11.3 model was deemd appropriate. The 11 nutrients to encourage in the final NRF11.3 model used in this study were protein, fibre, calcium, potassium, magnesium, folate, iron, zinc, vitamin A, vitamin C and vitamin E.

Secondly, data on added sugar and saturated fat for the food items were unavailable in the FCTs used, therefore, total sugars was used in place of added sugars as has been conduected in similar studies (Sluik et al., 2015, Drewnowski, 2017). Evidence has demonstrated that total sugars and added sugars of foods are correlated (Fulgoni et al., 2009). Furthermore, the use of total fat, in place of saturated fat, in the nutrient profiling model in this study is justified since total fat and saturated fats in food and drink are highly correlated (Drewnowski and Fulgoni, 2008; Fulgoni et al. 2009). Consequently, the three nutrients to encourage in the NRF11.3 model used in this study were total fat, total sugar and sodium

The steps followed in the nutrient profiling are described in the following section.

4.3.1 Food Composition Tables Used

In order to create nutrient profiling models for foods, both nutrient composition and dietary intake data are required (Drewnowski, 2017). The same list of foods (from the 24hr recall) assessed for environmental impact was used for nutrient profiling. Of the 203 individual food items, 202 were profiled. Only one food item (powdered fruit-flavoured drink) was not profiled as nutritional information for this item was unavailable from all food composition tables (FCTs). Nutritional content information (macro and micro-nutrients for the nutrients input into the NRF11.3 model) for each of these unique food items (n=202) were identified using a combination of five FCTs.

Primary Food Composition Table

The primary FCT used was the 2011 Uganda Food Composition Table (UFCT) produced by HarvestPlus. The UFCT was produced from food consumption data that collected from a representative sample of women in Eastern and Central Uganda (Hotz et al., 2011). The UFCT was used as the primary FCT to ensure nutrient information for foods was collated from a context-appropriate source. However, it contained information for only eight of the 11 nutrients input into the nutrient profiling model, i.e. protein, calcium, zinc, dietary fibre, total fat, vitamin A, vitamin C, and folate. For all foods from the dataset that appeared in the UFCT, nutrient information for the available eight nutrients was obtained. Since the nutrient composition information from UFCT was incomplete, the

2008 Tanzania Food Composition Table (TFCT) was used to supplement the nutrient information, i.e. nutrient content of foods for the additional five nutrients missing from the UFCT .

Supplementary Food Composition Tables

Following this, a list of foods that did not appear at all in the UFCT was obtained. For these food items, the TFCT was used to obtain the complete nutrient composition. Where a food item was unavailable in the TFCT, the 2018 Kenya Food Composition Table (KFCT) was used. The TFCT and KFCT were used as secondary FCT because the countries are neighbouring countries to Uganda and therefore have some similarities in food consumption with Uganda. The TFCT and KFCT were particularly relevant for mixed dishes, as the UFCT did not have nutrient information for some mixed dishes, e.g. '*entula sauce*' and '*rolex*'. If the food item was not in any of these three FCTs, the seventh Edition McCance Widdowson UK Food Composition Table (UKFCT) was used. A fifth database, West Africa Food Composition Table (WAFCT) was only consulted once, when a food item was not found in any of the four earlier-mentioned FCTs. Regardless the FCT used, when extracting the nutrient information, food items that had identical names as those in the dataset, were used. If a food item did not exist by its exact name in any of the FCTs, the closest possible alternative to that food was used instead, e.g. for '*fried nakatti*' the nutrient information for '*green leaf relish with oil*' was used. This was performed even if it meant in some instances, the dish used as a substitute, had some ingredients missing, i.e. was not an exact replica of the mixed dish. Out of all the 202 foods profiled, this exercise was undertaken for (n=13) dishes.

In other instances, nutrient information for constituent parts of a mixed dish were available, but not for the whole mixed dish. Based on knowledge of the local context, an assumption was made that the mixed dish was composed of equal parts of the constituent parts. Therefore, the average of nutrient information of the constituent parts was used to estimate the nutrient composition for the mixed dish, e.g. '*rolex*', a street food local to Uganda, is akin to a wrap comprised of an omelette and chapatti. To obtain the nutrient composition of the rolex, therefore, the nutrient composition of both chapatti and omelette were separately obtained from the FCTs and the average of these was taken as an estimate of the nutrient composition of the rolex per 100gram. This exercise was undertaken for (n=12) dishes.

During the nutrient profiling exercise, unsweetened coffee and unsweetened tea were assumed the same, as these drinks are often used interchangeably in the study context.

4.3.2 Steps in the Nutrient Profiling using the NRFn.3 Model

For each food item (n=202), the nutritional information per 100gram for 11 nutrients to encourage (protein, fibre, calcium, zinc, potassium, magnesium, iron, folate, vitamin A, vitamin C and vitamin E) and three nutrients to limit (total fat, sodium and total sugars) were obtained from the FCTs and entered into a spreadsheet. Using USDA dietary recommendations (USDA, 2013), the % daily value (%dv) for each of the 11 nutrients to encourage and 3 nutrients to limit per 100g was calculated. The energy density (ED) of the food, measured as kcal/100 gram was also entered on the same spreadsheet. In order to prevent some foods that met over 100 %dv influencing the resulting nutrient rich foods index, capping was conducted (Drewnowski, 2017). To do this, any columns that had any value above 100 for the %daily value for each of the 11 positive nutrients to encourage were identified. Following this, a new column was created right next to that column that had one or more values above 100 for %dv and labelled %dv_capped. In these new columns, all %dv were copied and pasted from the initial column, but any value that was >100 was changed to 100. This resulted in a new column of %dv_capped, with the maximum possible %dv for that nutrient set at 100. At the end of this step, all the %dv per 100g for each of the 11 nutrients had a maximum value of 100. This capping, however, was not done for the nutrients to limit, and their %dv per 100g was left as is.

The next step was to separately sum all the %dv and %dv_capped per 100g for positive nutrients to encourage and negative nutrients to limit for each food item. The final step involved generating the nutrient rich food index score per 100g ($NRF11.3_{100g}$) for each food item (n=202) by subtracting the sum of the nutrients to limit from the sum of the positive nutrients to encourage for that food item. The algorthm used was:

> $NRF11.3_{100g}$ = [(%DV protein + %DV fiber + %DV calcium + %DV magnesium + %DV iron + %DV zinc+ %DV potassium +%DV folate + %DV vitamin A + %DV vitamin C + %DV vitamin E) – (%DV total fat + %DV sodium + % DV total sugars)] / 100g

Similar to GHGE (see section 4.2.3), findings on the nutrient density of foods was based on the $NRF11.3_{100g}$ model and not $NRF_{100kcal}$ given that people are generally more likely to consume or make food purchasing descisions by weight rather than in calorific terms. However, to allow for comparisons between nutrient densities for foods by weight and by energy, $NRF11.3_{100g}$ were converted to nutrient rich food index score per 100kcal ($NRF11.3_{100kcal}$) by multiplying the $NRF11.3_{100g}$ obtained by 100 and dividing the result by the ED of the respective food item. Nutrient density scores for the foods consumed (n=202) by this sample of women are attached in Appendix 16.

Although unsweetened tea and unsweetened peppermint tea were profiled, their nutrient density scores and environmental impact estimates were not considered for further analyses since they are not typically consumed as food but as drinks (Ledikwe et al., 2005; Vieux et al., 2013; Perignon et al., 2016). Notwithstanding, in the study context, particularly in rural areas and among the urban poor, in the absence of a suitable sauce, e.g. vegetables, legumes or animal-based dishes, sweetened tea is often consumed alongside the staple as a main meal. It is for this reason that the nutrient density scores and environmental impact estimates for sweetened tea and sweetened coffee were included in further analyses.

4.3.3 Healthiness and Environmental Impact of Foods using Nutrient Density, Energy Density and Environmental Impact Estimates

To classify food items based on healthiness and environmentally impact, an approach adapted from other published studies was used (Vieux et al., 2013; Masset et al., 2014). Both authors classified foods as 'healthy and sustainable' based on whether their estimated nutrient density scores, GHGE and ED fell above or below the median cut-off point. To this end, in this study, foods were classified as lower environmental impact if their GHGE estimate was below the median and higher environmetal impact if it was above the median. Foods were labelled as 'healthy' if both their nutrient rich food index score ($NRF11.3_{100g}$) was >median, and the ED was <225kcal/100g threshold (Bechtold, 2005; WCRF/AICR, 2007). Food items were then classified as 'healthy and lower environmental impact'(and therefore more sustainable) if they met three criteria ($NRF11.3_{100g}$>median, ED<225kcal/100g and GHGE<median). Foods were classified as 'unhealthy and higher environmental impact' foods (and therefore less sustainable) if they also met three criteria ($NRF11.3_{100g}$<median, ED>225kcal/100g and GHGE>median).

4.4 Data Analysis

Differences in proportions of food groups consumed between urban and rural WRA were tested using the Fischer's exact test for independence, given that this was a non-random sample of relatively small size (n=73). To test the relationship between environmental impact estimates, ED and nutrient density scores for food groups, the weighted non-parametric Spearman's Rank-Order Correlation test was used since food groups were composed of varying numbers of food items. The Spearman's rho, which ranges from -1 to +1, is a non-parametric test that measures how strong the relationship is between pairs of non-randomly distributed variables (Field, 2013). The test is ideal for rank data (Field, 2013), e.g. nutrient density scores, ED and environmental impact estimates in the present study. In interpreting Spearman's rho values, ρ = -1 was indicative of a perfect negative correlation, while +1 was indicative of a perfect positive correlation between two variables. Spearman's ρ = ± 0.09–1.0 was indicative of a very strong correlation, ρ = ± 0.70-0.90 was indicative of a strong relationship, ρ = ± 0.50-0.70 was indicative of a moderate relationship, ρ = ± 0.30-0.50 was indicative of a weak relationship (Hinkle et al., 2003). Lastly ρ= ± 0.30-0.00 was indicative of little or no relationship (Hinkle et al., 2003). In interpreting correlations, p values <0.05 were indicative of a significant relationship at the 95% confidence interval level.

Kernel density plots were constructed to visualise the relationship between periodicity and healthiness and environmental impact food categories. To test the relationship between healthiness and environmental impact of foods and sociodemographic variables as well tempo and synchronisation, multiple logistic regression was performed. In the first model (unadjusted), only the eating practice variables were input. The second logistic regression model (adjusted), controlled for sociodemographic variables. It was necessary to control for sociodemographic variables as these have been found to influence dietary behaviours (see section 1.7.1). In both logistic regression models (adjusted and non-adjusted), the lowest value for each of the input variables was used as the reference category, e.g. for SES, the low SES was the reference category against which the other two categories (mid SES and high SES) were compared. Logistic regression analysis was also run to test the relationship between sociodemographic variables alone and healthy and environmental impact food categories consumed among this sample of WRA.

Nutrient profiling and environmental impact estimation of foods consumed were performed using Microsoft Excel 2010. Statistical tests were performed using SPSS Version 23 (SPSS Statistics, IBM, New York). Kernel density plots were generated using the ggplot2 function in RStudio (v1.1.463, RStudio Team, Boston, MA, USA).

4.5 Findings

This section presents a description of the study participants, followed by key findings from the nutrient profiling and environmental impact assessment that were undertaken to assess the healthiness and environmental impact of the foods consumed by rural and urban Ugandan WRA. Thereafter, findings on the relationship between dietary intake and aspects of the eating practice (i.e. tempo, periodicity and synchronisation) are presented. The chapter concludes with a discussion of the study's main findings and implications for policy and practice.

4.5.1 Characteristics of Study Participants

The study sample had an almost equal proportion of rural and urban participants, although the number of urban participants was slightly higher compared with rural participants (Table 4.3). Rural and urban participants were similarly aged with the mean age of rural participants slightly higher than that of urban participants (Table 4.3), but this difference was not significant (27.9 vs. 26.4, p=0.477) (Table 4.3). There was no significant difference in socioeconomic status (SES) between rural and urban participants (p=0.654) (Table 4.3). Post-hoc pairwise comparisons showed no significant difference in proportions of rural and urban participants at any of the three SES levels (Table 4.3). That age and SES did not differ significantly between rural and urban participants was probably a result of the quota sampling method employed, as the aim was to obtain an equal number of participants in each quota based on age and SES. Findings also indicate that a significantly higher proportion of rural participants had not completed primary education compared with urban participants (Table 4.3). However, overall, there was no significant difference in the level of education between urban and rural participants (p=0.074) (Table 4.3). There was also no significant difference in the proportion of married or unmarried rural and urban women (p=0.881) (Table 4.3).

Table 4.3: Socio-demographic characteristics of study participants (n= 73) WRA in Kampala, Nakawa division and Wakiso, Ssisa sub-county

	Wakiso (n=33) (Rural)	Kampala (n=40) (Urban)	p-value
Age, Years (mean ± SD)	27.9±11.0	26.4±10.0	0.477
Education Level Completed (n, %)			0.074
Informal	10[a](30.3)	4[a](10.0)	
Primary	21[a](63.6)	30[a](75.0)	
Secondary	1[a](3.0)	1[a](2.5)	
Post-secondary	1[a](3.0)	5[a](12.5)	
Socioeconomic Status (n, %)			0.654
Low SES	8[a](24.2)	13[a](32.5)	
Mid SES	8[a](24.2)	10[a](25.0)	
High SES	17[a](51.5)	17[a](42.5)	
Marital Status (n, %)			0.881
Single	22[a](66.7)	26[a](65.0)	
Married or living with partner	11[a](33.3)	14[a](35.0)	

In terms of dietary intake, a significantly higher proportion of urban participants, compared with rural participants, consumed red meat (25.0% vs. 0%, p=0.002), sugar (87.5% vs. 51.5%, p=0.001) and sugary drinks (20.0% vs. 3.0%, p=0.035) in the 24hrs preceding the dietary recall interview (Table 4.4). Although a higher proportion of urban than rural participants reportedly consumed milk and milk products than rural participants, this difference was not significant (17.5% vs. 3.0%, p=0.065) (Table 4.4).

Table 4.4: Consumption of Food Groups between Rural and Urban WRA (n=73)

	Wakiso (n=33) (Rural)	Kampala (n=40) (Urban)	p-value
Food Groups	n (%)	n (%)	
Red meat	0[a](0)	10[b](25.0)	0.002**
Poultry, fish and eggs	7[a](21.2)	7[a](17.5)	0.770
Milk and milk products	1[a](3.0)	7[b](17.5)	0.065
Traditional cereals	22[a](66.7)	27[a](67.5)	1.000
Refined cereals	13[a](39.4)	24[a](60.0)	0.102
Matooke, roots and tubers	25[a](75.8)	11[a](72.5)	0.795
Legumes	14[a](42.4)	24[a](60.0)	0.162
Nuts and seeds	8[a](24.2)	11[a](27.5)	0.795
Fats, oils and spreads	19[a](57.6)	29[a](72.5)	0.220
Fruit	6[a](18.2)	8[a](20.0)	1.000
Vegetables	31[a](93.9)	37[a](92.5)	1.000
Sugar and honey	17[a](51.5)	35[b](87.5)	0.001**
Sweet and savoury snacks	2[a](6.1)	9[a](22.5)	0.097
Sugary drinks	1[a](3.0)	8[b](20.0)	0.035*
Tea and coffee	22[a](66.7)	30[a](75.0)	0.450

* significant at 0.05 level; ** significant at 0.01 level

The next section presents the results from the nutrient profiling and environmental impact assessment of foods consumed by study participants collected using a single qualitative 24hr recall interview. First, a description of results of the nutrient profiling exercise are presented, followed by a description of the environmental impact estimates. As highlighted in sections 4.2 and 4.3, findings on nutrient density and environmental impact of foods were calculated based on 100g. For comparison purposes, results based on 100kcal are highlighted.

4.5.2. Energy Density, Nutrient Density and Environmental Impact of Food Groups Consumed by Rural and Urban WRA

Findings indicate that the food groups lowest in energy were milk and milk products, sugary drinks, fruit, vegetables, legumes, traditional cereals, matooke, roots and tubers and non-traditional cereals (Table 4.5). These food groups all had ED<225kcal/100g. On the other hand, red meat, sugar and honey, nuts and seeds, sweet and savoury snacks, and fats, oils and spreads were highest in energy (Table 4.5).

Table 4.5: Mean Energy Density, Nutrient Density and Environmental Impact Scores for Food Groups Consumed by Rural and Urban WRA (n=73)

Food Groups	f	ED	$NRF11.3_{100g}$	$NRF11.3_{100kcal}$	$GHGE_{100g}$	$GHGE_{100kcal}$
Red meat	11	250	57.9	33.4	813.4	453.0
Poultry, fish and eggs	15	223	89.5	55.9	832.1	387.1
Milk and milk products	1	31	9.4	30.2	88.5	285.6
Traditional cereals	14	122	25.9	22.5	11.0	10.2
Non-traditional cereals	17	194	36.8	45.3	70.5	43.1
Matooke, roots and tubers[44]	20	130	46.8	37.6	26.7	22.5
Legumes	31	117	80.9	71.7	25.8	27.1
Nuts and seeds	14	375	132.3	38.0	47.9	15.1
Fruit	11	66	51.7	85.5	64.7	114.5
Vegetables	43	113	104.6	318.0	38.3	163.5
Fats, oils and spreads	3	707	7.3	7.9	376.5	46.2
Sugary drinks[45]	12	43	11.6	22.5	28.3	55.5
Sweet and savoury snacks	11	387	4.3	1.8	129.3	36.8
Sugar and honey	3	359	-69.6	-17.9	6.0	12.5

According to the NRF11.3 nutrient profiling model by weight ($NRF11.3_{100g}$), the most nutrient-dense food groups were fruit, red meat, poultry, fish and eggs, legumes, vegetables and nuts and seeds (Table 4.5). Sugary drinks, milk and milk products, fats, oils and spreads, sweet and savoury snacks and sugar and honey were lowest in nutrients (Table 4.5). When compared with the nutrient profiling model per 100kcal ($NRF11.3_{100kcal}$), some similarities were observed (Table 4.5). Like the $NRF11.3_{100g}$, the $NRF11.3_{100kcal}$ model identified poultry, fish and eggs, legumes, fresh fruit and vegetables as the most nutrient rich food groups, while sugary drinks, fats, oils and spreads, sweet and savoury snacks, and sugar and honey were nutrient poor (Table 4.5). However, unlike the $NRF11.3_{100g}$, the $NRF11.3_{100kcal}$ did not identify red meat or nuts and seeds as

[44] Includes katogo

[45] Includes sweetened teas, sweetened coffee and sweetened fruit juices and drinks

nutrient rich food groups (Table 4.5). Furthermore, unlike the $NRF11.3_{100g}$, the $NRF11.3_{100kcal}$ classified non-traditional cereals as nutrient rich (Table 4.5).

The lowest environmental impacts by weight ($GHGE_{100g}$) were observed for vegetables, sugary drinks, matooke, roots and tubers, legumes, traditional cereals and sugar and honey (Table 4.5). The food groups with the highest environmental impact by weight ($GHGE_{100g}$) were sweet and savoury snacks, fats, oils and spreads, red meat and poultry, fish and eggs (Table 4.5). When environmental impact (GHGE) for food groups were considered per 100kcal, the highest environmental impact food groups were primarily animal-based, i.e. milk and milk products, poultry, fish and eggs and red meat (Table 4.5). However, because of their lower energy densities, the vegetables and fruit food groups that previously had lower environmental impact per 100g now had considerably higher impact, closer to that of the animal-based food groups (Table 4.5). On the other hand, similar to the $GHGE_{100g}$, the lowest environmental impact food groups per 100kcal included matooke, roots and tubers, legumes, sugar and honey and traditional cereals (Table 4.5). While sweet and savoury snacks and fats, oils and spreads were both classified as higher impact per 100g, these two food groups had a much lower impact per 100kcal (Table 4.5).

4.5.3 Relationship between Energy Density, Nutrient Density and Environmental Impact Estimates for Food Groups Consumed by Rural and Urban WRA

Nutrient density by weight ($NRF11.3_{100g}$) and nutrient density by energy ($NRF11.3_{100kcal}$) were significantly, strongly positively correlated ($r=0.76$, $p<0.01$) (Table 4.6). There was a strong significant positive relationship observed between the environmental impact of food groups by weight ($GHGE_{100g}$) and environmental impact by energy ($GHGE_{100kcal}$) ($r=0.66$, $p<0.01$) (Table 4.6). This means that, among this sample of WRA, environmental impact and nutrient density of foods were similar regardless of whether they were estimated based on weight or caloric terms. These findings were similar to those obtained at the individual foods level correlation analysis. The ED of food groups was significantly negatively correlated with nutrient density by weight ($NRF11.3_{100g}$) ($r=-0.30$, $p<0.05$) (Table 4.6). This was similar between ED and nutrient density by energy ($NRF11.3_{100kcal}$) ($r=-0.68$, $p<0.01$) (Table 4.6). This indicates that among this sample of WRA, nutrient rich food groups are lower in energy than are nutrient poor food groups. Food group level ED was also significantly positively correlated with environmental impact by weight ($GHGE_{100g}$) ($r=0.43$, $p<0.01$) (Table 4.6). This means that, by weight, food groups higher in calories are more likely to have a higher environmental impact. Conversely, food group level ED was significantly negatively correlated with environmental impact by energy ($GHGE_{100kcal}$) ($r= -0.27$, $p<0.01$) (Table 4.6) meaning that food groups lower in calories were more likely to be higher in environmental impact.

Table 4.6: Relationship between Energy Density, Nutrient Density and Environmental Impact Scores for Food Groups Consumed by WRA (n=73)

	$NRF11.3_{100g}$	$NRF11.3_{100kcal}$	$GHGE_{100g}$	$GHGE_{100kcal}$	ED
$NRF11.3_{100g}$	1.00	0.76**	0.10	0.29**	-0.30*
$NRF11.3_{100kcal}$	0.76**	1.00	-0.01	0.44**	-0.68**
$GHGE_{100g}$	0.10	-0.01	1.00	0.66**	0.43**
$GHGE_{100kcal}$	0.29*	0.44**	0.66**	1.00	-0.27**
ED	-0.30*	-0.68**	0.43**	-0.27**	1.00

**significant at 0.01 level; *significant at 0.05 level

Findings from the weighted Spearman's rank-order test also showed that nutrient density by weight ($NRF11.3_{100g}$) had a weak positive correlation (r=0.10) with environmental impact by weight ($GHGE_{100g}$) (Table 4.6). However, nutrient density by weight ($NRF11.3_{100g}$) and environmental impact by energy ($GHGE_{100kcal}$) were significantly positively correlated (r=0.29, $p<0.01$) (Table 4.6). Nutrient density by energy ($NRF11.3_{100kcal}$) was also significantly positively correlated (r=0.441, $p<0.01$) with environmental impact by energy ($GHGE_{100kcal}$) (Table 4.6). These findings on food group level, were similar to those of individual foods using correlation analysis.

As mentioned in section 4.3.3 of this thesis, following nutrient profiling and environmental impact assessment, individual food items were categorised as 'healthy and lower impact' or 'unhealthy and higher impact' based on $NRF11.3_{100g}$, ED and $GHGE_{100g}$. This was undertaken to assess the relationship between the healthiness and environmental impact of dietary intake and aspects of the eating practice (tempo, periodicity and synchronisation). Healthiness of food items was gleaned from their $NRF11.3_{100g}$ scores and ED, while the environmental impact score of foods was gleaned from $GHGE_{100g}$ estimates. As mentioned earlier, the $GHGE_{100g}$ and $NRF11.3_{100g}$ were used in classification of food items given that consumers are generally more likely to consume or purchase food by weight rather than in calorific terms (see sections 4.2 and 4.3). Furthermore, results indicated that both the $GHGE_{100g}$ and $GHGE_{100kcal}$ and the $NRF11.3_{100g}$ and $NRF11.3_{100kcal}$ for food items were strongly positively correlated. This relationship was significant. This indicates a strong likelihood that similar results would have been obtained using the scores per 100kcal.

The following section summarises the findings from the categorisation of the food items based on healthiness and environmental impact.

4.5.4 Healthiness and Environmental Impact of Foods based on Combined Energy Density, Nutrient Density and Environmental Impact Estimates

Of 202 food items profiled for nutrient density and assessed for environmental impact, the bulk of food items were found to be intermediate, i.e. either scoring favourably for healthiness and above the median for environmental impact (GHGE) or scoring favourably for environmental impact (GHGE) but lower for healthiness. This was regardless of whether food items were categorised depending on their GHGE and NRF11.3 scores per 100g or per 100kcal. Such intermediate foods were mainly plant-based single and mixed dishes. (see attached in Appendix 17-18).

Results indicate that when items were categorised per 100g, less than a quarter (n=37 of 202 foods) scored maximum points for sustainability, i.e. were 'healthy and lower impact' (Table 4.7). These 37 foods were low in calories (ED<225kcal/100g), higher in nutrients ($NRF11.3_{100g}$>median) and scored lowest for environmental impact ($GHGE_{100g}$<median). This 'healthy and lower impact' food category mostly contained traditional cereals, boiled or steamed roots and tubers, vegetable dishes, some fruit and legume-based dishes (Table 4.7). Almost a tenth of all profiled dishes (n = 13 of 202 foods) scored lowest (least sustainable), i.e. ED>225kcal/100g, $NRF11.3_{100g}$<median and $GHGE_{100g}$>median (Table 4.7). This 'unhealthy and higher impact' food category was mostly comprised of confectionery and animal-based products, e.g. cakes, deep-fried beef and deep-fried chicken (Table 4.7). This food category also included sweet and savoury snack products, street food ('rolex') and some processed fats, oils and spreads (Table 4.7).

When items were categorised using $GHGE_{100kcal}$ and $NRF11.3_{100kcal}$, an almost equal number of items (n=36 of 202 foods, 17.8%) scored maximum points for sustainability, i.e. met the criteria for both 'healthiness and lower impact'. The 'healthy and lower impact' food category was still comprised of plant-based dishes, i.e. legume-based dishes, nut-based dishes, roots and tubers, some traditional cereals and a few vegetables (Table 4.7). Noticeably, some vegetable dishes that were previously categorised as 'healthy and lower impact' (per 100g) were categorised as intermediate foods based on 100kcal (Table 4.7). Similarly, on a per 100kcal basis, a lower number of food items (n= 10 of 202 foods, 5.4%) scored lowest, i.e. ED>225kcal/100g, $NRF11.3_{100kcal}$<median and $GHGE_{100kcal}$>median (Table 4.5). The 'unhealthy and higher impact' category per 100kcal, like that based on 100g, comprised animal-based dishes and confectionery snack products (Table 4.7). However, some food items that were previously categorised as 'unhealthy and higher impact' per 100g were no longer categorised as such on 100kcal basis, e.g. margarine, hydrogenated vegetable fat, samosa, rolex and sweet, yellow bread (Table 4.7).

These findings indicates that in categorising foods based on nutrient density and environmental impact, the metric which is used as a basis for calculation influences the results, which should be taken into consideration in interpreting such findings.

Table 4.7: Categorisation of Foods Consumed by Rural and Urban WRA (n=73) based on Healthiness and Environmental Impact Estimates

Healthy and Lower Impact Foods (per 100g) (n=37 foods)	Healthy and Lower Impact Foods (per 100kcal) (n=36 foods)	Unhealthy and Higher Impact Foods (per 100g) (n=13 foods)	Unhealthy and Higher Impact Foods (per 100kcal) (n=10 foods)
sweet potato (yellow-fleshed, boiled)	sweet potato (yellow-fleshed, boiled)	bread (refined wheat, sweet yellow, sliced)	pork (roasted)
sweet potato (white-fleshed, boiled)	sweet potato (white-fleshed, boiled)	beef (fresh) deep-fried with vegetable oil	beef (fresh) deep-fried with vegetable oil
sweet potato (white-fleshed, steamed)	sweet potato (white-fleshed, steamed)	chicken (deep-fried)	chicken (grilled)
sweet potato (yellow-fleshed, steamed)	sweet potato (yellow-fleshed, steamed)	margarine	chicken (deep-fried)
sweet potato (unknown colour, steamed)	sweet potato (unknown colour, steamed)	ghee	fish (tilapia, fresh) steamed
kalo[46] (millet flour)	white rice (boiled) with carrot, green peas	hydrogenated vegetable fat	ghee
fish sauce (mukene) boiled with tomato, salt	kalo (millet flour)	cake (banana)	cake (banana)
agira[47] (Nambaale, no cover, boiled)	porridge (millet)	cake (vanilla)	cake (vanilla)
bean sauce (black, dried) boiled with onion	pea sauce (cowpea, dried) fried with onion, tomato, vegetable oil	cake (chocolate)	cake (chocolate)
bean sauce (other kidney, dried) boiled with onion, tomato	agira (Nambaale, no cover, boiled)	cake (muffin, vanilla)	cake (unknown type)
bean sauce (yellow, dried) fried with onion, vegetable oil	bean sauce (black, dried) boiled with onion	cake (unknown type)	
bean sauce (yellow, dried) fried with onion, tomato, vegetable oil	bean sauce (black, dried) fried with onion, vegetable oil	samosa (cowpea)	
bean sauce (yellow, dried) fried with onion, tomato, green pepper, garlic, vegetable oil, curry powder	bean sauce (black, dried) fried with onion, tomato, carrot, vegetable oil	rolex (onion, tomato, egg, chapatti)	
bean sauce (yellow, dried) fried with onion, tomato, green pepper, carrot, vegetable oil, curry powder, royco[48]	bean sauce (other kidney, dried) boiled with onion, tomato		
bean sauce (red kidney, dried) fried with onion, tomato, vegetable oil	bean sauce (yellow, dried) fried with onion, vegetable oil		
bean sauce (Kanyebwa, fresh) boiled with onion, tomato	bean sauce (yellow, dried) fried with onion, tomato, vegetable oil		
	bean sauce (yellow, dried) fried with onion, tomato, green pepper, garlic, vegetable oil, curry powder		
	bean sauce (yellow, dried) fried with onion, tomato, green pepper, carrot, vegetable oil, curry powder, royco		
	bean sauce (red kidney, dried) fried with onion, tomato, vegetable oil		

[46] Traditional polenta-like bread made from finely millet flour and water
[47] Traditional dish made from beans that have had their covers removed
[48] Processed powdered condiment used to flavour food

Healthy and Lower Impact Foods (per 100g) (n=37 foods)	Healthy and Lower Impact Foods (per 100kcal) (n=36 foods)	Unhealthy and Higher Impact Foods (per 100g) (n=13 foods)	Unhealthy and Higher Impact Foods (per 100kcal) (n=10 foods)
bean sauce (Kanyebwa[49], fresh) boiled with onion, tomato, green pepper	bean sauce (Kanyebwa, fresh) boiled with onion, tomato		
bean sauce (Kanyebwa, fresh) boiled with onion, tomato, ginger, salt	bean sauce (Kanyebwa, fresh) boiled with onion, tomato, green pepper		
bean sauce (Kanyebwa, fresh) fried with onion, tomato, entula, carrot, vegetable oil, royco	bean sauce (Kanyebwa, fresh) boiled with onion, tomato, ginger, salt		
bean sauce (Nambaale, fresh) boiled with onion	bean sauce (Kanyebwa, fresh) fried with onion, tomato, entula, carrot, vegetable oil, royco		
bean sauce (Nambaale, dried) fried with onion, tomato, entula, vegetable oil	bean sauce (Kanyebwa, dried) fried with tomato, vegetable oil, curry powder, salt		
bean sauce (Nambaale, dried) fried with onion, tomato, entula, vegetable oil, salt	bean sauce (Nambaale, fresh) boiled with onion		
groundnut sauce (boiled) with entula	bean sauce (Nambaale, dried) boiled with onion, tomato, salt		
groundnut sauce (boiled) with onion, egg plant	bean sauce (Nambaale, dried) fried with onion, vegetable oil, salt		
carrot (fresh)	bean sauce (Nambaale, dried) fried with onion, tomato, vegetable oil		
cabbage (fresh, white)	bean sauce (Nambaale, dried) fried with onion, tomato, entula, vegetable oil		
cabbage (fresh, white) boiled	bean sauce (Nambaale, dried) fried with onion, tomato, vegetable oil, curry powder, royco, salt		
cabbage (fresh, white) fried with vegetable oil	bean sauce (Nambaale, dried) fried with onion, tomato, green pepper, vegetable oil, curry powder, salt		
mushroom sauce	bean sauce (Nambaale, dried) fried with onion, tomato, entula, vegetable oil, salt		
nakatti (boiled) with onion, salt	groundnut sauce (boiled) with mushroom, onion, tomato		
bugga[50] (boiled) with onion, salt			
doodo (boiled) with onion			
sukuma wiki (boiled) with onion			
sukuma wiki (fried) with vegetable oil			
sukuma wiki (fried) with onion, tomato, vegetable oil			
lemon			
pawpaw (ripe)			

[49] Pinto bean
[50] Traditional leafy vegetable that is dark green, purple or deep red in colour. This is a variety of Amaranth spp.

Healthy and Lower Impact Foods (per 100g) (n=37 foods)	Healthy and Lower Impact Foods (per 100kcal) (n=36 foods)	Unhealthy and Higher Impact Foods (per 100g) (n=13 foods)	Unhealthy and Higher Impact Foods (per 100kcal) (n=10 foods)
	groundnut sauce (boiled) with mushroom, onion, salt cabbage (fresh, white) fried with vegetable oil mushroom sauce		

Following the categorisation of food items, the relationship between the healthiness and environmental impact of dietary intake and aspects of the eating practice, i.e. tempo, periodicity and synchronisation) was assessed. The key findings presented in the next section focuses on the two aforementioned healthy and environmental impact food categories per 100g, i.e. 'unhealthy and higher impact' and 'healthy and lower impact'.

4.5.5 Relationship between Aspects of Eating Practice and the Healthiness and Environmental Impact of Foods Consumed by WRA

Findings showed that more WRA consumed healthy and lower impact foods than unhealthy and higher impact foods (54.8% vs 21.9%) (Table 4.8). Furthermore, more urban (n=24) than rural participants (n=16) consumed 'healthy and lower impact' foods on any eating occasion (Table 4.8). Additionally, a higher proportion of urban than rural participants (30.00% vs. 12.12%) consumed 'unhealthy and lower impact foods', e.g. sugar-sweetened drinks but this did not reach significance (Table 4.8).

Table 4.8: Consumption of Healthy and Environmental Impact Foods among Rural and Urban Ugandan WRA (n=73)

	Total (n=73)	**Wakiso (n=33) (Rural)**	**Kampala (n=40) (Urban)**	**p-value**
Healthiness and Environmental Impact Food Category	n (%)	n (%)	n (%)	
Healthy and Lower Impact	40 (54.8)	16 (48.48)	24 (60.00)	0.35
Unhealthy and Higher Impact	16 (21.9)	4 (12.12)	12 (30.00)	0.09

Healthy and Lower Impact Foods

Findings from the unadjusted multiple logistic regression analysis (Table 4.9) showed that the odds of consuming 'healthy and lower impact' foods at any eating occasion were 4.7 times higher for WRA with post-secondary education (OR = 4.70, 95%CI 1.28, 17.30) than those with the lowest level of education. Additionally, the odds of consuming 'healthy and lower impact' foods was 2.4 times higher (OR = 2.41, 95%CI 1.21, 4.80) for participants in the highest wealth tertile compared with the lowest wealth quintile. This suggests that wealthier and better-educated women were more likely to consume healthy and lower impact foods compared with less educated and poorer women. The consumption of 'healthy and lower impact' foods did not vary according to other sociodemographic factors investigated, i.e. place of residence (rural vs urban), whether participants had children and marital status (Table 4.9). However, urban WRA were 33% less likely (OR = 0.67, 95%CI 0.37, 1.21) than rural WRA to consume 'healthy and lower impact' foods (Table 4.9). Findings from the unadjusted logistic regression model indicated that the odds of WRA consuming 'healthy and lower impact' foods at out-of-home eating events was 2.5 times (OR = 2.51, 95%CI 0.78, 2.90) that of eating events in the home (Table 4.9). Furthermore, at the odds of consuming 'healthy and lower impact' foods was higher at longer eating occasions (Table 4.9).

Table 4.9: Adjusted and Unadjusted Logistic Regression Results for Healthy and Lower Impact Foods and Eating Practice

Variable	OR	95% CI	p-value	OR	95% CI	p-value
	Unadjusted			Adjusted		
Age	1.02	0.98, 1.06	0.26	1.02	0.98, 1.06	0.35
Residence						
Urban	0.67	0.37, 1.21	0.19	0.47	0.24, 0.91	0.03*
Education Completed			0.01*			0.09
Primary Education	1.25	0.40, 3.89		1.18	0.37, 3.78	
Secondary Education	0.77	0.30, 1.97		0.68	0.25, 1.82	
Post-secondary	4.70	1.28, 17.30		2.49	0.65, 9.59	
Marital Status						
Married	1.22	0.61, 2.46	0.57	1.60	0.76, 3.38	0.22
Parity (1 or more children)	1.59	0.64, 3.96	0.32	1.36	0.54, 3.43	0.52
Socio-economic Status			0.04*			0.05
Mid SES	1.73	0.78, 3.83		1.48	0.67, 3.27	
High SES	2.41	1.21, 4.80		2.51	1.20, 5.28	
Synchronisation						
Eating with friends and family	0.67	0.29, 1.60	0.37	0.76	0.31, 1.90	0.57
Tempo			0.96			0.15
Short (10-29 minutes)	1.60	0.50, 5.11		0.95	0.27, 3.37	
Long (30-59 minutes)	2.20	0.73, 6.67		1.62	0.49, 5.33	
Very long (60+ minutes)	2.74	0.92, 8.17		2.23	0.70, 7.15	
Location of eating event						
Out-of-home	2.51	0.78, 2.90	0.22	2.23	1.05, 4.47	0.04*

adjusted for age, residence, education, marital status, parity and socioeconomic status; *significant at 0.05 level

When the logistics regression model was adjusted for sociodemographic variables, findings indicated that the odds of consuming 'healthy and lower impact foods' were 53% less for urban residents (OR = 0.47, 95%CI 0.24, 0.91) than rural residents (Table 4.9). Similar to findings obtained from the unadjusted model, the odds of consuming 'healthy and lower impact foods' were 2.5 times higher (OR =2.51, 95%CI 1.20, 5.28) for participants in the highest wealth tertile compared with those in the lowest. The findings for aspects of the eating practice were similar to those obtained from the unadjusted model (Table 4.9). Similar to the unadjusted model, out-of-home eating occasions were twice as likely (OR=2.23, 95%CI 1.05, 4.47) to contain 'healthy, low-impact' foods compared with those within the home (Table 4.9). Additionally, the regression model showed no significant association between consuming 'healthy and lower impact' foods and the length of eating events (p=0.15) and eating in the company of friends and family (p=0.57).

In terms of periodicity, i.e. at which time of day the eating events occurred, findings indicated that consumption of foods categorised as 'healthy and lower impact' occured in small quantities earlier in the day, i.e. between 5-10.00am (Figure 4.1). Consumption of these food items, however, peaked between 12.00-4.00pm and again between about 6-

11.00pm, albeit at a much lower frequency (Figure 4.1). These two peak consumption times coincide with the two main meal times, i.e. lunchtime and dinnertime. This suggests that, among this sample of rural and urban WRA, 'healthy and lower impact foods', e.g. legume-based dishes, boiled and steamed sweet potatoes and vegetables are less likely to be consumed between meals as snack foods than 'unhealthy and higher impact' foods.

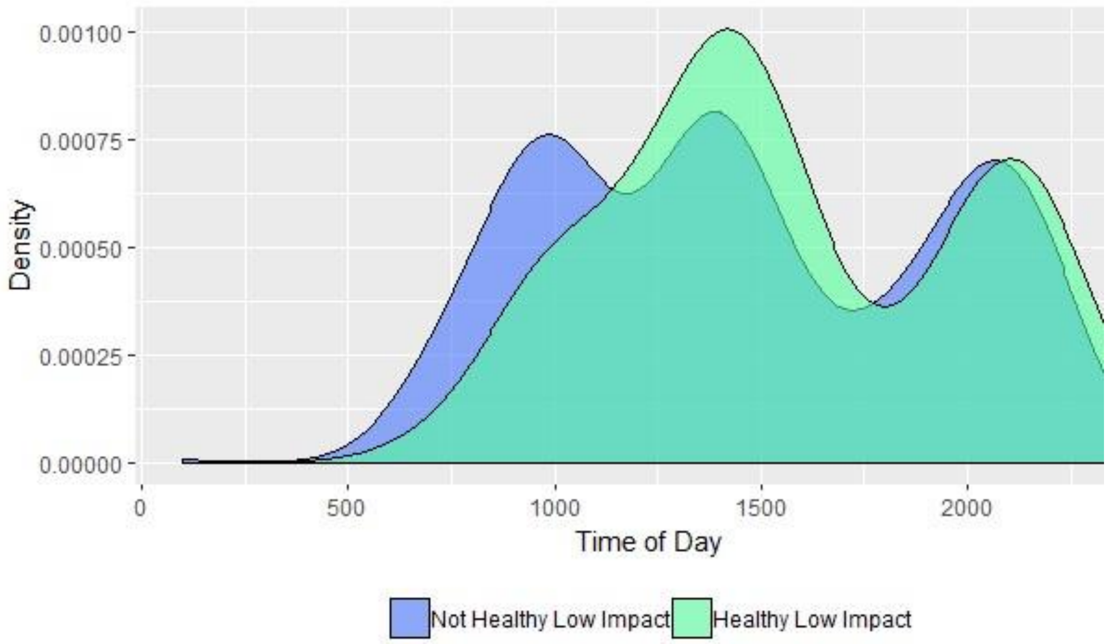

Figure 4.1: Periodicity of Consumption of Healthy and Lower Impact Foods

Unhealthy and Higher Impact Foods

The unadjusted logistic regression model indicated that the odds of urban participants consuming 'unhealthy and higher impact' foods were 77% (OR = 0.23, 95%CI 0.06, 0.92) lower than that of rural participants (Table 4.10). This suggests that among this sample, rural women were relatively more likely to consume 'unhealthy and higher impact' foods at any eating occasion compared with urban women. The odds of consuming 'unhealthy and higher impact' foods were 92% lower for participants in the middle wealth tertile (OR = 0.08, 95%CI 0.01, 0.89) compared with those in the lowest wealth tertile (Table 4.10). On the other hand, the odds of the wealthiest women consuming 'unhealthy, higher impact foods' on any eating occasion were 76% lower (OR = 0.42, 95%CI 0.05, 1.14) than women from the lowest wealth tertile (Table 4.10). These findings suggest that, among this sample, the wealthier a woman was, the less likely she was to consume 'unhealthy, higher impact foods', such as cakes and deep-fried meats compared with the poorest women. Findings from the unadjusted logistic regression model (Table 4.10) indicated that the odds of consuming 'unhealthy and higher' impact foods were 71% lower (OR=0.29, 95%CI 0.11, 0.75) for out-of-home eating occasions than those within the home. The odds of consuming 'unhealthy and higher impact' foods were also 12% lower (OR=0.88, 95%CI 0.26, 2.98) for eating occasions longer than an hour compared with those lasting less than 10 minutes (Table 4.10). This suggests that this sample of WRA were less likely to consume 'unhealthy and higher impact foods' such as confectionery products at longer eating events.

Table 4.10: Adjusted and Unadjuated Logistic Regression Results for Unhealthy and Higher Impact Foods and Eating Practice

Variable	OR	95% CI	p-value	OR	95% CI	p-value
		Unadjusted			Adjusted	
Age	1.00	0.98, 1.06	0.95	0.98	0.89, 1.07	0.61
Residence						
Urban	0.23	0.37, 1.21	0.04*	0.27	0.05, 1.36	0.11
Education Completed			0.78			0.85
Primary Education	2.84	0.40, 3.89		2.14	0.21, 22.44	
Secondary Education	0.95	0.30, 1.97		0.84	0.18, 3.90	
Post-secondary	0.82	1.28, 17.30		0.62	0.04, 9.99	
Marital Status						
Married	2.99	0.61, 2.46	0.08	3.28	0.81, 13.25	0.10
Parity (1 or more children)	0.57	0.64, 3.96	0.51	0.32	0.05, 2.11	0.24
Socio-economic Status			0.03*			0.06
Mid SES	0.08	0.78, 3.83		0.11	0.01, 1.15	
High SES	0.24	1.21, 4.80		0.26	0.05, 1.30	
Synchronisation						
Eating with friends and family	0.60	0.16, 2.31	0.46	0.45	0.10, 2.05	0.30
Tempo			0.25			0.35
Short (10-29 minutes)	0.74	0.18, 3.11		1.28	0.20, 8.41	
Long (30-59 minutes)	0.19	0.03, 1.10		0.46	0.05, 3.99	
Very long (60+ minutes)	0.88	0.26, 2.98		1.98	0.35, 11.11	
Location of eating event						
Out-of-home	0.29	0.11, 0.75	0.01*	0.43	0.15, 1.30	0.14

adjusted for age, residence, education, marital status, parity and socioeconomic status; *significant at 0.05 level

When the model was adjusted for sociodemographic variables, there were no significant associations between any of the aspects of eating practice (tempo, synchronisation) and the consumption of 'unhealthy and higher impact' foods (Table 4.10). However, the odds of consuming 'unhealthy and higher impact' foods during eating events >1 hour were almost twice (OR=1.98, 95%CI 0.35, 11.11) those of eating events < 10 minutes (Table 4.10). Like the unadjusted model, the odds of eating events out of the home containing an 'unhealthy and higher impact' food item were lower compared with when in the home (Table 4.10).

Although 'unhealthy and higher impact' foods were consumed throughout the day, this peaked in the morning (9.00-11.00am), encompassing breakfast time (Figure 4.2).

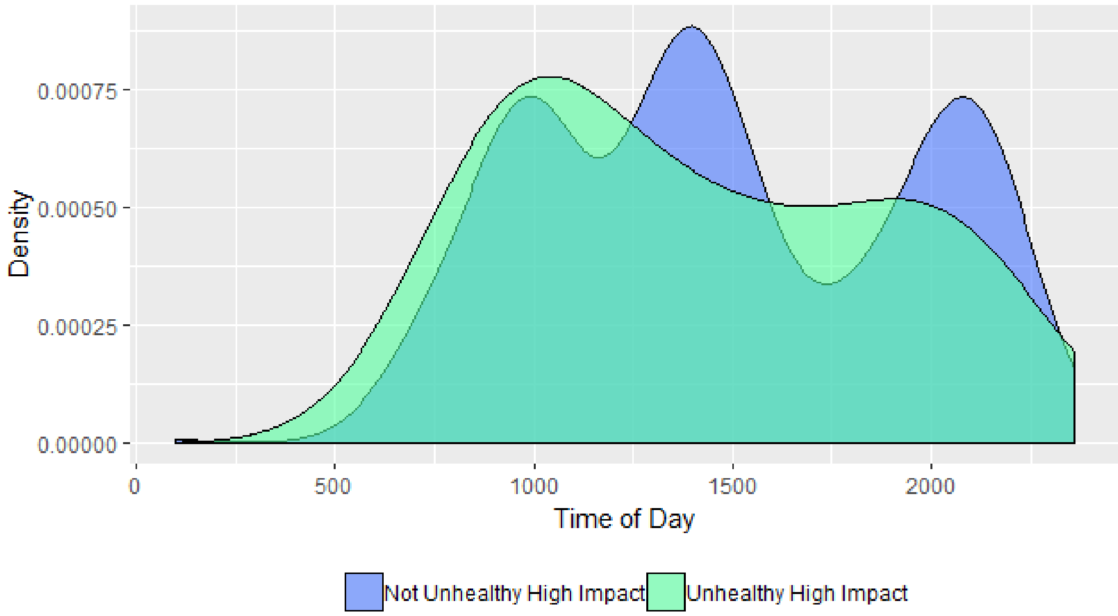

Figure 4.2: Periodicity of Consumption of Unhealthy and Higher Impact Foods

4.6 Discussion

The objectives of this second study were (i) to assess the healthiness and environmental impact of the foods of rural and urban Ugandan women of reproductive age and (ii) explore the relationship between these and aspects of the eating practice, i.e. tempo, periodicity and synchronisation.

Healthiness and Environmental Impact of Participants' Dietary Intake

Findings from this study indicate that the food groups with the highest energy density (in descending order ranging from 707-223 kcal/100g) were: fats, oils and spreads, sweet and savoury snacks, nuts and seeds, sugar and honey, red meat and poultry, fish and eggs. This is unsurprising given the high fat and sugar content of the food items in these food groups. For example, the red meat food group included items like deep-fried meat and roasted pork, the sweet and savoury snacks food group included cakes and samosas and the nuts and seeds food group included sesame and peanuts, which are all have a high fat content. That the poultry, fish and eggs food group had relatively high energy content could be explained by the fact that this food group was mostly comprised of fish-based dishes, particularly '*mukene*', which is a highly nutritious pelagic fish species that has a high fat content (Kabahenda and Hüsken, 2009). On the other hand, the food groups with the lowest energy density (in ascending order ranging from 31-130 kcal/100g) were: milk and milk products, sugary drinks, fruit, vegetables, legumes, traditional cereals and matooke, roots and tubers. Several studies have demonstrated that these food groups are low in both fat and sugar, and high in water, explaining the lower energy density.

Based on the $NRF11.3_{100g}$ nutrient profiling model, the most nutrient rich food groups were fruit, red meat, poultry, fish and eggs, legumes, vegetables and nuts and seeds. These food items have been identified in other studies as 'healthy' or 'nutrient-rich' owing to their macro and micronutrient profile. For example, the legumes food group contained various bean, pea and lentil dishes, which have been described as nutrient rich (Messina, 1999; Maillot et al., 2007). The findings from this study are corroborated by other studies, which used similar nutrient profiling model and reported similar food groups as nutrient-rich (Dikmen et al., 2015; Drewnowski et al., 2015; Sluik et al., 2015; Hess et al., 2017). On the other hand, sugar and honey, sweet and savoury snacks, fats, oils and spreads, milk and milk products and sugary drinks were lowest in nutrients. It is important to note that regardless of the units of measurement used (100g or 100kcal), fats, oils and spreads, sugar and honey, sugar-sweetened beverages and a variety of sweet and savoury snack foods were classified as the least nutrient-dense. Several studies have demonstrated similar findings (Dikmen et al., 2015; Sluik et al., 2015; Hess et al., 2017).

The food groups with the highest environmental impact estimates ($GHGE_{100g}$) were largely animal-based, i.e. poultry, fish and eggs, red meat, fats, oils and spreads and sweet and savoury snacks. These food groups were comprised of food items that have been demonstrated to have higher environmental impact. For example, fish, chicken, eggs and ruminant meat (including beef, pork) had the highest carbon footprint in previous studies (Vieux et al., 2013; Masset et al., 2014; Drewnowski et al., 2015). Although animal-based dishes in this third study had the highest environmental impact, some of these were lower than other studies. This could be because many of these animal-based dishes usually include many vegetables, so that the meat forms a small proportion of the overall dish, therefore lowering the GHGE per portion. The lowest environmental impacts by weight ($GHGE_{100g}$), in descending order, were observed for fresh fruit, nuts and seeds, fresh vegetables, sugary drinks, matooke, roots and tubers, legumes, traditional cereals and sugar and honey food groups. These food groups had the lowest carbon cost per g relative to other food groups consumed. These findings are consistent with those from a study by Drewnowski et al. (2015), which demonstrated that the foods (groups) with the lowest environmental impact, regardless of whether this was per 100g or 100kcal, included sugar, sweetened beverages and sweet and savoury snacks. Although these food groups scored the lowest for environmental impact in study two, they also had the lowest nutrient density per gram. These findings indicate that the lowest carbon-cost food groups might not necessarily be the healthiest, therefore caution should be exercised in encouraging their consumption despite their low carbon footprint.

It is important to note that when environmental impact estimates were obtained per 100kcal, fruit and vegetables had higher scores compared with their scores per 100g. These findings are similar to those reported by others (Vieux et al., 2013; Drewnowski et al., 2015) who have demonstrated that when GHGE estimates were obtained per 100kcal, fruit and vegetables had a higher environmental impact, similar to that of the pork, poultry, eggs food group, although less than that of ruminant meat. Regardless of reference point, i.e. 100g or 100kcal, the food groups with the lowest environmental impact estimates included sugar and honey and plant-based food groups including matooke, roots and tubers, traditional cereals and legumes.

Findings from this study showed a significant positive correlation between energy density and environmental impact ($GHGE_{100g}$) of food groups consumed by this sample of WRA. This contrasted with results from Drewnowski et al. (2015), who found that energy density and environmental impact ($GHGE_{100g}$) were negatively correlated. The different food composition tables and environmental impact data used could explain why similar food items had different energy density and environmental impact values. The different food items in each food groups could have resulted in the different estimates between this PhD study and theirs. This study also showed significant negative correlation between energy density and both environmental impact ($GHGE_{100kcal}$) and nutrient density ($NRF11.3_{100kcal}$) at the individual foods and food group levels of analysis. This means that food items (and food groups) that were less energy dense were higher in both environmental impact and nutrients. In this case, the low energy density and high-nutrient density of these foods is offset by their higher environmental impact. Findings from this study also demonstrate that the environmental impact ($GHGE_{100kcal}$) and nutrient density ($NRF11.3_{100kcal}$) of individual foods and food groups are also significantly positively correlated. This suggests that nutrient-dense foods (and food groups) were higher in environmental impact. These findings corroborate those from other studies, which found that higher nutrient density scores were associated with higher environmental impact estimates per 100kcal (Vieux et al., 2013; Drewnowski et al., 2015). This is unsurprising given that converting GHGE from a weight basis to a 100kcal basis pushes fruits, vegetables and other low-impact foods into a higher impact bracket owing to their low energy density. Moreover, the NRF model based on 100kcal tends to categorise these same foods as nutrient-dense due to their lower energy density and higher water content (Drewnowski and Fulgoni, 2008; Drewnowski et al., 2009).

Eating Practice and Healthiness and Environmental Impact of Foods

As described in section 4.3.3, the healthiness and environmental impact of foods consumed by participants was deduced from the ED, $NRF11.3_{100g}$ and $GHGE_{100g}$. Findings indicate that most foods consumed by this sample of rural and urban Ugandan WRA were intermediate in terms of 'healthiness and environmental impact'. Only a small proportion (18.3%) of 202 foods profiled met the criteria for 'healthiness and sustainability', i.e. were low in energy, nutrient-dense and lower in environmental impact. These findings corroborate those from an earlier study, in which only 26% of food items consumed by French adults was considered 'sustainable', i.e. had high nutrient quality score, low environmental impact score and were lower in price (per 100g) (Masset et al., 2014). However, since this study did not assess cost of foods consumed by participants, I am unable to comment on the economic sustainability of foods as in the Masset study.

Food items classified as 'healthy and lower impact' were plant-based, such as boiled and steamed sweet potatoes, bean sauces, boiled and steamed vegetables and some fresh fruit. These foods are indicative of more traditional (pre-transition) dietary practices. Findings from this study indicate that among this sample of rural and urban Ugandan

WRA, the bulk of eating occasions at which such 'healthy and lower impact' foods were consumed, occurred at the times of the day that coincided with two conventional main mealtimes, i.e. lunch and dinner. This suggests that meals eaten within the household are still healthy and therefore the NT has not fully taken hold within the home. Byaruhanga and Opedun (2008) note that in Uganda, households tend to eat their largest meal at the end of the day as this is when all or most household members are likely to be present. Considering this sample comprised both adolescents and adults, the influence of parents on adolescent participants' dietary behaviours (Story et al., 2002; Savage et al., 2007; Salvy et al., 2011; Reicks et al., 2015) could partly explain this peak of consumption of plant-based foods as parents are more likely to be present at such main means. To this end, a study in Hong Kong demonstrated that low and middle-income adolescents were more likely to eat healthier foods, e.g. vegetables and cereals at main mealtimes on the advice of their mothers (Chan et al., 2009). In a study among South African adolescents, Sedibe et al. (2018) highlighted how especially rural adolescents, were often persuaded by other family members to either finish the food they had been given or eat even more. According to the authors, this cajoling of adolescents to eat is a cultural practice (Sedibe et al., 2018) that has applicability in other SSA contexts. It is possible, therefore, that among this sample of Ugandan WRA, the presence of mothers or other guardians during these main mealtimes encouraged the consumption of 'healthy and lower impact foods. Indeed, the way we eat is influenced by how those around us eat (Higgs and Thomas, 2016; Mylan et al., 2016).

Findings from this study indicated that the wealthiest (high SES) and most highly educated (post secondary) WRA had the highest odds of consuming 'healthy and lower impact' foods. These findings are consistent with previous authors' findings, which propose that in transitioning contexts, wealthier and more highly educated people are not only more likely to have knowledge of health benefits of different foods but are also more likely to afford a diversified food basket containing fruits, vegetables and pulses, among others (Sodjinou et al., 2009; Mayen et al. 2016). However, being an urban resident was associated with reduced odds of consuming 'healthy and lower impact' foods, such as some fruit, vegetables and legume-based dishes. This is indicative of some dietary transitions among some urban as these 'healthy and lower impact' foods are indicative of more traditional dietary practices. However, it cannot be ascertained whether this can be attributed to the 'urban rich' or 'urban poor' as data were not disaggregated at this level. (This addressed by study three in which WRA are grouped into dietary typologies of similar dietary intake).

The finding that eating events outside of the home were more likely to contain 'healthy and lower impact' foods, appears to contradict the pervasive discourse that out-of-home eating is more likely to contain EDNP foods in other studies (Lachat et al., 2012; Myhre et al. 2015; Ziauddeen et al., 2018). However, a Kenyan study in one low-income (Korogocho) and one middle-income area (Dandora) of Nairobi, established that eating occasions out of the home, were associated with better intake of dietary fat, vitamin A and Fe and calcium particularly among women (van't Riet et al., 2002). In this Kenyan study, foods consumed out of the home were mostly traditional foods, which had a better nutritional profile (van't Riet et al., 2002). It is possible in this study two, much like the Kenyan study, that foods eaten out of the home were primarily plant-based, explaining the findings. Furthermore, it is important to note that differences in how 'eating out venues' are defined between other studies and this PhD study. For example, Myhre et al. (2015) investigated Norwegian adults primarily eating in restaurants, food outlets and other private homes. Alternatively, Ziauddeen et al. (2018) studied children in the UK and excluded friends or relatives' homes and places of worship because they were a 'non-homogenous mix of locations' (p994). Owing to the importance of social ties and religion in the context under study in this PhD, it was imperative to include such places in the analysis. As such, 'out of home eating occasions' in this study encompassed several venues: friends' homes (n=2 participants), school (n=2 participants) and church (n= 2 participants). Most participants that ate outside of their homes consumed their meals at work (n=18), with some participants carrying home-cooked food. Only one women, out of the 73 participants, reported an eating occasion at a restaurant. This could therefore explain the differences in findings between this study and other studies in the literature. The findings from this study, therefore, highlight the importance of eating out of the home in improving the dietary intake of Ugandan WRA.

On the other hand, foods categorised as 'unhealthy and higher impact' (indicative of dietary changes associated with the nutrition transition) were mostly consumed in the morning at breakfast time. Most of these food items, such as rolex, samosa, cakes and sweet yellow bread can be categorised as ready-to-eat street food, fast food or convenience food, which require little or no additional preparation. Breakfast usually coincides with the time period during which people are either making their way to work or school (Sedibe et al., 2018). Given that a large proportion of both rural and urban participants in this study were involved in some form of employment (52.1%) or were in school (19.12%), the consumption of such foods in the morning is unsurprising since these foods demand less of the consumer's limited time. One study (Sedibe et al., 2018) demonstrated that female, urban South African adolescents replaced breakfast with EDNP street food from vendors just before they attended school due to lack of time in the mornings. To this end, it has been proposed that as women in transitioning economies get more involved in the workforce, they tend to replace traditional foods that require more time and energy in food preparation traditional with convenience foods within their households (Popkin, 2001).

4.7 Strengths, Limitations and Methodological Challenges

4.7.1 Strengths and Limitations

To my knowledge, this is the first study that has looked at the nutrient profile and environmental impact of a moderately large number of food items in a SSA context using primary data collected from both rural and urban Ugandan women. This is a major strength of this study. The fact that diet quality was assessed using a nutrient profiling system that encompassed a wide variety of both macro and micronutrients, rather than just focusing on one nutrient, is another strength of this study. A few authors have proposed that the nutrient density and environmental impact should be approached from a caloric perspective (Streppel et al., 2012; Doran-Browne et al., 2015; Drewnowski, 2017). This might be identified as a limitation in this study since classification of foods was based on 100g. However, given that one of the purposes of nutrient profiling is to help consumers make informed choices about which foods can provide optimum nutrition (Drewnowski et al., 2009); it was more realistic to base classifications on per 100g basis as consumers in this study are more likely to make food purchases on a weight basis and not on calories. That being said, the study was based on data collected from a relatively small sample of women (n=73) and therefore findings cannot be generalised to all Ugandan WRA, however, findings provide a basis for future research on healthy and environmentally sustainable diets in Uganda and SSA. Additionally, the study is cross-sectional in nature, therefore conclusions drawn can only be interpreted as such, bearing in mind that dietary behaviours are in constant flux. Lastly, the lack of association between sociodemographic variables and intake of 'healthy and low-impact' foods or 'unhealthy and high' impact foods could be attributed, in part, to the relatively small sample size in this study which could have reduced the statistical power to detect any significant differences. However, the sampling strategy employed in this study was aimed at generating a diverse sample that would both provide data on dietray intake and participate in a subsequent PV study, thereby providing depth on different aspects of healthy and environmentally sustainable dietray behaviours of WRA rather than generalisability.

4.7.2 Methodological Challenges

The nutrient information for food items used in this study was obtained from food composition tables, which themselves have their own limitations. For example, nutrient values in these FCTs do not consider other factors, such as the nutrient content of soils in which foods are grown that could affect micronutrient composition particularly. This means that FCTs are at best approximations, therefore some of the nutrient content of foods obtained might be misestimates. Findings should be interpreted with this in mind. In assessing the nutritional quality of foods, the NRF model assigns equal value to all nutrients regardless of how many nutrients are entered into the model. This could result in erroneous estimation of nutrient density scores, given that this does not adequately account for interactions between nutrients as they are metabolised in the human body (Hess et al., 2017). For example, it is well established that vitamin C enhances the absorption of plant-derived non-haeme iron, a nutrient that is important for the health of WRA, particularly those who might have limited access to animal-derived haeme iron. Perignon et al. (2016) advise that further nutrient models might benefit from incorporating the bioavailability of such micronutrients.

Although this study used empirical data, meaning food items were culturally acceptable, it did not consider other aspects of sustainability, e.g. price, another limitation.

Environmental impact estimates were not calculated based on edible portions, possible over-estimating the impact of some foods, e.g. matooke, roots and tubers for which peelings are removed before cooking. However, some authors (Scarborough et al., 2014) have previously used this approach. Additionally, the impact of transport from retail to home was not considered in the food GHGE estimates. The GHGE data used were based on the environmental impact of food production up to the RDC. This could have resulted in over estimation of the GHGE of foods, considering that a large proportion of study participants reported that they produced their own food.

Lastly, data on food items consumed were obtained using a single qualitative 24hr recall during which participants described in detail what they ate and how these foods were prepared. This means that the descriptions for many food items were participant-specific. Because of this, there were no standard recipes for several food items, and as such, approximate recipes were used (see sections 4.2 and 4.3). This could have resulted in misestimating both nutrient density and environmental impact scores. Because the food consumption patterns in the study context are largely season-dependent, nutrient profiling and diet-related GHGE estimations were based on a limited number of foods that were available only at the time of data collection.

4.8 Implications for Policy and Practice

Findings from this study demonstrate that plant-based food groups have higher nutrient density scores ($NRF11.3_{100g}$) and lower environmental impact estimates ($GHGE_{100g}$). Although some animal-based food groups are high in nutrients, they also have a higher environmental impact. EDNP food groups, such as sugar and honey and sweet and savoury snacks have lower nutrient density and lower environmental impact. Furthermore, only a small proportion of foods were both low in energy density, high in nutrient density and lower in environmental impact. The Eat Lancet Commission Report recommends a healthy and environmentally sustainabe diet as one that is based on the consumption of fruit, vegetables, nuts and seeds and legumes with modest amounts of meat and dairy and low intake of EDNP foods (Willett et al., 2019). Findings from this study suggest that in order to encourage the consumption of such a diet recommended by the Eat Lancet Commission Report, concessions must be made. For example, it is does not benefit health to encourage the consumption of EDNP simply because they have less of an impact on the environment. Similarly, it is neither sustainable nor realistic to focus dietary intake on a limited number of foods simply because they meet criteria for both healthiness and lower environmental impact. Based on these women's dietary intake, rather than focusing on a reduction in meat and dairy products intake, it is infact necessary that policy makers and practitioners encourage an increase in meat, fish and dairy intake, particularly among rural WRA as consumption is already low. Additionally, while the intake of plant-based food groups is already high, policy makers and practitioners might realise more benefit for health and environmental sustainability by placing emphasis on more diversity within these food groups among both rural and urban

WRA range of foods, e.g. encouraging a range of lower-impact traditional cereals (maize, millet, sorghum) rather than focusing the diet on only maize, for example.

An understanding of the relationship between the different aspects of the eating practice and healthy and lower impact foods, gleaned from this study, provides an avenue for interventions aimed at encouraging more consumption of such foods. For example, an awareness that eating occasions outside of the home can include healthy and lower impact foods highlights the importance of designing policies that encourage healthy and lower impact foods in out-of-home contexts. Furthermore, policy makers and practitioners can look at interventions that encourage WRA to make healthier food choices at breakfast time as this is when most 'unhealthy and higher impact' foods are consumed.

4.9 Chapter Summary

The findings from this study are consistent with those from the literature, i.e. plant-based foods are generally healthier and have lower environmental impact (GHGE) compared with animal-based foods which tend to have higher impact on a per weight basis. Furthermore, although findings from this study provide some insight on the relationship between aspects of the eating practices (tempo, periodicity and synchronisation) and healthiness and environmental impact of foods, an in-depth understanding of the contextual issues at play during these eating occasions is necessary. This is addressed by study three and study four. In study three, using the same dietary intake data used in this study two, rural and urban Ugandan WRA are categorised into dietary typologies of similar dietary intake. Then in study four, using the dietary typologies identified in study three as a basis, the factors that influence the dietary behaviours of the same sample of rural and urban Ugandan WRA is explored using the Photovoice methodology.

The next chapter presents the third study of this mixed methods PhD.

5 CHAPTER FIVE: DESCRIBING DIETARY PATTERNS AND DIETARY TYPOLOGIES AMONG RURAL AND URBAN UGANDAN WOMEN OF REPRODUCTIVE AGE (STUDY THREE)

The objectives of this study were (i) to describe the existing dietary patterns of a sample of rural and urban Ugandan WRA, (ii) compare existing dietary patterns among this sample of rural and urban Uganda WRA with those obtained in study one and (iii) to categorise WRA with similar dietary profiles into dietary typologies. This chapter presents the methods used and summarises the key findings. First, a description of the methods employed in the study is provided. The chapter then goes on to discuss the main findings of the study and concludes with possible implications for policy and practice.

Using dietary data collected during the qualitative 24hr recall (see section 4.1), the dietary patterns of rural and urban Ugandan WRA were generated using multiple correspondence analysis (MCA). Then using the output from MCA, study participants were organised into dietary typologies using hierarchical cluster analysis (HCA). The following section provides a description of the steps involved in the MCA. First, a summary of the data collection methods used is provided. Following this are the data cleaning and data management procedures and subsequently, the steps in the MCA are described.

5.1. Generating Existing Dietary Patterns among Rural and Urban Ugandan WRA

5.1.1 Study Setting, Sampling and Data Collection

Dietary data used in this study were obtained from a single qualitative 24h recall conducted among rural and urban Ugandan WRA (n=73) in study two. Details of study setting, sampling procedures and data collection methods are described in detail in section 4.1 of this thesis.

5.1.2 Data Management

Prior to analysis, food items consumed by each participant, as recorded in the qualitative 24hr recall, were classified into food groups. First, a list of all food items consumed by each participant in the rural and urban settings was obtained. Then, similar to what was performed for PCA (see section 3.2), the unique food items were placed into food groups by merging different food items together. Similar to study one, food groups were formed based on conventional food groups found in the literature (FAO, 2013), knowledge of the local context and findings on healthiness and environmental impact of food groups from study two. To allow for comparison between dietary patterns formed in this study and those formed from PCA, reference was also made to food groupings used in the PCA (study one).

The number of food groups to include in the MCA is contentious, i.e. there is no agreed-upon number of what is adequate. To obtain the number of food groups in this present study, a few strategies were employed. Since MCA has been described as a factor analysis method (Guinot et al., 2001; p506), the assumption that food groups should have a minimum consumption frequency of 5-10 recommended in factor analysis (Comrey and Lee, 1992) was used as a starting point. This resulted in an initial 23 food groups. However, taking into consideration Machón et al. (2018)'s argument that inputting food groups with small frequencies (f<10) could result in their ''over-representativeness in the final output'' (p4), the number of food groups was reduced from 23 to 15 by further merging food items. This in some cases resulted in food grouping not commonly used in the literature e.g. poultry, eggs, and fish (Table 5.1). However, such unconventional food groups have been cited in previous studies, e.g. Machón et al. (2018). From Table 5.1 it is obvious that the milk food group has a relatively small frequency (f=8) compared to other food groups. While this food group could have been merged with another food group e.g. poultry, eggs and fish, given the exploratory nature of this study, the researcher saw it as necessary to leave this as a separate food group in order for the data to be as reflective of the context as possible. Additionally, given that milk is consumed as a drink, much different from other food groups, it was necessary to retain it as an individual food group.

Table 5.1: Food Groups for Multiple Correspondence Analysis

Food Group	Frequency	Food items consumed by study participants from qualitative 24hr recall
Red meat	10	Beef, goat meat, pork, beef sausage
Poultry, Eggs and Fish	14	Nile Tilapia, mukene, ngege[51], other fish, boiled chicken egg, fried chicken egg, omelette, fried chicken, grilled chicken
Milk	8	Milk
Traditional Cereals and Grains	49	Posho, kalo (millet), kalo (sorghum), popcorn, maize porridge, millet porridge, bushera (sorghum porridge)
Non-traditional Cereals and Grains	37	Whole-wheat bread, white bread, yellow bread, whole-wheat buns, white buns, chapatti, white rice, brown rice, pilau rice, rice porridge
Matooke, roots and tubers	54	Boiled or steamed matooke, potato, sweet potato, yam or cassava; fried potato; kwenongora[52]
Legumes	38	Red kidney beans, other kidney beans, black beans, yellow kidney beans, green peas, pigeon peas, Nambaale beans, agira, Kanyebwa beans
Nuts and seeds	19	Cashew nuts, groundnut sauce, groundnut paste, simsim (sesame) paste
Fresh fruit	14	Avocado, pineapple, pawpaw, watermelon, lemon, mango, jackfruit
Vegetables	68	nakatti, doodo, bugga, sukuma wiki, onion, tomato, cabbage, green pepper, carrots, kachumbari (vegetable salad); cucumber
Fats, oils and spreads	48	Vegetable oil, cow ghee, vegetable cooking fat, margarine
Teas and coffee	52	Peppermint tea, black tea, black coffee
Sugary drinks	9	Fruit juice sweetened with sugar, sugar-sweetened juice, soda, fruit-flavoured drink

[51] Tilapia
[52] Traditional staple made from boiling and then mashing finely milled cassava flour

Food Group	Frequency	Food items consumed by study participants from qualitative 24hr recall
Sugar	52	Sugar, honey, sugar cane
Sweet and savoury snacks	11	Potato crisps, banana cake, chocolate cake, muffin, pea samosa, other cake
Total (n=15)		

Once food groups were formed, participants' consumption of each food group was recoded as a binary variable, i.e. 1=not consumed, 2=consumed. Data management for this part of the study was performed in Microsoft Excel 2010.

The next section describes the steps in the MCA procedure undertaken in this study. In the MCA, the active[53] variables used in the analysis were the food groups consumed (n=15). No supplementary variables[54] were input into the MCA model.

5.1.3 Generating the MCA Dimensions

The first step in the MCA involved running the analysis to produce a solution that contained the maximum possible number of dimensions (Costa et al., 2013). In MCA, the maximum possible number of dimensions can be obtained by subtracting the total number of active variables from the total number of variable categories (Costa et al., 2013). In this case, there were 15 active variables (food groups), each of which was a binary variable, i.e. had two category levels (consumed and not consumed). From this, the total number of variable categories was computed as 15*2. The maximum possible number of dimensions in the MCA was thus computed by subtracting 15 from (15*2), resulting in 15 dimensions.

The next step was to run the MCA in SPSS with the maximum number of dimensions (n=15) specified. This procedure yielded a number of outputs, including the Cronbach's α and percent (%) variance (inertia) explained by adding each subsequent dimension. In a similar way to PCA, these outputs are important in helping the researcher to decide how many dimensions to keep in the final MCA solution. Deciding how many dimensions to retain from those produced in this step is not straightforward. To begin with, a number of authors propose that generally no more than 2-3 dimensions are sufficient for the final solution (Ayele et al., 2014; Hair et al., 2014). Further to this, Costa et al. (2013) propose additional strategies that can be employed to guide the decision on the retention of dimensions, e.g. examining the scree plot of eigenvalues and Cronbach's α. For this study, several strategies gleaned from the literature were employed in combination to decide on how many out of the 15 maximum dimensions to retain. First, as in PCA, a scree plot of eigenvalues was plotted (Figure 5.1). Breaks in the scree plot of eigenvalues were then identified (Costa et al., 2012; Hair et al., 2014; Krieger et al., 2018). The break in the scree plot (elbow) was between the fourth and fifth dimensions (indicated by the bold arrow

[53] These are the variables used in the MCA, i.e. input variables.
[54] These are variables that do not participate in the MCA, e.g. sociodemographic variables.

in Figure 5.1) suggesting that the final MCA solution could include the first four dimensions, collectively explaining 51.3% of the variance in dietary intake (Table 5.2). It was decided, at this point, that the first four dimensions could probably be retained.

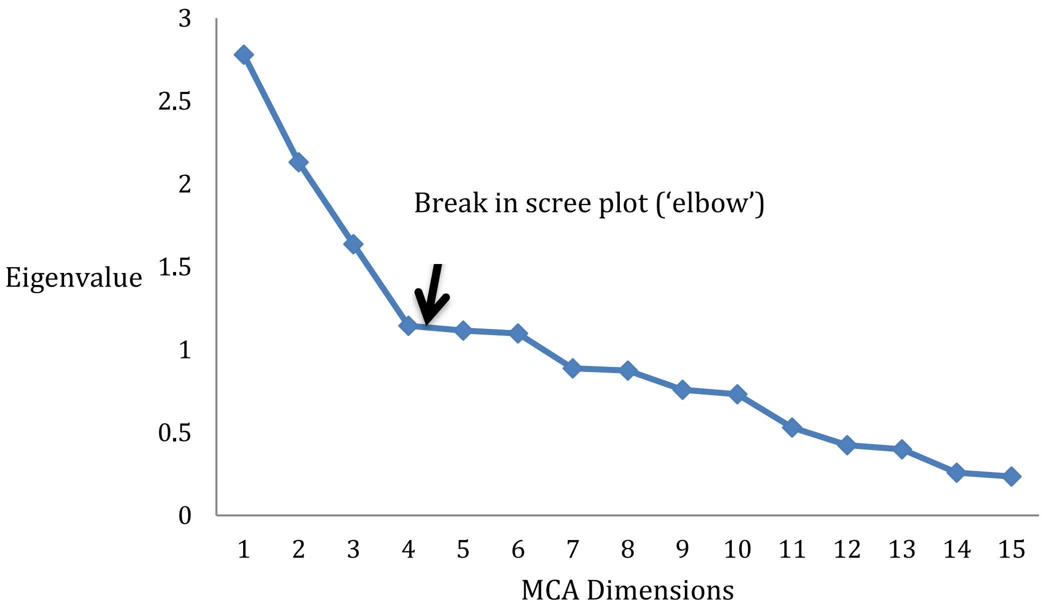

Figure 5.1: Screeplot of Eigenvalues for 15 MCA Dimensions

Table 5.2: Cronbach's Aplha and Variance Explained by 15 MCA Dimensions

Dimension	Cronbach's Alpha	Total (Eigenvalue)	Inertia	% of Variance	Cummulative inertia
1	0.686	2.779	0.185	18.529	18.529
2	0.569	2.131	0.142	14.205	32.734
3	0.417	1.637	0.109	10.911	43.645
4	0.135	1.144	0.076	7.628	51.273
5	0.11	1.115	0.074	7.432	58.705
6	0.096	1.098	0.073	7.32	66.025
7	-0.135	0.888	0.059	5.92	71.945
8	-0.154	0.874	0.058	5.83	77.775
9	-0.343	0.758	0.051	5.051	82.826
10	-0.395	0.73	0.049	4.87	87.696
11	-0.947	0.531	0.035	3.539	91.235
12	-1.455	0.424	0.028	2.828	94.063
13	-1.62	0.398	0.027	2.654	96.717
14	-3.089	0.258	0.017	1.717	98.434
15	-3.486	0.235	0.016	1.567	100
Total		15	1		

Following this, each of the first four dimensions was scrutinised for interpretability (Guinot et al., 2001; Krieger et al., 2018). A 'factor loading' (discrimination measure) of 0.30 (highlighted in blue in Table 5.3) of food groups on the dimension was considered significant (Krieger et al., 2018). The fourth dimension was represented by only one food group (poultry, eggs and fish) and was therefore not interpretable (Table 5.3). It was therefore decided that the final MCA solution would include only the first three dimensions, as they were the most interpretable out of the four dimensions. Additionally, the cumulative inertia above 40% (Krieger et al., 2018) occurred at the third dimension, further justifying the retention of only the first three dimensions in the final MCA solution.

Table 5.3: Factor Loadings on Four Retained Dietary Patterns

	MCA Dimensions			
Food Group	1	2	3	4
Red meat	0.57	0.05	0.01	0.04
Poultry, eggs and fish	0.12	0.04	0.06	0.39
Milk and milk products	0.29	0.03	0.05	0.01
Traditional cereals	0.11	0.33	0.10	0.17
Non-traditional cereals	0.51	0.04	0.01	0.00
Legumes	0.08	0.5	0.03	0.02
Nuts and seeds	0.02	0.03	0.06	0.12
Fats, oils and spreads	0.10	0.48	0.00	0.01
Fruit	0.16	0.03	0.00	0.1
Sugar	0.12	0.25	0.30	0.00
Sweet and savoury snacks	0.32	0.00	0.03	0.00
Sugary drinks	0.24	0.04	0.04	0.14
Teas and coffees	0.00	0.00	0.64	0.07
Matooke, roots and tubers	0.00	0.15	0.26	0.06
Vegetables	0.14	0.18	0.05	0.02
Eigenvalue	2.78	2.13	1.64	1.14
% Total Variance	18.53	14.21	10.91	7.63

In the final step of the analysis, a final MCA solution was run in SPSS, with only three dimensions specified. The objects scores for all participants (n=73) on these three dimensions were retained. Following MCA, the object scores of participants on the first three MCA dimensions, which were retained, were used to group participants into dietary clusters of similar dietary profiles using hierarchical cluster analysis as described in the following section.

5.2 Identifying Groups of Rural and Urban Ugandan WRA with Similar Dietary Profiles

In any cluster analysis (CA), there are several steps involved. After data management and prior to cluster formation, the preliminary steps include selecting participants (cases) to cluster, deciding on the clustering variables to be used in the analysis and standardising the data, if applicable (Milligan and Cooper, 1985;1987; Sarstedt and Mooi, 2014). Once these are accomplished, the following steps are undertaken: formation of clusters (including choosing the dissimilarity measure and clustering method) and selecting the final cluster solution, interpretation of clusters to understand their characteristics;

validating results of the final cluster solution and naming and describing the clusters based on their characteristics, e.g. using demographic variables (Hair et al., 2014).

5.2.1 Selecting Participants for the Cluster Analysis

The participants involved in the CA included all participants (n=73) that were sampled for the qualitative 24hr recall (see section 4.1). Although it has been suggested that the sample of participants, for whom a cluster analysis is carried out, should be representative of the population from which it was drawn (Milligan and Cooper, 1985;1987; Hair et al., 2014); Hair et al. (2014) argue that the adequacy of sample size depends on the research objectives. To this end, the authors argue that if the CA is aimed at identifying small groups of people within the wider population, a large sample is necessary. However, if the aim is to broadly explore larger groups, then a large sample is not as necessary (Hair et al., 2014 p429). Given the dearth of literature on healthy and environmentally sustainable diets in LMIC, this PhD study was largely exploratory in nature. The aim of the CA in this study, therefore, was to group a sample of participants based on similarities in their reported dietary intakes, and less so to describe the underlying structure of dietary intake among all Ugandan WRA. The outputs from the CA in this study would then provide a starting framework to understanding factors influencing dietary behaviours among this sample of Ugandan WRA. For this reason, it was decided that the sample size (n=73) was appropriate for the CA.

5.2.2 Deciding on Clustering Variables and Standardisation

As was the case in previous studies (Conti et al., 2004; Costa et al., 2014; Krieger et al., 2018; Machón et al., 2018), the object scores on each of the three retained MCA dimensions for each participant were used as input variables in the CA. Hair et al. (2014) argue that there appears to be no solid reason necessitating the standardisation of clustering variables prior to CA, although variables may be standardised for a number of reasons, e.g. if they are measured on different scales. Given that the clustering variables in this HCA were outputs from a previous MCA and were thus measured on the same scale, they were not standardised.

5.2.3 Formation of Clusters

Before clusters are formed, the researcher must decide on which clustering method to use, and within this, the method through which clusters are linked together. The decision on which method to use depends on the kind of data, sample size and on whether there is a pre-determined number of clusters for the final cluster solution (Everitt et al., 2001). Hierarchical cluster analysis (HCA) methods, for instance, can be used for the analysis of either continuous or categorical data and are more appropriate with smaller sample sizes (n<300-400) (Hair et al., 2013; Sarstedt and Mooi, 2014). These methods are also appropriate when the researcher has no *a priori* knowledge of how many clusters to expect (Hair et al., 2014; Sarstedt and Mooi, 2014). On the other hand, non-hierarchical methods can accommodate larger samples or many variables (Hair et al., 2014).

Therefore, owing to the relatively small sample size (n=73), small number of variables (n=15) and the fact that the purpose of carrying out the CA was more exploratory than confirmatory in nature, HCA was used in this study. Within the HCA method, there are few ways through which clusters are constructed, e.g. the single linkage (nearest neighbour), farthest neighbour, group average, Ward's method, among others. For this study, the Ward's method was used in cluster construction. The Ward's method was used over other methods because it tends to create homogenous clusters of similar size despite its sensitivity to outliers in the data (Hair et al., 2014 p456; Sarstedt and Mooi, 2014 p281). Ward's method has been used in similar studies where HCA was used to group individuals with similar dietary intake, e.g. Conti et al. (2004).

Following all these steps, HCA was run in SPSS using the object scores on the first three dimensions retained from MCA as the input variables. The Ward's method was specified as the clustering method with the squared Euclidean distance specified as the measure of dissimilarity (measure of distance).

5.2.4 Choosing the Final Cluster Solution

Hair et al. (2014) propose that no single objective measure exists to define the right number of clusters to retain in the final cluster solution. To decide on which clusters to retain in the final cluster solution, from the initial cluster solution, the agglomeration schedule and dendrogram (Appendix 19-20), outputs from the HCA, were examined (Hair et al., 2014). This resulted in a final 4-cluster solution. Once this was decided, the final HCA with four clusters specified in the final cluster solution was run in SPSS, with the cluster membership for each participant (n=73) retained.

5.2.5 Validating the Stability of the Clusters

Clusters formed were validated using the non-parametric Kruskal-Wallis test in SPSS. In this procedure, participants' cluster memberships were entered as independent variables and the object measures for each of the three retained dimensions from MCA were entered as dependent variables (Hair et al., 2014). The Kruskal-Wallis test provided strong evidence of a difference ($p<0.001$) between the means of at least one pair of cluster memberships. Dunn's pairwise tests, adjusted using the Bonferroni correction, were also carried out to compare pairs of clusters. Results showed that strong evidence ($p<0.001$), of a difference between clusters 2 and 1; 3 and 1; 3 and 2; 4 and 3; and 4 and 2. Although clusters 1 and 4 were different, there was no evidence to suggest that these two clusters were significantly different on any of the MCA dimensions (object scores). Example SPSS outputs for these analyses are attached in Appendix 21.

To test the stability of the clusters, the split-half-sample method was used, i.e. a 50% split-half-sample of participants (n=43) was randomly generated using the 'select cases' function in SPSS. Clusters were formed for this split-half sample using the same procedure as with the full sample (Hair et al., 2014; Green et al., 2015a), i.e. obtaining an initial cluster solution without specifications using Ward's method and squared

Euclidean distance, looking at the agglomeration schedule and dendrogram to decide which clusters to retain, and running the analysis again with a defined cluster number. This resulted in similar outputs as with the whole sample. The proportion of individuals assigned to different clusters (between the whole and split-half sample) was compared. Out of the 43 participants in the split-half sample, 6 (14%) were assigned to clusters different from those they were assigned to as part of the whole sample, while the rest of the participants (n=37) were assigned to the same clusters. According to Hair et al. (2014), this is indicative of stability of the four-cluster solution (Hair et al., 2014, p450). Additionally, cluster memberships for the two solutions (whole and split-half-sample) were compared using Cohen's κ to check for agreement (Green et al., 2015a: p259). The results were indicative of strong agreement (Cohen, 1960; Landis and Koch, 1977) between the two cluster membership assignments for the split-half-sample, $\kappa = .809$ (95% CI, 0.668, 0.95, $p < .0001$). SPSS outputs for these analyses are in Appendix 21.

5.2.6 Naming and Describing the Formed Clusters

To describe and characterise the four retained dietary clusters, a comparison of proportions of participants in the four clusters that consumed the 15 food groups (Machón et al. 2018), was performed using the Fisher's exact test of independence, adjusted using the Bonferroni correction. Participants in the four clusters were also compared on sociodemographic variables, i.e. rural and urban residence, SES, education using the Fisher's exact test. The Fisher's exact test is a non-parametric test that is used to compare two or more categorical variables, when the sample size is relatively small (Field 2013; McDonald, 2014). For larger sample sizes, comparisons between two categorical variables usually use the Pearson's Chi-square test of independence since larger samples increase the likelihood that the data will meet all the test assumptions (Field 2013). Given the sample size for this study (n=73), not all the assumptions for the Chi-square test were met, i.e. some of the cells had expected count below five ($f<5$). This justified the use of the Fisher's exact test. For those paired comparisons that fulfilled the requirements of the chi-square test of independence, i.e. no cells with expected counts less than 5, this was performed instead.

Following this, clusters were named based on the food groups that most characterised them, i.e. the first point of reference was the food groups for which proportions were highest relative to other clusters. Additionally, other food groups for which proportions were high (>50%) were considered in naming the clusters. As the thesis was focused on healthiness and environmentally sustainable dietary practices in the context of the nutrition transition, the clusters were named to reflect this.

5.3 Data Analysis Software

Analyses involved in the MCA and the subsequent HCA were performed using SPSS Version 23 (SPSS Statistics, IBM, New York). The two-dimension MCA plots were produced using the FactoMineR package in the free statistical software RStudio (v1.1.463, RStudio Team, Boston, MA, USA).

The next section presents the study's key findings. First, a description of the dietary patterns obtained from MCA is presented, with comparisons made between dietary patterns obtained from PCA in study one. This is followed with a description of the dietary typologies formed from the HCA.

5.4 Findings

5.4.1 Characteristics of Study Participants

Characteristics of study participants are described in section 4.5.1 of this thesis.

5.4.2 Characteristics of Existing Dietary Patterns

As described previously, MCA was used to obtain the dietary patterns among this sample (n=73) of rural and urban Ugandan WRA (see section 5.1). MCA resulted in a total of 15 dimensions, of which, three dimensions, which collectively explained 43.6% of the variation in dietary intake, were retained based on the eigenvalue, total variance (inertia) explained and interpretability (see section 5.1.3). The first retained MCA dimension accounted for 18.5% of the variance in dietary intake, while the second and third MCA dimensions accounted for 14.2% and 10.9% of the variance in the dietary intake, respectively (see section 5.1.3).

As has been presented in similar studies the two bi-plots (Figure 5.2 and Figure 5.3) show each of the study participants (numbered blue dots, n=73) and each category of the food groups[55] (red triangles) plotted on the three retained MCA dimensions. In these two figures, the three MCA dimensions are plotted against each other, thereby illustrating dietary intake among this sample of rural and urban Ugandan WRA. In Figure 5.2, dimension 1 and dimension 2 are plotted against each other while dimensions 2 and 3 are plotted against each other in Figure 5.3. A rule of thumb in interpreting such MCA bi-plots is that the smaller the distance between two (or more) points on the bi-plot, the stronger the relationship between either the individuals or the variable categories represented by those points and vice versa (Machón et al., 2018).

[55] 1 and 2 attached to food group names indicate the categories of the variable, i.e. 1 denotes intake and 2 denotes no intake, therefore milk_1 means consumed milk while milk_2 means did not consume milk

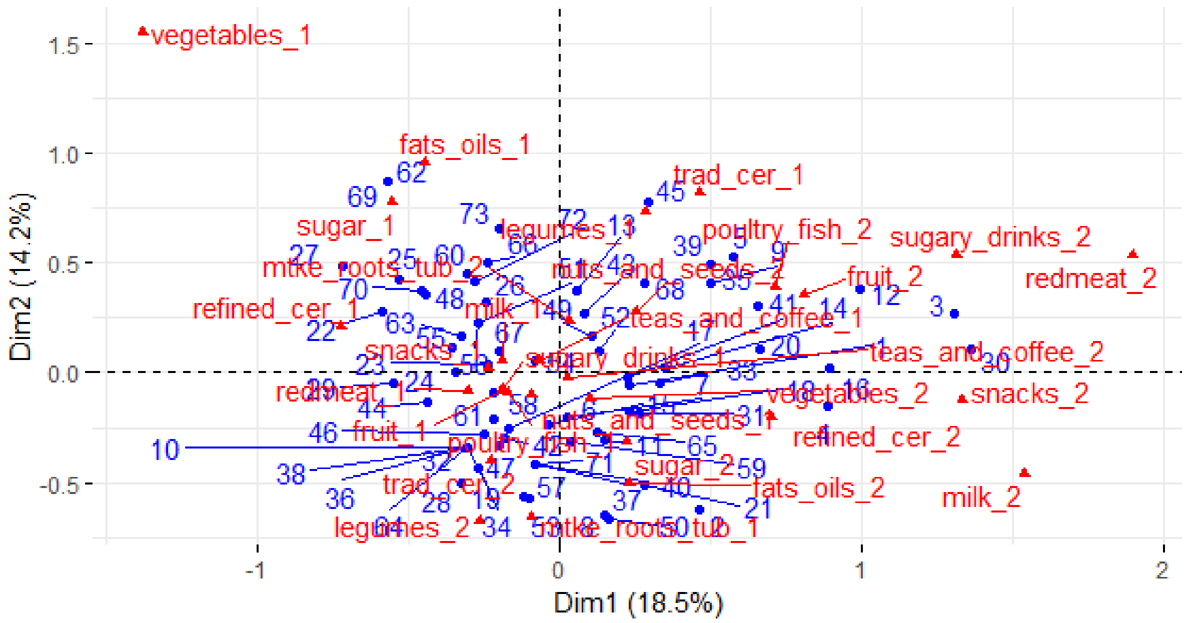

Figure 5.2: Bi-plot of Individuals and Food Groups on Dimensions 1 and 2

Figure 5.2 suggests that dimension 1 was characterised by high negative correlation for the consumption of refined cereals as the food group (refined cereals_1) is located on the left side of the origin 0 (at about point -0.6 on the plot). This dimension also shows no consumption of animal-based foods, fruit, snacks and sugar-sweetened beverages indicated by the positive correlation of the dimension with the food groups red meat_2, fruit_2, poultry, fish and eggs_2, sugary drinks_2 and snacks_2 (Figure 5.2), which are all located to the right of the origin. Based on these characteristics, i.e. low consumption of food groups associated with the NT (refined cereals, animal products and EDNP products), this dimension was labelled the '*low-impact, plant-based, traditional*' dietary pattern.

Dimension 2 was characterised by high positive correlation and therefore intake of vegetables, fats and oils, sugar, traditional cereals and legumes (Figure 5.2). These food groups are all located on the positive side (above the origin 0) of dimension 2 (Figure 5.2). Conversely, the dimension is negatively associated with consumption of matooke, roots and tubers (Figure 5.2), which is located on the negative side (below the origin, 0) of the dimension. The second dimension, although still characterised by low-impact plant-based food groups shows higher consumption of food groups associated with the NT, i.e. fats and oils, sugar and less intake of traditional starches (matooke, roots and tubers). Based on these characteristics, this dimension was labelled the '*low-impact, plant-based, mid-stage transition*' dietary pattern.

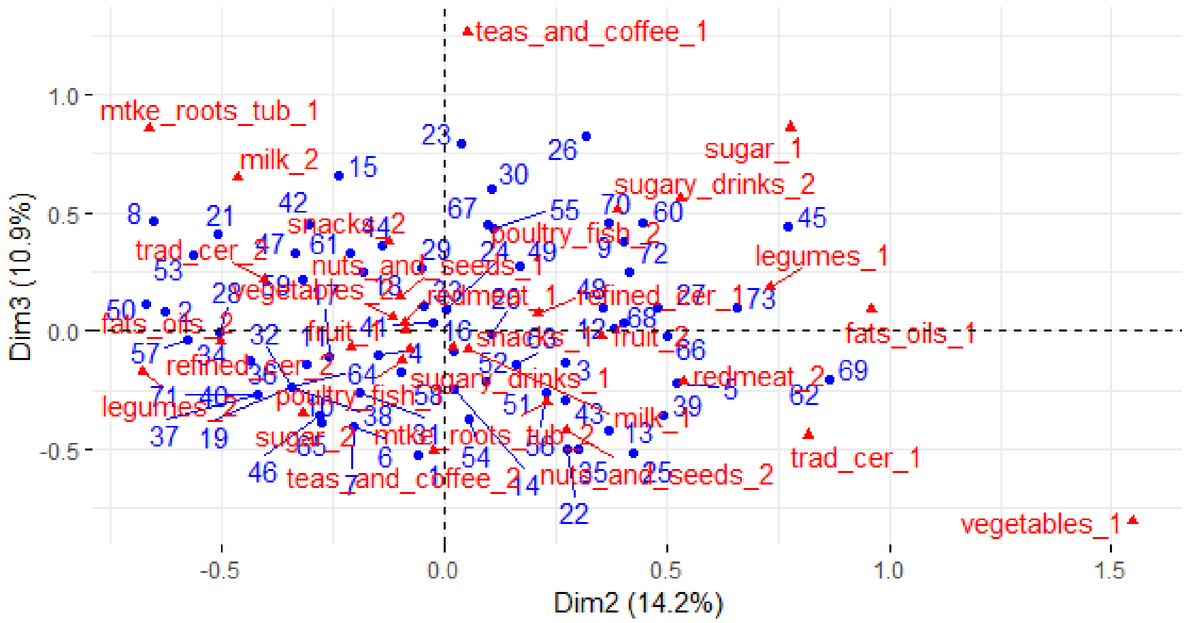

Figure 5.3: Bi-plot of Individuals and Food Groups on Dimensions 2 and 3

Figure 5.3 shows that dimension 3 is associated with intake of teas and coffee, sugar and matooke, roots and tubers. Conversely, the dimension is negatively associated with intake of vegetables and traditional cereals indicated by the relatively large negative correlations (Figure 5.3). Based on these characteristics, this dimension was labelled the '*low-impact, plant-based, early-stage transition*' dietary pattern.

5.4.3 Characteristics of Dietary Clusters

As highlighted above (see section 5.2), HCA was conducted to group participants with similar dietary profiles into dietary typologies based on the three retained MCA dimensions, i.e. '*low-impact, plant-based, traditional*' dietary pattern, '*low-impact, plant-based, mid-stage transition*' dietary pattern and '*low-impact, plant-based, early-stage transition*' dietary pattern. HCA identified four dietary clusters of participants. As mentioned in section 5.2.6 above, to describe the dietary clusters, comparison between groups of individuals was performed using sociodemographic characteristics and dietary intake data. Following this, each of the clusters were labelled as 'dietary typologies' to reflect the characteristics resulting from the statistical analysis. The following section describes the characteristics of the four dietary clusters of individuals and the resulting dietary typologies.

Results indicated that there was no significant difference in age between the four dietary clusters of participants; therefore, there was no evidence to suggest that age varied by cluster among this sample of women (Table 5.4). The level of education completed (p=0.503) and socioeconomic status (p=0.208) of this sample of rural and urban women also did not vary significantly by cluster (Table 5.4). There was significantly higher proportion of high SES participants in Cluster 3 compared with the proportion of high

SES participants in all other clusters (Table 5.4; post-hoc Bonferroni test). Findings indicated a significant difference in place of residence by cluster (Table 5.4). When pairs of clusters were compared, Cluster 3 was found to have a significantly higher proportion of urban participants compared with all other clusters (Table 5.4).

Table 5.4: Sociodemographic Characteristics of Dietary Clusters among Rural and Urban Ugandan WRA (n=73)

	Cluster 1 n=23 (31.5%)	**Cluster 2 n=22 (30.1%)**	**Cluster 3 n=13 (17.8%)**	**Cluster 4 n=15 (20.5%)**	**p-value**
Age, years (mean ± SD)	24.7±8.7	28.0±11.9	27.8±8.7	29.0±12.1	0.75
Residence					
Urban	16[a,b] (69.6)	10[a,b] (45.5)	10[b] (76.9)	4[a] (26.7)	
Rural	7[a,b] (30.4)	12[a,b] (54.5)	3[b] (23.1)	11[a] (73.3)	0.02*
Socioeconomic Status					
Low SES	7[a] (30.4)	7[a] (31.8)	1[a] (7.7)	6[a] (40.0)	
Mid SES	7[a] (30.4)	4[a] (18.2)	2[a] (15.4)	5[a] (33.3)	
High SES	9[a,b] (39.1)	11[a,b] (50.0)	10[b] (76.9)	4[a] (26.7)	0.21
Education					
Less than primary	5[a] (21.7)	6[a] (27.3)	0[a] (0.0)	3[a] (20.0)	
Primary					
Secondary	15[a] (65.2)	15[a] (68.2)	10[a] (76.9)	11[a] (73.3)	
Post-secondary	1[a] (4.4)	0[a] (0.0)	1[a] (7.7)	0[a] (0.0)	
	2[a] (8.7)	1[a] (4.5)	2[a] (15.4)	1[a] (6.7)	0.50
Marital Status					
Single	15[a] (65.2)	16[a] (72.7)	8[a] (61.5)	9[a] (60.0)	
Married	8[a] (34.8)	6[a] (27.3)	5[a] (38.5)	6[a] (40.0)	0.85

*significant at 0.05 significance level

Cluster 1 was the largest and youngest dietary cluster of the four. It was constituted of an almost equal proportion of participants in each of the three SES levels, i.e. low, mid and high (Table 5.4). Cluster 1 was largely urban and was characterised by a significantly higher proportion of participants, compared with all other clusters that consumed sugar and honey and fats, oils and spreads (Table 5.5), which are markers of early-stage dietary transition. Although not significantly different from other clusters, Cluster 1 also had high proportion of participants that consumed traditional cereals, legumes, vegetables, matooke, roots and tubers (Table 5.5). These are all low-impact food groups as highlighted in Chapters 3 and 4 of this PhD thesis. Participants in this cluster did not consume any red meat or milk and milk products (Table 5.5). This cluster was thus labelled the '*urban, low-impact, early-stage transitioners*' dietary typology.

Table 5.5: Food Groups Consumed by Dietary Clusters of Rural and Urban Ugandan WRA (n=73)

	Cluster 1 n=23 (31.5%)	**Cluster 2 n=22 (30.1%)**	**Cluster 3 n=13 (17.8%)**	**Cluster 4 n=15 (20.5%)**	**p-value**
Red meat	0^{a} (0)	1^{a} (4.5)	9^{b} (69.2)	0^{a} (0)	0.00**
Poultry and fish	2^{a} (8.7)	4^{a} (18.2)	6^{a} (46.2)	2^{a} (13.3)	0.06
Milk and milk products	0^{a} (0)	$4^{a,b}$ (18.2)	4^{b} (30.8)	$0^{a,b}$ (0)	0.01**
Traditional cereals	$18^{a,b}$ (78.3)	21^{b} (95.5)	3^{c} (23.1)	$7^{a,c}$ (46.7)	0.00**
Refined cereals	11^{a} (47.8)	11^{a} (50.0)	13^{b} (100)	2^{a} (13.3)	0.00**
Matooke, roots and tubers	20^{a} (87.0)	8^{b} (36.4)	11^{a} (84.6)	15^{a} (100)	0.00**
Legumes	20^{a} (87.0)	$12^{a,b}$ (54.5)	1^{c} (7.7)	$5^{b,c}$ (33.3)	0.00**
Nuts and seeds	5^{a} (21.7)	2^{a} (9.1)	5^{a} (38.5)	7^{a} (46.7)	0.045*
Fats, oils and spreads	23^{a} (100)	15^{b} (68.2)	9^{b} (69.2)	1^{c} (6.7)	0.00*
Fruit	3^{a} (13.0)	3^{a} (13.6)	6^{a} (46.2)	2^{a} (13.3)	0.09
Vegetables	23^{a} (100)	22^{a} (100)	$13^{a,b}$ (100)	10^{b} (66.7)	0.00**
Sugar and honey	23^{a} (100)	12^{b}(54.5)	9^{b} (69.2)	8^{b} (53.3)	0.00**
Sweet and savoury snacks	$2^{a,b}$ (8.7)	$4^{a,b}$ (18.2)	5^{b} (38.5)	0^{a} (0)	0.03*
Sugary drinks	1^{a} (4.3)	1^{a} (4.5)	7^{b} (53.8)	0^{a} (0)	0.00**
Teas and coffee	23^{a}(100)	6^{b} (27.3)	10^{a} (76.9)	13^{a} (86.7)	0.00**

*significant at 0.05 level, ** significant at 0.01 level

Cluster 2 was relatively older than Cluster 1 and had a slightly higher proportion of rural than urban participants (Table 5.4). Half the participants in this cluster were of high SES (Table 5.5). Cluster 2 was characterised by a significantly higher proportion of participants who consumed traditional cereals compared with all other clusters and a significantly lower proportion of participants that consumed teas and coffee and matooke, roots and tubers compared with all other clusters (Table 5.5). Cluster 2 also had a moderately high proportion of participants that consumed refined cereals, legumes, fats, oils and spreads and sugar and honey (Table 5.5), although these were not significantly different from clusters. Participants in this cluster also consumed a significantly higher proportion of legumes compared with cluster 4 (Table 5.5). Lastly, although a higher proportion of participants in this cluster consumed sweet and savoury snacks compared with those in cluster 1, this was not statistically significant. Cluster 2 was labelled the, '*rural, low-impact, early-stage transitioners*' dietary typology because it was characterised by a high proportion of participants that consumed traditional cereals, a low-impact food group. Although characterised by low vegetable consumption, this cluster had relatively high consumption for sugar, refined cereals, legumes and fats and oils, all low and medium-impact food groups as described in Chapters 3 and 4 (Table 5.5).

Cluster 3 was the smallest of all four dietary clusters. Participants in this cluster were generally more highly educated than other clusters (Table 5.4). Although Cluster 3 was significantly more urban compared with all other clusters, participants in this cluster were similarly aged as those in Cluster 4 (Table 5.5). Cluster 3 was the wealthiest cluster, i.e. a significantly higher proportion of participants were in the high SES level compared with all other clusters. It was characterised by a significantly higher proportion of participants consuming red meat, milk and milk products, refined cereals, sweet and savoury snacks and sugary drinks compared with all other clusters (Table 5.5). Cluster 3 was also characterised by a significantly lower proportion of participants that consumed traditional cereals and legumes compared with all other clusters (Table 5.5). Cluster 3 was therefore labelled the '*urban, medium-impact, mid-stage transitioners*' dietary typology since it was largely urban and was characterised by the highest proportion of participants that consumed animal-based food groups, sweet and savoury snacks and sugary drinks compared to other clusters (mid-impact and high-impact food groups) (Table 5.5). Although Cluster 3, like Cluster 1, was characterised by consumption of sugar and honey and fats and oils, the fact that it had the highest consumption of animal-based food groups, sweet and savoury snacks and sugary drinks alludes to a different stage of the dietary transition than Cluster 1.

Cluster 4 was largely rural, similar to Cluster 2 (Table 5.4). This was the oldest cluster and comprised members that were relatively less affluent compared with the other clusters; almost 50% of cluster members belonged to the low SES bracket and the cluster had the smallest proportion of high SES participants relative to other clusters (Table 5.4). Cluster 4 was characterised by a significantly lower proportion of participants who consumed vegetables and fats, oils and spreads compared with all other dietary clusters (Table 20). Although they both had a moderately high proportion of participants that consumed legumes (Table 5.5), compared with Cluster 3, Cluster 4 had a significantly lower proportion of participants who consumed legumes (Table 5.5). Participants in this cluster did not consume any red meat, milk and milk products, snacks or sugary drinks. Cluster 4 was labelled the '*rural, low-impact, traditionalists*' dietary typology since it seemed to exemplify a dietary pattern at the cusp of dietary transition.

Table 5.6 below provides a summary of the characteristics of the dietary typologies resulting from cluster analysis of the dietary intake of this sample of rural and urban WRA.

Table 5.6: Characteristics of Dietary Typologies among Rural and Urban WRA

Dietary Cluster	Dietary Typology	Characteristics of Dietary Typology
1	'urban, low-impact, early-stage transitioners'	• Largely urban • Significantly high proportion of participants that consumed sugar and honey, and fats, oils and spreads relative to all other clusters (all low impact foods groups). No red meat or milk intake. • Relatively high proportion of participants who consumed traditional cereals, legumes, vegetables and teas and coffees matooke, roots and tubers (all low impact food groups).
2	'rural, low-impact, early-stage transitioners'	• Rural cluster • Significantly high proportion of participants that consumed traditional cereals and significantly lower proportion that consumed tea and coffee

		and matooke, roots and tubers (all low impact food groups). • Relatively high proportion for consumption of sugar and honey, refined cereals, legumes and fats, oils and spreads (low impact food groups).
3	'urban, medium-impact, mid-stage transitioners'	• Largely urban • Highly educated and wealthiest cluster. • Significantly high proportion of individuals consuming red meat, refined cereals, milk and milk products, sweet and savoury snacks and sugary drinks (mid and high impact food groups). • Significantly lower proportion of participants that consumed traditional cereals (low impact food group). • High proportion of participants consuming matooke, roots and tubers and sugar (low impact food groups).
4	'rural, low-impact, traditionalists'	• Largely rural • Significantly lower consumption of vegetables and fats and oils. • High consumption of nuts and seeds and matooke, roots and tubers (low impact food groups). No consumption of red meat, milk and milk products, sweet and savoury snacks and sugary drinks.

5.4.4 Relationship between Dietary Typologies and Dietary Patterns among Rural and Urban WRA

As highlighted above (section 5.2), HCA was conducted to group participants with similar dietary profiles into dietary typologies based on three retained MCA dimensions, i.e. '*low-impact, plant-based, traditional*' dietary pattern, '*low-impact, plant-based, mid-stage transition*' dietary pattern and '*low-impact, plant-based, early-stage transition*' dietary pattern. HCA identified four clusters of participants, i.e. '*urban, low-impact, early stage transitioners*', '*rural, low-impact, early stage transitioners*', '*urban, medium-impact, mid stage transitioners*' and '*rural, low-impact, traditionalists*'. Figures 10 and 11 illustrate the relative position of each of the study participants (n=73) on the three MCA dimensions depending on their HCA grouping.

Those participants grouped together in Cluster 4 (red) are located on the positive side of imension 1, while Clusters 1, 2 and 3 are located on the negative side of Dimension 1 (Figure 5.4). This suggests a positive association of Cluster 4 members ('*rural, low-impact, traditionalists*' dietary typology) with Dimension 1 ('*low-impact, plant-based, traditional*' dietary pattern). Figure 11 indicates that Clusters 2 (yellow) and 3 (grey) are differentiated by Dimension 2, i.e. Cluster 2 is on the positive side of Dimension 2 (above 0) while Cluster 3 is on the negative side of Dimension 2. This suggests that Cluster 2 ('*rural, low-impact, early-stage transitioners*' dietary typology) members are positively associated with the dietary pattern represented by Dimension 2 (‘*low-impact, plant-based, mid-stage transition*’ dietary pattern).

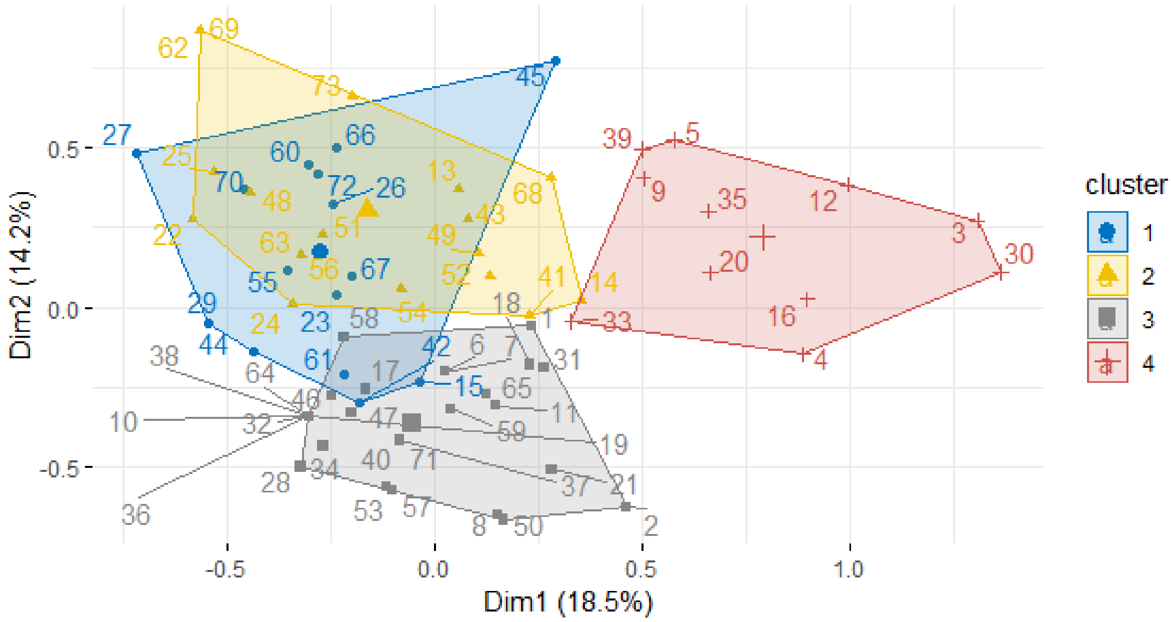

Figure 5.4: Location of Four Dietary Clusters on MCA Dimensions 1 and 2

Figure 5.5 shows that Cluster 1 (blue) is located on the positive side of Dimension 2, therefore members of Cluster 1 (‘*urban, low-impact, early-stage transitioners*’ dietary typology) are likely to adhere to the dietary pattern represented by Dimension 2 (‘*low-impact, mid-stage transition*’ dietary pattern). On the other hand, Cluster 3 (‘*urban, medium-impact, mid-stage transitioners*’ dietary typology) is located on the negative side of Dimension 3. This means that Cluster 3 members are negatively associated with adherence to the ‘*low-impact, plant-based, early-stage transition*’ dietary pattern (Dimension 3).

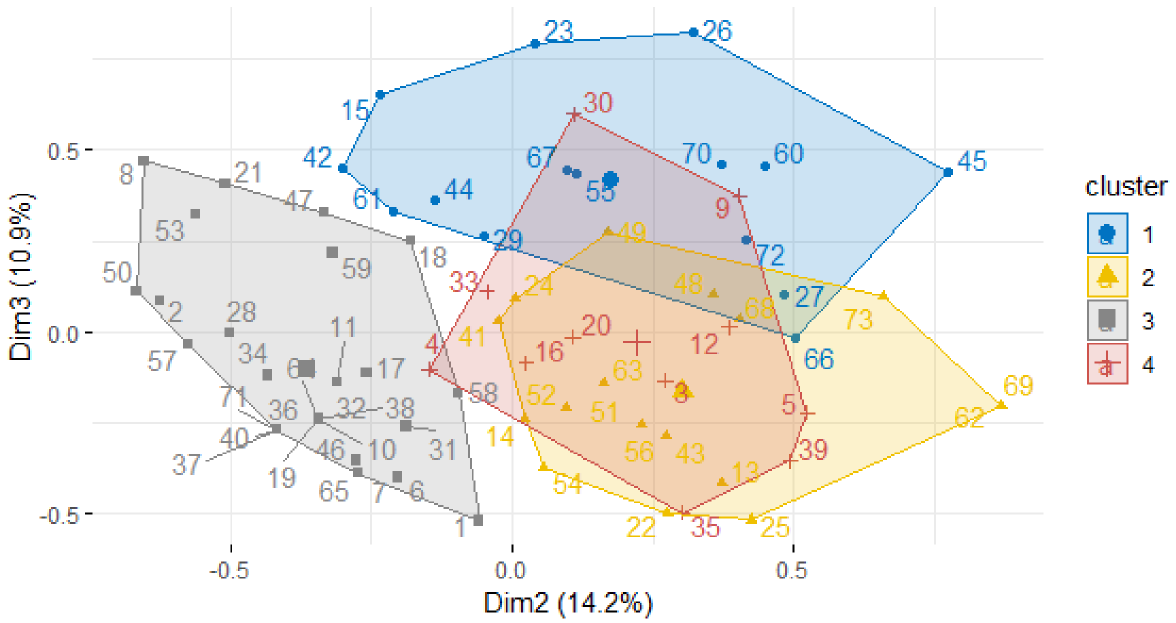

Figure 5.5: Location of Four Dietary Clusters on MCA Dimensions 2 and 3

5.5 Discussion

The objectives of this cross-sectional study were (i) to describe the existing dietary patterns of a sample of rural and urban Ugandan WRA, (ii) compare existing dietary patterns among this sample of rural and urban Uganda WRA with those obtained in study one and (iii) to categorise WRA with similar dietary profiles into dietary typologies. The following section presents a discussion of the key findings of this study, beginning with the dietary patterns and followed with the dietary typologies formed among this sample of WRA.

Existing Dietary Patterns among Rural and Urban Ugandan WRA

Three dietary patterns collectively accounted for 43.6% of the variability in dietary intake among this sample of rural and urban Ugandan WRA (n=73). The '*low-impact, plant-based, traditional*' dietary pattern (Dimension 1) was characterised by low intake of refined cereals, fruit, red meat, poultry, fish and eggs, sweet and savoury snacks and sugary drinks. The '*low-impact, plant-based, mid-stage transition*' dietary pattern (Dimension 2) was characterised by high intake of vegetables, fats and oils, sugar and honey, traditional cereals and legumes, while the '*low-impact, early-stage transition*' dietary pattern (Dimension 3) was characterised by high intake of sugar and honey, teas and coffee, and matooke, roots and tubers and low intake of vegetables. The second and third dimensions were suggestive of transitioning dietary patterns among this sample of rural and urban Ugandan WRA as they are characterised by a mix of traditional (traditional cereals, legumes, matooke, roots and tubers and some fruit and vegetables) and non-traditional food groups (fats and oils, sugar and honey, teas and coffee). The first dietary pattern ('*low-impact, plant-based, traditional*' dietary pattern), however, appears suggestive of more traditional dietary patterns, given its negative association with food groups that might be considered characteristic of transitioning diets or modern dietary practices, i.e. red meat, poultry, fish and eggs, sugary drinks and sweet and savoury snacks.

Dimension 1 ('*low-impact, plant-based, traditional*' dietary pattern) obtained in this study showed stark differences from principal component two ('*transitioning, processed, low environmental impact*' dietary pattern) and principal component four ('*animal-based, high environmental impact*' dietary pattern) obtained among a nationally representative sample of rural and urban Ugandan WRA in study one (see section 3.4.3). On the other hand, dimension 2 ('*low-impact, plant-based, mid-stage transition*' dietary pattern) obtained in this present study showed some similarities with the first principal component ('*traditional, high fat, medium environmental impact*' dietary pattern) obtained in study one. Both these dietary patterns were characterised by high intake of fats and oils and traditional cereals. The main difference, however, was that the traditional, high fat, medium environmental impact' dietary pattern was also characterised by high positive factor loading on fish, nuts and seeds and boiled traditional vegetables (see section 3.4.3). Dimension 3 ('*low-impact, plant-based, early-stage transition*' dietary pattern), however, did not show much similarity with any of the principal components obtained in study one. Notwithstanding, like principal component three ('*plant-based, low environmental impact*' dietary pattern), obtained using PCA in study one, it was associated with consumption of roots and tubers and similar to principal component two ('*transitioning, processed, medium environmental impact*' dietary pattern) it is associated with intake of teas and coffee and sugar and honey. This suggests that this dietary pattern could be a mix of dietary patterns two and three obtained in study one using PCA.

The findings on dietary patterns obtained in study one using data collected in 2008 and those obtained in the present study using data collected more recently in 2018, suggest that rural and urban Ugandan WRA consume a low-impact plant-based diet and are still at an early to mid stage of the nutrition transition. This corresponds with phases 3 (receding famine) and 4 (degenerative disease) in Popkin's NT framework model described in section 1.2 of this thesis. MCA and PCA are similar data reduction methods, therefore, differences observed in the dietary patterns between the two studies could be attributed to finer methodological differences employed, including sample size (n=955 in study one vs n=73 in the present study) and number of food groups (n=35 in study one vs n=15 in study three).

In comparison to other dietary pattern analysis methods, MCA has been used in only a very limited number of studies, particularly in LMIC. In a study among Tunisian adolescents (15-19 years), Aounallah-Shkiri et al. (2011) described a 'traditional-modern gradient' in which food groups that were previously considered part of the traditional Tunisian cuisine appeared to be replaced by modern foods. In their study, the main dietary pattern, labelled the '*modern*' dietary pattern, had high consumption of white bread, dairy, added fat, sugar, fresh fruit and decreased intake of oils, cereals and grains, vegetables and legumes. This dietary pattern was somewhat similar to the second and third MCA dimensions (‘*low-impact, plant-based, mid-stage transition*’ and ‘*low-impact, plant-based, early-stage transition*’ dietary patterns) owing to high intake of refined cereals, sugar and honey, and fats, oils and spreads in both. However, in this PhD study, unlike in the Tunisian study, foods that are more ‘modern’ coexisted with traditional foods evidenced by the high positive association of traditional cereals and legumes with dimension two and matooke, roots and tubers with dimension three. While the modern diet was more prevalent among Tunisian adolescents who were more affluent, resided in urban areas or had more highly educated mothers (Aounallah-Shkiri et al., 2011); in this study, associations between MCA dimensions and demographic variables were not explored. This is because the purpose of the MCA was to generate object scores that would be used in the cluster analysis to categorise participants into groups of similar dietary profiles.

In the Tunisian study, the ‘*meat-fish*’ dietary pattern was characterised by high intake of meat and fish and low intake of white bread, butter, milk and milk products, confectionery products and sugar (Aounallah-Shkiri et al., 2011). This dietary pattern was similar, to an extent, to the first MCA dimension (‘*low-impact, plant-based, traditional*’ dietary pattern) described in this study in that both dietary patterns were characterised by low intake of refined cereals (including white bread), milk, sugar and sweetened beverages. The main difference between the two, however, was the high consumption of meat and fish in the ‘meat-fish’ dietary pattern. Because the relationship between the dietary patterns and sociodemographic factors were not analysed in this study, differences in the findings between this study and the Tunisia study might be attributed, in part, to differences in location between the two study settings, i.e. North Africa (Tunisia) vs East Africa (Uganda). These differences are likely to result in differing food environments between the two contexts. Differences in economic conditions, i.e. low-income (Uganda) vs lower-middle income (Tunisia) (UN, 2018) could also play a role in differences in dietary patterns.

Dietary Typologies among Rural and Urban Ugandan WRA

The findings from this third study indicate that among this sample of rural and urban Ugandan women, two rural and two urban dietary typologies exist. The ‘*urban, low-impact, early-stage transitioners*’ dietary typology from this study was characterised by high intake of two food groups (fats and oils and sugar and honey) that are considered characteristic of the beginning phase of dietary transition (Keding et al., 2011). This dietary cluster showed no intake of animal-protein and low intake of EDNP food groups, which are considered more indicative of later stages of the NT (Keding et al., 2011). The ‘*urban, medium-impact, mid-stage transitioners*’ dietary typology, on the other hand, showed higher food group diversity, characterised by significantly higher intake of red meat, refined cereals, dairy products, sweet and savoury snacks and sugary drinks, in addition to some intake of traditional food groups, e.g. legumes. Uusitalo et al. (2005) propose that in transitioning contexts, food groups like meats, potatoes, white bread, fast food, and dairy products are typically indicative of dietary ‘westernisation’. Indeed, in other sub-Saharan Africa studies, 'transitional dietary patterns' do not show a total shift from the 'traditional' to the 'modern', but rather are characterised by an incorporation of aspects of so-called 'westernised' diets with the traditional (Sodjinou et al., 2009; Keding et al., 2011). Therefore, these findings could be emblematic of more advanced stages in the NT among participants in the '*urban, medium-impact, mid-stage transitioners*' dietary typology relative to participants in the other urban cluster.

The two rural dietary typologies were similar in that they were both characterised by significantly low consumption of vegetables and no consumption of red meat or dairy. However, while the '*rural, low-impact, early stage transitioners*' showed some, albeit low, consumption of sweet and savoury snacks and sugary drinks, the '*rural, low-impact, traditionalists*' showed no consumption of these two food groups at all. This suggests that while these two dietary typologies could generally be described as 'traditional', the '*rural, low-impact, early-stage transitioners*' appears less traditional of the two.

Although only a handful of studies have explored dietary patterns using cluster analysis methods in sub-Saharan African contexts, some similarities have been found between the findings from this third study and those from other SSA countries as well as those from non-SSA transitioning contexts. For example, in a study among Burkinabé adults (25-60y) in Ouagadougou two dietary (clusters) patterns were identified (Zeba et al., 2014). The smaller '*urban*' dietary pattern was characterised by high intake of rice and wheat products, oil seeds, red meat, eggs, dairy products, non-green leafy vegetables, fruit, locally-sweetened drinks and soft drinks (Zeba et al., 2014). This dietary pattern bears a striking resemblance to the '*urban, medium-impact, mid-stage transitioners*' dietary typology identified in this study. The '*urban*' dietary pattern (Zeba et al., 2014), like the '*urban, medium-impact, mid-stage transitioners*' dietary typology in this study, also aggregated both wealthier and more highly educated participants. The '*urban, medium-impact, mid-stage transitioners*' dietary typology in this study was also similar to the less prevalent 'transitional' dietary (cluster) pattern identified among Beninese adults, which was characterised by high intake of bread and pasta, roots and tubers, nuts and seeds, red and white meats, dairy, fats and sweets (Sodjinou et al., 2009). The 'transitional' dietary pattern like the '*urban, medium-impact, mid-stage transitioners*' was significantly associated with being more highly educated as well as being born in the city (Sodjinou et al., 2009).

The '*urban, medium-impact, mid-stage transitioners*' dietary typology was somewhat different to the '*western*' dietary pattern among immigrant West Africans in Madrid, which was characterised by high intake of processed meat, animal fat, sweetened drinks, sweets, potatoes and mixed dishes (Delislé et al., 2009). The '*urban, medium-impact, mid-stage transitioners*' dietary typology was also somewhat different to the '*unsustainable*' dietary pattern among Irish adults. While both dietary (clusters) patterns were characterised by carbonated drinks and savoury snacks, unlike the '*urban, medium-impact, mid-stage transitioners*' dietary typology, the '*unsustainable*' dietary pattern was labelled so owing to the highest impact (GHGE) from red and processed meat and alcoholic drinks and low intake of dairy products, fruit, vegetables and fish (Hyland et al., 2017).

On the other hand, in the same study among Burkinabé adults, the larger '*traditional*' dietary pattern was characterised by high consumption of maize and millet (traditional cereals), traditional leafy green vegetables and legumes (Zeba et al., 2014). The dietary pattern was significantly associated with having no education, being female and less affluent (Zeba et al., 2014). This dietary (cluster) pattern bears some similarities with the '*rural, low-impact, early-stage transitioners*' dietary typology in this study owing to its high consumption of traditional cereals. In the Benin study, the more common '*traditional*' dietary pattern among Beninese adults was characterised by high intake of grains and fruit and was associated with lower income and being born in a rural area (Sodjinou et al., 2009). This '*traditional*' dietary pattern bears some similarity with the '*rural, low-impact, early-stage transitioners*' dietary typology in this study, owing to high intake of cereals and grains food group. The main difference between the two dietary clusters, however, is the high intake of fruit in the '*traditional*' pattern in Benin, which is not the case in the '*rural, low-impact, early-stage transitioners*' dietary typology. These traditional diets in Benin and Burkina Faso, while similar to the '*rural, low-impact, early-stage transitioners*' dietary typology, differed from the '*rural, low-impact, traditionalists*' dietary typology in this study.

The coexistence of one traditional and three transitioning dietary typologies in this study, from a sample of participants recruited from one urban and one rural area is suggestive of a traditional-transitional gradient. This has been evidenced by other studies (Sodjinou et al., 2009; Aounallah-Shkiri et al., 2011; Keding et al., 2011) although in these contexts either urban or rural populations were looked at in isolation. Findings from some middle-income countries, which are at later stages of the NT, have also demonstrated clear differences in dietary patterns when rural and urban populations are considered together as in this study. These studies demonstrated a coexistence of both traditional and more 'westernised' dietary patterns among the same sample or population. For example, in a study among Mexican children, the traditional 'tortilla and beans' dietary pattern was more common among rural children (Afeiche et al., 2017). On the other hand, the less traditional dietary patterns, i.e. '*sandwiches and quesadillas*' and '*milk and sweetened beverages*' were more common among urban Mexican children (Afeiche et al., 2017). This is similar to the findings from this PhD study in which more traditional dietary typologies aggregated rural participants, while the transitional dietary typologies aggregated urban participants. Therefore, while the dietary patterns from such studies may differ in composition, to some extent, from those obtained in this study, the rural-urban differences in these middle-income mirror the rural-urban differences in this PhD thesis. The findings from these middle-income contexts, although somewhat different, could therefore be illustrative of what to expect in Uganda, and other similar low-income, transitioning contexts, as the NT takes hold.

This gradient in dietary patterns observed in this study could be due, in part, to differences in both education and income. Although overall there was no difference in socioeconomic status, a proxy for participants' level of income, between participants across the four dietary typologies, the '*urban, medium-impact, mid-stage transitioners*' dietary typology had a significantly higher proportion of participants from the highest wealth tertile. Sodjinou et al. (2009) and Mayen et al. (2016) propose that individuals that are more affluent usually have greater economic access to a wider diversity of foods. On the other hand, the urban poor often face food insecurity and are therefore often forced to contend with a less diverse food basket that might include cheaper fats and oils and EDNP foods (Raschke and Cheema, 2007; Sodjinou et al., 2009; Tacoli, 2017). This could explain the existence of the '*urban, low-impact, early-stage transitioners*' dietary typology in which more than half the participants belonged to either the mid or low SES bracket. Similar findings have been reported elsewhere. In a Mexican study, the proportion of children in the '*cereal and milk*' dietary pattern, described in the paper as a westernised dietary pattern, increased with income, while the proportion of children in the traditional '*tortilla and beans*' dietary cluster was highest at the lowest SES level (Afeiche et al., 2017). On the other hand, the '*rural, low-impact, early-stage transitioners*', a transitioning dietary pattern among largely rural participants, could be explained by the cluster having half its participants in the highest income tertile. In a Tanzanian study, a transitioning dietary pattern called the '*purchase*' dietary pattern, which was indicative of early stages in the NT, was identified among rural women. Given the similarity in context between Ugandan and Tanzania, this suggests that it is not uncommon for rural women to experience the NT, albeit at a slower pace than their urban counterparts are.

The extent to which differences in socioeconomic status can explain the dietary differences between this sample of rural and urban participants is limited, however. This is because, owing to the quota sampling method used in this study, there were no significant differences in socioeconomic status between rural and urban participants, although the '*urban, medium-impact, mid-stage transitioners*' dietary typology had a significantly higher proportion of high SES participants compared to all other clusters. Additionally, although Mayén et al. (2017) found a significant association between high income and high education and adherence to the less traditional '*snacks and drinks*' dietary pattern among Seychellois adults, the fact that there was no significant difference in education level between rural and urban participants suggests that education does adequately explain differences in dietary clusters obtained in this study. This suggests that among this sample of rural and urban Ugandan WRA, other individual-level factors or indeed other factors beyond the individual level could explain differences in dietary profiles observed. To this end, some authors have attributed dietary differences among rural and urban populations to several other factors. For example, Popkin (1999) proposes that factors within the wider food system, e.g. transportation and distribution inefficiencies could be at play. These factors are collectively suggestive of influences outside of an individual's direct realm of control, which points to some aspects of the food environment in which participants reside.

5.6 Study Strengths, Limitations and Methodological Challenges

5.6.1 Strengths and Limitations

Findings from this study add to the body of knowledge on dietary transitions and environmental sustainability of diets from a LMIC context. By providing important descriptive data on dietary intakes among rural and urban Ugandan WRA, findings provide some evidence that points to the NT among this sample of urban WRA and pockets of rural WRA. The use of MCA, an underutilised method of dietary pattern analysis, to explore dietary behaviours in a LMIC, is another strength of this study.

The study's main limitation is the use of a single qualitative 24hr recall in the collection of dietary data. This means that these data at best provide only a snapshot of participants' dietary intake and are not indicative of habitual intake, which would require repeat 24hr recalls. Although the dietary patterns and dietary typologies formed were based on dietary data collected using a rigorously conducted single qualitative 24hr dietary recall that incorporated the validated multiple-pass method to reduce memory bias, because the recall was qualitative, energy and nutrient intakes could not be estimated for this sample of rural and urban Ugandan WRA. Lastly, the relatively small sample size (n=73) could be seen as another limitation, however, given that the study was exploratory in nature, this was deemed adequate.

5.6.2 Methodological Challenges

This study was of cross-sectional nature; therefore, dietary clusters formed lack stability and are likely to change with time. Furthermore, dietary clusters obtained in this study are only indicative of this sample of participants and cannot be generalised to all rural and urban Ugandan WRA. Cluster analysis and multiple correspondence analysis as methods of dietary pattern analysis have been criticised for various reasons. Firstly, like other data-driven approaches, it involves subjective decisions regarding formation of food grouping and labelling of cluster labelling (Sodjinou et al., 2009; Aounallah-Shkiri et al., 2011; Zeba et al., 2014). This limits the comparison of dietary patterns and clusters across studies (Sodjinou et al. 2009; Zeba et al. 2014), even in similar populations. Finally, data were collected between September and January, which coincides with the dry season, which could have influenced the findings.

5.7 Implications for Policy and Practice

The findings from this study provide evidence of dietary transitions among this sample of rural and urban WRA. Urban participants appeared to be at a more advanced stage of the NT compared to their rural counterparts who were at an earlier stage of dietary change. That difference in socioeconomic status and education could adequately account for differences in dietary practices between rural and urban participants points to factors possibly beyond the individual-level playing a major role in influencing dietary practices among this sample of WRA. Findings from this study emphasize the importance of incorporating a more holistic perspective in future studies that aim to uncover factors that influence dietary behaviours among WRA in these LMIC contexts. This could ensure that context-specific interventions and interventions aimed at encouraging healthy and lower impact dietary behaviours among this sub-group are identified.

5.8 Chapter Summary

The objectives of this study were (i) to describe the existing dietary patterns of a sample of rural and urban Ugandan WRA, (ii) compare existing dietary patterns among this sample of rural and urban Uganda WRA with those obtained in study one and (iii) to categorise groups of participants with similar dietary profiles into dietary typologies. Dietary patterns arising from this study bear some similarities to those obtained from study one using PCA of dietary data from 2008. This indicates that rural and urban Ugandan WRA are experiencing dietary changes associated with early to mid stages of the NT, as was established from 2008 data. The dietary patterns arising from the MCA in this study indicate a traditional-transitioning gradient in the diets of this sample of rural and urban Ugandan WRA. Findings from MCA and HCA of dietary data collectively indicate that among this sample, urban Ugandan WRA are experiencing a more advanced stage of the nutrition transition compared to their rural counterparts. This was consistent with findings from study one and reinforces the notion that changes in dietary behaviours are transient in nature, requiring long periods of time to take full effect. Unlike other studies, difference in socioeconomic status and education did not adequately account for differences in dietary practices between rural and urban participants, in this study, indicating that environmental-level factors might have a stronger influence over the dietary practices among this sample of women. Future research requires an exploration of the factors, beyond the individual-level, that might influence dietary behaviours among rural and urban Ugandan WRA. This is addressed using Photovoice in study four, described in the next chapter of this thesis.

6 CHAPTER SIX: WHAT FACTORS INFLUENCE UGANDAN WOMEN'S DIETARY PRACTICES? A STUDY OF SIMILARITIES AND DIFFERENCES BETWEEN FOUR DIETARY TYPOLOGIES (STUDY FOUR)

This chapter presents the fourth study of this mixed methods PhD. The objective of this study was to establish individual-level and environmental-level factors that influence the dietary practices of rural and urban Ugandan WRA. The chapter starts with a review of the theoretical perspectives underpinning the study. Following this, a description of the Photovoice methodology used in the study is provided, including steps undertaken and the researcher's reflection on Photovoice. Next, the chapter presents the key findings from the study. Since participants in this study were drawn from those that took part in studies two and three (described in Chapters 4 and 5), the findings on the factors influencing dietary practices are presented with reference to the dietary typologies into which study participants were clustered in study three. The chapter concludes with a discussion of the study's main findings, followed by implications of findings for policy and practice.

First, the theoretical perspectives underpinning this study are highlighted.

6.1 Review of Theoretical Perepectives Underpinning the Study

The theoretical perspectives on which this study is hinged include the socioecological framework model supported by social practice theory. As highlighted in section 1.7.2, practices are routinised behaviours composed of several interconnected elements. These elements include materials (tangible things such as objects, structures, infrastructure, goods), competence (know-how and skills) and meanings (emotions, reactions, values, traditions and understandings of social significance of the practice framed from past experiences). When the different elements of which practices are comprised are linked, different practices are born or modified, i.e. new practices emerge or old practices are performed in new ways. The elements of which dietary practices are comprised are in turn reflective of the multi-level influences on dietary behaviours captured by Story et al. (2008)'s socioecological framework model. However, while the socioecological framework model conceptualises the drivers of dietary behaviour, a practice-oriented approach plays the supplementary role of pointing towards the mechanisms by which these influences (the elements of which dietary practices are comprised) evolve, mutually shape and hinder each other to result in the observed dietary practices. Therefore, by taking dietary practices (one aspect of dietary behaviour) as a unit of inquiry, this study examines their enactment in the daily lives of rural and urban Ugandan WRA and highlights possible ways through which these dietary practices might remain the same or change.

The next section provides an overview of the Photovoice methodology, including a justification for its use in this study.

6.2 The Photovoice Methodology

Photovoice (PV), formerly called photo novella is a participatory method of inquiry in which stories about various aspects of individual's daily lives are told using cameras (Wang and Burris, 1997; Baker and Wang, 2006). As highlighted previously in section 2.2, PV aims to empwer and give a voice to often-marginalised groups, e.g. women (Wang and Burris, 1997; Wang and Redwood-Jones, 2001; Sutton-Brown, 2014). By promoting dialogue on important issues captured by people's photos and reflections, PV aims to effect change by reaching policy makers (Wang and Burris, 1997; Wang and Redwood-Jones, 2001). One major strength of the PV methdology, which explains its suitability for use in this study, is its adaptability to the exploration of a wide range of public health issues in different research contexts (Wang and Burris, 1997). For example, PV has been used to explore chronic pain in adults (Baker and Wang, 2006), ageing in care homes (Miller et al., 2019), adolescent mental health issues (Vélez-Grau, 2018) and the food environment (Turk et al., 2015; Belon et al., 2016; Diez et al., 2017). While PV has been used to explore barriers to maternal health (Musoke et al. 2015) and climate change issues (Berrang-Ford et al., 2012) in rural Uganda, this study is the first to use the methodology to explore individual-level and environmental-level factors that influence women's dietary practices.

PV also offers the advantage of allowing for the expression of what might otherwise not be expressed in words (Mitchell and Sommer, 2016) and might therefore prompt recall and depth in narratives. It was anticipated, therefore, that the use of photographs in this study would evoke participant's recall of people, places and events around their dietary practices and ground the researchers' interview questions while providing a more nuanced context to the interview (Bryman, 2016). In so doing, using PV in this study would provide a picture of participants' dietary practices that might not have been readily accessible through the sole use of traditional qualitative methods, e.g. narrative or in-depth interviews. Furthermore, unlike traditional qualitative methods, PV offers the unique advantage of giving research participants a greater sense of involvelent in the research process by providing them the opportunity to actively take photographs that reflect their perspectives (Wang and Burris, 1997; Catalani and Minkler, 2010). In using PV in this study, therefore, it was envisaged that participants would feel more motivated to express their views since they would have a greater sense of ownership over what would be discussed concerning their dietary practices.

PV is conventionally carried out following a prescribed series of steps (protocol), i.e. establishing contact with the community to identify issues, recruiting study participants, training of study participants, data collection, data analysis, community photo exhibition and engagement with policy makers (Wang and Burris, 1997; Wang and Redwood-Jones, 2001; Catalani and Minkler, 2010). These steps, however, can be adapted to suit the context under study, while still maintaining the fundamental underpinnings of the methodolgy (Wang and Burris, 1997). Thus, the PV methodology was adopted for this study. To begin with, unlike other PV projects, in this study, issues to be explored, i.e. dietary practices among WRA, were identified through identification of research gaps following a narrative literature review (this is presented in Chapter 1) and not through engagement with the target communities. Secondly, unlike other PV projects, a cap was placed on the number of photographs that participants in this study could capture. Third, while PV places emphasis on group participation along most stages of the process, e.g. using FGD when discussing photographs, in the present study, participants' photographs were instead discussed at in-depth interviews. Given that food can be an emotive and contentious issue, it was envisaged that allowing participants to discuss their photographs individually would make them feel more comfortable to tell their photo-stories. The modifications in the PV methodology for this PhD thesis were pragmatic decisions made owing to the researcher's limited resources (time and money).

The next section describes the study setting, sampling and participant recruitment. This is followed by the steps followed in the PV exercise.

6.3. Study Setting, Sampling and Participant Recruitment

6.3.1 Study Setting

This study took place in urban (Nakawa division, Kampala) and rural (Ssisa sub-county, Wakiso) Uganda. The present study followed from studies two and three, therefore, the study setting is not described here as this has already been detailed in section 4.1.1.

6.3.2 Sampling

Participants for this study were drawn from the sample of WRA that participated in studies two and three. As described in section 4.1.2, 40 urban and 33 rural women, distributed across 18 quotas based on age and SES, participated in studies two and three. Participants for studies two and three (n=73) were sampled using quota sampling to ensure that a range of perespectives on dietary practices would be captured in the subsequent PV study. At the end of each 24hr recall interview, participants were asked whether they would be interested in participating in the subsequent PV exercise. Of all participants in studies two and three (n=73), one rural and 24 urban participants expressed no interest. Within each of the 18 quotas, one participant out of all those that expressed interest in participating in PV was selected using simple random sampling. To do this, for each quota, the ID number for each interested participant was written on individual pieces of paper, the papers folded and placed in a hat. One piece of folded paper was then picked at random from the hat. The participant ID written on whichever piece of paper was picked was taken as that of the participant that would represent that quota in the PV exercise (study four). This exercise was performed for each of the 18 quotas until all the quotas across both the rural (n=9) and urban (n=9) study settings had a PV participant. In some quotas, only one participant had expressed interest in the PV exercise by the end of recruitment. This was taken as the participant for that quota.

6.3.3 Sample Recruitment

As highlighted previously, participants that took part in the present study were randomly drawn from those that participated in studies two and three. As described in section 4.1.3, sample recruitment in both rural and urban study sites was facilitated by gatekeepers as has been suggested in a previous Photovoice study in Uganda (Musoke et al., 2016). The four gatekeepers in the urban (n=2) and rural (n=2) study sites also acted as field assistants (FAs) (see section 4.1.3). Of the two rural gatekeepers, the FA from Nakawuka (HB) was assigned as the rural site coordinator owing to ease of communication with the lead researcher (CIA). HB had also participated in a previous PV study, which CIA anticipated might be helpful in the present study. Detailed sample recruitment is presented in section 4.1.3 of this thesis.

A detailed account of subsequent steps followed in the PV methodology used in this study is presented in the following section, including explanantions of modifications made to the conventional PV protocol.

6.4 Steps Involved in the Photovoice Exercise

At this point, it is important to point out that not all participants sampled across the 18 quotas (see section 6.3.2) took part in the PV exercise. Some urban participants (n=4 out of 9) expressed interest in only being interviewed on their dietary practices, but not in taking photographs. The reasons participants gave for not wanting to take photographs included suspicion on the part of older participants and parents of younger participants, lack of time and travel commitments since data collection coincided with the Christmas period. Therefore, this section describes the steps followed, for those participants (n=14) that actually took part in the PV exercise. Each of these steps, i.e. preparation of PV materials, training of field assistants, piloting of PV methodlogy, training of study participants, participant photography and discussion of participant photographs, is explained in detail.

6.4.1 Preparation of Photovoice Materials

A number of PV materials were prepared prior to commencement of data collection. These included participant recruitment posters (for Kampala and Wakiso), informed consent forms for adult participants (labelled Form A), informed assent forms for participants younger than 18 years (labelled Form A); photography guide; acknowledgement and release form; and the consent form for private property and persons (labelled Form B). The informed consent and assent forms ensured that participants were knowledgeable about the aims of the research and agreed to participate voluntarily. The consent form for private property and persons ensured that participants got permission from anyone whose private property or recognisable image appeared in the photographs they took. The acknowledgement and release forms were used as a testament that participants allowed the researcher to analyse the photographs captured by participants since these were considered their property. This form also gave the researcher permission to use the participants' photographs in future research activities, e.g. conferences and publications, with acknowledgement given to the participants as the photographers. The photography guide covered the topic areas around which photographs were to be taken. The photography guide comprised five questions (topic areas) that would allow participants to take photographs that captured the food(s) they ate, where they sourced food(s) from, how they prepared the food(s), who they ate with and where they ate from. The photography guide is discussed in more detail in the subsequent steps of the Photovoice exercise. All PV materials, with the exception of the recruitmeny posters which were not used, are attached in Appendix 8-13; 23-24) .

A PV training manual was also produced prior to fieldwork (see Appendix 22). The FAs and researcher used this manual during the training of research participants, although modifications were made to the training manual during the training session for PV participants. These modifications, which mainly pertained to the flow and organisation of the training session, were necessary given that the training was an iterative exercise that involved extensive discussion between researcher, FAs and participants. The reflexive nature of qualitative studies allowed for these modifications to be made. Lastly, the PV training manual served as a reference point for the FAs in Wakiso. They could quickly refer to this manual during the one-week period when participants took photographs, at which point the researcher was engaged in data collection in Kampala.

Although all the forms described were initially produced in English, they were all translated into the local language most commonly used in the rural study site (Luganda) prior to data collection. The PV training manual was not translated as all FAs could speak, read and understand English. The English version forms were most commonly used in Kampala while the translated forms were mostly used in Wakiso.

6.4.2 Training of Field Assistants

As briefly mentioned, FAs were recruited from within the two study sites. The FAs, who were all local community members, had a good understanding of each context and so provided the researcher with nuanced advice, e.g. what was appropriate to say and what wasn't. Prior to the participants' PV training, all FAs (in Kampala and Wakiso) received a briefing on the PV exercise. FAs were informed of the aims of the PV exercise and the PV training manual was discussed with them, with emphasis placed on the importance of 'ethics of photography'. Training of FAs was done on three separate occasions, i.e. two in Kampala and one in Wakiso.

6.4.3 Piloting of Photovoice Methodology

The PV exercise, including the semi-structured, in-depth interview following participant photography, was piloted in September 2018 before data collection commenced. Two participants (one participant in Kampala and another in Wakiso) were asked to help with piloting the PV methodology. Both participants met the inclusion criteria used in recruiting actual study participants. First, the aims of the study were explained to the pilot study participants. Following this, pilot study participants underwent a PV training exercise and were given digital cameras to take photographs pertaining to their dietary practices (with the aid of the photography guide) over a one week period. At the end of the PV pilot exercise, participants were asked about their experience of the PV exercise. The two participants had many positive comments regarding their PV experience. They both were able to take an excess of the required number of photographs within the photography period (one week). They suggested that they felt the one-week period was adequate, i.e. any longer might have felt burdensome. They also highlighted that fewer than seven days may be difficult for busier participants. Pilot participants were also asked to suggest any changes they felt might have made the PV exercise better. From this discussion, it came to light that the urban participant sometimes forgot to take the photographs and would have benefited from a reminder from the researcher. Therefore, the researcher made a note to contact each future research participant halfway through the one-week photography period to check whether they were facing any challenges and remind them of the photographs.

At every point throughout the piloting exercise in Wakiso, the lead FA (HB) was present, so he could translate between English and Luganda as necessary. This gave the researcher and FA an idea of what actual interviews in Wakiso might be like. A number of lessons were gleaned following a discussion between the researcher and FA on the pilot exercise as well as the researcher's personal reflection. For example, it was decided that translation was necessary during the course of the PV interviews and could not wait until the end of the interview. It was also noted that at least an hour was necessary to complete the interview as participants often spoke at length regarding their dietary practices and the interviews seemed to flow better when participants chose the photographs they wanted to speak of first although this did not match the order of questions in the interview guide. These were all incorporated in future interviews with actual PV participants. The pilot PV exercise in Kampala was conducted in English, while that in Wakiso was conducted in Luganda. Following pilot interviews, data collection for PV with actual study participants commenced in October 2018. The steps involved are described in the following sections 6.4.4 – 6.4.6.

6.4.4 Training of Photovoice Participants

As previously highlighted, out of 18 sampled participants, only 14 took part in PV. Training for PV participants varied between rural (Wakiso) and urban (Kampala) context.

Training of PV Participants in Wakiso

Rural participants chosen to participate in PV were invited to a training session at the '*Strengthening Community Health Project Office*' in Nakawuka parish (Wakiso). The training, which lasted about two hours, took place in October 2018. All rural PV participants attended the training at the same time. As advised in previous studies (Musoke et al., 2015; Belon et al., 2016), the PV training was presided over by the lead researcher with the assistance of the FAs, mainly as translators. The training session began with an icebreaker game, providing a friendly ambience that allowed the participants to relax and get to know each other. It was important to set a relaxed tone because in the course of the training, the content of the PV exercise would be discussed with the participants and such an atmosphere would facilitate a two-way exchange during which participants could provide honest feedback. This was very important in ensuring that participants' voice were heard throughout the process. This would increase the likelihood that the PV exercise was relevant to participants and therefore successful. Since the participants who took part in the PV were drawn from those who participated in studies two and three, they already had an idea of the research topic. However, following the icebreaker, the researcher re-introduced the participants to the research topic and explained the aims of the PV exercise. The researcher felt it was important to reiterate this just in case any participants had forgotten or had any questions.

Following this, the PV methodology was discussed. Participants were informed of what PV was all about, why it was important and what it added to our understanding of phenomena. The participants and researcher also discussed the ethics of photography, including why it was important to explain to people why their photographs were being taken and the importance of getting permission before taking photographs of people or their private property. Participants had questions regarding what would happen if they took photographs of their own children or spouses. They were informed that because children (below 18 years) could not provide consent as adults, any other adult in the household could sign the consent (Form B) on their behalf. In response to this, participants said, as adults they felt no need to explain to children either why their photos were being taken or ask their permission to do so. This, they said, was something they did not do culturally, i.e. asking children's' consent before doing anything since they were their parents and older than them. Participants also expressed how challenging it would be to ask their spouses (or parents for younger participants) to sign a form consenting to their photographs being taken. This might be misconstrued as a sign of disrespect and was just unnatural. While the researcher made it clear that she understood where participants were coming from, it was stressed at this point that it was paramount to get consent as long as the person in the photograph was clearly identifiable (as proposed by Wang and Redwood-Jones, 2001). If the person in the photograph was unidentifiable, e.g. if only their hand was captured or they appeared blurry or in the background, participants did not need to obtain consent. Following much deliberation, participants agreed that they would get consent from their spouses, parents and children as long as they were identifiable.

Following a discussion of the ethics and practicalities of PV, the photography guide (see Appendix 17) was discussed. For example, some participants wanted to know whether they could take more than the required five photographs. After discussion, it was agreed that they could if they felt that would help them tell their stories better. In another instance, some rural participants expressed confusion about the meaning behind question '*what is food?*' According to some participants, 'food' meant one specific item, i.e. *matooke*. To others, food meant something they eat but may not necessarily like, while to others it meant something they eat because they liked it. At this point, the researcher reiterated that the aim behind the PV exercise was for participants to express their perspectives as to what they felt influenced their dietary practices. They were therefore encouraged to capture photographs in any way they saw fit to answer the questions from their perspective.

The last part of the PV training was an introduction to basic photography skills. Each participant was given a basic, labelled digital camera that was fitted with an SD memory card. Younger PV participants got pink cameras, while the older participants got black cameras. The researcher thought it might make it more exciting to give younger participants coloured cameras and hoped the colour of the cameras would incentivise them to interface more with the cameras and complete the assignment. The researcher showed participants the parts of the camera, and they practiced how to turn it on and off. When all participants reported feeling confident to turn the camera on and off, the researcher and participants discussed the right way to hold the camera (without blocking the lens). Participants then practiced how to take an actual photograph of a prop in the interview room. During this, participants' experience of taking photos of the prop was discussed. Participants practised taking photographs of the prop until they felt confident. When all participants expressed confidence in taking photographs on their own, the researcher highlighted some additional photography tips, e.g. where to stand when taking photos. Participants were not shown how to delete photographs as the researcher felt that this might lead them to erase photographs unintentionally since they were novice photographers. Participants were therefore advised that all the photographs they captured would remain on the cameras until the in-depth interviews, during which they could then choose the pictures they wanted to retain and discuss.

Throughout the PV training process, participants were urged to ask as many questions as possible if anything was unclear. Before the training session closed, participants' contact details were recorded and they were advised that either the researcher or one of the FAs would contact them during the one-week photography period to check on their progress.

Training of PV Participants in Kampala

For those urban participants that agreed to take photographs (n=5 out of 9 participants), a similar PV training process as that conducted in Wakiso was undertaken on an individual, and not group, basis. Individual trainings were conducted in Kampala because all five participants resided in different areas within the study site and had different schedules, so it was difficult getting them to one place at the same time.

6.4.5 Photography

With the photography guide (Appendix 23-24) as a reference point, participants (n=14) were asked to take photographs, over a one-week period as was done in the study by Diez et al. (2017). Participants were asked to take five photographs which they felt best addressed the five topic areas in the photography guide from their perspective and best described what they want to say (Amos and Lordly, 2014; Turk et al., 2015; Diez et al., 2017). The five topic areas included questions on what participants understood as food, where participants primarily got their food, how participants prepared their food, whom participants eat with and from where they have their meals. While the cap placed on the number of photographs participants could take differs from conventional PV protocol, as was agreed during the training session, participants were told they could take more than five photographs if they felt that the photography guide did not adequately capture everything related to food and what influences their dietary practices. Halfway through the one-week photography exercise, each participant whose mobile number was available was contacted by the researcher to check on their progress and address any challenges they might have had. For those rural participants who did not have mobile numbers, house visits were made by the FAs to check on progress halfway through the one-week period.

6.4.6 Semi-structured, In-depth Interviews with Study Participants

Interviews with Photovoice Participants in Wakiso

At the end of the one-week period, participants in Wakiso returned the digital cameras, and each camera SD card was inserted into an encrypted portable tablet so that the researcher and each participant could look at the photographs while they were being discussed. The researcher and participant scrolled through all the photographs that each respective participant captured a first time. Then the researcher and participant scrolled through all photographs a second time so that the participant could choose the photographs they felt best captured their stories. Participants discussed the photographs they chose to retain with the researcher by telling 'photo-stories' (Belon et al., 2016). The researcher used a previously-developed interview topic guide to steer the direction of the interview (Appendix 25-26) but also allowed the participant to guide the course of the interview through their narratives. From these narratives, the researcher was able to gain an understanding of how dietary practices fit within the daily life of these participants. The researcher also gained insight on how participants' social, physical and socio-cultural environments influences shaped their dietary practices. Unlike the conventional PV methodology, photographs were discussed at individual in-depth interviews relative to FGDs because the researcher was more interested in personal narratives which can be better and more easily elicited through in-depth interviews. Additionally, as highlighted in section 6.2, food is an emotive and sometimes sensitive topic, meant that in-depth interviews provided privacy for participants to honestly tell their photo stories. This was important to avoid stigma given that many participants, particularly the rural and the less affluent urban participants, lived in tightknit communities.

Interviews with Photovoice Participants in Kampala

The same interviewing process, described above, was followed for those participants in Kampala (n=5) who took photographs.

Interviews with Non-Photovoice Participants in Kampala

For those urban participants that did not take any photographs (n=4), semi-structured, in-depth interviews were conducted using the same PV interview topic guide as that used for participants that took part in the PV exercise. This ensured that both participants who took photographs and those who did not take any photographs, discussed issues round the same topics. During these in-depth interviews, participants who did not take photographs were asked by the researcher to imagine and describe what kind of photograph they might have taken had they participated in PV. While the lack of photographs during these interviews meant a lack of memory prompt, it was hoped that this exercise in imagination would set the tone for the interviews.

To ensure quality control of the data, all in-depth interviews (both with PV and non-PV participants) were led by the lead researcher. However, FAs were present at each interview, to translate participants' narratives and the researcher's questions between English, Luganda and Luo, as necessary.

The next section highlights data quality in this study.

6.5 Data Quality

For any research to have credibility there must be a way of assessing its quality (Draper, 2004). Quality assessment criteria used in quantitative research, i.e. reliability, validity and generalisability have limited applicability in qualitative research (Draper, 2004; Lewis et al., 2014). For qualitative research, a different set of criteria is offered, i.e. dependability (in place of reliability), confirmability (in place of objectivity), credibility (in place of validity) and transferability (in place of generalisability) (Lincoln and Guba, 1985). Confirmability refers to whether findings from one study can be attested to by other researchers while transferability deals with the degree to which the findings in a study can apply to other participants, contexts or settings (Lincoln and Guba, 1985). Reliability (dependability) refers to how repeatable the research is (Lewis et al., 2014). While reliability of qualitative research is so contentious that it is sometimes not emphasised at all, validity (credibility) encompasses the plausibility of the narrative and whether participants' accounts and the intended meanings behind them have been correctly captured (Lewis et al., 2014). To improve the quality of qualitative research, a few strategies have been proposed. For credibility (validity), authors recommend respondent validation, audit trail (clear description of data collection and analysis methods), fair dealing and exploration of deviant cases (Lincoln and Guba, 1985; Mays and Pope, 2000; Draper, 2004; Thomas and Magilvy, 2011; Lewis et al., 2014). To improve other aspects of qualitative research quality the following are recommended - an audit trail (for dependability), reflexivity (for confirmability) and thick description (for transeferability) (Thomas and Magilvy, 2011). Each of these strategies as applied in this study are described in the following section.

In respondent validation, data collected from interviews is reviewed with study participants for clarification (Lincoln and Guba, 1985). While this technique can also provide an avenue for participants to remember things they did not speak of before, its main limitation is that participants could backtrack on their original narratives or change their minds about which portions of their accounts the study can use (Lewis et al., 2014). In the present study, rather than waiting until the interview finished, respondent validation was incorporated into the length of each in-depth interview as recommended by Mays and Pope (2000). To this end, throughout the the interviews, each participant was asked to provide clarifications on their accounts. To do this, the researcher repeated portions of what participants said and then asked participants to confirm whether what they (researcher) had understood was what the participant meant. In instances where there was disagreement in understanding, the issues were explored further until agreement was reached. In some instances, in addition to providing clairty, respondent valuation also served to prompt recall among some participants.

Fair dealing pertains to whether the research represents a wide range of perspectives while exploration of deviant cases deals with establishing whether any contradictions exist within the data (Mays and Pope, 2000; Lewis et al., 2014). In this study, these were achieved by drawing the PV study participants from a quota sample that was recruited to maximise diversity in views. This ensures the validity of this study. By providing an audit trail of the research process, the validity of this study has been further improved. To this end, the researcher has presented, in this PhD thesis, an explicit account of the research process (including study aims, sample recruitment, data collection and analysis methods) and reported findings in sufficient detail to allow a reader to make their own conclusion on the robustness of the research and conclusions drawn. Moreover, given its systematic nature (Gale et al., 2013), the framework analysis method used in the analysis of data in this study (refer to section 6.6), is another example of how validity has been ensured. In addition to validity, the audit trail also provides evidence of the dependability of the study as proposed by Thomas and Magilvy (2011).

While the transeferability (generalisability) of qualitative resarch findings is debatable, the researcher has provided a detailed description of study participants from both rural and urban contexts, including demographic characteristics. Moreover, study participants were drawn from a larger sample (n=73) of participants from in studies two and three that are described in great detail in Chapter 4 and 5. For confirmability (objectivity), the researcher kept a detailed field diary, which contained a reflection on how their presence, preconceptions, assumptions and personal characteristics might have affected the research planning process as well as what participants said (Mays and Pope, 2000; Thomas and Magilvy, 2011). A summarised version of the researcher's reflections is provided section 6.7 of this thesis.

6.6 Data Analysis

Priority was given to data arising from participants that took part in the PV exercise (n=14). This was triangulated with data from those urban participants that only took part in the in-depth interviews (n=4).

In response to the topic areas described in the photography guide, participant photographs depicted different food items consumed by participants, various places from which participants obtained their food, e.g. shops and home gardens, different stages in the food preparation process, eating occasions with social networks and places at which participants had their meals. Data arising from participants' photo stories were analysed using the thematic framework analysis method. Thematic analysis methods were deemed appropriate as they are not attached to either theoretical perspective or disciplines and are therefore widely adaptable. Additionally, thematic analysis methods are ideal for situations in which the research question warrants "*discovering, interpreting and reporting patterns and clusters of meaning*" (Spencer at al., 2014 p.271) as was the case in this study. This is unlike other qualitative data analysis methods, e.g. discourse and content analysis, which place more emphasis on how the narratives are constructed and less so on the content of the narrative (Spencer at al., 2014). More specifically, the thematic framework analysis was chosen as the method of analysis for this study because it allows for the comparison of participants' accounts by themes while simultaneously situating each participant's perspective in context by retaining the connection to other aspects of their own individual accounts (Gale et al., 2013). Additionally, thematic framework analysis is amenable to novice qualitative researchers, such as this PhD researcher, and is therefore a good starting point into qualitative research. Lastly, because it follows a systematic process, the use of framework analysis method provides an avenue for producing credible, relevant findings and improving validity and reliability of qualitative data as highlighted in section 6.5 of this thesis.

Thematic framework analysis is carried out through a series of steps, i.e. transcription, familiarisation, coding, developing an analytical framework, applying the analytical framework to the data, charting the data and lastly, interpreting the data by constructing categories, identifying links and explaining any observed patterns (Gale et al., 2013; Spencer et al., 2014). Although presented as a sequential process, data analysis in this study was in fact was carried out iteratively.

The next section describes each of these steps as used in this study.

6.6.1 Transcription

During transcription, the researcher listened to the audio-recorded interviews four times. The first time listening served to remind the researcher of the interview and gave a feel for what participants said. The second time listening involved the researcher writing down what she heard participants saying, without correcting the transcript text. The third time the researcher listened to the recorded interviews and made corrections to the previously produced transcript text, so that the transcript would reflect exactly what the study participants said (Gale at al., 2013). The fourth time the researcher listened to the recordings and inserted the respective photographs within the transcript text in the order in which participants referred to them. Listening to interviews four times during transcription improved the validity of the findings by ensuring that final transcripts reflected participants' true accounts.

Many interviews in Wakiso and a few in Kampala were carried out in Luganda. Only one interview in Kampala was conducted in Luo, another local language. Although the FAs made translations, of what the researcher did not understand, during the semi-structured, in-depth interviews, further translation occurred at this point as interviews were transcribed. Given the iterative nature of qualitative data analysis, although transcription involved listening to the audio recordings four times, the recordings were consulted for clarification at subsequent points during the analytical process as needed.

6.6.2 Familiarisation

Familiarisation involved immersion of the researcher into the data to get a thorough understanding of it. This improved the validity and confirmability of the research by ensuring that any themes generated in subsequent steps emerged from and were supported by the data (Gale at al., 2013; Spencer at al., 2014). To do this, interview transcripts were printed out and read at least three times. When necessary, particularly in instances where interviews were not conducted in English, audio recordings were consulted (Gale et al., 2013). To ensure that data were situated within the right context (Gale et al., 2013), the researcher also consulted the field notes.

6.6.3 Coding and Developing a Working Analytical Framework

From the 18 interview transcripts, six interview transcripts (three urban and three rural) were randomly chosen. Each line of the six interview transcripts was closely read to identify a paraphrase or label (code) which the researcher felt best described what participants said (Gale et al., 2013). Codes used were generated inductively and deductively; inductively from Story et al.'s 2008 socioecological framework on factors influencing healthy eating and deductively from the data itself. (Examples of deductive and inductive codes are provided in the codebook attached in Appendix 27). The coding exercise was performed on paper transcripts using a pencil and highlighter pens. Following coding, the codes were organised into categories, sub-themes and subsequently themes to form a working analytical framework (Gale at al., 2013; Spencer at al., 2014). Coding was performed using NVivo Version 16.

While the bulk of data analysis occurred at this stage, i.e. following fieldwork completion, during data collection, some preliminary themes (from Story et al. 2008's model) were identified by the researcher following a daily reflection on interviews. These preliminary themes were tested in subsequent interviews to asecrtain whether they were pervasive among other participants or if they were only particular to certain participants.

6.6.4 Applying the analytical framework to the data

Themes and sub-themes that comprised the working analytical framework (obtained from the six initial transcripts) were applied to each of the remaining interview transcripts (n=12). Any new themes identified at this point were added the working analytical framework.

6.6.5 Charting

Data from transcripts were charted onto a row-by-column framework matrix. By placing their responses in the respective row (participant) and column (theme) a summary of what each participant said under a particular theme or sub-theme was generated (Gale et al., 2013; Spencer et al., 2014). A different framework matrix was made for each of the four dietary typologies into which study participants were clustered in study three (see section 5.5). A snapshot of a framework matrix generated in the analysis of this data is attached in Appendix 28.

6.6.6 Interpretation of Findings

The initial stages in interpretation involved identifying the study's main findings. For each theme, participants' quotes were reviewed to assess differences and similarities in responses among participants across the four dietary typologies (Ritchie et al., 2014). The exploration of deviant cases, through the identification of contradictions in the range of participants' responses, improved the validity of the study. In interpreting findings, mapping of connections between key themes and sub-themes was conducted to highlight relationships between them (Gale at al., 2013; Spencer at al., 2014). Given that data from this study was a combination of narratives and photographs and was therefore deemed of sufficient depth the last step in interpretation involved suggesting possible explanations for the observed dietary practices among participants (Gale et al., 2013; Spencer at al., 2014).

6.6.7 Data Analysis Software

Transcripts were prepared using Microsoft Word 2010. All data, i.e. transcripts and photographs were managed and analysed using Nvivo Software Version 16. Framework matrices were generated using Nvivo Version 16 and later transferred and managed using Microsoft Excel 2010.

6.7 Researcher's Reflection on the Photovoice Methodology

My fieldwork took place between July 2017 and January 2018. Being a food scientist and nutritionist that had previously worked in the structured Nutrition and Food Science and Technology environments; this was my first experience of social science research, moreover using PV. PV, a participatory method of inquiry, which is increasingly being used in research, has been promoted as 'ideal' particularly in instances where the aim is to effect change by engaging policy makers (Wang and Burris, 1997; Baker and Wang, 2006; Catalani and Minkler, 2010). The PV methodology postulates that putting cameras into the hands of study participants, who are often the most vulnerable and marginalised, creates a shift in power, i.e. away from 'the researcher' towards 'the researched'. This encourages participants to tell their true photo-stories. Furthermore, proponents of the methodology argue that participants are more driven to participate in research that involves PV because handling cameras gives them a greater sense of ownership and control. However, despite the claims of those proposing the method, my fieldwork experience using PV in Uganda reveals that this is not always the case.

Prior to leaving for Uganda, I read about the PV methodology and prepared all my research materials accordingly. Perhaps owing to my coming from a more structured, quantitative background, I remember feeling confident that things would play out much in the same way as what I had read in the literature, if only I followed the 'prescribed steps' in the PV framework. I was conscious somewhere in the recesses of my mind, of the possible power and positionality dynamics (Merriam et al., 2001; Herr and Anderson 2005; Greene, 2014) generally involved in qualitative research. However, being armed with the 'book knowledge' that one of fundamentals of PV is that it promises to tilt the power balance towards 'the researched', I went into the field with an 'idealistic' assumption that by virtue of the fact that I was using PV, this would automatically be taken care of. I did not realise at the time how much conscious, and sometimes unconscious, negotiation would be involved in eliciting my participants' 'true' photo stories.

I naively assumed that being a Ugandan was enough to assign me an 'insider' label; however, I soon found out that having knowledge of the culture and context does not necessarily justify one's insider status. In this regard, Merriam and colleagues (2001) write about a researcher always having something of an 'outsider' status unless they have themselves lived within the community of interest. This could explain why I felt less alien around some of my urban participants, particularly those who lived in the same area as I once had, or in close proximity. Because I had never resided in Wakiso (rural study site), I found myself in what has been classified as the fringes of the insider circle, relative to community residents – the 'true insiders'. Seeking assistance and insight of 'true' insiders in the form of my FAs was therefore very necessary. My feelings about sometimes being an insider or an outsider, and at other times feeling like both, are best explained by ideas proposed by Merriam and colleagues, who in their 2001 paper, advise that the positionality of the same researcher can change throughout the research as it is largely dependent on how people external of yourself perceive you. Being a western-educated female that was raised in Kampala (urban study site) and did not belong to the culture in Wakiso often shifted my position from being an insider to an outsider among my rural participants despite my being Ugandan. Herr and Anderson (2005), who speak of a 'positionality continuum', peculiar to participatory research studies such as this one, highlight some of what I experienced. The 'positionality continuum' proposes that in participatory research studies, it is unsurprising for power imbalances to constantly shift.

A reflection on my fieldwork experiences, during and post data collection, gave me the realisation that I went into the field with an 'oversimplified' idea of how power imbalances might play out. I assumed that because the literature suggested that PV 'gave voice to the voiceless', my participants would automatically have more power, or at the very best, the power equilibrium would be balanced. I was naïve in thinking this way. Indeed Merriam et al. in their 2001 their paper (p409), speak of power being 'negotiated and not given' during fieldwork. Sometimes I feared that my 'privileged outsider' status put me on a pedestal and compelled my participants to tell me what they thought I might want to hear in as much as I made every effort to let them know that the point of the PV exercise was for me to hear about their lives through their photo stories. Often I had to reassure my participants that I was more interested in hearing about the stories behind their photographs than discussing whether I thought the responses they gave to my inquiries were correct or wrong. The works of Edwards and Alexander (2011) best explain the evolution of my power, in balance to that of my participants, as the fieldwork evolved. The authors, in speaking of the fluidity in power, attest to the fact that researchers are more 'powerful' at the stage of project conceptualisation, but less so during data collection when translation and insider knowledge is paramount. My initial reflections on the challenges I faced with relinquishing my power by giving my participants more control, and thus power to express their voices, seemed more to me like the pains of a novice trying to cut their teeth into qualitative research. However, Call-Cummings and co-authors (2018) state that it is common, for participatory researchers to find challenges in finding the right balance between effectively running the research project and achieving their aims while allowing participants to take more control.

To summarise, while I went into my fieldwork expecting to create a sense of empowerment among 'the researched', due to my use of PV, I in fact found that in practice, my fieldwork felt was a constant juggling act of power imbalances. This was challenging for me, a novice qualitative researcher, because I understood that seamlessly navigating this line was eliciting my participants' 'true' photo stories. The findings from this study should be interpreted bearing this in mind. The next section presents the key findings from the present study.

6.8 Findings

This section presents the findings from the study that was undertaken to explore the individual-level and environmental-level factors that influence the dietary practices of rural and urban Ugandan WRA. First, a description of study participants is provided, followed by a summary of the key findings from the PV exercise and in-depth interviews.

6.8.1 Characteristics of Study Participants

Eighteen women participated in this study (Table 22). On average, urban participants were older (28.6 years) than rural participants (26.1 years). Seven of the nine urban participants were unmarried, while six of the nine rural participants were single (Table 6.1). In both settings, almost all participants reported completing at least the primary level of schooling, although education attainment was higher among urban participants overall (Table 6.1). An equal proportion (55.6%) of rural and urban participants were involved in some form of employment (Table 6.1). However, while rural participants were more involved in subsistence farming, urban participants were involved in various forms of formal and informal employment.

Table 6.1: Sociodemographic Characteristics of Study Participants from Kampala and Wakiso (n=18)

	Wakiso (n=9) (Rural)	Kampala (n=9) (Urban)
Age, Years (mean ± SD)	26.11±10.59	28.56±11.86
Education Completed (n, %)		
Informal (not completed primary)	2(22.22)	1(11.11)
Primary	6(66.67)	5(55.56)
Secondary	1(11.1)	2(22.22)
Higher than secondary	0(0.00)	1(11.11)
Socioeconomic Status* (n, %)		
Low SES	3(33.3)	3(33.3)
Mid SES	3(33.3)	3(33.3)
High SES	3(33.3)	3(33.3)
Occupation (n, %)		
Employed (Formal and Informal)	5 (55.56)	5(55.56)
Unemployed	4(44.44)	4(44.44)
Marital Status (n, %)		
Single	6(66.67)	7(77.78)
Married or living with partner	3(33.33)	2(22.22)

*based on quintiles generated from EquityTool for Uganda

Participants were grouped into either of four dietary clusters that were labelled as dietary typologies in study three. As highlighted in section 5.4.3, Cluster 1 ('*urban, low-impact, early-stage transitioners*' dietary typology) was largely urban and was characterised by a significantly higher proportion of participants that consumed fats and oils and sugar. This dietary typology was also characterised by a high consumption of matooke, roots and tubers, legumes, vegetables and teas and coffees. Cluster 2 ('*rural, low-impact, early-stage transitioners*' dietary typology) was mostly rural and was characterised by a significantly higher proportion of participants that consumed traditional cereals and a significantly lower proportion of participants that consumed tea and coffee and matooke, roots and tubers compared with all other dietary clusters. Cluster 3 ('*urban, medium-impact, mid-stage transitioners*' dietary typology) was urban and characterised by a significantly higher proportion of participants that consumed red meat, milk and milk products, refined cereals, sweet and savoury snacks and sugary drinks compared with all other dietary clusters. Cluster 4, ('*rural, low-impact traditionalists*' dietary typology) was largely rural and was characterised by a significantly lower proportion of participants that consumed fats and oils and vegetables compared with all other clusters.

Of the 18 women that participated in this study, an equal number (n=5) belonged to the '*urban, low-impact, early-stage transitioners*' dietary typology , the '*rural, low-impact, early-stage transitioners*' dietary typology , and the '*urban, medium-impact, mid-stage* *transitioners*' dietary typology (Table 6.2). In keeping with results from the larger pool of 73 rural and urban WRA (see section 5.4.3), all urban participants belonged to either the '*urban, low-impact, early-stage transitioners*', the '*rural, low-impact, early-stage transitioners*' or the '*urban, medium-impact, mid-stage transitioners*' dietary typologies (Table 6.2). Rural participants mostly belonged to the '*rural, low-impact, early-stage transitioners*' and the '*rural, low-impact traditionalists*' dietary typologies (Table 6.2). The '*rural, low-impact traditionalists*' had the smallest membership (n=3, 16.67%) of the four dietary typologies and all members were rural (Table 6.2). None of the urban women who participated in this study belonged to the fourth dietary typology (Table 6.2). Four of the five women in the '*urban, medium-impact, mid-stage transitioners*' dietary typology were of mid or high-SES (Table 6.2). Participants in the '*urban, low-impact, early-stage transitioners*' were mostly of low SES although one of the two rural participants who belonged to this dietary typology was of high-SES (Table 6.2). Four of the five women in the '*rural, low-impact, early-stage transitioners*' dietary typologies were of mid and high-SES. The two urban women that belonged to this dietary typology were of low and mid-SES (Table 6.2).

Table 6.2: Dietary Typologies and Sociodemographic Characteristics of Study Participants from Kampala and Wakiso (n=18)

Participant no.	Age (Years)	SES	Education Completed	Occupation	Marital Status	Location
'Urban, medium-impact, mid-stage transitioners' dietary typology (n=5)						
Participant 1	33	High	Post-secondary	Lawyer	Single	Urban
Participant 2	22	Mid	Primary	Shop attendant	Single	Urban
Participant 3	42	High	Secondary	Business woman	Single	Urban
Participant 7	15	High	Primary	Student	Single	Urban
Participant 17	17	Low	Primary	Unemployed	Single	Rural
'Urban, low-impact, early-stage transitioners' dietary typology (n=5)						
Participant 6	25	Low	Primary	Housewife	Married	Urban
Participant 8	17	Low	Not completed primary	Restaurant worker	Single	Urban
Participant 9	17	Mid	Primary	Student	Single	Urban
Participant 11	19	High	Secondary	Unemployed	Single	Rural
Participant 14	20	Low	Primary	Peasant farmer	Married	Rural
'Rural, low-impact, early-stage transitioners' dietary typology (n=5)						
Participant 10	16	High	Not completed primary	Restaurant worker	Single	Rural
Participant 4	44	Mid	Primary	Tailor	Married	Urban
Participant 15	16	Mid	Primary	Unemployed	Single	Rural
Participant 16	30	Mid	Primary	Unemployed	Single	Rural
Participant 5	42	Low	Secondary	Unemployed	Single	Urban
'Rural, low-impact, traditionalists' dietary typology (n=3)						
Participant 12	41	High	Primary	Peasant farmer	Married	Rural
Participant 13	39	Mid	Primary	Peasant farmer	Single	Rural
Participant 18	37	Low	Not completed primary	Contract farmer	Married	Rural

(participants highlighted in blue only participated in in-depth interviews and not Photovoice)

The next section provides a summary of participants' perspectives of what influences their dietary practices.

Participants' photo-stories highlighted impalpable aspects including feelings, preferences, cultural ties and social interactions with family and friends, which provided context to the physical attributes captured in the photographs they described. Participants' narratives revealed that these aforementioned factors operating at the individual, social environment, physical environment and macro-environment levels influenced their dietary practices. These factors acted in isolation but usually in combination, thereby painting a holistic picture of the rural and urban food environments. Although the overarching emergent themes, i.e. individual-level and environmental-level factors (social networks, physical environment, socio-cultural environment, macro-environment) were highlighted by participants across the four dietary typologies (Table 6.2), the ways in which participants in the different dietary typologies experienced these themes sometimes differed. The findings in this section, therefore, are structured around the aforementioned overarching individual and environmental-level factors, with differences and similarities in the narratives between participants from the different dietary typologies highlighted.

First, a description of individual-level influences around participants' dietary practices is provided, followed by the influences in the participants' social networks (social environment) and physical environment. This section concludes by highlighting the socio-cultural and macro-environment level influences behind participants' dietary practices. Participant photographs and italicised interview quotations from participants' photo-stories are provided under each theme and sub-theme for illustrative purposes.

6.8.2 Individual-level Factors

In this PhD, individual-level factors encompassed individual characteristics, e.g. age as well things within an individual's immediate realm of control, e.g. preferences, perceptions, attitudes (Story et al., 2008; Larson and Story, 2009). Five common sub-themes emerged among participants in this study concerning individual-level influences around dietary practices, i.e. participants' perceptions, meal balancing, convenience, day-to-day variations and participants' feelings towards food. The following section presents each of these sub-themes.

Sub-theme: Participants' Perceptions

Across all four dietary typologies, participants spoke of the influence of their perceptions on their dietary practices. From their narratives, it was apparent that perceptions encompassed participants' ideas of what they thought could pass for 'food' in the first place as well as what they thought of the various attributes of different foods. The perceptions participants held seemed to govern and guide how they made choices regarding what foods to eat and what to avoid. Some participants from the two urban dietary typologies highlighted perceptions regarding the tastiness of food while one of the most commonly spoken of perceptions among participants from the two rural dietary typologies was the perceived 'naturalness' of foods. The bulk of quotes on this sub-theme (participants' perceptions) came from participants in the two rural dietary typologies, therefore, this sub-theme focuses on the photo-stories from participants in these two rural dietary typologies.

A number of concepts came to the fore when the two rural dietary typology participants spoke of the perceived 'naturalness' of foods, i.e. '*home production as quality*', '*medicine-free as tastier*' and '*oil-free as healthier*'. Participants described these concepts in a number of ways in relation to how food is grown or reared, what it tastes like, how it feels in the body once it has been eaten and how well it can be stored. First, '*home production as quality*' is explored through the account of participant 5. Participant 5 was a 42-year-old unmarried woman that lived with her children in Naguru Barracks, a low-income urban area, and occasionally engaged in petty trade at the nearby Nakawa market. This participant, who spoke of why she consumed a lot of simsim (sesame) paste[56] instead of vegetable oil, insisted on what she phrased as the 'naturalness' of her homemade simsim paste. The fact that she made this simsim paste at home somehow automatically made it a better option than industry-processed oils available on the market. It was for this reason that she ate 'pasted' rather than fried food:

> *'…that oil [homemade simsim oil] even one year it can stay [without going bad] so long as you have kept it properly; even one year…because there is nothing like chemical or what, preservatives, nothing. It is natural. It is even better than the one [vegetable oil] they buy from the shop.' (Participant 5, 'rural, low-impact, early-stage transitioners', urban, 35-49Y)*

The naturalness of food, as illustrated by homemade simsim paste, is closely associated with meanings of superior quality. Vegetable oils are thus understood by this participant to be of inferior quality because not only are they produced beyond the confines of the household, but also, more importantly, because this production involves the addition, to what was otherwise natural, of 'chemicals' (such as preservatives). From this, we can deduce that, for some participants, meanings about quality, i.e. a longer shelf life, translate to food being consumed in its most natural state and less so on the inherent chemical composition of the product.

The importance of the 'naturalness' of foods is not just linked to oils. Some rural dietary typology participants also used this language when discussing chicken meat, i.e. the way the chicken is raised and produced and how it feels in the body once it is eaten. This alludes to the concept of '*chemical-free as tasier*'. Participant 18, a married, 37-year-old woman that did not own a plot of land and so occasionally farmed other people's land in exchange for food, exemplifies this point. To illustrate '*medicine-free as tasier*' participant 18 explains the difference between *local chicken*[57] and *exotic chicken*:

> *'…local chicken has nutrients, which build the body. When you eat local chicken, you can go up to a week feeling like the chicken is still literally 'moving in your body'. The other 'exotic chickens' of 10,000 [Uganda shillings], they inject them with a lot of medicine…they take a lot of medicine. In fact, those ones [exotic chicken] are made to grow very fast using drugs, which is why you see that in three weeks the chicken is ready for sale…even though it is not even a month old. The local chicken at three weeks is still small and does not even have proper feathers and so it takes time for them to bulk up. The amount of 'meat' the local chicken would have built up in three months is similar to the one the exotic chicken would have generated in three weeks because it [local chicken] does not grow on medicine. However, the exotic one, particularly the white ones of 10,000 [Uganda shillings], grow at a high speed because of the medicine, which is also why they do not taste good.' (Participant 18, 'rural, low-impact, traditionalists', rural, 35-49Y)*

[56] Simsim paste and simsim oil are synonymous as the participant used the two terms were used interchangeably throughout the interview.

[57] Participant described local chicken as local breeds reared using the free-range method. Local chicken forage for their own food and are treated for diseases using locally made, traditional medicines, e.g. ash, chillies. Use of antibiotics and other drugs in the rearing of local chickens is virtually non-existent.

For this participant, the medicine-free rearing of local chicken translates into it not only tasting better, but also having more nutrients that 'build the body'. However, owing to the high cost of local chicken, this participant was often forced to sacrifice naturalness (taste and bodybuilding) for practicality by buying Kuroiler[58] chicken instead. According to the participant, although Kuroiler meat was not exactly as natural as local chicken it was reared with less medicine than the exotic chicken and so had a somewhat similar texture to local chicken, a compromise she was willing to make. While this participants' quote further cements the close link between food quality and the presence (or lack thereof) of 'added chemicals', it highlights other dimensions to the meanings participants' associate with naturalness of food, i.e. taste and freshness.

These same themes, around 'naturalness' of food can be seen in relation to how '*rural, low-impact traditionalists*' cooked food, i.e. '*oil-free as healthier*'. Many participants in this dietary typology justified cooking, and therefore, eating in certain ways because of the perceptions they held about what adding things to foods in the process of cooking might mean. As it was spoken of in the previously described '*medicine-free as tasier*, most '*rural, low-impact traditionalists'* participants spoke of cooking food traditionally, e.g. steaming matooke, roots and tubers in banana leaves without directly adding water or oil. This was attributed, in a few instances, to traditionally cooked foods being tastier than boiled versions. For example, Participant 12, a married, 41-year-old peasant farmer that resided in the rural Bulwanyi parish remarked:

> '*Although the boiled sweet potato requires less time, firewood and banana leaves than the other steamed one, it is not as tasty. Moreover, if you plan to eat the leftover sweet potatoes for breakfast or lunch the following day, the ones that you just boil in water do not look nearly as appetising as the ones you have steamed in banana leaves*' *(Participant 12, 'rural, low-impact traditionalists', rural, 35-49Y)*

In most instances, however, '*rural, low-impact, traditionalists*' participants were of the mind that traditional cooking, i.e. steamed greens[59] offered more health benefits than fried greens. From their narratives, most participants in this dietary typology enacted their dietary practices so as to exclude fried greens because they believed that steamed greens, unlike fried greens, would keep them from falling sick. Participant 13, a single, 39-year-old peasant farmer had this to say about the steamed greens vs. fried greens:

> *'...they [greens] contain vitamin A. [When you eat greens] you are always strong and you do not fall ill. However, that is only if you do not fry the greens. If you fry [the greens], the 'ekiliisa' [nutrients] will be depleted' (Participant 13, 'rural, low-impact traditionalists', rural, 35-49Y)*

From this participant's narrative, as was observed with most '*rural, low-impact traditionalists*', the addition of vegetable oil, rather than enhancing, stripped the greens of something vital ('*ekiliisa*') and protective, which they believed kept them in a state of

[58] Kuroiler is a high-yielding, fast-growing, disease-resistant crossbreed (between indigenous and commercial chicken breeds) developed in India in 1993 to be adaptable to the rural environments in many LMIC (Wong et al., 2017).
[59] Participants refer to various traditional vegetables, e.g. doodo, nakatti, bugga as greens

health. However, while most '*rural, low-impact traditionalists*' agreed with this, one '*rural, low-impact traditionalist*' (Participant 18), who earlier spoke at length of local and exotic chicken, alluded to the fact that not all oils were equally at fault. Participant 18 spoke of regularly consuming ghee because she believed it was healthier than vegetable cooking oil since it (ghee) was eaten in a state of naturalness:

> *'Ghee is better because it does not negatively affect your life in the same way that cooking oil does. For example, when you use cooking oil, you first put the saucepan on the fire and wait for it to dry and heat up, then you add the oil. Now when you place the onions in the pan you hear that sound 'chaaa' and it produces smoke that rises up, and you who is cooking or those around you do not feel good. But, when you are using ghee, and you are cooking maybe 'entula' or 'katogo', whatever, you do not need to fry it [ghee] first in the pan. You just use a spoon to measure out some [ghee] and add to your [already] cooked food.' (Participant 18, 'rural, low-impact traditionalists', rural, 35-49Y)*

For most '*rural, low-impact traditionalists*', particularly, the addition of either water (boiling) or vegetable oil (frying), removes staples and greens from a state of naturalness, which interferes with both the taste and healthiness of the food. The addition of water is linked with taking away from the way the food is intended to taste, while the addition of oil (an increase in the fat content of the food) is linked with a loss of *ekiliisa*, and therefore, healthiness. However, while most '*rural, low-impact traditionalist*' participants seem to agree with '*oil-free as healthier*', Participant 18's narrative adds another layer to the debate around fried food, i.e. intake of fried foods can be influenced by the meanings around how additives (vegetable oil) are added to food, rather than the additives themselves.

From their collective narratives, it is clear that among this group of rural dietary typology participants, understandings of the meanings around naturalness of food require a high degree of skill, i.e. being well versed in how foods are produced (or reared), cooked and prepared. The enactment of dietary practices that allow these participants to maintain the quality, taste and healthiness of food, by keeping its natural state, involves the application of these food knowledges, coupled with time, energy and materials to do this work. This is how, for example healthier and lower environmental impact dietary practices, e.g. eating *local chicken* over *exotic chicken*, 'pasted food' over fried food and consuming steamed food over fried food are perpetuated in these participants' daily lives.

Sub-theme: Meal Balancing

Unlike participants in the two rural dietary typologies, participants from the '*urban, medium-impact, mid-stage transitioners*' and the '*urban, low-impact early stage transitioners*' dietary typologies highlighted a need to strike some kind of 'nutritional or health balance' as a motivator in their dietary practices. Participants appraoched this balancing act in two ways, i.e. 'elimination and compensation' and 'introduction and replacement', depending on the dietary typology to which they belonged. With regards to this sub-theme, 'elimination' pertained to the attempts participants made to temporarily remove certain foods from their diets while compensation pertained to adding certain foods in larger-than-normal amounts to offset a perceived 'imbalance'. On the other hand, 'introduction' referred to bringing into the diet new foods that were previously not consumed by the participant, while 'replacement' pertained to subsituting one food for another on a more permanent basis than seen with 'elimination'. Each of these, as it pertained to participants' dietary practices are now discussed in turn.

'Elimination and compensation' were spoken of by many '*urban, medium-impact, mid-stage transitioners*' dietary typology participants. In this regard, participants told of actively and presently making conscious efforts to include meat-free eating occasions (elimination) in their daily lives. In other instances, participants spoke of deliberately including more green leafy vegetables or fresh salad (compensation) during certain mealtimes to balance out the meal. For example, Participant 1 said:

> *'Um, my breakfast for the past five days before I took this photo always had meat, meat, meat. I would do sausages. At times I would end up taking meat still, so I chose for lunch I wouldn't have meat.' (Participant 1, 'urban, medium-impact, mid-stage transitioners', urban, 18-34Y)*

Elimination and compensation were not only spoken of by '*urban, medium-impact, mid-stage transitioners*' dietary typology participants with regards to meat. Participants in this dietary typology expressed using similar strategies when it came to their eating of fried foods. In this sense, participants described compensating for a meal that included some fried food by including a good portion of boiled foods and in the same sitting, thereby avoiding 'too much oil'. Participant 3, a 42-year-old divorcee who had moved back into her parents' home with her children and had recently opened her own clothes shop in the area, exemplified this:

> *'…but when it is sauce like meat, and you have already used the oil for frying [the meat] …then you need [on your plate] something boiled without oil…' (Participant 3, 'urban, medium-impact, mid-stage transitioners', urban, 35-49Y)*

In this way, '*urban, medium-impact, mid-stage transitioners*' dietary typology participants negotiated between healthier and lower impact dietary practices (more vegetables and less meat and fried food) and higher impact dietary practices (more meat).

While elimination and compensation were more pervasive among '*urban, medium-impact, mid-stage transitioners*' participants, '*urban, low-impact, early-stage transitioners*' participants spoke of achieving 'meal balancing' by employing 'introducing and replacement' strategies. To begin with, most participants in this dietary typology spoke of regularly eating lower environmental impact plant-based foods in their present lives, including pulses like beans and peas, roots and tubers, traditional grains and some vegetables. Nevertheless, a number of participants in this dietary typology expressed a desire to eliminate some of these traditional grains, e.g. millet from their diets while at the same time incorporating or introducing a wider diversity of fruit, vegetables and animal-based foods, e.g. chicken and milk. For example, Participant 9, a 17-year-old who had just written her O' Level examinations and lived with her family in a semi-permanent structure in Naguru Go-down, a low-income, informal urban settlement, said:

> *'We would be balancing. Like now different meals…not like lunch, you eat beans and posho, then again at night you eat beans and posho... We would be balancing. Lunch…we would buy maybe like chicken. We would also eat avocado and maybe matooke and also juice would be there. Maybe we would have [at dinner] greens like cabbage and maybe fish and then maybe rice.' (Participant 9, 'urban, low-impact, early-stage transitioners' urban, 15-17Y)*

Unlike the '*urban, medium-impact, mid-stage transitioners*' participants, the 'introducing and replacement' strategies were spoken of by '*urban, low-impact, early-stage transitioners*' participants in more aspirational terms as they were largely dependent on participants' future financial means.

From these examples, it is apparent that while '*urban, medium-impact, mid-stage transitioners*' and '*urban, low-impact early-stage transitioners*' participants both speak of their dietary practices being influenced by a need to achieve balance, meanings of balance, and therefore strategies employed, were different. 'Elimination and compensation' were strategies presently employed by '*urban, medium-impact, mid-stage transitioners*' in an effort to offset what they perceived were high amounts of meat and (or) oil they were consuming and increase vegetable intake. In so doing, participants tailored their dietary practices to revolve between healthier and more sustainable meals that did not include higher-impact meats and higher-impact meals that included meats. On the other hand, 'introduction and replacement' were strategies that '*urban, low-impact early-stage transitioners*' hoped to employ in a future of increased financial freedom to achieve balance around their diets. By incorporating higher-impact, albeit nutrient-rich foods (meat, dairy), characteristic of more advanced stages in the NT, these participants' future dietary practices would be less sustainable compared to current dietary practices.

Sub-theme: Convenience

Convenience was a predominant theme among participants from two dietary typologies, i.e. *'urban medium-impact, mid-stage transitioners*' and '*rural, low-impact, early-stage traditionalists*'. Meanings of convenience, however, differed between participants in these two dietary typologies. First, experiences of the *'urban medium-impact, mid-stage transitioners*' are highlighted, followed with those of the'*rural, low-impact, early-stage traditionalists*' dietary typology.

Some participants from the *'urban medium-impact, mid-stage transitioners*' spoke of being motivated to consume a variety of foods that were conveniently packaged, could quickly be found, were easily cooked or ready-made. For example, in explaining why she frequently ate chicken and not *ndengus* (green grams), one of the few nutrient-dense, lower impact legumes that she could 'tolerate', Participant 1 remarked that:

> *'But the 'ndengus'…I do not know where they are. I have a feeling I saw them one time in Owino [downtown open market] but that was when I was in school. And who has the time to go all the way [down there] just to buy 'ndengus…' (Participant 1, 'urban, medium-impact, mid-stage transitioners, urban, 18-34Y)*

Possibly taking a trip to the downtown market to look for ndengus was a time-consuming, inconvenient chore in which this participant was not willing to participate. On the other hand, she could easily find pre-packaged, portioned chicken at any of her neighborhood supermarkets, which would demand less of her time. However, while regular consumption of nutrient-rich, higher environmental impact chicken by Participant 1 was motivated by convenience, Participant 2, a member of the same dietary typology, was motivated by the same need for convenience to partake of EDNP snack foods. Participant 2, a recently employed, single, 22-year-old woman that lived with her extended family in Naguru Go-down, a low-income, informal urban settlement, said:

> *'Let me say, for example, I need doughnuts, what I will do; I will have to get it from the [nearby] shop, not from the market [which is a bit further along]. I will 'just' go to the shop and get them.' (Participant 2, 'urban, medium-impact, mid-stage transitioners, urban, 18-34Y)*

These two examples highlight that while convenience is an important factor in influencing transitioning dietary practices more characteristic of the NT, i.e. animal protein consumption and EDNP convenience foods, the relative importance consumers place on the different dimensions of convenience depends on whichever person is making the choice on what to eat. To this end, when two similarly aged participants are presented with options on what to eat, all choices being time-saving time since they can be easily found, one person opts for pre-packaged chicken (easy to cook) while another opts for doughnuts (ready-to-eat).

Far from the *'urban medium-impact, mid-stage transitioners*', most participants from the '*rural, low-impact traditionalists*' spoke of their dietary practices being governed by what they could conveniently produce, i.e. what was easier for them to grow on land they either owned or rented. Participant 13, a single, 39-year-old peasant farmer, who explained why she frequently ate lower impact roots and tubers despite her preference for matooke, illustrates this:

'The easiest food to grow is cassava, sweet potato and maize because even if you do not own a plot of land, you can rent some land and grow [these foods on] it and have what to eat.' (Participant 13, 'rural, low-impact, traditionalists', rural, 35-49Y)

From this participant's account, as with that of many '*rural, low-impact traditionalists*', more importance is placed on what would save time in terms of cultivation.

The narratives from participants across these two different dietary typologies collectively highlight that while convenience alludes to an aspect of timesaving, it means different things to different people. For participants that obtain most of their food from 'own production', convenience relates to what is easiest and fastest to grow. On the other hand, for participants that rely on food purchases, convenience pertains to what is easy to find and prepare.

Sub-theme: Day-to-Day Variations

Participants across all four dietary typologies spoke of varying their diets to match different days, however, the particulars of this day-to-day variations in food intake differed between dietary typologies. To begin with, many participants across the four dietary typologies talked of making a deliberate effort to consume foods like white rice, meat, milk and fried foods on what they described as '*big days*', e.g. birthdays, Christmas and New Years'. For example, Participant 18, a 'rural, low-impact, traditionalist' that lived in rural Bulwanyi said:

> *'Yes, so the price of the local chicken is from 30,000 [Uganda] shillings upwards. So, when I have been fortunate enough to get at least 20,000 [Uganda] shillings, and there is a big day in the near future…I cannot lie by the way, I mostly eat chicken on 'big days'…' (Participant 18, 'rural, low-impact, traditionalist', rural, 35-49Y)*

For most participants across the four dietary typologies such '*big days*' held significant meaning in their lives which necessitated them being celebrated by eating 'special' foods. Because many participants in this study did not generally consume a lot of meat, dairy, and fried foods (markers of dietary transitions), these foods held a somewhat 'special' status making them particularly suited to celebrating these '*big days*'.

Nevertheless, in addition to '*big days*', some participants from the more affluent '*urban, medium-impact, mid-stage*' transitioners' dietary typology spoke of weekend days. While a number of these particpants spoke of eating meat more frequently through the week compared with participants from the other three dietary typologies, they still spoke of making a thing of eating meat at the weekends. Therefore, in addition to meat being a marker of '*big days*', amongst the '*urban, medium-impact, mid-stage transitioners*' participants, meat signals the rest afforded by the weekend as Participant 1 illustrates:

'[At the weekend] I would have an egg, I will have sausages…even if I do not have the juice with my breakfast, I will take most probably juice either an hour after or in the course of the morning I'll take the juice…and a fruit. And it is because I am at home [and I have time], so I can prepare it myself.' (Participant 1, 'urban, medium-impact, mid-stage transitioners', urban, 18-34Y)

In summary, across all four dietary typologies, '*big days*' (special days) are taken by participants as moments that should be celebrated by eating special food, of which meat and fried food are prime examples. However, more affluent dietary typology participants seem to attach similar meanings to weekend days and therefore indulge with more frequency in such less healthy and higher impact dietary practices compared with participants from less affluent dietary typologies.

Sub-theme: Feelings

Many participants' narratives, across the different dietary typologies expressed an underlying sentimentality about certain foods. While feelings of nostalgia seemed more prevalent among older participants across all four dietary typologies, a few younger participants spoke of resonating more with the ways in which eating certain foods made them feel presently. Feelings of enjoyment were spoken of when '*rural, low-impact traditionalists*' spoke of eating meat. This section explores feelings of nostaligia and enjoyment as these were more prevalent from participants' narratives.

Feelings of nostalgia seemed more prevalent among older participants, across the four dietary typologies. Nostalgia, for example, encouraged Participant 4, a married, 44-year-old woman in a peri-urban Kampala, to regularly partake of nutrient-rich, lower impact roots, tubers and traditional cereals despite the availability of more 'modern' (transitionary) foods, e.g. rice and '*posho*' in her neighbourhood:

'Potatoes first.... they are the ones I like most.... they just work for me. I do not know if it is because I grew up eating them, but I like them very much. When I eat them, I feel very happy and at peace. Even 'matooke'...and 'bushera'...' (Participant 4, 'rural, low-impact, early-stage transitioners', urban, 35-49Y)

Because their childhoods revolved around these foods, eating them often evoked feelings of nostalgia, coupled with enjoyment and happiness that motivated participants to continue eating these foods even as adults. For these older participants, enacting these dietary practices held more meaning than just being an act of eating. The enactment of these dietary practices served also as an act of holding on to happy memories from when they were children.

Somewhat different from participants in the other dietary typologies, '*rural, low-impact traditionalists*', particularly, frequently described feelings of enjoyment when eating foods like meat and chicken as a motivation to occassionally eat these foods. For example, in illustrating this sub-theme among participants of this dietary typology, Participant 13 remarked:

'Exactly, because I like it [matooke and meat] and I feel like I am really enjoying myself as I am eating that [matooke and meat]. I mean beef or goat. Really, I mean whatever it is that I can find as long as it is meat' (Participant 13, 'rural, low-impact, traditionalists', rural, 35-49Y)

It is unsurpising that feelings of enjoyment were more pronounced among the '*rural, low-impact traditionalists'* dietary typology because these participants spoke of not eating meat, except on the 'big days' previously described.

In summary, participants generally spoke about the way eating certain foods made them feel, i.e. the feelings evoked by this act of eating these foods. Indulging in the consumption of these foods, therefore, meant more than the act of eating, but was also a way of feeling these positive emotions.

Theme Summary: Individual-level Factors

The five main sub-themes pertaining to the individual-level factors among this sample of women were feelings, day-to-day variations, convenience, meal balancing and perceptions. While participants across all the four dietary typologies spoke around these themes, the meaning often varied between the four dietary typologies, e.g. meanings of convenience varied between '*urban, medium-impact, mid-stage transitioners*' (easy to cook and find) and '*rural, low-impact traditionalists*' (easy to grow). Participants' narratives show that pre-existing meanings (perceptions) play an important role in shaping dietary practices.

6.8.3 Social Networks

In this study, social networks encompassed the interactions between participants and family, friends, work colleagues and other people within their various physical environments. Three common sub-themes emerged among participants regarding how their social networks influence their dietary practices, i.e. parents, friends and other family members and food vendor reputation and trust. Parental influence was by far the most predominant influence on participants' dietary practices across all four dietary typologies. Friends' preferences was more prevalent among '*urban, medium-impact, mid-stage transitioners*' while 'other family members' was more frequently spoken of by '*rural, low-impact, early-stage transitioners*', '*urban, low-impact, early-stage transitioners*' and '*rural, low-impact, traditionalists*' dietary typologies participants. On the other hand, food vendor reputation and trust appeared more important to '*urban, medium-impact, mid-stage transitioners*' participants.

Each of the three sub-themes is discussed in the following section beginning with parents, and followed with 'friends and other family members' and 'vendor reuptation and trust'.

Sub-theme: Parents

A number of participants across all four dietary typologies expressed strong sentiments alluding to '*role modelling in the present time*' as the main way in which parents[60] imparted their influences on their dietary practices. From participants' narratives, it was apparent that the mechanisms by which parents exerted their influences served firstly to establish and then with time, to entrench dietary practices at different points along participants' lifecycles (from childhood through to adulthood). Parental '*role modelling in the present time*' is presented in the following section using examples from participants of the '*urban, medium-impact, mid-stage transitioners*' and '*rural, low-impact, early-stage transitioners*' dietary typologies from whom the bulk of narratives were unearthed.

Participants from the '*urban, medium-impact, mid-stage transitioners*' dietary typology spoke of experiencing the role modelling mechanism of parental influence differently depending on how old they were. For virtually all younger participants of this dietary typology, parental influence seemed to relate directly with food provisioning in the present time, i.e. what parents made available within the household. Since they were still in their care, these younger participants projected that they often felt as if they had no choice but to eat what was provided by their parents. From their narratives, it was clear that these participants' mothers, rather than their fathers, usually played this provisioning role. Participant 7, a 15-year-old high school student who lived with her parents and helped her mother at the small family restaurant during the school holidays, had this to say regarding her photograph that illustrates this point:

[60] Parents in this PhD thesis include participants' biological parents, aunts, uncles, grandparents and other older relatives that might have played a parenting role in participants' upbringing

'Um, I came [to the family restaurant] early morning then my mum prepared [breakfast]. Then she told us to come and eat and I took a photo. I was having matooke, irish potatoes, with meat and then rice, plus a cup of black tea.' (Participant 7, 'urban, medium-impact, mid-stage transitioners', urban, 15-17Y)

While the narratives for most younger participants in the '*urban, medium-impact, mid-stage' transitioners*' dietary typology seemed to indicate that mothers were more influential in this sense, a few of these participants spoke of their fathers influencing their dietary practices by impressing their own food preferences over the entire household when they refused to eat certain things. This was usually the case when fried foods were involved. This is illustrated by the accounts of two participants, one rural (Participant 17) and another urban (Participant 7). Participant 17 was a 17-year-old single unemployed girl who lived with her parents in peri-urban Nakawuka parish. She remarked that:

'If my dad however is going to eat the 'nakatti' [traditional vegetables], or any other thing for that matter, and he prefers for the food not to be fried, then all of us will eat boiled food that day.' (Participant 17, 'urban, medium-impact, mid-stage transitioners', rural, 15-17Y)

Participant 7, a 15-year-old high school student who lived with her parents remarked:

> *'...because my father is not used to that much cooking oil because it [meat] might already be having [a lot of fat] and if we add [vegetable oil or cooking fat] it [oil] might become too much and he might not eat.' (Participant 7, 'urban, medium-impact, mid-stage transitioners', urban, 15-17Y)*

These sentiments were shared by a number of similarly-aged '*rural, low-impact, early-stage transitioners*' dietary typology expressed similar views. For example, Participant 15, an unmarried 16-year-old girl who lived with her siblings at her parent's home in peri-urban Nakawuka parish, which housed a small poultry business, stated:

> *'At home, we do not eat 'local chicken'. I do not know why. Unless maybe the local chicken is sick. That is the only time when we can eat them at home. That is what my dad said. He refused us to eat them [local chicken] when they are still alive and well because it affects his business negatively when we do.' (Participant 15, rural, low-impact, early-stage transitioners, rural, 15-17Y)*

The narratives among such younger participants is illustrative of gender dynamics in parental role modelling, i.e. different parents approach the responsibility of shaping their younger children's dietary practices in different ways. While mothers seem to play a more direct role by limiting what is available through provisioning (you cannot eat what is not there), fathers act less directly (you cannot go against the 'law').

On the other hand, for older participants from the same '*urban, medium-impact, mid-stage transitioners*' dietary typology, parental influence was less exacting. Parents, particularly mothers, rather than provisioning or 'enforcing' what fathers said must be eaten, advised participants on what they thought they should eat and then allowed them to make their own decisions. For example, in speaking about githeri minji[61] , Participant 1 mentioned:

> *'I grew up eating the one [githeri] with the beans, but since I do not like the beans…so this [githeri minji] was introduced to me by my mum and when she introduced it to me I was like 'oh, good substitute for the beans!' (Participant 1, 'urban, medium-impact, mid-stage, transitioners', urban, 35-49Y)*

From these participants' accounts, parents are one of the vehicles through which dietary practices are established in participants' lives. Younger participants speak more about

[61] Traditional Kenyan dish made from boiling maize and garden peas in the same pot

their dietary practices being shaped more directly by what parents provide, while older participants highlight less exacting parental influences.

Sub-theme: Other Family Members and Friends

From their photo-stories, it was clear that when participants ate by themselves (not in company), they were more likely to yield to their personal preferences. However, when participants ate in the company of family or friends, their preferences (and therefore perceptions) appeared less important. Participants across all four dietary typologies projected that eating in the company of 'other family members' (apart from parents) and sometimes even friends, rather than by themselves shaped their dietary practices in two ways. Firstly, eating in company motivated participants to partake in the practice of eating food, although they might not have otherwise planned to do so. Secondly, eating in company influenced what kinds of things participants ate. Among '*urban, medium-impact, mid-stage transitioners*', the influence of friends was more common, while 'other family member' influence was prevalent among participants across the other three dietary typologies. The following section describes this sub-theme beginning with the experiences of participants from the '*rural, low-impact, early-stage transitioners*', '*urban, low-impact, early-stage transitioners*' and '*rural, low-impact, traditionalists*' dietary typologies. This is followed by photostories from '*urban, medium-impact, mid-stage transitioners*' dietary typology participants.

A number of participants from the '*rural, low-impact, early-stage transitioners*', '*urban, low-impact, early-stage transitioners*' and '*rural, low-impact, traditionalists*' dietary typologies spoke about at length of how their non-parent family members' shaped their dietary practices. From these participants' accounts these non-family members were predominantly their spouses and children. Eating in the company of spouses and children was sometimes enough to encourage participants to eat what they otherwise disliked. For example, Participant 4, a 44-year-old married woman who had moved to Kampala from Southwestern Uganda where she spent her non-adulthood years and lived with her husband and children near her tailoring business, said:

> *'I can eat even [when I am] with my family 'posho' but [it is] not what I want.' (Participant 4, 'urban, medium-impact, mid-stage transitioners', urban, 35-49Y)*

Being married and having children also seemed to serve as a motivation for many participants across the three aforementioned dietary typologies to eat a wider variety of foods. Participants mentioned sometimes making concessions to engage in less healthy dietary practices, e.g. eat more nutrient-poor foods like white rice, chips and other fried foods in place of what they might have otherwise preferred (nutrient-rich boiled or steamed matooke and yams) because it was what their children preferred. For example, Participant 16, a 32-year-old woman who resided in peri-urban Nakawuka parish, with her extended family, in explaining why she constantly bought rice, even sometimes on credit, despite having other options in the home garden said:

'… at home, if you want to see each one's happiness, like mainly the kids, you just prepare rice.' (Participant 16, 'rural, low-impact, early-stage' transitioners', rural, 18-34Y)

In these instances, these 'other family members' impress their own pre-existing preferences, for different foods on participants, and in an effort to make them happy, participants oblige.

However, while 'other family member' preferences seemed more important among the three previously highlighted dietary typologies, among the '*urban, medium-impact, mid-stage transitioners'*, friends seemed to play a similar role in shaping participants' dietary practices. This was often observed in situations during which participants socialised, e.g. home visits by friends, hanging out and eating out at restaurants. In these circumstances, participants described a number of mechanisms through which friends influenced their food choice paramount of which was choosing what they and the participant ate or shared at that eating occassion, which this was sometimes an unfamiliar dish, they thought the participant should try. For example, Participant 1, in narrating why she ate fish instead of chicken, which she described as her '*comfort zone*', spoke about her friend:

'...it was at a restaurant. It was a Friday…a Saturday afternoon. We just decided to go out with a friend of mine, and I had a meal because I was hungry. If it is…now like this, even just the meal alone it was someone else's influence. Even the place that we went to, it was more of their choice than mine.' (Participant 1, 'urban, medium-impact, mid-stage transitioners', urban 18-34Y)

Similar to other family members, friends challenge the preferences that participants held toward certain foods by impressing their own pre-existing preferences on them. Therefore, in enacting what they believe it means to be a good spouse, mother or friend, participants prioritise the preferences and needs of either their non-parent family members or friends, participants' are introduced to new food ways although this sometimes translates into eating more nutrient-poor foods that they would otherwise have preferred to avoid. 'Other family member' preferences appear more influential among '*rural, low-impact, early-stage' transitioners*', '*urban, low-impact, early-stage transitioners*' and '*rural, low-impact, traditionalists*' participants while among '*urban, medium-impact, mid-stage transitioners*', friends exert a similar influence by cajoling participants to sometimes try out new foods.

Sub-theme: Food Vendor Reputation and Trust

In addition to the previously mentioned sub-themes, the reputation of food vendors was a common theme among most '*urban, medium-impact, mid-stage transitioners*' dietary typology participants. Among participants across the other three dietary typologies, i.e. '*rural, low-impact, early-stage' transitioners*', '*rural, low-impact, traditionalists*' and '*urban, low-impact, early-stage transitioners'*, issues around reputation and trust were not as salient. This is perhaps because most participants in these three dietary typologies, especially in the two rural typologies, grew their own food and so possibly had a greater sense of control over the 'quality' of what they ate. Reputation and trust, as experienced by '*urban, medium-impact, mid-stage transitioners*' practitioners is explored below.

Participants of the '*urban, medium-impact, mid-stage transitioners*' dietary typology mentioned food vendor reputation and trust when it came to the purchase and consumption of fruit and vegetables, both nutrient-rich and lower environmental impact options. For example, Participant 7, an adolescent living in a middle-income urban neighbourhood, felt motivated to visit a particular food outlet because she was sure of the quality of the produce and liked the kind of service she received from the food vendor. Owing to this, she had forged some kind of relationship with the vendor, which she exercised by regularly purchasing fruit and vegetables from there. She remarked:

'...because she [food outlet attendant] is always free [friendly and welcoming]...um...and they do not over sell their things at a higher price...they sell their products at a lower price and they are of good quality.' (Participant 7, 'urban, medium-impact, mid-stage transitioners', urban, 15-17Y)

However, not all participants in this dietary typology expressed positive sentiments regarding fresh food vendors in their neighbourhood environments. For example, rather than feeling motivated, Participant 2, who lived in a low-income urban neighbourhood, felt discouraged from purchasing vegetables from the local fresh food market owing to the questionable quality of the produce sold. She remarked:

'...when I need something, which is fresh like the greens, obviously I have to go to the market...no to the garden. Remember I have my own garden, so I will just rush to the garden and then I go get them and come and cook than going to the market. Sometimes they have stayed for some two days [in the market] and they [food vendors] keep on watering them to make them not dry. So, I need something which is fresh, and you know and with all that colour.' (Participant 2, 'urban, medium-impact, mid-stage, transitioners' urban, 18-34Y)

For '*urban, medium-impact, mid-stage transitioners*' participants, dietary practices regarding particularly the consumption of healthier and more sustainable fresh produce, are influenced by the level of trust they have in fresh food vendors at food outlets in their neighbourhood environments.

Theme Summary: Social Networks

Participants across all four dietary typologies highlighted parents, other family members and friends and food vendor reputation and trust as important factors within their social environment that influenced their dietary practices. Food outlet reputation and trust were spoken of in the purchasing of fresh produce among '*urban, medium-impact, mid-stage transitioners*'. From their collective narratives, it is apparent that the meanings that participants across all four dietary typologies attach to being a 'good' mother, spouse or friend are drawn on to support the enactment of certain dietary practices, e.g. sometimes eating less healthy foods like chips to appease their children.

6.8.4 Physical Environment Factors

The physical food environment mainly encompassed the areas in which participants lived and to a lesser extent the places where they schooled or worked. Four overarching sub-themes emerged in as far as participants' physical environment was concerned. These four sub-themes centred on the type(s) of food available within the household, physical access (distance) to neighbourhood food outlets, kind(s) of food available in neighbourhood food outlets and economic access i.e. cost of food at the neighbourhood food outlets. The next section highlights each of these four sub-themes with reference to the four dietary typologies into which participants were clustered.

Sub-theme: Household Food Availability

Many participants across all four dietary typologies spoke of eating certain foods because this was what was readily available within their households. The availability of foods within participants' households was dictated by the presence or absence of different resources or facilities (materials) within the home environment. For many participants across all the four dietary typologies, these facilities and resources (materials) took the form of home gardens that allowed participants to grow and regularly eat fresh, low-environmental impact plant-based foods, e.g. various fruit, vegetables, legumes (beans and groundnuts), roots and tubers (sweet potatoes and cassava), matooke and some grains e.g. maize. However, while home gardens and what they made available within the home environment were highlighted by a number of participants across all four dietary typologies, the quotations on this sub-theme were dominated by women from the two rural dietary typologies, i.e. '*rural, low-impact, traditionalists*' and the '*rural, low-impact, early-stage transitioners'*. This suggests that the dietary practices of participants in these two rural dietary typologies are more tied to 'own production' compared with participants in the two urban dietary typologies, who sourced their food from elsewhere in addition to own production. The significance of home gardens is demonstrated by this photograph and quote by Participant 12, a married, 41-year-old peasant farmer:

'…that is the garden from which we get our food.... Although you cannot see it properly, there is some cassava in there. What you can see clearly is the 'gyobyo' [spider plant], soya beans and beans. …there is another photo I took of [another section of] the garden, showing maize and groundnuts...' (Participant 12, 'rural, low-impact, traditionalist', rural, 35-49Y)

Among the '*urban, medium-impact, mid-stage transitioners*', in particular, the presence of other tangible resources (materials) apart from home gardens, in the form of home ovens and refrigerators, played a role in participants' dietary practices. These additional resources or facilities allowed participants to cook and therefore make available different foods as well as facilitated the storage of excess food so that participants could eat them whenever they wanted. For example, in speaking about why she was able to eat '*githeri* *minji*', whenever she had a hankering for it, Participant 1 mentioned the revolutionary role of the fridge:

> *'Now, the surprising thing is this thing [githeri minji] has been in my fridge since September…the mixture of maize and peas since September. So, I boiled it and I froze it. So, I have been having it in my fridge.' (Participant 1, 'urban, medium-impact, mid-stage transitioners', urban, 18-34Y)*

While there is no doubt that a home garden is useful in that it can provide the requisite materials (in this case the ingredients required to make *githeri minji*, i.e. peas and maize), the refrigerator adds another dimension to the importance of the right materials within the physical environment. By being the place in which the participant can store cooked food, the refrigerator provides an enabling environment that allows the participant to partake in the practice of eating this traditional plant-based dish when the need arises.

From these narratives, it can be said that the availability of food within the home environment, mediated by participant-owned materials, in the form of home gardens and some electronic appliances, by providing an enabling environment that supports the enactment of healthier and lower impact dietary practices that revolve round the consumption of mostly plant-based foods.

Sub-theme: Economic Access

Participants in three dietary typologies, i.e. '*urban, low-impact, early-stage transitioners*', '*rural, low-impact, early-stage transitioners*' and '*urban, medium-impact, mid-stage transitioners*' highlighted financial constraints, often spoken of as the high cost of different food items, as influencing their dietary practices. From these participants' narratives, it was clear that finances played an important role in their making decisions regarding the places from where they could purchase food. Even after deciding where they could buy food from, many participants across these three dietary typologies revealed that finances dictated whether they could afford and purchase certain food items and therefore why they bought certain food items over others. Finances limited the consumption of different foods depending on the dietary typologies under consideration, of the aforementioned three. For '*urban, medium-impact, mid-stage transitioners*', finances served as a barrier to dietary practices associated with more advanced stages in the NT, i.e. eating out more regularly at high-end restaurants (Participant 1) and purchasing sugar-sweetened juice drinks (Participant 17), as one rural adolescent said:

> *'There is some packed mango juice, which is nice but is expensive. We cannot afford it' (Participant 17, 'urban, medium-impact, mid-stage transitioners, rural, 15-17Y)*

In one incident, however Participant 7, an urban adolescent from the '*urban, medium-impact, mid-stage transitioners*' dietary typology spoke of the affordable cost of fresh produce at a neighbourhood food establishment as motivation to regularly purchase and consume fresh vegetables:

> *'…um…and they [neighbourhood food outlet] do not over sell their things at a higher price…they sell their products at a lower price… onions, tomatoes, carrots, green peppers, irish potatoes plus so many other things' (Participant 7, 'urban, medium-impact, mid-stage, transitioners', urban, 15-17Y)*

From their accounts, it can be said that for participants in the '*urban, medium-impact, mid-stage transitioners*' dietary typology, when cost of food is highlighted as a barrier, this is generally towards the consumption of items that might be considered somewhat 'luxurious' or 'modern', i.e. hallmarks of transitioning dietary practices.

On the other hand, among '*urban, low-impact, early-stage transitioners*' and '*rural, low-impact, early-stage transitioners*', the cost of food was highlighted as a limitation to purchasing even the most basic food items required daily. For example, Participant 5, an urban resident from the '*rural, low-impact, early-stage transitioners*' dietary typology lamented the high cost of pulses in her local neighbourhood market as a barrier:

> *'…here in Nakawa [market] it [black beans] is there, but it is a bit expensive; it is like a kilo 5,000 [Uganda shillings] or 4,000 [Uganda shillings]. Here it is quite expensive. 'Lapena' [pigeon peas] even is 5,000 [Uganda shillings per kilogram].' (Participant 5, 'rural, low-impact, early-stage transitioners', urban, 35-49Y)*

Moreover, among women in these two dietary typologies ('*urban, low-impact, early-stage transitioners*' and '*rural, low-impact, early-stage transitioners*'), food cost was even more limiting during periods when fruit, vegetables and legumes were out of season or during periods when participants that had home gardens waited for their produce to mature. Furthermore, participants across these two dietary typologies ('*urban, low-impact, early-stage transitioners*' and '*rural, low-impact, early-stage transitioners*') mentioned the high cost of animal foods, so much so that they were forced to consume these products irregularly, reserving them for only for '*big days*'. In this way, cost served as a limitation (and therefore buffer) against regular meat consumption among participants in these two dietary typologies. For example, Participant 11, a 19-year-old volunteer community health worker who resided in peri-urban Nakawuka parish with her extended family explained why she rarely ate chicken, which she described as 'her food':

'If I get money, I eat 'my food'. If I do not get, I just eat for the satisfaction whatever…the satisfaction factor' (Participant 11, 'urban, low-impact, early-stage transitioners', rural, 18-34Y)

These examples demonstrate the clear importance of money as a material (reflected in food cost) in facilitating or limiting participants' dietary practices. High cost is a limitation to purchasing packaged items and eating out among '*urban, medium-impact, mid-stage transitioners*'. Conversely, eating fruit, vegetables and legumes out of season, eating meat regularly and sometimes purchasing basic food items is limited by lack of money among '*urban, low-impact, early-stage transitioners*' and '*rural, low-impact, early-stage transitioners*'.

Sub-theme: Neighbourhood Food Availability

According to participants' accounts, even in instances where they had money, the kinds of food available to them in their immediate neighbourhood food outlets could be either a limitation or facilitator in the consumption of certain food. The dominance of perspectives from *'urban, low-impact, early-stage transitioners*', '*rural, low-impact, early-stage transitioners*' and *'urban, medium-impact, mid-stage transitioners'* suggests this was a more important influence over the dietary practices of participants from these three dietary typologies compared with '*rural, low-impact traditionalists*'. The kinds of food available in the urban neighbourhood or rural communities in which participants lived directly influenced what participants could or could not eat, simply because you cannot eat what is unavailable. For example, Participant 14 was vexed by the lack of '*matooke'* in her rural neighbourhood of Bulwanyi parish:

> *'…but what I like most is matooke. The only problem is that, in the area in which I live, there is no matooke. If I want it, then I have to travel far to get it. I would have to, for instance, leave home and travel a long distance to buy it.' (Participant 14, 'urban, low-impact, early-stage transitioners', rural, 18-34Y)*

In addition to food availability within the immediate home neighbourhoods or communities, '*urban, medium-impact, mid-stage transitioners*' spoke of the kinds of foods that were available in the physical spaces beyond their places of residence. For example, Participant 7, an urban adolescent told of how she felt she had no option but to wait until the school holidays to drink her juice because it was unavailable at school:

'OK. I drink it [passion fruit juice] when I am at home because when I am school, I do not often drink it because it is not there. That is why when I return home, I have to drink it all the time because I am used of it and I like it' (Participant 7, 'urban, medium-impact, mid-stage transitioners', urban, 15-17Y)

Participant 1 spoke of eating a banana and snacks daily courtesy of her workplace:

'So [for lunch] it a mug of yoghurt and whatever snack is provided by the office…that is an ordinary working day. I think it [lunch] is always [accompanied by] a banana because it is readily available….' (Participant 1, 'urban, medium-impact, mid-stage transitioners', urban, 18-34Y)

While the work environment provided an enabling environment for Participant 1 to eat fruit and snacks daily, it was the opposite for Participant 8, a 17-year-old restaurant worker, who dropped out of school to supplement her family income and lived with her parents in a low-income area. Participant 8 felt limited in what she could eat at her workplace (restaurant) because she could have her meals until the lunch rush had finished. This meant that she was often forced to eat whatever customers left behind, and not what she might have preferred if she were a paying customer:

'We [the restaurant workers] tend to eat sweet potatoes and cassava because the matooke never remains…it is always finished because whichever customer comes [to the restaurant] asks first for matooke. That is what they like most.' (Participant 8, 'urban, low-impact, early-stage transitioners', urban, 15-17Y)

The availability of foods in the neighbourhood environment plays a direct (enabling or limiting) role in influencing participants' dietary practices by making available (or unavailable) different foods in the various spaces that participants interact with in their daily lives.

Sub-theme: Physical Access

For participants who obtained a significant proportion of their food from sources other than their home gardens, physical access to neighbourhood food outlets was highlighted as an important influence behind dietary practices. Since most participants in the two rural dietary typologies spoke of producing their own food, it was unsurprising that physical access to food outlets was more important to participants from the two urban dietary typologies. Most participants in the two urban dietary typologies discussed physical access to food outlets, e.g. shops, restaurants, supermarkets, markets in terms of the distance between their homes and the food outlets. For these participants the nearness to neighbourhood food outlets provided convenience, especially when participants were faced with time constraints. In such circumstances food choice decisions, which had previously been enacted in similar circumstances, came to the fore resulting in participants eating specific foods. To illustrate this, Participant 2, one of the '*urban, medium-impact, mid-stage transitioners*', explained how she came to rely on spaghetti, on the days when she got home late from work:

> *'Let me say for example I need to eat spaghetti so I will just run to the shop…whereby I know that garden does not have it. I will just go to the shop, I get my spaghetti and come and prepare' (Participant 2, 'urban, medium-impact, mid-stage transitioners', urban, 18-34Y)*

On the other hand, one participant from the same '*urban, medium-impact, mid-stage transitioners*' dietary typology, who lived in the rural Bulwanyi parish, told of how her and her family mostly ate sweet potatoes because it was readily available at the fresh food stall right next to her home. This saved her, on many occasions, from making the somewhat long journey to the market:

'Sweet potatoes are the food that are readily available and nearest to us, and so they are the food we usually eat. Moreover, at that stall from which we buy food, it is what is available. At that stall, they do not sell anything else like rice. All she has is sweet potatoes and matooke' (Participant 17, 'urban, medium-impact, mid-stage transitioners, rural, 15-17Y)

In other instances, some participants expressed frustration at being unable to eat certain foods, in part, because they would have to travel far to get them, which would interfere with other activities in their daily lives. For example, Participant 14 mentioned:

> *'…it [sweet potatoes] is what I eat most of the time but what I like most is matooke. The only problem is that, in the area in which I live, there is no matooke. If I want it, then I have to travel far to get it. Or maybe I could come here to Nakawuka to buy it but that would have to be when I am running other errands because I cannot just travel all the way from home to Nakawuka purposely to buy matooke when the sweet potatoes are readily available at home. I can just go to the garden, get the sweet potatoes, cook them and eat. So, for me, that is how sweet potatoes have become my food.'' (Participant 14, 'urban, low-impact, early-stage transitioners', rural, 18-34Y)*

The nearness of participants to certain food outlets offered convenience such that participants were willing to eat whatever was available in these food outlets.

Theme Summary: Physical Environment

The common four sub-themes in participants' physical environments that influenced their dietary practices included economic access, physical access, household and neighborhood food availablity. Physical access interacted with convenience to either enable or limit participants from consuming certain foods, while economic access (affordability), physical access and availability were also closely inter-linked.

6.8.5 Sociocultural Environment Factors

The socio-cultural environment, in the context of this study includes the values, expectations and understandings that encompass the context in which study participants lived, worked and studied (Osei-Kwasi et al., 2017) at the time of the study. The social-cultural environment did not seem as common as other factors (individual-level, social networks and physical environment) to participants across all four dietary typologies. The main sub-theme regarding the sociocultural environment was sociocultural norms, which was expressed by participants as '*the way we grew up*', '*they say*', '*people say*' as discussed in the next section.

Sub-theme: Sociocultural Norms

The influence of parents in past times (*'the way we grew up'*) was strikingly apparent in the narratives of some participants across all four dietary typologies. For example, '*rural, low-impact traditionalists*' seemed generally resolute that, based on the parental advice they received as children, it was best to eat plenty of steamed vegetables. Frying vegetables carried a negative connotation, as participants' parents had given them the impression that the addition of vegetable oil would somehow make the otherwise good vegetables 'bad' (less healthy). However, this was not limited to the intake of fried vegetables vs steamed vegetables. This parental influence (past translating into the present) also explained why some '*rural, low-impact, early-stage transitioners*' and '*rural, low-impact, traditionalists*' participants spoke of eating meat less frequently (or not at all) compared to participants from the two urban dietary typologies. For example, Participant 12, a married, 41-year-old peasant farmer explains why she does not eat pork and fish as an adult, although she occasionally eats chicken and beef:

> *'…At home, I lived with my mum and dad. When my father would buy pork and bring it home, he would bring another [plant-based] sauce as well. We would cook it and then my mother and we the girls would eat that other [plant-based] sauce while my father and the boys would eat the pork. He would eat with the boys, and then the rest of us [females] would eat separately.' (Participant 12, 'rural, low-impact traditionalist', rural, 35-49Y)*

Parents impress 'dietary norms' on their children when they are still young and impressionable. From these accounts, it is apparent that eating (or not eating) certain foods in adulthood has more meaning to participants than just eating but is an act of paying homage to their parents. For most participants, 'dietary norms' introduced by their parents during their childhoods, were often kept later on in adulthood, even though participants did not exactly understand why, had greater autonomy over their food choice as adults and their parents were no longer present to enforce such norms.

However, while it seemed that most participants across the four dietary typologies seemed to keep with these childhood-established norms of dietary practice, two '*urban, low-impact, early-stage transitioners*' (Participant 6 and Participant 14) spoke otherwise. Participant 6, an unemployed 25-year-old housewife who lived with her family in Naguru Go-down, a low-income informal urban settlement, and occasionally travelled to the village to visit her extended family, spoke of deliberately seeking out things she did not eat as a child and avoiding those things she felt she had too much of growing up. From her narratives, it was apparent that two transitions served as the turning points that facilitated a deviation from her childhood dietary norms. The first was becoming an adult and therefore achieving more autonomy over her own home, and therefore food choices, and the second was relocating from the village to the capital, Kampala. This move afforded her access to a wider diversity of foods. These two turning points together seemed to provide fertile ground for Participant 6 to 'rebel' against what, for one reason or another, she had been 'denied', as a child growing up in the village. To illustrate this, Participant 6 explained, in both present and aspirational terms, why sometimes she substituted millet (lower impact, traditional grain) with rice (higher impact, 'modern' grain):

> *'[If I had the financial means to] I would kick away the millet, 'banange' [oh my goodness]. At least beans. That one, yes, I would still remain eating. Then greens, yes, as my side dish also. [Because] I ate much of it [as a child] I got tired of it [millet].' (Participant 6, 'urban, low-impact, early-stage transitioners', urban, 18-34Y)*

However, while marriage was liberating to Participant 6, the same could not be said for Participant 14, a married 20-year-old peasant farmer that lived in the rural Bulwanyi parish with her family. Participant 14 spoke of moving to her husband's hometown from her parents' home (after she got married) as the transition that forced her to substitute her childhood food (medium-impact 'matooke') with cassava and sweet potatoes (lower impact roots and tubers):

'I like 'matooke' best because it is what I grew up eating at my parents. I have actually learnt to eat all other 'emmere enkalu' [dry food] as an adult. I did not even know much about other foods before. Where I live now, however, there is no…. you know when you find yourself living in a place with people who live within certain means and you find that they eat certain foods, you must adapt and learn to eat the same things. You do not really have a choice. You cannot begin throwing tantrums and demanding that they provide for you something to eat, which is different from what they themselves eat.' (Participant 14, 'urban, low-impact, early-stage transitioners', rural, 18-34Y)

From these examples, it is clear that old ways of doing things (dietary norms) passed on during childhood are usually maintained in adulthood, almost as an ode to parents. However, where such norms are challenged, intentions to change dietary practices are sometimes insufficient. In these instances, materials such as money are required to purchase alternative foods and facilitate new ways of doing dietary practice.

Still with regards to sociocultural norms, some participants from all four dietary typologies spoke of eating certain foods because these things were what qualified as food in the sociocultural contexts within which they lived. These participants used words and phrases such as '*our food*' and '*in our culture*' to denote attachment to their traditional foods and traditional ways of doing things, e.g. cooking. This conviction to keep with the old ways of doing things as stipulated by her cultural heritage meant Participant 2, one of the '*urban, low-impact, early-stage transitioners*', ate millet (traditional grain) in place of 'posho' or rice (both refined cereals) despite living in the capital, because that was what was considered the food of the people from her culture. In another instance, Participant 14, another '*urban, low-impact, early-stage transitioners*', that lived in the rural context, spoke of a desire to eat matooke, and not cassava and sweet potatoes because that was what a 'real food' meant for people from her hometown:

> *'In Masaka, matooke is what they know as food. Only now, it is extremely hot so the matooke has dried up, but there, someone cannot eat sweet potatoes two days in a row and feel as if they have eaten food. Even a person of minimal means will see to it that if they have sweet potatoes maybe for lunch, then at supper they eat matooke'. (Participant 14, 'urban, low-impact, early-stage transitioners', rural, 18-34Y)*

In the instances where participants spoke of ties to their cultural heritage, their upbringing was often highlighted as the points at which these traditions were infused. However, while participants generally spoke of links with the past tradition, Participant 7, an urban adolescent from the '*urban, medium-impact, mid-stage transitioners*' expressed sentiments from a somewhat different perspective. This participant first highlighted the 'current understanding', among people in her urban community as well as her contemporaries in boarding school, towards beans and 'posho' (two lower environmental impact options):

> *'Um, because they tell us that there are prisoners who eat beans with posho…posho. OK, like posho for maybe chicken and they give it to human beings in prison…and beans, which are not fried. So, I just hate them [posho and beans] because I am not a prisoner' (Participant 7, urban, 'urban, medium-impact, mid-stage transotioners', 15-17Y)*

From this account, while it was not apparently clear to the participant who '*they*' referred to, the sullied reputation these foods held among the people with whom she presently interacted, such that anyone who ate them became inferior, served as a deterrent. This participant, therefore, felt compelled to gravitate towards eating meat and matooke (two higher environmental impact options) instead:

> *'Yes, when they talk of matooke and meat they say it is for the rich people…the ones who are hardworking…the ones who have good hearts. Then I just eat [meat and matooke]'. (Participant 7, 'urban, medium-impact, mid-stage transitioners', urban, 15-17Y)*

Participant 7, therefore, used this act of turning away from 'bad' food towards 'good' food, as dictated by *they*, as a way of asserting that she is different (good, rich) as opposed to bad (poor, lacking freedom). In this way, her sociocultural environment (societal labels) shapes her dietary practices.

Theme Summary: Scociocultural Environment

While not the most frequently highlighted influence on dietary practices among this sample of women, in instances where it was highlighted, the sociocultural environment came across in two ways, i.e. 'informed of the past' and 'moulded by the present'. For most participants the influence of the sociocultural environment was often tied to keeping with the traditions of their places of origin, i.e. informed of their cultural heritage stemming from the past. That most participants highlighted their upbringing as the point at which dietary traditions were infused is suggestive of the role of parents and other similar caretakers as purveyors and vehicles through which dietary practices, borne of the sociocultural norms at that any point in time, are introduced and enacted by participants in later life. The importance of 'current' norms, as established by what the present society is like, is also briefly highlighted. In these instances, parents seem to play less of a central role, the general society ('*they*') and peers being more influential.

6.8.6 Macro Environment Factors

The macro environment encompassed factors operating within the larger society over which the individual may have limited direct control, e.g. food marketing and advertising, media, food production and transportation systems and agriculture and economic policies (Story et al., 2008). The main sub-themes in as far as participants' macro environment was concerned pertained to food production (seasonality) and transportation. Participants interacted with these themes in different ways depending on whether they belonged to rural or urban dietary typologies, however, because participants across the dietary typologies often spoke of these two sub-themes in tandem, they are presented together.

Sub-theme: Food Production and Transportation

While participants across all four dietary typologies spoke less of macro-level influences compared with other factors, there was some mention of the role of food production in the form of seasonality. Among participants in the two rural dietary typologies, particularly, it was apparent that seasonality directly influenced dietary practices by dictating what foods could grow at different periods of the year (what participants had available to eat). This seemed particularly important to these participants in the two rural dietary typologies given that most of them spoke of cultivating the bulk of what they ate from their home gardens. For example, Participant 31, who lived in the peri-urban Nakawuka parish mentioned:

> *'…we have [in the garden] some bananas…yellow bananas. So, if it is ready [in season], we just take it as part of an escort, and it has to be part of the menu. [Otherwise] we cannot get money that we are going to buy yellow bananas [from the market] but when it is ready from the garden, we just put it on the menu as an escort' (Participant 16, rural, low-impact, early-stage transitioners', rural, 18-34Y)*

For these participants, seasonality plays an important enabling (in season) or limiting (out of season) role in shaping 'plant-based food' intake, particularly fruit and vegetable, legumes, staples (matooke, sweet potatoes and cassava) and some grains (maize).

Among participants in the two urban dietary typologies, seasonality influenced dietary practices in a slightly different form. When certain foods were in season in other parts of the country, it provided a buffer against high cost in the urban markets. This coupled with the transport infrastructure, from rural areas where the bulk of foods are produced, meant that such participants could have better economic access to these plant-based foods. For example, Participant 6 explained how she was able to eat fruit while living in the city:

> *'Um, sometimes I do have watermelon, like as per now it is the season so you can get them cheaply in the market. You can buy one and you eat that one. Then sometimes these 'bu' banana bananas, those small ones, these sweet bananas…' (Participant 6, 'urban, low-impact, early-stage transitioners', urban, 18-34Y)*

This same Participant 6 spoke of the interplay between transport and seasonality when she spoke at length of how she was able to bring into her home in Kampala, a variety of pulses, e.g. black beans and pigeon peas, from her village home. The pulses were dried by her extended family in the village when they were in season. She obtained the pulses when either she travelled to the village or they were sent to her by bus so that she could eat them cheaply all-year round, since they were otherwise highly priced where she lived in Kampala. While she was able to obtain pulses in this way, she was unable to get cheap in-season fruit from the village because it would go bad in transit.

These narratives indicate that seasonality clearly plays a direct role (food availability) in the dietary practices of participants from the two rural dietary typologies. However, seasonality appears to play a more distal role for urban dietary typology participants. While the transport infrastructure serves as an enabling factor in the consumption of some foods (dried) among urban dietary typology participants, it is in equal measure a disabling factor in the consumption of perishable in-season foods.

Theme Summary: Macro Environment

From these participants' accounts, it is clear that seasonality and transportation, and the materials of which they are constituted (seasonal food, transport trucks, roads), are inextricably linked in influencing dietary practices that revolve around the consumption of healthy, lower impact plant-based foods, particularly among participants from the two urban dietary typologies.

The next section discusses the study's main findings with respect to the literature on influences behind dietary practices of rural and urban women in both HIC and LMIC.

6.9 Discussion

The aim of this study was to explore the factors that influence the dietary practices of a sample of rural and urban Ugandan WRA. From participants' narratives, it was clear that many influences across, and within, the different levels of the socioecological model, i.e. individual-level, social networks, socio-cultural environment, physical environment and macro-environment interacted to shape participants' dietary practices. Among these women, the physical environment (cost, availability and physical access), social networks (parents, friends and other family members, vendor reputation and trust) and individual-level factors (perceptions, big days, convenience, meal balancing and feelings) were the most frequently highlighted factors influencing their dietary practices, although the socio-cultural environment and macro-environment were spoken of to a lesser extent.

The individual-level factors most frequently highlighted among these WRA were perceptions towards foods, convenience, meal balancing, big days and feelings. Of these, the bulk of participants' narratives centred on perceptions, convenience, meal balancing and big days. Participants across the four dietary typologies generally held the perception that fruits and vegetables were 'healthy' foods. From their narratives, it was clear that most participants in the '*rural, low-impact traditionalists*' dietary typology, in particular, perceived traditionally prepared food as healthier than fried food. As such, these study participants spoke of largely cooking food by steaming or boiling and avoiding foods that contained 'too much oil' as these were believed to have negative connotations for health. The findings from this study are similar to findings from other SSA contexts. A study among Black South Africans in an urban township and among rural and urban Cameroonian adolescents highlighted that fruits and vegetables were recognised as healthy foods, which contained among other nutrients, vitamins (Puoane et al., 2006; Dapi et al., 2017). On the other hand, urban poor adults in Ghana (Boatemaa et al., 2018), urban Black South Africans (Puoane et al., 2006) and rural and urban Cameroonian adolescents (Dapi et al., 2017) identified fried foods and sugar as unhealthy foods. Interestingly, neither the participants in this study, nor those in other sub-Saharan African studies spoke much of EDNP beverages, e.g. various versions of sugar-sweetened drinks as unhealthy. This could possibly be explained by the fact that in the study context in which this PhD study was carried out, drinks are generally not regarded as food items, but merely as extras. The perception, among some '*rural, low-impact, early-stage transitioners*', that 'natural' (raw, chemical-free or home-processed) foods were somehow healthier than store-bought foods among some participants in this study has been evidenced by other studies. For example, a 2011 Ugandan study reported that urban consumers in Kampala felt more inclined to purchase local chicken, although it cost about three times as much as exotic chicken, because it was strongly perceived that local chicken was tastier, held its tough texture when cooked and was free of 'chemicals' (Kyarisiima et al., 2011). However, in the same study, as with participants in this study, most consumers were often forced to purchase the exotic chicken owing to the high cost of local chicken (Kyarisiima et al., 2011).

Convenience, although experienced in differing ways, was particularly important among '*urban, medium-impact, mid-stage transitioners*' and '*rural, low-impact traditionalists*'. '*Rural, low-impact traditionalists*', who largely produced their own food, regularly reported eating foods low environmental impact roots and tubers such as sweet potatoes and cassava, which they found were easier to grow and matured faster. Evidence from previous studies has shown that roots and tubers, e.g. sweet potatoes and cassava are hardy crops that can produce good yield even under the most stressful conditions, i.e. poor soils, water-stress, in addition to having a short life cycle (Low et al., 2007; Mwanga et al., 2009; Sugri et al., 2017). These attributes make such foods ideal food security crops for poor, subsistence farmers in low and middle-income contexts, who are usually rural women (Okonya and Korschel, 2014; Low et al., 2017). Indeed, such crops are often regarded as 'a woman's crop' (Okonya and Korschel, 2014). It is no surprise, therefore, that '*rural, low-impact traditionalists*' were partial to eating sweet potatoes and cassava although these might not have been their personal preference. On the other hand, '*urban, medium-impact mid-stage transitioners*', when pressed for time, were more likely to consume processed and ready-to-eat foods, which were often higher in energy, lower in nutrients and are markers of dietary transitions. It has been proposed that urban residents in transitioning LMIC contexts consume more convenience foods than rural residents due to several factors, including less time for cooking, limited access to cooking facilities and fuel sources (Hawkes et al., 2017; Ruel et al., 2017;). Evidence from studies in similar SSA contexts, have reported similar findings, for example among school-going female adolescents in urban South Africa (Sedibe et al., 2014).

Food is closely linked to the culture, traditions and the daily lives of many sub-Saharan Africans. In Uganda, as in many SSA countries, in addition to food being an identifier of one's cultural heritage, important event such as marriages, births and deaths are accompanied by the consumption of special foods (Amone, 2014). It is unsurprising therefore, that many women across the four dietary typologies, spoke of eating 'special foods' on '*big days*', i.e. occasions during which they had something to celebrate. These 'special foods', e.g. meat, chicken, white rice, dairy, fried food are characteristic of the dietary changes associated with the NT. Similar findings have been established in a South African study, in which participants reported consuming 'special foods', e.g. sweets, ice-cream, cake on birthdays and weddings (Puoane et al., 2006).

Among women across all four dietary typologies, social networks appeared to have a close connection to participants' dietary practices. Participants spoke, often at length, of the influence of parents, friends and other family members and vendor reputation and trust on how they cooked and what they ate. Younger participants in this study, for example, spoke of parents either providing certain food items or establishing some kinds of rules on what could be eaten. Although research on the social environment and dietary practices in SSA is limited, a few studies have shown similar findings as those from this PhD. Among rural and urban Cameroonian (Dapi et al., 2017) and urban South African adolescents (Sedibe et al., 2014), participants reported eating certain food items, e.g. leafy green vegetables because this was what was made available at home by their mothers. Furthermore, narratives from partiicpants in this study, indicate that friends and peers play an influencing role in the dietary patterns of especially younger study participants. Similar findings have been reported among adult urban-poor Ghanaians, rural and urban Cameroonian adolescents and urban South African adolescents who all reported being motivated to eat EDNP foods in the company of their friends and peers (Sedibe et al., 2014; Dapi et al., 2017; Boatemaa et al., 2018). Indeed, Holdsworth and Landais (2019) have written of people often 'mirroring' the dietary practices of those in their social networks to impress them or signal identity. Among older participants in this study, other (non-parent) family members were also important influences around dietary practices. These findings corroborate those from a recent study among women in India, a middle-income country undergoing the NT. In their study, participants reported that, in trying to make them happy, they often ate the food that they knew their spouses and children preferred (Bailey et al., 2018).

From the narratives of older participants in this study it was also apparent that many participants oftentimes did not make conscious decisions regarding what to eat or not to eat. Participants spoke of eating 'little oil' or not wanting 'too much fats' seemingly out of habit, i.e. this is what they had always done, from when they were children, and could not imagine doing differently. Eating practices from participants' childhoods (dietary norms) had led to persistent patterns of food choice in adulthood. These habituations, which were established in childhood, while enforced by participants' parents, were often a product of the socio-cultural environment in which participants were raised. The pivotal role of parents particularly mothers in shaping children's dietary practices, whether as role-models or providers, has been well-documented in various studies in both high-income and low and middle-income contexts. In their study, Boatemaa et al. (2018) highlighted the role of socialisation by mothers, during participants' childhood, in shaping the dietary practices of urban-poor Ghanaian men and women in adulthood. While participants in this PhD study, like those in other SSA studies largely spoke of maintaining childhood-established dietary practices (dietary norms), some urban-residing '*rural, low-impact, early-stage transitioners*' aspired to eat in different ways, e.g. include more meat and dairy in their diets, if their financial situations improved. These findings corroborate those from a study among urban South Africans. Puoane et al. (2006) wrote that when participants moved to urban townships and their socioeconomic status improved, they reported eating more meat and chicken. Indeed, the authors established that people who felt they had been deprived of some foods during their childhoods consider it necessary to indulge in these foods, when the opportunity arises, in order to show their improved socioeconomic status (Puoane et al., 2006).

Further to this, although the socio-cultural environment was spoken of to a lesser extent compared with the social and physical environment, some study participants spoke of avoiding certain foods e.g. beans because they were perceived as 'poor-people food' by the society in which they lived. In a South African study, participants tried to eat meat daily because it was associated with belonging to a high socioeconomic status (Puoane et al., 2006). In the same study, traditional foods were seen to be associated with poverty (Puoane et al., 2006). To this end, Oniang'o et al. (2003) write that, in SSA, while meat and dairy products are regarded as 'urban' foods, vegetables, particularly traditional versions, are regarded as part of a poor man's diet and are more widely consumed by those of a lower socioeconomic status. In fact, Ruel et al. (2017) write about urban residents facing increased pressure to replace traditional foods with EDNP foods, often seen as hallmarks of city lifestyle. However, in this study, none of the participants spoke of completely replacing their traditional diets with 'modern' foods. This has been reported in other sub-Saharan African studies where traditional and more modern diets coexist. This is not surprising given that dietary transition is a gradual process that takes time such that people often remain attached to their food roots. Participants also spoke of sticking with old ways of enacting dietary practice as dictated by their cultural heritage. This is unsurprising given that Uganda, food is an integral part of both social and cultural activities, e.g. traditional marriages (Byaruhanga and Opedun, 2008; Amone, 2014). Different Ugandan tribes or ethnicities attach different understandings to what constitutes food or a meal and in so doing, attach different meanings to the same foods. For example, the traditional millet grain is important among Nilotic tribes, e.g. the Acholi[62]. On the other hand, the Acholi, eat cassava, an identifier of the Lugbara[63] people, only during the lean seasons (Amone, 2014). In Buganda, the region in which this study

[62] Nilotic tribe in Northern Uganda
[63] Sudanic tribe in Northwestern Uganda (West Nile)

was carried out, when one asks for 'food', regardless of the time of day, it is literally taken to mean '*matooke*' (Amone, 2014; Pottier, 2015).

Participants highlighted food availability as a motivator towards consuming certain foods, e.g. nutrient-rich, lower impact fruit and vegetables, roots and tubers. While household availability seemed more important to participants from the two rural dietary typologies because they largely produced their own food, participants in the two urban dietary typologies recognised neighbourhood food availability as more important. It has been argued that urban residents generally have more diverse food options than their rural counterparts owing to a wider variety of food sources in their neighbourhoods, including shops, supermarkets, street food outlets, restaurants and markets (Hawkes et al., 2017; Ruel et al., 2017). However, many '*urban, medium-impact, mid-stage transitioners*', '*urban, low-impact, early-stage transitioners*' and '*rural, low-impact, early-stage transitioners*' demonstrated that availability alone does not necessarily translate into the enactment of certain dietary practices. Participants demonstrated that physical and economic access were just as important in influencing their dietary practices as availability. Most participants in this study discussed physical access in terms of distance between their homes and the various food sources. For participants who had home gardens, the immediate access to them was particularly enabling in the enactment of dietary practices around the consumption of lower impact, plant-based foods. For participants that did not have home gardens, particularly urban women, nearness to neighbourhood food outlets was salient. Physical access often interacted with convenience, when participants were faced with time constraints, to result in certain food choice, i.e. guided participants in choosing which foods to eat. However, findings from this study demonstrate that physical access and availability of both healthy and unhealthy foods in urban areas do not necessarily imply consumption among urban residents. In addition to these two factors, the high cost of nutrient-rich, low impact foods, e.g. fruits, vegetables and nutrient-rich, high-impact animal foods relative to EDNP foods could explain higher meat and dairy consumption among the urban rich '*urban, medium-impact, mid-stage transitioners'* (urban-rich) compared with the '*urban, low-impact, early-stage transitioners*'(urban-poor). The role of food cost in influencing dietary practices has been highlighted by many studies in both HIC and LMIC. For example, a Photovoice study among Canadians found that financial cost played an important role in determining where people could buy groceries and whether they could afford fruit, vegetables, milk and other healthy foods (Belon et al., 2016). In SSA, fruit and vegetable were considered expensive and thus consumption was limited among the urban-poor in a Ghanaian study (Boatemaa et al., 2018), while urban female South African adolescents and rural male and female Cameroonian adolescents considered convenience foods (EDNP) more affordable than healthier options (Sedibe et al., 2014; Dapi et al., 2017). To summarise, the findings on the physical environment from this study collectively corroborate what Hawkes et al. (2017) proposed, i.e. while income shapes economic access to food, physical access shapes what is available for purchase. It is almost impossible, therefore, to look at these three factors in isolation.

Findings from this study appear to contradict the narrative that urban populations in LMIC contexts necessarily have greater access to marketing and are therefore more inclined to purchase EDNP foods that comprise the bulk of food adverts (Global Panel, 2017; Ruel et al. 2017). Participants hardly spoke of the media, advertising or product branding influencing how they made food-purchasing decisions or what they ate. This does not mean to say that advertising was absent in the two study contexts, more so in Kampala. Rather, it could be a case of consumers being unaware that they are being directly targeted by marketing. Participants, especially those from the two rural dietary typologies, spoke at length about seasonality being a major macro-environment level influence over their consumption of nutrient-rich, lower impact plant-based foods, most notably fruits and vegetables. Previous studies have reported that in SSA contexts, the intake of fruits and vegetables intake, especially by rural populations that largely produce their own food is highly season-dependent. As such, fruits and vegetables are consumed in abundance when they are in season and hardly consumed when they are out of season (Oniang'o et al., 2003; Global Panel, 2017; Hawkes et al. 2017; Ruel et al. 2017). On the other hand, participants from the two urban dietary typologies hardly mentioned food seasonality of food as a primary influence over their dietary practices. This could be because urban residents, especially the 'urban-rich', generally have access to both increased income and a wider variety of foods, sourced from food-producing rural areas, including refrigerated and frozen options in supermarkets (Sodjinou et al. 2009; Hawkes et al. 2017; Ruel et al. 2017). These act as buffers, among the urban-rich such that they might not notice much variation between seasons. The urban-poor, however, might have challenges accessing fruits and vegetables when they are out of season as they become more expensive compared to when they are in season.

The next section highlights the study's strengths, limitations and methodological challenges.

6.10 Strengths, Limitations and Methodological Challenges

6.10.1 Strengths and Limitations

The use of PV, complemented by in-depth interviews, to explore the various factors that influence the dietary practices of a diverse sample of both urban and rural Ugandan women of reproductive age is the main strength of this study. The use of photographs, in combination with participants' photo stories produced a rich dataset that might not have been obtained using traditional qualitative methods, e.g. interviews alone or quantitative methods, e.g. GIS mapping. The use of PV allowed participants to feel more involved in the research process and have more ownership of the project, while learning new skills and building confidence. Photographs were very helpful in prompting recall among participants during the in-depth interviews. In addition to individual-level factors, the study identified social, physical, socio-cultural and macro-environment level factors around dietary practices, which are limited in the SSA research literature. Owing to the quota sampling method used and relatively small sample size, the findings of this study are not generalizable to all rural and urban Ugandan WRA. Nevertheless, the quota sampling method used allowed for the recruitment of a diverse sample that provided a wide range of views, i.e. depth in the dataset.

6.10.2 Methodological Challenges

One of the study's main limitations is that not all participants that were recruited into the PV exercise took photographs, due to several reasons, e.g. distrust of the researcher's use of photographs, lack of time, refusal by parents (for younger participants) and embarrassment. However, the fact that the same interview schedule was used, and references made to the photography guide during interviews with these participants, to some extent, mitigated this. While participants were advised that they had the freedom to take photographs, from their own perspective, in response to photography guide it is possible that there might have been some element of bias as participants might have shown the researcher what they thought was more acceptable.

Nevertheless, the findings provide valuable insight on factors influencing healthy and environmentally sustainable dietary practices among women from a SSA population that could provide a framework for further research in the area.

6.11 Implications for Policy and Practice

While important, this study's findings demonstrate that individual-level factors may not be the most important influence around dietary practices among this sample of women, particularly as regards the consumption of fruit, vegetables and fried foods. To focus on policies or interventions aimed at addressing gaps or loopholes at the individual-level would ignore the fundamental role of intangible factors within the physical and social environments, which sometimes override the individual-level factors in food decision-making as this study has illustrated. Findings from this study have demonstrated the complex interlinks between various factors, across the different environmental levels of the socioecological model, in influencing dietary patterns. For example, participants spoke of cost, seasonality and availability together interacting to either facilitate or limit fruit and vegetable consumption. Therefore, any policies and interventions aimed at encouraging the consumption of healthy and low-environmental impact foods among rural and urban Ugandan women, must consider this by being multi-level and holistic. Such policies or interventions could for example include government-run programmes that provide community-level storage facilities e.g. silos (home and neighbourhood food availability – physical environment) to address seasonal variations in commonly consumed legumes and pulses (seasonality – macro-environment) while educating community members on the nutritional benefits of such foods (perceptions).

6.12 Chapter Summary

The aim of this study was to explore the individual-level and environmental-level factors that influenced the dietary practices among a sample (n=18) rural and urban WRA. Important individual-level factors that influenced participants' dietary practices included perceptions, feelings, meal balancing, convenience and day-to- day variations. Important factors that influenced the dietary practices among these WRA were parents, other family members and friends, vendor reputation and trust (social environment), food availability and physical and economic access (physical food environment), sociocultural norms (sociocultural environment) and food production and transport (macro environment). These factors acted in isolation, but often in combination to shape participants' enactment of different healthy and environmentally sustainable dietary practices, for example parents (social environment) through role modelling were the vehicles through which dietary norms (socio-cultural environment), and therefore, perceptions (meanings) towards different foods were passed on to participants. In so doing, dietary participants were introduced to certain healthier dietary practices, e.g. eating more vegetables and less fried foods. Findings from this study demonstrate that dietary practices change or remain the same as different components of which dietary practices are comprised, i.e. materials, meanings and skills (reflective of the individual-level and environmental-level factors) change, remain the same and shape each other.

7 CHAPTER SEVEN: DISCUSSION OF ALL STUDIES

The overall aim of this PhD was to assess the healthiness and environmental impact of the dietary behaviours of rural and urban Ugandan WRA and identify individual-level and environmental-level factors influencing these dietary behaviours. As highlighted in section 1.10.2, to address the aim of the PhD, three research questions were formulated, i.e.

i. What is the healthiness and environmental impact of the dietary behaviours of rural and urban Ugandan WRA?
ii. How do dietary behaviours differ between rural and urban Ugandan WRA in terms of healthiness and environmental impact?
iii. How do factors at the individual-level and the environmental-level perpetuate the dietary behaviours of Ugandan WRA?

At the end of each of the chapters 3-6, in-depth discussions of the key findings from each of the four studies are presented. While these serve as stand-alone discussions, the current chapter complements these in-depth discussions by integrating the main findings from all four studies conducted to answer the research questions. By integrating findings from all studies, this chapter addresses gaps identified in the literature (see section 1.9) and therefore presents the contributions of this thesis to existing knowledge on healthy and environmentally sustainable dietary behaviours in the context of the NT in a LMIC context. This chapter also summarises the methodological considerations regarding the use of the different methods in this PhD as well as strengths and limitations. Lastly, implications for policy and practice are presented.

To begin, the triangulation approach that was used to integrate the findings from the four studies is described, followed by a presentation and discussion of the key findings from the studies.

7.1 Integrating Key Findings from all Studies using Triangulation

Triangulation is the process of studying a problem using more than one method to obtain a clearer picture (O'Cathain et al., 2010; Curry and Nunez-Smith, 2015). In mixed methods studies, triangulation of findings comes after all results from the analysis of the different studies have been obtained separately (O'Cathain et al., 2010; Curry and Nunez-Smith, 2015). A few methods have been proposed to triangulate mixed methods findings, i.e. triangulation matrix, following a thread and mixed method matrix (O'Cathain et al., 2010). These methods involve listing on the same page, the findings from all the components (studies) of the mixed methods study and looking for convergence (agreement), complementarity (information on one issue that one study's findings might add to another study's findings) and dissonance (disagreements on one issue between different studies) (O'Cathain et al., 2010; Curry and Nunez-Smith, 2015). O'Cathain et al. (2010) propose that explicitly identifying any disagreements between findings from the different studies is a crucial part of the triangulation process.

The findings from the four studies were integrated using an adopted triangulation protocol, which offers a detailed, systematic system of carrying out triangulation of findings (Farmer et al., 2006; O'Cathain et al., 2010). In this process, a grid or matrix of the findings arising from each of the studies is prepared and the matrix analysed for agreement, partial agreement, dissonance and silence (Farmer et al., 2006; O'Cathain et al., 2010). Farmer et al. (2006) recommend that ideally, two researchers should carry out the triangulation protocol. However, because one researcher (CIA) conducted the data collection and analysis for all studies of this PhD, the lead researcher (CIA) conducted the triangulation matrix (see Appendix 29). The steps followed in the integration of findings for this PhD, using the triangulation protocol, were taken from Farmer et al. (2006) and O'Cathain et al. (2010). These steps included sorting (identifying findings from each of the four studies that answered each research question); convergence coding (comparing findings from the studies, in relation to the research questions, for agreement, partial agreement, and dissonance) and complementarity (Farmer et al., 2006; O'Cathain et al., 2010). This was followed by convergence assessment and completeness comparison (O'Cathain et al., 2010). Although researcher comparison and feedback were not conducted in this PhD, this discussion chapter was shared with the supervision team to check that triangulation was conducted objectively.

For ease of reading, the key findings from all studies are first summarised under the three research questions highlighted previously.

7.2. RQ1: What is the healthiness and environmental impact of the dietary behaviours of rural and urban WRA?

In study one, PCA was conducted on dietary intake data from a representative sample (n=955) of rural and urban Ugandan WRA. Four dietary patterns, which accounted for 23.6% of the variance in dietary intake were identified, i.e. '*traditional, high fat, medium environmental impact*', '*transitioning, processed, low environmental impact*', '*plant-based, low environmental impact*' and '*animal-based, high environmental impact*'. Findings from this cross-sectional study, based on data collected in 2008, indicated that Ugandan WRA generally consumed a low-environmental impact diet and were in the early to mid stages of the NT. Findings from MCA (study three) of primary dietary data collected in 2018 from a small sample (n=73) of rural and urban Ugandan WRA identified three dietary patterns that explained 43.6% of the variance in dietary intake, i.e. '*low-impact, plant-based, traditional*' dietary pattern, '*low-impact, plant-based, mid-stage transition*' dietary pattern and '*low-impact, plant-based, early-stage transition*' dietary pattern. The second ('*low-impact, plant-based, mid-stage transition*') and third ('*low-impact, plant-based, early-stage transition*') dietary patterns were suggestive of transitioning dietary practices among this sample of rural and urban Ugandan WRA while the '*low-impact, plant-based, traditional*' dietary pattern was more suggestive of traditional dietary practices.

Some similarities were observed between dietary patterns obtained using PCA (study one) and MCA (study three), providing some validity to findings emerging from both studies. The '*low-impact, plant-based, mid-stage transition*' dietary pattern obtained in study three showed some similarities with the '*traditional, high fat, medium environmental impact*' dietary pattern obtained in study one. The '*low-impact, plant-based, early-stage transition*' dietary pattern obtained using MCA, however, did not show much similarity with any of the dietary patterns obtained using PCA. Notwithstanding, like the '*plant-based, low environmental impact*' dietary pattern, obtained in study one, it was associated with the intake of roots and tubers and similar to the '*transitioning, processed, medium environmental impact*' dietary pattern, it was associated with consumption of sugar and tea and coffee. This suggests that the '*low-impact, plant-based, early-stage transition*' dietary pattern in study three could be a mix of the '*plant-based, low environmental impact*' dietary pattern and the '*transitioning, processed, medium environmental impact*' dietary pattern obtained in study one. On the other hand, the '*low-impact, plant-based, traditional*' dietary pattern obtained using MCA (study three) showed stark differences to the '*transitioning, processed, low environmental impact*' dietary pattern and the '*animal-based, high environmental impact*' dietary pattern identified using PCA (study one).

In study two, nutrient profiling and environmental impact assessment were conducted on foods consumed by rural and urban Ugandan WRA (n=73). Fruit, red meat, poultry, fish and eggs, legumes, vegetables and nuts and seeds were the most nutrient-dense food groups consumed, while sugary drinks, milk and milk products, fats, oils and spreads, sweet and savoury snacks and sugar and honey were lowest in nutrients. Findings from study two indicated that plant-based food groups generally had lower environmental impact than animal-based food groups. Of all foods profiled (n=202), a small proportion (18.3%) were classified as healthy and lower impact. Likewise, only 13 of 202 (6.5%) foods profiled were classified as unhealthy and higher impact. Study two findings also indicated that a higher proportion of WRA consumed foods classified as healthy and lower impact compared with unhealthy and higher impact foods (54.8% vs 21.9%).

The agreement in findings between study one (PCA) and three (MCA) collectively indicate that Ugandan WRA could still be at a similar stage in the NT in 2018 as they were in 2008. Furthermore, findings from study one, two and three collectively suggest that while aspects of the traditional diet remain, Ugandan WRA are experiencing early to mid stages of the NT, indicated by their dietary intakes collected at two points in time. This early to mid stage in the NT corresponds to stages 3 (receding famine) and 4 (degenerative disease) in Popkin's NT framework model highlighted in Figure 1.1 (see section 1.2). Findings from these three studies also suggest that in terms of healthiness and environmental impact, the dietary behaviours of Ugandan WRA have remained consistent (have not necessarily worsened). To this end, Ugandan WRA still consume a relatively low environmental impact diet that includes higher amounts of nutrient-rich, plant-based, food groups than EDNP food groups associated with more advanced stages in the NT.

7.3 RQ2: How do dietary behaviours differ between rural and urban Ugandan WRA in terms of healthiness and environmental impact?

Findings from study one indicated that urban residency was significantly positively associated with the '*transitioning, processed, low environmental impact*' and '*animal-based high environmental impact*' dietary patterns, but not with the '*plant-based low environmental impact*' pattern. Compared with rural women, study one indicated that urban WRA consumed a more varied diet that was higher in environmental impact (GHGE) owing to higher intake of animal-based food groups. Rural WRA consumed a plant-based dietary pattern that was lower in environmental impact. In study three, hierarchical cluster analysis, following MCA, identified four dietary typologies among of rural and urban Ugandan WRA (n=73), i.e. '*urban, low-impact, early-stage transitioners*', '*rural, low-impact, early-stage transitioners*', '*urban, medium-impact, mid-stage transitioners*' and '*rural, low-impact, traditionalists*'. Although both dietary typologies were predominantly urban, the '*urban, medium-impact, mid-stage transitioners*' dietary typology had more affluent cluster membership than the '*urban, low-impact early-stage transitioners*'. The '*rural, low-impact, early-stage transitioners*' and '*rural, low-impact traditionalists*' dietary typologies were predominantly rural. Findings from study one and three indicate that urban WRA, compared with rural WRA, are consuming a diet that is characteristic of more advanced stage in the NT. Findings from study one and three are further supported by those from study two given that more urban (30.0%) than rural WRA (12.1%) consumed foods classified as 'unhealthy and higher impact' (associated with the NT) at any eating occasion. Moreover, study two also indicated that the odds of urban women consuming 'healthy and lower impact' foods were lower than those of rural WRA, even after adjusting the logistic regression model for sociodemographic factors.

Therefore, based on dietary data obtained in 2008 and 2018, studies one, two and three complement each other to indicate that urban WRA are experiencing a later stage in the NT (degenerative disease, i.e. stage 4 in Popkin's NT framework model) compared with rural women (receding famine, i.e. stage 3 in Popkin's NT framework model). Furthermore, findings from study three add depth to those from study one and two by illustrating that a 'dietary transitionary gradient' exists between and among rural and urban Ugandan WRA. To this end, while urban WRA are clearly experiencing a more advanced stage in the NT compared with rural WRA, among urban WRA, some are at a more advanced stage in the NT than others are. Likewise, although rural women are in the early stages of the NT, some are at a more advanced stage than others are.

It is important to note, however, that findings from study two also indicated that the odds of urban WRA consuming 'unhealthy and higher impact' foods were lower than those of rural WRA. These findings appear to contradict, to some extent, the previously discussed convergence between study one, two and three. However, these differences could be attributed, in part, to smaller sample sizes in study two as well as differences in sample size between studies one, two and three (n=955 vs n=73).

7.4 RQ3: How do factors at the individual-level and the environmental-level perpetuate the dietary practices among Ugandan WRA?

Findings from study three suggested no significant association between socioeconomic status and any of the four dietary typologies among WRA, i.e. '*urban, low-impact, early-stage transitioners*', '*rural, low-impact, early-stage transitioners*', '*urban, medium-impact, mid-stage transitioners*' and '*rural, low-impact, traditionalists*'. However, findings from study two indicated that, among this sample of WRA (n=73), wealthier and better-educated women were more likely to consume 'healthy and lower' impact foods compared with less educated and poorer women. In terms of eating practice, study two resulted in some surprising findings. For example, findings indicated that this sample of WRA (n=73) were more likely to consume 'healthy and lower impact' foods at out-of-home eating events as well as at lunch and dinnertime. Furthermore, 'unhealthy and higher impact' foods were more likely to be consumed at eating events within the home and were mostly eaten at breakfast time, which was surprising. On the other hand, study two also produced some findings that were not surprising. For example, the odds of consuming 'healthy and lower impact' foods increased with increasing length in eating time, i.e. longer eating times had higher odds of containing 'healthy and lower impact' foods. Additionally, the odds of consuming 'unhealthy and higher impact' foods decreased with length in eating time. Lastly, the odds of eating 'unhealthy and higher impact' foods were lower at eating events spent with friends and family compared with those when WRA ate by themselves.

Study four (PV exercise) identified a myriad of individual-level and environmental-level factors influenced the dietary practices of these rural and urban WRA (n=18). Individual-level factors spoken of by many WRA were convenience, perceptions, meal balancing, day-to-day variations and feelings. Perceptions (meanings) around tastiness were highlighted by most participants in the two urban dietary typologies ('*urban, low-impact, early-stage transitioners*' and '*urban, medium-impact, mid-stage transitioners*') while meanings around the perceived healthiness of foods that was attached to their naturalness were highlighted by most participants in the two rural typologies ('*rural, low-impact, early-stage transitioners*' and '*rural, low-impact, traditionalists*'). Participants in the urban dietary typologies experienced convenience in relation to what was easy to find or cook, while WRA in the two rural dietary typologies spoke of convenience in terms of what was easy to grow. Findings from study four also indicated that participant identified parents, other family members (spouses and children) and friends and vendor reputation and trust as important factors in their social environments. Vendor reputation and trust were more important to participants in the two urban dietary typologies when it came to the purchase of lower environmental impact, nutrient-dense fresh produce, i.e. fruit and vegetables. Physical environment factors spoken of by most WRA were economic access as well as household and neighbourhood food availability, which influenced what participants had at their disposal and what they could afford. Many participants across all four dietary typologies also spoke of physical access. In addition to factors at the individual-level and social and physical environments, participants also highlighted sociocultural norms (sociocultural environment) and food production and transportation (macro-environment) as influencing their dietary behaviours. From their narratives, it was apparent that interactions in participants' social networks were the means through which perceptions (meanings) and sociocultural norms around food were challenged and passed on to participants and therefore how their dietary practices changed or remained the same.

Findings from study two support those from study four in highlighting the importance of social networks, i.e. family and friends in influencing dietary practices. While findings from study three seem to suggest that individual-level factors (socioeconomic status) may not be an important factor in influencing dietary behaviours, findings from study four clearly indicate that economic access (a proxy of the SES), is an important influence around these women's dietary practices. This is supported by findings from study two, in which wealthier and more educated women were more likely to consume 'healthy and lower' impact foods.

7.5 Discussion

Findings from this mixed methods PhD study suggest that Ugandan WRA mostly consume a plant-based diet that is higher in nutrient rich plant-based food groups and lower in environmental impact. The consumption of animal foods, including eggs, chicken, beef, pork and dairy products (with higher environmental impact) and ultra-processed EDNP foods is quite low. While it appears that some aspects of the traditional Ugandan diet remain prevalent among WRA, findings from the four studies provide evidence that dietary behaviours associated with the NT are underway among rural and urban Ugandan WRA. Further to this, urban WRA are experiencing a relatively more advanced stage in Popkin's NT framework model (stage 4, i.e. degenerative disease) compared with rural WRA (stage 3, i.e. receding famine). These findings support the narrative that urban women tend to experience dietary changes associated with the NT earlier than do rural women (Abrahams et al., 2011; Popkin et al., 2012; Steyn et al., 2012). However, dietary patterns and dietary typologies illustrate that not all urban residents can be classified as in advanced stages of the NT and neither can all rural residents be classified as dietary-transition laggards. The findings thus illustrate differences in dietary behaviours between, for example, the 'urban rich or middle-class', the 'urban poor', the 'rural middle-class' and the 'rural poor'. This is supported by a paper by Tschirley et al. (2015) in which differences were observed in consumption patterns of processed foods between various income groups, i.e. (urban and rural) poor, vulnerable middle, lower-middle, upper middle and upper classes.

That dietary patterns obtained from dietary data collected in 2008 (study one) are similar to those obtained using recently collected data (study three) provides evidence that the NT is transient, i.e. changes to dietary behaviours require time to come into full effect. In this sense, findings from this PhD give limited support to the widely held narrative that the NT in LMIC necessarily occurs at an accelerated rate (Drewnowski and Popkin, 1997;

Popkin, 2001; Popkin and Gordon-Larsen, 2004). This argument is supported by findings from a recent cross-sectional study in which it was established that high-salt, processed foods, including cheese, pizza, savoury snacks, processed meats and breakfast cereals were not regularly consumed by adults (25-65 years) in large urban areas of Benin, Guinea, Kenya, Mozambique and the Seychelles (Leyvraz et al., 2018). However, although the two studies complemented each other, any disparities in dietary patterns obtained between study one and study three can be attributed, in part, to sampling differences. While sampling methods used in both studies were quantitative in nature, the quota sampling method used in study three is a non-random sampling method while the multi-stage cluster sampling method used in study one is a random sampling method. Data used in study one were obtained from the 2008 UFCS, whose aim was to generate a representative sample from which generalisations could be drawn regarding dietary intake among Ugandan WRA, necessitating a random sampling method. On the other hand, studies two, three and four were designed to generate a sample of WRA that could firstly provide dietary intake data, and subsequently illicit a diversity of views around factors influencing dietary behaviours, hence the need for the quota sampling technique, which could facilitate this. Additionally, given that data collection for study three was carried out by only one researcher (CIA), who had limited resources (time and money), this necessitated the pragmatic use of quota sampling.

Within the NT discourse, it is posited that as transitioning contexts urbanise and more women engage in employed work, they are more likely to eat out of home (Popkin, 2006; Walls et al., 2018). While most women in this study were engaged in some form of employment, findings from study two provide little support to the commonly held narrative that these out-of-home eating occasions are necessarily unhealthy (Lachat et al., 2012; Myhre et al., 2015; Walls et al., 2018; Ziauddeen et al., 2018). Differences in food sources in these out-of-home eating occasions between this PhD and other studies could explain this. It is fair to say that most studies in the literature consider out-of-home eating events as opportunities during which food is purchased, e.g. from restaurants, canteens, street food. However, findings from this study indicate that this is not always the case, i.e. out-of-home consumption does not equate to purchase. The failure of various authors to account for foods cooked within the home but consumed out-of-home, might therefore explain, in part, the differences between findings in this study and those in the literature. This highlights the importance of streamlining the characterisation of out-of-home eating occasions when describing dietary behaviours in the NT literature.

In as far as factors influencing dietary behaviours among WRA are concerned, various studies have demonstrated the importance of income or socioeconomic status in driving food choice (Amuna and Zotor, 2008; Gissing et al., 2018). While findings from study three suggest no significant association between SES and the four dietary typologies, findings from study four indicate that economic access (food cost), which can be seen as a proxy of the socioeconomic status, is an important influence on dietary behaviours. This disparity in findings between this PhD and the literature could be attributed to the relatively small sample size used in study three (n=73). Four dietary typologies were generated from this sample of WRA, therefore sample sizes for the dietary typologies were most likely too small to generate enough statistical power to detect any significant differences.

It has long been established that individual-level factors are important in influencing dietary behaviours. Apart from these factors, findings from this mixed methods PhD support other authors that have demonstrated the importance of the social environment in influencing dietary behaviours (Story et al., 2008; Larson and Story, 2009). Rather than simply listing, findings from this PhD add to the literature by pointing to some mechanisms through which interactions between WRA and other persons in their social networks entrench and modify healthy and environmentally sustainable dietary behaviours. For example, study four demonstrates that parents and friends are the vehicles through which meanings (perceptions) around certain food and associated dietary behaviours are imparted (through role modelling and 'laying the law') or challenged (advising on what to eat). From this, it becomes apparent that changes in meanings (one of the components of which dietary practices are comprised according to practice theory) attached to certain dietary practices results in changes in dietary behaviours. Findings from study four also demonstrated how, by holding onto and practising what it means to be a good parent or partner, WRA prioritise meanings (perceptions) that other family members attach to food. In so doing, they are introduced to new dietary behaviours, e.g. eating new foods or cooking food in different ways (boiling or steaming vs frying). These examples not only demonstrate how closely linked different factors are, but also suggest that the family avenue through which WRA could interventions aimed at encouraging WRA to consistently choose healthier, low environmental impact dietary behaviours could be targeted.

Lastly, in as far as the social environment is concerned, findings from this PhD extend both Story et al. (2008) and Gissing et al. (2018)'s models (see section 1.7.1) by highlighting the importance of vendor reputation and trust among urban WRA. This suggests that to encourage consumption of plant-based, low-impact, nutrient-rich foods among urban WRA, policies and interventions that ensure the safety of these foods at these vending sites are necessary. To build confidence among urban consumers, interventions could take on the form of, for example, working with vendors to put in place good handling practices for fresh foodstuffs. On the other hand, policies could streamline the routine quality testing (microbial and chemical content) of produce offered at these vending sites, permissible amounts of contamination and implications for non-compliance.

7.5 Strengths, Limitations and Methodological Challenges

7.5.1 Strengths and Limitations

The strengths and limitations for each of the four studies are presented in detail at the end of each respective study chapter, i.e. sections 3.6.1, 4.8.1, 5.7.1 and 6.9.1. This section summarises the strengths and limitations of the mixed methods methodology as well as the different studies.

To the best of my knowledge, this is the first study to explore both the healthiness and environmental sustainability of the dietary behaviours of rural and urban Ugandan WRA in the context of the NT, and the influences behind these dietary behaviours. This is a major strength of this PhD. The use of a mixed methods approach is another strength. Findings from all four studies complemented each other, thereby providing a more comprehensive picture of healthy and environmentally sustainable dietary behaviours, i.e. limitations in one study were addressed by strengths of another study. For example, while study one, two and three provided data on quantifiable aspects of dietary behaviour, study four provided depth and context on non-quantifiable (e.g. social environment) and some quantifiable (e.g. SES reflected as economic inaccess) aspects of dietary behaviours. The findings from the four studies also supplemented each other, e.g. findings from study three added depth to broader findings from study one and two.

The use of a large sample size (n=955) was a major strength of study one, although data on sociodemographic factors were unavailable and the dataset was >10 years old, making it less relevant for assessing current dietary patterns. The sample size (n=73) used for studies two and three was relatively small compared with that from study one, nevertheless, findings from study three provided continuity to study one by elucidating what the picture looks like a decade later (compared with 2008). The use of a relatively small sample size (n=73) in study three could be seen as a limitation, however, findings provide a basis for further assessing relationships between 'health and lower impact' foods and 'unhealthy and higher impact' foods and aspects of eating practice.

PV, used in study four, has been lauded as particularly useful, given that it provides an opportunity for often-marginalised sub-groups to tell stories from their perspectives. Proponents of PV argue that this fact increases project participation as people feel more ownership of the research. The limitation with this method, however, is the fact that it does not adequately account for suspicion on the part of participants, which may limit participation as was seen in this study. Nevertheless, the use of participant photographs provided more depth and breadth of perspectives than would have been gleaned from participant narratives alone.

7.5.2 Methodological Challenges

The methodological challenges of the methods used in study one, two and three are highlighted in sections 3.6.2, 4.8.2 and 5.7.2, respectively. PCA, MCA and CA have been criticised on grounds of being subjective in many steps involved in the analysis. Nevertheless, these methods were used as exploratory tools, and not confirmatory tools in this PhD thesis. Due to the quota sampling method used, the findings from this PhD, particularly studies two, three and four may have limited generalisability to other Ugandan WRA, as well as WRA in other LMIC. Nevertheless, the quota sample ensured that a breadth of perspectives on dietary behaviours was explored (Marshall, 1996; Bryman, 2016). Additionally, detailed descriptions of all studies are provided to allow the reader to judge the transferability of findings to similar contexts.

Furthermore, the translation of interviews from local dialect ('Luganda' and sometimes 'Luo') into English, during studies two, three and four, could have introduced some element of bias, as some information could have been lost in translation (Temple and Young, 2004). However, the researcher is fluent in Luganda and had a translator present at all interviews to check for correctness of interpretation and provide context and nuance to participants' narratives. Lastly, all four studies were cross-sectional in nature, meaning that they cannot adequately depict dietary behaviours in flux, although the fact that study one and three were conducted 10 years apart provides some evidence of the NT in action. Given the transient nature of the NT, longitudinal studies on the process of dietary change would be ideal, i.e. to explore the mechanisms through which this takes place over time.

As highlighted in section 4.1, the EquityTool for Uganda was used to capture information on SES of participants in studies two, three and four. In June 2018 (following completion of data collection), the EquityTool was updated to capture data on asset ownership not included in the old tool previously used in studies two, three and four. Some of the modifications included changes in household assets captured by the EquityTool 2018, e.g. cd/dvd/cassette player and using mobile money accounts as a proxy for bank accounts (Metrics for Management, 2018). Given that many study participants in the three studies, for example, had mobile money accounts but not bank accounts, they would have been ranked differently for SES using the updated EquityTool 2018 compared with that, which was used at the time of data collection.

7.6 Conclusion and Implications for Policy and Practice

The findings from this PhD build on existing knowledge on the dietary differences between rural and urban areas. Aside from demonstrating that rural and urban Ugandan WRA are experiencing early to mid stages in the NT, findings also affirm that there is a 'transitionary gradient'. Dietary patterns and dietary typologies illustrate that not all urban residents can be classified as in advanced stages of the NT and neither can all rural residents be classified as dietary-transition laggards. Further to this, differences in factors that influence dietary behaviours among women across the four dietary typologies collectively highlight the relevance of taking into consideration such variations in designing policies and interventions aimed at encouraging HES dietary behaviours. To begin, for example, policy makers and practitioners can take advantage of the family unit, which this PhD has demonstrated is a significant avenue through which perceptions that shape healthy and environmentally sustainable dietary behaviours of WRA can be modified or kept consistent. In this regard, policies and interventions, e.g. nutrition education that target perceptions around tastiness of 'unhealthy, higher impact' food vs 'healthy, lower impact' foods might have more relevance for urban WRA. On the other hand, policies and interventions that target perceptions (meanings) associated with naturalness of food may have more relevance in encouraging the consumption of healthier, lower impact foods among rural WRA.

Home gardens were highlighted as important in facilitating food availability among rural WRA, while among urban WRA, the lack of home gardens was seen as limiting. Policy makers might want to consider interventions such as community trainings as integral in encouraging the urban poor to produce healthier, lower impact plant-based foods using the available spaces and tools that they have. Furthermore, policy makers, with the assistance of local community leaders and urban planners, could look into policies that allow the urban poor to communally cultivate un-used spaces under the mandate of the city council for a nominal charge.

Among urban WRA, particularly those of the less affluent urban dietary typology, food availability was mediated by the transportation infrastructure (macro environment). In this sense, the infrastructure facilitated the distribution of dry foods but limited that of fresh foods in season due to high perishability. By working with players in the food industry, policy makers could look at strategies aimed at improving the cold storage food transportation and distribution chain. This could entail, for example, providing avenues through which organised groups of market traders can access subsidised cold storage options that are suitable to the context, such as solar-powered. This would reduce inequalities in food availability especially among the urban poor.

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APPENDICES

Appendix 1: Ethical Approval for use of Secondary Data from the 2008 UFCS

The University Of Sheffield.

School Of Health And Related Research.

ScHARR

Ellie Nicolson
Ethics Administrator

Regent Court
30 Regent Street
Sheffield S1 4DA

Telephone: +44 (0) 114 222 25446
Fax: +44 (0) 114 272 4095 (non confidential)
Email: e.l.nicolson@sheffield.ac.uk

28 October 2016

ScHARR

Dear Carolyn,

Project Title: Urbanisation and the Nutrition Transition in Uganda: Perspectives and Implications for Environmental Sustainability

I am pleased to inform you that your project has been classed as 'low risk' so you can proceed with your research. The research must be conducted within the requirements of the hosting/employing organisation or the organisation where the research is being undertaken.

I have received a copy of your declaration together with your confirmation for research that does not involve human participants and that you will be undertaking research which involves analysis of already existing data ('secondary data').

Yours sincerely

E. Nicol

Ellie Nicolson
On behalf of the ScHARR Research Ethics Committee

Appendix 2: Ethical Approval from Makerere University School of Public Health HDREC

MAKERERE UNIVERSITY

P.O. Box 7072 Kampala Uganda
Website: www.musph.ac.ug

Tel: 256 414 532207/543872/543437
Fax: 256 414 531807

COLLEGE OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH
HIGHER DEGREES, RESEARCH AND ETHICS COMMITTEE

July, 27th, 2017

CAROLYN IMELDA AUMA
Principal Investigator, Protocol 495
The University of Sheffield

Re: Approval of Proposal titled: WOMEN'S DIETARY PRACTICES IN CONTEMPORARY UGANDA

This is to inform you that, the MAKSPH, Higher Degrees, Research and Ethics Committee (HDREC) has granted approval to the above referenced study, the HDREC reviewed the proposal during the HDREC meeting held on 25th/07/2017 and made some suggestions and comments which you have adequately incorporated:

Please note that your study protocol number with HDREC is **495**. Please be sure to reference this number in any correspondence with HDREC. Note that the initial approval date for your proposal by HDREC is 27th/07/2017, and therefore approval expires at every annual anniversary of this approval date. The current approval is therefore valid until: **26th/07/2018**.

Continued approval is conditional upon your compliance with the following requirements:

1) No other consent form(s), questionnaire and/or advertisement documents should be used. The consent form(s) must be signed by each subject prior to initiation of any protocol procedures. In addition, each subject must be given a copy of the signed consent form.

2) All protocol amendments and changes to other approved documents must be submitted to HDREC and not be implemented until approved by HDREC except where necessary to eliminate apparent immediate hazards to the study subjects.
3) Significant changes to the study site and significant deviations from the research protocol and all unanticipated problems that may involve risks or affect the safety or welfare of subjects or others, or that may affect the integrity of the research must be promptly reported to HDREC.
4) All deaths, life threatening problems or serious or unexpected adverse events, *whether related to the study or not,* must be reported to HDREC in a timely manner as specified in the National Guidelines for Research Involving Humans as Research Participants.

- Please complete and submit reports to HDREC as follows:

Makerere University School of Public Health • Higher Degrees, Research and Ethics Committee •
Valid Thru:
26 JUL 2018

1

Appendix 3: Ethical Approval from the Uganda National Council for Science and Technology (UNCST)

The University Of Sheffield.

Carolyn I Auma <ciauma1@sheffield.ac.uk>

Study Approval - (HS111ES)

1 message

Research Management - UNCST <research@uncst.go.ug> 26 September 2017 at 06:04
Reply-To: Carolyn <ciauma1@sheffield.ac.uk>
To: Carolyn <ciauma1@sheffield.ac.uk>

UNCST

Uganda National Council for Science and Technology

(Established by Act of Parliament of the Republic of Uganda)

Dear Carolyn Auma,

I am pleased to inform you that on **26/09/2017**, the Uganda National Council for Science and Technology (UNCST) approved your study titled, **Women's Dietary Practices in Contemporary Uganda**. The Approval is valid for the period of **26/09/2017** to **26/09/2018**.

Your study reference number is **HS111ES**. Please, cite this number in all your future correspondences with UNCST in respect of the above study.

Please, note that as Principal Investigator, you are responsible for:

1. Keeping all co-investigators informed about the status of the study.
2. Submitting any changes, amendments, and addenda to the study protocol or the consent form, where applicable, to the designated local Research Ethics Committee (REC) or Lead Agency, where applicable, for re-review and approval prior to the activation of the changes.
3. Notifying UNCST about the REC or lead agency approved changes, where applicable, within five working days.
4. For clinical trials, reporting all serious adverse events promptly to the designated local REC for review with copies to the National Drug Authority.
5. Promptly reporting any unanticipated problems involving risks to study subjects/participants to the UNCST.
6. Providing any new information which could change the risk/benefit ratio of the study to the UNCST for review.
7. Submitting annual progress reports electronically to UNCST. Failure to do so may result in termination of the research project.

Please, note that this approval includes all study related tools submitted as part of the application.

Yours sincerely,

Hellen Opolot
For: Executive Secretary
UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Appendix 4: Participant Information Sheet and Informed Consent for 24hr Recall Interview (English)

WOMEN'S DIETARY PRACTICES IN CONTEMPORARY UGANDA

24-HOUR RECALL PARTICIPANT INFORMED CONSENT FORM

<u>Part 1: Information</u>

Hello,

You are being invited to take part in this research study on the dietary practices of Ugandan women at different stages in their lives. It has been identified that the food people eat and how they eat it can influence their health and also the environment. We also know that what and how people eat is affected by the people and places around them. Therefore with this research, we want to understand what Ugandan women eat and how they eat it and the reasons why they eat in a particular way. While you may not directly benefit from this research, the information that collected from you, and others, will be used to inform ways to improve eating practices, health and the environment.

You have been approached because we feel that your experiences will give us important information which will help us understand how different people eat and incorporate food and eating into their daily lives. You are free to choose whether or not to take part. If you do choose to take part, we will discuss any questions you might have about your participation. I will then ask you to sign a consent form confirming that you have agreed to participate. If at any one time you feel like you wish to leave the study, you are free to do so. If you choose to leave the study, please contact Carolyn Auma (contact details are on the information sheet provided to you). Please understand that if you choose to leave the study at any point, you do not have to give a reason; and nothing bad will happen to you. There is no foreseen harm associated with taking part in this study. Your participation in this research is completely voluntary. You do not have to answer any question that you do not want to. You can choose to end your participation at any time during the research. If you choose to end your participation, you will not be affected in any way.

Your participation in this research will involve you engaging in discussions with the researcher. Each discussion will last between 40 - 60 minutes. In this first discussion we will talk about you and what you eat. Between the first and the second discussion, if you are selected, you will be given a camera to use to take photographs that show what food means to you, how, where and with whom you eat and the things in your environment which you feel make you eat the way you do. In the second discussion we will talk about the photographs you have taken. Details about how to take the photographs will be explained to you, before you are given the camera. To make sure that the researcher gets exactly what you say during the interviews, the researcher will ask your permission to record each of the meetings. Everything you say will not be shared with anyone except those on the research team. Your name or address will not be used in documents, reports, or publications related to this research, a special number will be assigned to you instead.

Compensation will be provided to reimburse you for the time you have spent in this research. You will be provided with a transport refund at the end of each interview; and an airtime voucher worth UGX 5,000 at the end of each interview.

The Makerere University School of Public Health Research Ethics Committee has approved this research. It is being undertaken by Miss Carolyn Auma, a student at the School of Health and Related Research, in the University of Sheffield (UK) as part of her PhD research project. Carolyn Auma will be under the supervision of academics at the University of Sheffield and Dr David Musoke (at Makerere University School of Public Health) throughout the study period. If you have any further questions, concerns or problems related to participating in this study, please contact Carolyn Auma or Dr David Musoke. You may also contact Dr Suzanne Kiwanuka for questions around the research study ethics at the Makerere University School of Public Health Ethics Institutional Review Board or your rights regarding participation in this study (contact details are provide below).

Miss Carolyn Auma, PhD Student, School of Health and Related Research (ScHARR), University of Sheffield - Email: Ciauma1@sheffield.ac.uk; Telephone: 0790634107

Dr. David Musoke, Senior Lecturer, Makerere University School of Public Health, and Email: dmusoke@musph.ac.ug; Telephone: +256712987736/ +256704814265

Dr. Suzanne Kiwanuka, Chairperson Makerere University School of Public Health Institutional Review Board; Email: skiwanuka@musph.ac.ug; Telephone: +256701888163/ +256312291397

Part II: Consent

Please sign below to show that you have accepted to participate in this study:

PARTICIPANT IDENTIFICATION NUMBER: PLEASE INITIAL/TICK BOX
(*to be completed by interviewer after interview*)

1. I agree that the purpose and detail of this research study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Makerere University (School of Public Health Ethics Institutional Review Board) ☐

2. I have read and understood the information sheet and had an opportunity to ask questions about taking part in this interview. ☐

3. I understand that my participation is voluntary. I am free to leave at any time without giving any reason and if I do, nothing bad will happen to me. If I do not want to answer any particular questions, I am free to refuse. ☐

4. I understand that my responses will be kept strictly private (confidential). I understand that my name will not be linked with the interview (anonymised) and I will not be identified or identifiable. I agree for the data collected from me to be used in future research respecting my anonymity. ☐

5. I agree to take part in this study. ☐

______________________	______________	____________________
Participant's Name (*or legal representative*)	Date	Signature / Thumbprint

If volunteers cannot read the form themselves, a witness must sign here:

'I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.'

______________________	______________	____________________
Name of witness	Date	Signature / Thumbprint

__________________________ ________________ ____________________

Name of person taking consent Date Signature / Thumbprint

(*Only to be completed if different from lead researcher. To be signed and dated in presence of the participant*)

__________________________ ________________ ____________________

Lead Researcher Date Signature/ Thumbprint

(*To be signed and dated in presence of the participant*)

After this first interview, you might be invited to take part in a further study using cameras to take photographs of food in your daily lives. Please, tick if you would like to participate in this interview or not.

YES, I would like to participate in the study using cameras ☐

NO, I do not want to participate in the study using cameras ☐

(Remember you can change your mind at any time. If you decide you no longer want to take part in the study with cameras, please let Carol know. Also, if you had chosen not to participate but decide later that you would now like to participate, please contact Carol)

Appendix 5: Participant Information Sheet and Informed Consent for 24hr Recall Interview (Luganda)

WOMEN'S DIETARY PRACTICES IN CONTEMPORARY UGANDA

24-HOUR RECALL PARTICIPANT INFORMED CONSENT FOOMU

Part I: Information

Gyebaale,

Mbadde nkuyita okwegatta mu kunoonyereza kuno ezi kwatta ku emeere ne byokulya mu abakazi n'abavubuka bawala mu Uganda mu bulamu byabwe. Bafunye mu sayansi nti emeere abantu gye balya atte bwebalya esobola kola ebintu nnungi oba mbi mu obulamu bwe atte ne mubutonde. Ekiddako, mu sayansi bafunye nti abantu ne butone bisobola ku kola omuntu alye kano oba kali. Kati mu kunoonyereza kuno, twagala kumanya atte kutegere nti ki abakyaka n'abavubuka bawala banaUganda gyebalya atte lwaki. Wadde tojja kufunira mu kunoonyereza kuno, ebintu byetujja kwogela kko nawe, n'abalala nga ggwe, bijja tuyamba kumanya nti emmere ne byokulya tubikole atya okuyamba obulamu, ne obutonde.

Tusubiza nti obumanyirivu gyo esobola tuyamba okutegera emmere n'ekitundu eky'emeere mu obulamu gy'abantu. Olina eddembe okulonda oba ojja kwegatta oba toyagala okwegatta mu kunoonyereza kuno. Oba oyagala kwegatta, tujja kwogela oba olina ebibuzo gy'oyagala kumbuuza. Ekiddako, njakubuza nti owandike mu foomu nti okiriziganya okwegatta mu kunoonyereza kuno. Oba ku saawa olulala owulila nti tokyayagala okwegatta mu konoonyereza kuno, osobola kunyimiriza ovemu. Oba kunoonyereza okivira mu, munoonyereza Carol Auma mugambe ko (essimu eriko ku kapapulagy'ebakuwadde okutwala ekka ejilina ebiwandiko ebya kunoonyereza kuno mubujjuvu). Bambi kimanye nti oba kunoonyereza okivira mu, tewali mutawana, tweali kye tujja kola.

Okwegatta mu kunoonyereza kuno, ky'etaga kubera mu olukunganya bbiri ne munoonyereza (ekinonomu ddakika nga 40 – 60). Mu olukunganya ey'okusoka, tujja kwogela ku ggwe atte ne emeere gy'olya. Ekiddako, waliwo abamu bwetujja kuwa kamera, bagende bakube ebifanaanyi egyilaga emeere etegeza ki mubulamu bwe, wa, n'ani gy'ebalya n'abo atte n'ebintu mu olutonde gyebawulila nti ebakolelaa nti balye gy'ebalya. Oba ye gwe gye tuwaa kamera, mu olukunganya bbri ekiddako, tujja kwogela ko tueese ku ebifaananyi gye wa kubye. Ebyokukuba ebifaananyi tujja bikunonyola mu bujuvu ngatonaba kufuna kamera. Okukakasa nti munoonyereza akwata buli kyogamba mu olukunganya, omunoonyereza ajja kozesa akuuma akakwata amaloboozi mu olukunganya naye olina okukiriziganya. Ebintu byetujja kwogela ko, omunoonyereza tajja bilaga wadde okujja ko bannasaayansi bwakolela nabo e Makerere University ne The University of Sheffield. Nga nkola alippota oba presentationi oba workshop sijja kuteeka ko elinnya lyo wadde. Nja kozesa omuwendo gyebayitta 'codi', naye nga tewali nga amanyi nti en'omuwendo y'ono mukazi oba muvubuka.

Tujja kweyaanza ku saawa jjyo tekka mu kunoonyereza kuno. Ojja kufuna transport refund nga tumaliriza olukunganya kinonomu ate ne ka airtime eya nkumi tano (5,000).

Eno researchi ekolebwa munoonyereza mukyala Carol Auma, omusomi owa School of Health and Related Research mu Univasite eya Sheffield mu bungereza. Akola kunoonyereza kuno nga omulimu owa emisomo owa PhD diguli. Carol Auma ajjakola ne bannasaayansi balala mu Univasite eya Sheffield ne mu Makerere Univasite e Kampala mu kunoonyereza kuno. Kunoonyereza kuno efunye ethics approval e Makerere Univasite School of Public Health. Oba ng'olina ebibuzo ezikwatta ku kunoonyereza kuno, osobola kubuza Carol Auma oba Dr David Musoke oba ne Dr Suzanne Kiwanuka ku omuwendo zino:

Miss Carolyn I. Auma, PhD Student, School of Health and Related Research (ScHARR), University of Sheffield - Email: Ciauma1@sheffield.ac.uk; Telephone: 0790634107

Dr. David Musoke, Senior Lecturer, Makerere University School of Public Health, and Email: dmusoke@musph.ac.ug; Telephone: +256712987736/ +256704814265

Dr. Suzanne Kiwanuka, Chairperson Makerere University School of Public Health Institutional Review Board; Email: skiwanuka@musph.ac.ug; Telephone: +256701888163/ +256312291397

Part II: Consent

Bambi, wandiika wano oba okiriziganya okwegatta mu kunoonyereza kuno:

PARTICIPANT IDENTIFICATION NUMBER: INITIAL/TICK BOX
(to be completed by interviewer after interview)

1. Nkiriziganya nti bamaze ku nyonyola ku kunonyereza kuno. Nki tegera nti munonyereza ono tali mukuumi wa mateeka, anooya bunonyereza. Nki tegera nti ku noonyereza kuno egenda kwongera mu ku sayansi ku by'okulya. Ebintu mu kunoonyereza kuno ziyitiddwa e Makerere Univasite (School of Public Health Ethics Institutional Review Board). ☐

2. Okukiriza nti bybanngambye mbtiegedde. Ebibuzo by'embadde nina kukwata ku kunonyereza kuno, mmaze bibuza atte bamaze ku damu. ☐

3. Nki manyi nti okwegatta ku kunoonyereza kuno sikyakukaka. Nkitegera nti nsobola okunyimiriza bwoba nga mpulira sikyayagala kwegatta ku kunoonyereza kuno. Oba waliwo ekabuzo nga ssagala ki ddamu, tewali mutawaana. Nsobola gaana. ☐

4. Tewali ajja kumanya byonna byoonatubilira okujako abakolagana ne munonyereza. Bangambye nti elinya lyanga tebajja ki Nkiriziganya nti ebintu bye'nja kwogela ko omunonyereza asobola zi kozesa mu kunonyereza endala naye nga elinya lyanga azijjeko. ☐

5. Nkiriziganya okubeera mu kunoonyereza kuno. ☐

____________________	______________	________________
Erinnya (or legal representative)	Olunaku lwa leero	Signature / Ekyenkumu

If volunteers cannot read the form themselves, a witness must sign here:

'Nabadde yo nga okufuna n'ebintu ebirala eby'a kwegatta mu konoonyereza kuno babadde bazi nyonyola ku mukazi ono; atte n'akiriza okwegatta mu kunoonyereza kuno'.

____________________	______________	________________
Erinnya z'omujuluzi	Olunaku lwa leero	Signature/ Ekyenkumu

___________________________ _________________ _____________________

Erinnya g'omusasi Olunaku lwa leero Signature / Ekyenkumu

(Only to be completed if different from lead researcher. To be signed and dated in presence of the participant)

___________________________ _________________ _____________________

Munoonyereza Olunaku lwa leero Signature/ Ekyenkumu

(To be signed and dated in presence of the participant)

Waliwo ekitundu my kunoonyereza kuno ezijja kozesa kamera okukuba ebifanaanyi ezikkwata ku emeere n'ebyokulya mu bulamu gyo. Oba ng'oyagala kwegatta ne kitundu kino edddako mu kanoonyereza kuno, wandika wansi wano:

YYE, njagala kwegatta mu kitundu ekya kunoonyereza ezikozesa kamera ☐

NEDDA, saagala kwegatta mu kitundu ekya kunoonyereza ezikozesa kamera ☐

(Juukira nti osobola okunyimiriza bwoba nga owulira tokyayagala kwegatta ku kunoonyereza kuno. Oba ngoyagala ku vamu, bambi munonyereza Carol mugambe oba n'omusasi mugambe. Oba nga wabadde wagambye nti toyagala kwegatta ne kanoonyereza akakozesa kamera, naye olunaku olulala owulira nti oyagala kubeera mu, munoonyereza Carol mugambe oba omusasi)

Appendix 6: Participant Information Sheet and Informed Assent for 24hr Recall Interview (English)

WOMEN'S DIETARY PRACTICES IN CONTEMPORARY UGANDA
- 24-HOUR RECALL INFORMED ASSENT FORM -
(For participants between the ages of 15 and 17 years of age only)

Hello, my name is Carolyn Auma, and I am a student at the University of Sheffield. I am going to give you information and ask you to be part of a research study that I am doing on food and how people eat.

We know that the food people eat and how they eat can affect their health and the environment. We also know that the things people eat and the ways in which they eat is affected by the people and the places around them. With this research, we want to understand what Ugandan women and young people, like you, eat and how they eat it, and also the reasons why they eat in a particular way.

You have been asked to participate because we feel that your experiences will give us important information which will help us understand how different people eat and how food and eating fits into their daily lives. You may not directly benefit from this research, but the information collected from you and others who take part will be used to inform ways to make eating practices, health and the environment better. We have discussed this research with your parents/guardian and they know we are also asking for your agreement. If you are going to take part, your parents/guardian have to agree. If they agree but you feel you do not want to take part, you are free to choose not to take part. If you do choose to take part, we will discuss any questions you might have about your participation. I will then ask you to sign an assent form confirming that you have agreed to participate. You do not have to decide immediately. If you would like to first discuss with your parents/guardian, you are free to do so.

If you choose to take part and then you decide at any one time, that you wish to leave the study, you are free to do so. If you choose to leave the study, please contact Carolyn Auma (contact details will be on the information sheet given to you to take home). Please understand that if you choose to leave the study at any point, you do not have to give a reason; and nothing bad will happen to you. We do not think that taking part in this research will cause you any pain but if you feel any discomfort at any time, please talk to the researcher, Carolyn Auma or to your parents/guardian.

Taking part in this research will involve you engaging in discussions with the researcher. Each discussion will last between 40 - 60 minutes. The location for the discussions will be St. Jude Nagulu Parish Hall. In this first discussion we will talk about you and what you eat. Between the first and the second discussion, if you are selected, you will be given a camera to use to take photographs that show what food you eat, how you eat food, where you eat and the people and places around you which you feel make you eat the way you do. In the second discussion, we will talk about the photographs you have taken. Before we give you the camera, we shall show you how to use it. To make sure that the researcher gets exactly what you say during the discussions, we will ask your permission to record each of the discussions. During the discussions, remember you do not have to answer any question that you do not want to. Nothing you say will be shared with anyone except those on the research team. Your name or address will not be used in documents, reports, or publications related to this research. Instead of putting your name, only a number will be used and only the researcher will know that this number belongs to your name.

At a later date, we shall share with you, the participants, and other members in the community what we have found from this research. We shall also write a report which other Ugandans and people in other countries can read to share what we have found out from this research.

To compensate you for the time you spend talking to us, we will give you an airtime worth UGX 5,000 at the end of each interview. You will also be provided with a transport refund of 5,000 at the end of each interview.

The Makerere University School of Public Health Research Ethics Committee has approved this research. It is being undertaken by Miss Carolyn Auma, a student at the School of Health and Related Research, in the University of Sheffield (UK) as part of her PhD research project. Carol Auma will be under the supervision of academics at the University of Sheffield and Dr David Musoke (at Makerere University School of Public Health) throughout the study period.

If you have any other questions about taking part in this research, please contact Carolyn Auma or Dr David Musoke. You may also contact Dr Suzanne Kiwanuka to ask questions about your rights regarding participation in this study (contact details are provided).

Miss Carolyn I. Auma, PhD Student, School of Health and Related Research (ScHARR), University of Sheffield - Email: Ciauma1@sheffield.ac.uk; Telephone: 0790634107

Dr. David Musoke, Senior Lecturer, Makerere University School of Public Health, and Email: dmusoke@musph.ac.ug; Telephone: +256712987736/ +256704814265

Dr. Suzanne Kiwanuka, Chairperson Makerere University School of Public Health Institutional Review Board; Email: skiwanuka@musph.ac.ug; Telephone: +256701888163/ +256312291397

Please sign below to show that you have/ have not accepted to participate in this study:

PARTICIPANT IDENTIFICATION NUMBER: INITIAL/TICK BOX
(to be completed by interviewer after interview)

1. I agree that the purpose and detail of this research study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Makerere University School of Public Health Research Ethics Committee ☐

2. I have read or had the information read to me. I have understood it and had my questions answered. I know I can also ask questions later. ☐

3. I understand that my participation is voluntary. I am free to leave at any time without giving any reason. If I choose to leave, nothing bad will happen to me. If I do not want to answer any questions, I do not have to. ☐

4. I understand that my responses will be kept strictly private. I understand that my name will not be linked with the discussion and I will not be identified or identifiable. I agree for the data collected from me to be used in future research respecting my anonymity. ☐

5. I agree to take part in this study. ☐

______________________	______________	______________________
Participant's Name (or legal representative)	Date	Signature / Thumbprint

<u>If participants cannot read the form themselves, a witness must sign here:</u>

'I was present while the benefits, risks and procedures were read to the participant. All questions were answered and the volunteer has agreed to take part in the research.'

______________________	______________	______________________
Name of witness	Date	Signature / Thumbprint

‘I confirm that the participant (child) was allowed to ask questions about the study, and all questions were answered to the best of my ability. I confirm that consent has been given freely and voluntarily’.

__________________________ _________________ _____________________

Researcher Date Signature/ Thumbprint

(To be signed and dated in presence of the participant)

__________________________ _________________ _____________________

Name of person taking consent Date Signature / Thumbprint

(Only to be completed if different from lead researcher. To be signed and dated in presence of the participant)

After this first interview, you might be invited to take part in a further study using cameras to take photographs of food in your daily lives. Please, tick if you would like to participate in this interview or not.

YES, I would like to participate in the study using cameras ☐

NO, I do not want to participate in the study using cameras ☐

(Remember you can change your mind at any time. If you decide you no longer want to take part in the study with cameras, please let Carol know. Also, if you had chosen not to participate but decide later that you would now like to participate, please contact Carolyn)

Appendix 7: Participant Information Sheet and Informed Assent for 24hr Recall Interview (Luganda)

WOMEN'S DIETARY PRACTICES IN CONTEMPORARY UGANDA
- PARTICIPANT INFORMED ASSENT FORM –
(Eno foomu y'abavubuuka abayina emyaka 15 – 17)

Part I: Information

Gyebala, errinya lyange bampitta Carolyn Auma, omusomi e The University of Sheffield mu bungereza. Ngenda kutegeeza nkuyite oba oyagala okwegatta mu kunoonyereza kyenkola elikwatta ku emeere ne byokulya mu abakazi nabavubuka bawala mu Uganda mu bulamu byabwe.

Bafunye mu sayansi nti emeere abantu gye balya atte bwebalya esobola kola ebintu nnungi oba mbi mu obulamu bwe atte ne mubutonde. Ekiddako, tumanyi nti abantu ne butone abantu gyebasuula oba gy'ebakolebwa bisobola ku kola omuntu alye kano oba kali. Kati mu kunoonyereza kuno, twagala kumanya atte kutegere ki abakyaka n'abavubuka bawala, nga gwe, bana Uganda gyebalya atte lwaki.

Tusubiza nti obumanyirivu gywo esobola tuyamba okutegera emmere n'ekitundu eky'emeere mu obulamu gy'abantu. Wadde tojja kufunira mu kunoonyereza kuno, ebintu byetujja kwogela kko bijja tuyamba kumanya nti emmere ne byokulya, tujja bikola atya okuyamba obulamu, ne obutonde. Tumazze okwogela n'abazadde bo ne ku banonyola ebya kunoonyereza kuno. Bamanyi nti nawe tujja kwogela nawe tukubuziza nto okiriziganye oba ngoyagala. Tosobola kwegatta ne kunoonyereza kuno nga bazadde bo tebakiriziganya, wadde nga gwe wakiriziganya. Oba nga bazadde bakiriziganya naye nga gwe toyagala, tewali mutawana. Tolina kwegatta ne kunoonyereza kuno. Olina eddembe okulonda oba ojja kwegatta oba toyagala okwegatta mu kunoonyereza kuno. oba oyagala kwegatta, tujja kwogela oba olina ebibuzo gy'oyagala kumbuuza. Ekiddako, njakubuza nti owandike mu foomu nti okiriziganya okwegatta mu kunoonyereza kuno. Oba ku saawa olulala owulila nti tokya yagala okwegatta mu konoonyereza kuno, osobola kunyimiriza ovemu. Oba kunoonyereza okivira mu, munoonyereza Carolyn Auma mugambe ko (essimu eriko ku kapapulagy'ebakuwadde okutwala ekka ejilina ebiwandiko ebya kunoonyereza kuno mubujjuvu). Bambi kimanye nti oba kunoonyereza okivira mu, tewali mutawana, tweali kye tujja kola.

Okwegatta mu kunoonyereza kuno, ky'etaga kubera mu olukunganya bbiri ne munoonyereza (ekinonomu ddakika nga 40 – 60). Olukunganya zoombi zijja bubeera mu 'Strengthening Community Health Workers Project Office' e Nakawuka. Mu olukunganya ey'okusoka, tujja kwogela ku ggwe atte ne emeere gy'olya. Ekiddako, waliwo abamu bwetujja kuwa kamera, bagende bakube ebifanaanyi ejilaga emeere etegeza ki mubulamu bwe, wa, n'ani gy'ebalya n'abo atte n'ebintu mu olutonde ekyi bakola nti balye gy'ebalya. Oba ye gwe gye tuwaa kamera, mu olukunganya bbri ekiddako, tujja kwogela ko tueese ku ebifaananyi gye wa kubye. Ebyokukuba ebifaananyi tujja bikunonyola mu bujuvu ngatonaba kufuna kamera. Okukakasa nti munoonyereza akwata buli kyogamba, omunoonyereza ajja kozesa akuuma akakwata amaloboozi mu olukunganya naye olina okukiriziganya. Oba nga mu olukunganya waliwo akabuzo nga toyagala ka ddamu, tewali mutawana.

Ebintu byetujja kwogela ko, sijja bilaga wadde okujja ko bannasaayansi bwenkola nabo e Makerere University ne The University of Sheffield. Nga nkola alippota oba presentationi oba workshop wadde oba njogela ko ne bannasayansi, sijja kuteeka ko elinnya lyo wadde. Nja kozesa omuwendo gye bayitta codi mukiffo k'errinya kyo, nga yiyo wekka. Atte tewali omuntu, okujjako nze, ajja kumanya nti eno codi y'ono omuntu. Olulala, tujja kuleta byetufuunye mu kunoonyereza kuno tubanyonyole, mwe ababadde mu kunoonyereza n'abalala abatabadde mu. Atte, tujja kuwandiika ne alipoota abalala abali mu Uganda ne munsi ezirala basobole okusooma gye twafuunye mu kunoonyereza kuno.

Tujja kweyaanza ku saawa jjyo tekka mu kunoonyereza kuno. Ojja kufuna transport refund nga tumaliriza olukunganya kinonomu. Oba ng'osula e Nakawuka ojja funna 5,000 naye oba ng'osula e Bulwanyi ojja funna 10,000. Tujja kuwa ne ka airtime eya nkumi tano (5,000).

Munoonyereza ku researchi eno ali mukyala Carol Auma, omusomi owa School of Health and Related Research mu Univasite eya Sheffield mu bungereza. Akola kunoonyereza kuno nga omulimu owa emisomo owa PhD diguli. Carolyn Auma ajjakola ne bannasaayansi balala mu Univasite eya Sheffield ne mu Makerere Univasite e Kampala mu kunoonyereza kuno. Kunoonyereza kuno efunye ethics approval oba ekirizibwa e Makerere Univasite School of Public Health. Oba ngolina ebibuzo ebirala ezikwattagana ne kunoonyereza kuno, osobola ku buza omunoonyereza, Carolyn Auma, oba Dr David Musoke ne Dr Suzanne Kiwanuka e Makerere Univasite ku omuwendo zino:

Miss Carolyn I. Auma, PhD Student, School of Health and Related Research (ScHARR), University of Sheffield - Email: Ciauma1@sheffield.ac.uk; Telephone: 0790634107

Dr. David Musoke, Senior Lecturer, Makerere University School of Public Health, and Email: dmusoke@musph.ac.ug; Telephone: +256712987736/ +256704814265

Dr. Suzanne Kiwanuka, Chairperson Makerere University School of Public Health Institutional Review Board; Email: skiwanuka@musph.ac.ug; Telephone: +256701888163/ +256312291397

Part II: Assent

Bambi wandiika wano oba okiriziganya oba tokiriziganya okwegatta ne kunooneyera kuno:

PARTICIPANT IDENTIFICATION NUMBER: INITIAL/TICK BOX

(to be completed by interviewer after interview)

1. Nkiriziganya nti bamaze ku nyonyola ku kunonyereza kuno. Nki tegera nti munonyereza ono tali mukuumi wa mateeka, anooya bunonyereza. Nki tegera nti ku noonyereza kuno egenda kwongera mu ku sayansi ku by'okulya. Ebintu mu kunoonyereza kuno ziyitiddwa e Makerere Univasite (School of Public Health Ethics Institutional Review Board). ☐

2. Okukiriza nti bybanngambye mbtiegedde. Ebibuzo by'embadde nina kukwata ku kunonyereza kuno, mmaze bibuza atte bamaze ku damu. ☐

3. Nki manyi nti okwegatta ku kunoonyereza kuno sikyakukaka. Nkitegera nti nsobola okunyimiriza bwoba nga mpulira sikyayagala kwegatta ku kunoonyereza kuno. Oba waliwo ekabuzo nga ssagala ki ddamu, tewali mutawaana. Nsobola gaana. ☐

4. Tewali ajja kumanya byonna byoonatubilira okujako abakolagana ne munonyereza. Bangambye nti elinya lyanga tebajja ki Nkiriziganya nti ebintu bye'nja kwogela ko omunonyereza asobola zi kozesa mu kunonyereza endala naye nga elinya lyanga azijjeko. ☐

5. Nkiriziganya okubeera mu kunoonyereza kuno. ☐

___________________	___________________	___________________
Erinnya (*or legal representative*)	Olunaku lwa leero	Signature / Ekyenkumu

Oba nga omuvubuka tasobola kusooma, omujuluzi alina okuwandiika wano:

'Nabadde yo nga okufuna n'ebintu ebirala eby'a kwegatta mu konoonyereza kuno babadde bazi nyonyola ku mukazi ono; atte n'akiriza okwegatta mu kunoonyereza kuno'.

___________________	___________________	___________________
Erinnya z'omujuluzi	Olunaku lwaleero	Signature/ Ekyenkumu

________________________ ________________ ____________________

Munoonyereza Olunaku lwaleero Signature/ Ekyenkumu

(*To be signed and dated in presence of the participant*)

__________________________ ________________ ____________________

Erinnya g'omusasi Olunaku lwaleero Signature / Ekyenkumu

(*Only to be completed if different from lead researcher. To be signed and dated in presence of the participant*)

Waliwo ekitundu my kunoonyereza kuno ezijja kozesa kamera okukuba ebifanaanyi ezikkwata ku emeere n'ebyokulya mu bulamu gyo. Oba ng'oyagala kwegatta ne kitundu kino edddako mu kanoonyereza kuno, wandika wansi wano:

YYE, njagala kwegatta mu kitundu ekya kunoonyereza ezikozesa kamera ☐

NEDDA, saagala kwegatta mu kitundu ekya kunoonyereza ezikozesa kamera ☐

(Juukira nti osobola okunyimiriza bwoba nga owulira tokyayagala kwegatta ku kunoonyereza kuno. Oba ngoyagala ku vamu, bambi munonyereza Carol mugambe oba n'omusasi mugambe. Oba nga wabadde wagambye nti toyagala kwegatta ne kanoonyereza akakozesa kamera, naye olunaku olulala owulira nti oyagala kubeera mu, munoonyereza Carol mugambe oba omusasi)

Appendix 8: Participant Information Sheet and Informed Assent for Photovoice (English)

WOMEN'S DIETARY PRACTICES IN CONTEMPORARY UGANDA
- PHOTOVOICE PARTICIPANT INFORMED ASSENT FORM -
(For participants between the ages of 15 and 17 years of age only)

Hello, my name is Carolyn Auma, and I am a student at the University of Sheffield. I am going to give you information and ask you to be part of a research study that I am doing on food and how people eat.

We know that the food people eat and how they eat can affect their health and the environment. We also know that the things people eat and the ways in which they eat is affected by the people and the places around them. With this research, we want to understand what Ugandan women and young people, like you, eat and how they eat it, and also the reasons why they eat in a particular way.

You have been asked to participate because we feel that your experiences will give us important information which will help us understand how different people eat and how food and eating fits into their daily lives. You may not directly benefit from this research, but the information collected from you and others who take part will be used to inform ways to make eating practices, health and the environment better. We have discussed this research with your parents/guardian and they know we are also asking for your agreement. If you are going to take part, your parents/guardian have to agree. If they agree but you feel you do not want to take part, you are free to choose not to take part. If you do choose to take part, we will discuss any questions you might have about your participation. I will then ask you to sign an assent form confirming that you have agreed to participate. You do not have to decide immediately. If you would like to first discuss with your parents/guardian, you are free to do so.

If you choose to take part and then you decide at any one time, that you wish to leave the study, you are free to do so. If you choose to leave the study, please contact Carolyn Auma (contact details will be on the information sheet given to you to take home). Please understand that if you choose to leave the study at any point, you do not have to give a reason; and nothing bad will happen to you. We do not think that taking part in this research will cause you any pain but if you feel any discomfort at any time, please talk to the researcher, Carolyn Auma or to your parents/guardian.

Taking part in this research will involve you engaging in discussions with the researcher. Each discussion will last between 40 minutes to an hour. The location for these discussions will be St. Jude Nagulu Parish Hall. In our first discussion we talked about you and what you eat. After the first discussion you were given a camera to use to take photographs that show what food you eat, what food means to you, how, where and with whom you eat and the people and places around you that you feel make you eat the way you do. In this second discussion we will now talk about the photographs you have taken. To make sure that the researcher gets exactly what you say during this discussion, we will ask your permission to make a recording. During the discussion, remember you do not have to answer any question that you do not want to. Nothing you say will be shared with anyone except those on the research team. Your name or address will not be used in documents, reports, or publications related to this research. Instead of putting your name, a special number will be used and only the researcher will know that this number belongs to your name.

At a later date, we shall share with you, the participants, and other members in the community what we have found from this research. We shall also write a report which other Ugandans and people in other countries can read to share what we have found out from this research.

To compensate you for the time you spend talking to us, we will give you an airtime worth UGX 5,000 at the end of each interview. You will also be provided with a transport refund of 5,000 at the end of each interview.

The Makerere University School of Public Health Research Ethics Committee has approved this research. It is being undertaken by Miss Carolyn Auma, a student at the School of Health and Related Research, in the University of Sheffield (UK) as part of her PhD research project. Carol Auma will be under the supervision of academics at the University of Sheffield and Dr David Musoke (at Makerere University School of Public Health) throughout the study period. If you have any other questions about taking part in this research, please contact Carolyn Auma or Dr David Musoke. You may also contact Dr Suzanne Kiwanuka to ask questions about your rights regarding participation in this study (contact details are provided below).

Miss Carolyn I. Auma, PhD Student, School of Health and Related Research (ScHARR), University of Sheffield - Email: Ciauma1@sheffield.ac.uk; Telephone: 0790634107

Dr. David Musoke, Senior Lecturer, Makerere University School of Public Health, and Email: dmusoke@musph.ac.ug; Telephone: +256712987736/ +256704814265

Dr. Suzanne Kiwanuka, Chairperson Makerere University School of Public Health Institutional Review Board; Email: skiwanuka@musph.ac.ug; Telephone: +256701888163/ +256312291397

Please sign below to show that you have/ have not accepted to participate in this study:

PARTICIPANT IDENTIFICATION NUMBER: INITIAL/TICK BOX
(to be completed by interviewer after interview)

1. I agree that the purpose and detail of this research study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Makerere University School of Public Health Research Ethics Committee ☐

2. I have read or had the information read to me. I have understood it and had my questions answered. I know I can also ask questions later. ☐

3. I understand that my participation is voluntary. I am free to leave at any time without giving any reason. If I choose to leave, nothing bad will happen to me. If I do not want to answer any questions, I do not have to. ☐

4. I understand that my responses will be kept strictly private (confidential). I understand that my name will not be linked with the discussion (anonymised) and I will not be identified or identifiable. I agree for the data collected from me to be used in future research respecting my anonymity. ☐

5. I agree to take part in this study. ☐

__________________________ _________________ _____________________

Participant's Name (or legal representative) | Date | Signature / Thumbprint

If participants cannot read the form themselves, a witness must sign here:

'I was present while the benefits, risks and procedures were read to the participant. All questions were answered and the volunteer has agreed to take part in the research.'

__________________________ _________________ _____________________

Name of witness | Date | Signature / Thumbprint

I confirm that the participant (child) was allowed to ask questions about the study, and all questions were answered to the best of my ability. I confirm that consent has been given freely and voluntarily.

__________________________ _________________ _____________________

Researcher | Date | Signature/ Thumbprint

(To be signed and dated in presence of the participant)

__________________________ _________________ _____________________

Name of person taking consent | Date | Signature / Thumbprint

(Only to be completed if different from lead researcher. To be signed and dated in presence of the participant)

Appendix 9: Participant Information Sheet and Informed Assent for Photovoice (Luganda)

WOMEN'S DIETARY PRACTICES IN CONTEMPORARY UGANDA
PHOTOVOICE PARTICIPANT INFORMED CONSENT – FORM A
(Eno foomu ekozesebwa abavubuuka abalina emyaka 15 – 17 bokka)

Part I: Information

Gyebala, errinya lyange bampitta Carolyn Auma, omusomi e The University of Sheffield mu bungereza. Ngenda kutegeeza nkuyite oba oyagala okwegatta mu kunoonyereza kyenkola elikwatta ku emeere ne byokulya mu abakazi nabavubuka bawala mu Uganda mu bulamu byabwe.

Bafunye mu sayansi nti emeere abantu gye balya atte bwebalya esobola kola ebintu nnungi oba mbi mu obulamu bwe atte ne mubutonde. Ekiddako, tumanyi nti abantu ne butone abantu gyebasuula oba gy'ebakolebwa bisobola ku kola omuntu alye kano oba kali. Kati mu kunoonyereza kuno, twagala kumanya atte kutegere ki abakyaka n'abavubuka bawala, nga gwe, bana Uganda gyebalya atte lwaki.

Tusubiza nti obumanyirivu gywo esobola tuyamba okutegera emmere n'ekitundu eky'emeere mu obulamu gy'abantu. Wadde tojja kufunira mu kunoonyereza kuno, ebintu byetujja kwogela kko bijja tuyamba kumanya nti emmere ne byokulya, tujja bikola atya okuyamba obulamu, ne obutonde. Tumazze okwogela n'abazadde bo ne ku banonyola ebya kunoonyereza kuno. Bamanyi nti nawe tujja kwogela nawe tukubuziza nto okiriziganye oba ngoyagala. Tosobola kwegatta ne kunoonyereza kuno nga bazadde bo tebakiriziganya, wadde nga gwe wakiriziganya. Oba nga bazadde bakiriziganya naye nga gwe toyagala, tewali mutawana. Tolina kwegatta ne kunoonyereza kuno. Olina eddembe okulonda oba ojja kwegatta oba toyagala okwegatta mu kunoonyereza kuno. oba oyagala kwegatta, tujja kwogela oba olina ebibuzo gy'oyagala kumbuuza. Ekiddako, njakubuza nti owandike mu foomu nti okiriziganya okwegatta mu kunoonyereza kuno. Oba ku saawa olulala owulila nti tokya yagala okwegatta mu konoonyereza kuno, osobola kunyimiriza ovemu. Oba kunoonyereza okivira mu, munoonyereza Carolyn Auma mugambe ko (essimu eriko ku kapapulagy'ebakuwadde okutwala ekka ejilina ebiwandiko ebya kunoonyereza kuno mubujjuvu). Bambi kimanye nti oba kunoonyereza okivira mu, tewali mutawana, tweali kye tujja kola.

Okwegatta mu kunoonyereza kuno, ky'etaga kubera mu olukunganya bbiri ne munoonyereza (ekinonomu ddakika nga 40 – 60). Olukunganya zoombi zijja bubeera mu 'Strengthening Community Health Workers Project Office' e Nakawuka. Mu olukunganya ey'okusoka, twayogedde ku ggwe atte ne ku emeere gy'olya. Jjukiira nti twakuwadde kamera ogende okube ebifaananyi. Leero, mu olukunganya bbri ekiddako, tujja kuteesa ku ebifaananyi gyewa kubye. Okukakasa nti munoonyereza akwata buli kyogamba, omunoonyereza ajja kozesa akuuma akakwata amaloboozi mu olukunganya naye olina okukiriziganya. Oba nga mu olukunganya waliwo akabuzo nga toyagala ka ddamu, tewali mutawana.

Ebintu byetujja kwogela ko, sijja bilaga wadde okujja ko bannasaayansi bwenkola nabo e Makerere University ne The University of Sheffield. Nga nkola alippota oba presentationi oba workshop wadde oba njogela ko ne bannasayansi, sijja kuteeka ko elinnya lyo wadde. Nja kozesa omuwendo gye bayitta codi mukiffo k'errinya kyo, nga yiyo wekka. Atte tewali omuntu, okujjako nze, ajja kumanya nti eno codi y'ono omuntu. Olulala, tujja kuleta byetufuunye mu kunoonyereza kuno tubanyonyole, mwe ababadde mu kunoonyereza n'abalala abatabadde mu. Atte, tujja kuwandiika ne alipoota abalala abali mu Uganda ne munsi ezirala basobole okusooma gye twafuunye mu kunoonyereza kuno.

Tujja kweyaanza ku saawa jjyo tekka mu kunoonyereza kuno. Ojja kufuna transport refund nga tumaliriza olukunganya kinonomu. Oba ng'osula e Nakawuka ojja funna 5,000 naye oba ng'osula e Bulwanyi ojja funna 10,000. Tujja kuwa ne ka airtime eya nkumi tano (5,000).

Munoonyereza ku researchi eno ali mukyala Carol Auma, omusomi owa School of Health and Related Research mu Univasite eya Sheffield mu bungereza. Akola kunoonyereza kuno nga omulimu owa emisomo owa PhD diguli. Carolyn Auma ajjakola ne bannasaayansi balala mu Univasite eya Sheffield ne mu Makerere Univasite e Kampala mu kunoonyereza kuno. Kunoonyereza kuno efunye ethics approval oba ekirizibwa e Makerere Univasite School of Public Health. Oba ngolina ebibuzo ebirala ezikwattagana ne kunoonyereza kuno, osobola ku buza omunoonyereza, Carolyn Auma, oba Dr David Musoke ne Dr Suzanne Kiwanuka e Makerere Univasite ku omuwendo zino:

Miss Carolyn I. Auma, PhD Student, School of Health and Related Research (ScHARR), University of Sheffield - Email: Ciauma1@sheffield.ac.uk; Telephone: 0790634107

Dr. David Musoke, Senior Lecturer, Makerere University School of Public Health, and Email: dmusoke@musph.ac.ug; Telephone: +256712987736/ +256704814265

Dr. Suzanne Kiwanuka, Chairperson Makerere University School of Public Health Institutional Review Board; Email: skiwanuka@musph.ac.ug; Telephone: +256701888163/ +256312291397

Part II: Assent

Bambi, wandiika wano oba okiriziganya oba tokiriziganya okwegatta ne kunoonyereza kuno:

PARTICIPANT IDENTIFICATION NUMBER: INITIAL/TICK BOX
(*to be completed by interviewer after interview*)

1. Nkiriziganya nti bamaze ku nyonyola ku kunonyereza kuno. Nki tegera nti munonyereza ono tali mukuumi wa mateeka, anooya bunonyereza. Nki tegera nti ku noonyereza kuno egenda kwongera mu ku sayansi ku by'okulya. Ebintu mu kunoonyereza kuno ziyitiddwa e Makerere Univasite (School of Public Health Ethics Institutional Review Board). ☐

2. Okukiriza nti bybanngambye mbtiegedde. Ebibuzo by'embadde nina kukwata ku kunonyereza kuno, mmaze bibuza atte bamaze ku damu. ☐

3. Nki manyi nti okwegatta ku kunoonyereza kuno sikyakukaka. Nkitegera nti nsobola okunyimiriza bwoba nga mpulira sikyayagala kwegatta ku kunoonyereza kuno. Oba waliwo ekabuzo nga ssagala ki ddamu, tewali mutawaana. Nsobola gaana. ☐

4. Tewali ajja kumanya byonna byoonatubilira okujako abakolagana ne munonyereza. Bangambye nti elinya lyanga tebajja ki Nkiriziganya nti ebintu bye'nja kwogela ko omunonyereza asobola zi kozesa mu kunonyereza endala naye nga elinya lyanga azijjeko. ☐

5. Nkiriziganya okubeera mu kunoonyereza kuno. ☐

____________________	______________	_________________
Erinnya (*or legal representative*)	Olunaku lwa leero	Signature / Ekyenkumu

Oba nga omuvubuka tasobola okusooma, omujuluzi alina kuwandiika wano:

'Nabadde yo nga okufuna n'ebintu ebirala eby'a kwegatta mu konoonyereza kuno babadde bazi nyonyola ku mukazi ono; atte n'akiriza okwegatta mu kunoonyereza kuno'.

____________________	______________	_________________
Erinnya z'omujuluzi	Olunaku lwaleero	Signature/ Ekyenkumu

__________________________ _________________ _____________________

Munoonyereza Olunaku lwaleero Signature/ Ekyenkumu

(*To be signed and dated in presence of the participant*)

__________________________ _________________ _____________________

Erinnya g'omusasi Olunaku lwaleero Signature / Ekyenkumu

(*Only to be completed if different from lead researcher. To be signed and dated in presence of the participant*)

Appendix 10: Participant Information Sheet and Informed Consent for Photovoice (Luganda)

WOMEN'S DIETARY PRACTICES IN CONTEMPORARY UGANDA

PHOTOVOICE PARTICIPANT INFORMED CONSENT – FOOMU A

<u>Part I: Information</u>
Hello,

Mbadde nkuyita okwegatta mu kunoonyereza kuno ku emeere ne byokulya mu abakazi nabavubuka bawala mu Uganda mu bulamu byabwe. Bafunye mu sayansi nti emeere abantu gye balya atte bwebalya esobola kola ebintu nnungi oba mbi mu obulamu bwe atte ne mubutonde. Ekiddako, mu sayansi nti abantu ne butone bisobola ku kola omuntu alye kano oba kali. Kati mu kunoonyereza kuno, twagala kumanya atte kutegera kiki abakyaka banaUganda gyebalya atte lwaki. Wadde tojja kufunira mu kunoonyereza kuno, ebintu byetujja kwogela kko bijja tuyamba kumanya nti emmere ne byokulya, tujja bikola atya okuyamba obulamu, ne obutonde.

Tusubiza nti obumanyirivu gywo esobola tuyamba okutegera emmere n'ekitundu eky'emeere mu obulamu gy'abantu. Olina eddembe okulonda oba ojja kwegatta oba toyagala okwegatta mu kunoonyereza kuno. oba oyagala kwegatta, tujja kwogela oba olina ebibuzo gy'oyagala kumbuuza. Ekiddako, njakubuza nti owandike mu foomu nti okiriziganya okwegatta mu kunoonyereza kuno. Oba ku saawa olulala owulila nti tokya yagala okwegatta mu konoonyereza kuno, osobola kunyimiriza ovemu. Oba kunoonyereza okivira mu, munoonyereza Carolyn Auma mugambe ko (essimu eriko ku kapapulagy'ebakuwadde okutwala ekka ejilina ebiwandiko ebya kunoonyereza kuno mubujjuvu). Bambi kimanye nti oba kunoonyereza okivira mu, tewali mutawana, tweali kye tujja kola.

Okwegatta mu kunoonyereza kuno, ky'etaga kubera mu olukunganya bbiri ne munoonyereza (ekinonomu ddakika nga 40 – 60). Mu olukunganya ey'okusoka, twa yogedde ku ggwe atte ne ku emeere gy'olya. Jjukiira nti twakuwadde kamera ogende okube ebifaananyi. Leero, mu olukunganya bbri ekiddako, tujja kuteesa ku ebifaananyi gyewa kubye. Okukakasa nti munoonyereza akwata buli kyogamba, omunoonyereza ajja kozesa akuuma akakwata amaloboozi mu olukunganya naye olina okukiriziganya. Ebintu byetujja kwogela ko, sijja bilaga wadde okujja ko bannasaayansi bwenkola nabo e Makerere University ne The University of Sheffield. Nga nkola alippota oba presentationi oba workshop sijja kuteeka ko elinnya lyo wadde. Omunoonyereza ajja kuwa omuwendo gyebayitta 'codi' nga ya gwe wekka alemeza koseza elinnya lyo. Tewali ajja kumanya nti omuwendo eno y'omukazi oba omuvubuka ono okujjako munoonyereza.

Tujja kweyaanza ku saawa jjyo tekka mu kunoonyereza kuno. Ojja kufuna transport refund nga tumaliriza olukunganya kinonomu ate ne ka airtime eya nkumi tano (5,000).

Munoonyereza ku researchi eno ali mukyala Carol Auma, omusomi owa School of Health and Related Research mu Univasite eya Sheffield mu bungereza. Akola kunoonyereza kuno nga omulimu owa emisomo owa PhD diguli. Carol Auma ajjakola ne bannasaayansi balala mu Univasite eya Sheffield ne mu Makerere Univasite e Kampala mu kunoonyereza kuno. Kunoonyereza kuno efunye ethics approval e Makerere Univasite School of Public Health. Oba ngolina ebibuzo birala elikwatta ku kunoonyereza kuno, osobola kubuza munoonyereza, Carolyn Auma, oba Dr David Musoke ne Dr Suzanne Kiwanuka e Makerere Univasite ku omuwendo gino:

Miss Carolyn I. Auma, PhD Student, School of Health and Related Research (ScHARR), University of Sheffield - Email: Ciauma1@sheffield.ac.uk; Omuwendo y'esimu: 0790634107

Dr. David Musoke, Senior Lecturer, Makerere University School of Public Health, and Email: dmusoke@musph.ac.ug; Omuwendo y'esimu: +256712987736/ +256704814265

Dr. Suzanne Kiwanuka, Chairperson Makerere University School of Public Health Institutional Review Board; Email: skiwanuka@musph.ac.ug; Omuwendo y'esimu: +256701888163/ +256312291397

Part II: Consent

Bambi wandikka wano nti okiriziganya okwegatta ne kunoonyereza kuno:

PARTICIPANT IDENTIFICATION NUMBER: INITIAL/TICK BOX
(to be completed by interviewer after interview)

1. Nkiriziganya nti bamaze ku nyonyola ku kunonyereza kuno. Nki tegera nti munonyereza ono tali mukuumi wa mateeka, anooya bunonyereza. Nki tegera nti ku noonyereza kuno egenda kwongera mu ku sayansi ku by'okulya. Ebintu mu kunoonyereza kuno ziyitiddwa e Makerere Univasite (School of Public Health Ethics Institutional Review Board).

2. Okukiriza nti bybanngambye mbtiegedde. Ebibuzo by'embadde nina kukwata ku kunonyereza kuno, mmaze bibuza atte bamaze ku damu.

3. Nki manyi nti okwegatta ku kunoonyereza kuno sikyakukaka. Nkitegera nti nsobola okunyimiriza bwoba nga mpulira sikyayagala kwegatta ku kunoonyereza kuno. Oba waliwo ekabuzo nga ssagala ki ddamu, tewali mutawaana. Nsobola gaana.

4. Tewali ajja kumanya byonna byoonatubilira okujako abakolagana ne munonyereza. Bangambye nti elinya lyanga tebajja ki Nkiriziganya nti ebintu bye'nja kwogela ko omunonyereza asobola zi kozesa mu kunonyereza endala naye nga elinya lyanga azijjeko.

5. Nkiriziganya okubeera mu kunoonyereza kuno.

________________________ ________________ ____________________

Erinnya Olunaku lwa leero Signature / Ekyenkumu
(*or legal representative*)

Oba ng'omukyala tasobola kusooma foomu eno, omujuluzi ayina okuwandiika wano:

'Nabadde yo nga okufuna n'ebintu ebirala eby'a kwegatta mu konoonyereza kuno babadde bazi nyonyola ku mukazi ono; atte n'akiriza okwegatta mu kunoonyereza kuno'.

________________________ ________________ ____________________

Erinnya z'omujuluzi Olunaku lwaleero Signature/ Ekyenkumu

__________________________ _________________ _____________________

Erinnya g'omusasi Olunaku lwaleero Signature / Ekyenkumu

(Only to be completed if different from lead researcher. To be signed and dated in presence of the participant)

__________________________ _________________ _____________________

Munoonyereza Olunaku lwaleero Signature/ Ekyenkumu

(*To be signed and dated in presence of the participant*)

(Juukira nti osobola okunyimiriza bwoba nga owulira tokyayagala kwegatta ku kunoonyereza kuno. Oba ngoyagala ku vamu, bambi munonyereza Carol mugambe oba n'omusasi mugambe. Oba nga wabadde wagambye nti toyagala kwegatta ne kanoonyereza akakozesa kamera, naye olunaku olulala owulira nti oyagala kubeera mu, munoonyereza Carol mugambe oba omusasi)

Appendix 11: Participant Information Sheet and Informed Consent for Photovoice (English)

WOMEN'S DIETARY PRACTICES IN CONTEMPORARY UGANDA
PHOTOVOICE PARTICIPANT INFORMED CONSENT – FORM A

Part I: Information
Hello,

You are being invited to take part in this research study on the dietary practices of Ugandan women at different stages in their lives. It has been identified that the food people eat and how they eat it can influence their health and also the environment. We also know that what and how people eat is affected by the people and places around them. Therefore with this research, we want to understand what Ugandan women eat and how they eat it but also the reasons why they eat in a particular way. While you may not directly benefit from this research, the information that collected from you will be used to inform ways to improve eating practices, health and the environment.

You have been approached because we feel that your experiences will give us important information which will help us understand how different people eat and incorporate food and eating into their daily lives. You are free to choose whether or not to take part. If you do choose to take part, we will discuss any questions you might have about your participation. I will then ask you to sign a consent form confirming that you have agreed to participate. If at any one time you feel like you wish to leave the study, you are free to do so. If you choose to leave the study, please contact Carolyn Auma (contact details are provided to you). Please understand that if you choose to leave the study at any point, you do not have to give a reason; and nothing bad will happen to you. There is no foreseen harm associated with taking part in this study. Your participation in this research is completely voluntary. You do not have to answer any question that you do not want to. You can choose to end your participation at any time during the research. If you choose to end your participation, you will not be affected in any way.

Your participation will involve you engaging in discussions with the researcher. Each discussion will last between 40 – 60 minutes. In the first discussion we will talked about you and what you eat. After the first discussion you were given a camera to use to take photographs that show what food means to you, how, where and with whom you eat and things in your environment which make you eat the way you do. In this second discussion we will now talk about the photographs you have taken. To make sure that the researcher gets exactly what you say during the interviews, the researcher will ask your permission to record each of the meetings. Everything you say will not be shared with anyone except those on the research team. Your name or address will not be used in documents, reports, or publications related to this research. A special numeric code will be attached to you and used instead of your name, and only the researcher will know which code is for which participant.

At a later date, the findings of this research will be communicated to you, the participants, as well as other members of the community. Publications will also be made to share the results with other members who might be interested in the research in Uganda and other countries. Your name will not be used at all.

Compensation will be provided to reimburse you for the time you have spent in this research. You will be provided with a transport refund at the end of each interview; and an airtime voucher worth UGX 5,000 at the end of each interview.

The Makerere University School of Public Health Research Ethics Committee has approved this research. It is being undertaken by Miss Carolyn Auma, a student at the School of Health and Related Research, in the University of Sheffield (UK) as part of her PhD research project. Carolyn Auma will be under the supervision of academics at the University of Sheffield and Dr David Musoke (at Makerere University School of Public

Health) throughout the study period. If you have any further questions, concerns or problems related to participating in this study, please contact Carolyn Auma or Dr David Musoke. You may also contact Dr Suzanne Kiwanuka for questions around the research study ethics at the Makerere University School of Public Health Ethics Institutional Review Board or your rights regarding participation in this study (contact details are provided).

Miss Carolyn Auma, PhD Student, School of Health and Related Research (ScHARR), University of Sheffield - Email: Ciauma1@sheffield.ac.uk; Telephone: 0790634107

Dr. David Musoke, Senior Lecturer, Makerere University School of Public Health, and Email: dmusoke@musph.ac.ug; Telephone: +256712987736/ +256704814265

Dr. Suzanne Kiwanuka, Chairperson Makerere University School of Public Health Institutional Review Board; Email: skiwanuka@musph.ac.ug; Telephone: +256701888163/ +256312291397

Part II: Consent

Please sign below to show that you have accepted to participate in this study:

PARTICIPANT IDENTIFICATION NUMBER: INITIAL/TICK BOX
(to be completed by interviewer after interview)

1. I agree that the purpose and detail of this research study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Makerere University (School of Public Health Ethics Institutional Review Board) ☐

2. I have read and understood the information sheet and had an opportunity to ask questions about taking part in this interview. ☐

3. I understand that my participation is voluntary. I am free to leave at any time without giving any reason and if I do, nothing bad will happen to me. If I do not want to answer any particular questions, I am free to refuse. ☐

4. I understand that my responses will be kept strictly private (confidential). I understand that my name will not be linked with the interview (anonymised) and I will not be identified or identifiable. I agree for the data collected from me to be used in future research respecting my anonymity. ☐

5. I agree to take part in this study. ☐

________________________ ________________ ____________________

Participant's Name (*or legal representative*) Date Signature / Thumbprint

If volunteers cannot read the form themselves, a witness must sign here:

'I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.'

________________________ ________________ ____________________

Name of witness Date Signature / Thumbprint

___________________________ _________________ ______________________

Name of person taking consent | Date | Signature / Thumbprint

(*Only to be completed if different from lead researcher. To be signed and dated in presence of the participant*)

___________________________ _________________ ______________________

Lead Researcher | Date | Signature/ Thumbprint

(*To be signed and dated in presence of the participant*)

(Remember you can change your mind at any time. If you decide you no longer want to take part in the study with cameras, please let Carolyn know. Also, if you had chosen not to participate but decide later that you would now like to participate, please contact Carolyn)

Appendix 12: Acknowledgement and Release Form (English)

Photovoice Acknowledgement and Release Form

(To be signed by photovoice study participants ONLY to release photographs they have taken for purposes of research including report writing, journal publishing etc.)

I accept the use of my photographs for the purpose of this research study by the principal investigator (and research supervisory team when required). They are free to use my photos for project-related activities like reports, seminars, workshops and presentations. Where my images are used, acknowledgment shall be given to me as the photographer.

Signature (or Thumbprint) of Participant:

Date:

Investigator:

Appendix 13: Acknowledgement and Release Form (Luganda)

Photovoice Acknowledgement and Release Form

(Information for Interviewer: To be signed by photovoice study participants ONLY to release photographs they have taken for purposes of research including report writing, journal publishing etc.)

Nze nkkiriziganya nti ba researcher basobola okoseza ebifananyi byange mu kunonyerezebwa kw'abwe. Nkkiriziganya nti basobola okozesa ebifananyi gyange n'e ddembe mu'ebintu ebi kwataganya ne kunonyereza nga alipoota, lukungaana, workshopsi, seminars oba presentationi. Oba nga ebifananyi gyange b'azikozesa, bajja ku wandiika awo nti y'enze eya tutte ekifananyi.

Signature oba Ekyenkumu kya engalo ensajja:

Olunaku lw'omweezi:

Munononyereza:

Appendix 14: Food Groups used in the PCA of the Dietary Intake of Rural and Urban WRA

Food Items in 2008 UFCS	PCA Food Group	Rationale for composition of food group with respect to environmental sustainability, health and NT	Environmental Impact Category
Fresh or dried pork, beef or goat meat; High fat, medium fat or lean pork, beef or goat meat; Boiled, steamed, fried or roasted pork, beef or goat meat	Red meat	Traditionally, most groups in East Africa ate meat only occasionally with the exception of pastoralists for whom it is a traditional food and whose livelihood depends on it (GoU, 1945). In Uganda, low consumption of animal protein by females in the past was largely due to taboos (GoU, 1945). Increased consumption of meat is as a marker of the NT (Popkin, 2006; Gill et al. 2015). Moderate amounts of red meat have nutritional benefits and so could be have positive health outcomes for nutritionally vulnerable people but overconsumption associated with NCDs (Gill et al. 2015). Red meat (beef and other ruminant meat) has the highest environmental impact of all food groups in terms of GHGEs (Bailey and Harper, 2015; Bajzelj et al. 2015; Clune et al. 2017).	High
Boiled, steamed, braised, roasted or deep-fried organ meats (tongue, chicken gizzards and animal hooves), liver and offal (intestine/tripe)	Organ meats	Offal and meat by-products (particularly pork and beef offal) present a healthier alternative to more common cuts of meat (Payne et al. 2016). Consumption of offal is a marker of traditional dietary habits; but also encompasses the healthy and sustainable eating principles, i.e. nose-to-tail consumption and reduction of food waste (Garnett, 2015).	High
Boiled, steamed, roasted, fried chicken (skin or skinless)	Chicken	Chicken is a source of protein, vitamins (B3, B6 and riboflavin) and minerals (phosphorous, zinc, selenium and potassium). Lower environmental footprint compared with ruminant animals.	Medium

Fresh, sun-dried, smoked, raw, deep-fried Nile tilapia, Nile perch, semutundu, mukene and nkejje cooked by boiling, steaming and deep-frying	Fish	Fish has a lot to offer nutritionally, i.e. protein (essential amino acids especially lysine and methionine), long-chain PUFAs; vitamins A, D and B; and minerals calcium, zinc, phosphorous, iodine, iron and selenium (Bene et al., 2015). Small pelagic fish (mukene, nkejje) are particularly healthy, even more so compared with 'conventional' Ugandan fish species (Kabahenda et al., 2011). Fish was traditionally available around the lake and coastal areas where it was usually consumed fresh, sun-dried or smoked (GoU, 1945). Fish is more efficient at converting feed into high quality protein and has smaller carbon footprint (GHGE) compared with other animal-source protein (Bene et al., 2015). But there are issues with overfishing – particularly in Uganda.	Medium
Grasshoppers, white ants, bee larvae	Insects	According to data compiled between 1930 and 1960, these were eaten as seasonal delicacies in Uganda (GoU, 1945) and they still are. Nutritionally, insects have varied nutrient content, but generally, have higher content of saturated fat, sodium and energy compared to meat (beef, pork and chicken); and are superior to meat in situations of undernutrition (Payne et al. 2016). Also, proposed as more environmentally friendly source of protein; moreover in Uganda they are largely seasonal and not commercially farmed, so smaller carbon footprint.	Low
Orange, pineapple, mango, guava, raspberries, 'nsaali', menvu, bogoya, passion fruit, papaya, guava, lemon, jackfruit, empafu, tangerine,	Fresh fruit and unsweetened fruit juice	Fruit, although a source of simple sugars, are rich in vitamins, minerals and dietary fibre. They are protective against some NCDs; and the micronutrients are important in the fight against micronutrient deficiency.	Low

watermelon, unsweetened fruit juice		Field grown[64] fruits have a low environmental impact, when looking at global warming potential (Clune et al., 2017). Only field grown vegetables have a lower impact than field grown fruit. In Uganda, most fruit is field-grown, so carbon footprint of this food group is low.	
Brown cane sugar, white cane sugar, honey, sugarcane	Sugar and sweeteners	Increased sugar consumption is an indicator of the nutrition transition dietary shifts in SSA (Popkin, 2006; Kimenju and Qaim, 2016).	Low
Sweet bread, salty bread, white buns, brown buns, white bread, brown bread	Bread and buns	The introduction of bread as a fixture in the morning meal of breakfast is indicative of transitioning dietary patterns. In fact, in Uganda in the 1930-60's, some ethnic groups did not have a breakfast time - there were only two main meals, i.e. at midday and in the evening (Courcy-Ireland et al.1937). Where there was breakfast, it mainly consisted of the left-overs from the previous day's evening meal (Courcy-Ireland et al.1937; Ruttishauser (1963). The consumption of (mainly) wheat flour in the production of bread and buns is therefore indicative of the increasing relevance of non-traditional cereal products in the Ugandan diet.	Low
Oil fried chapatti, dry fried chapatti	Chapatti	Chapatti is produced from refined wheat flour. Not reported anywhere in earlier accounts of traditional Ugandan food; therefore can be considered as a transitioning food item.	Low
Omelette, boiled egg, fried egg	Eggs	Nutritionally speaking, eggs offer a lot, i.e. high quality protein, riboflavin, B12, vitamins A and D, selenium, iodine and fats (including MUFAs and cholesterol), and choline etc. Has a moderately low environmental impact, i.e. lower than other conventional animal sources of high quality protein except for milk (Clune et al., 2017).	Medium

[64] Field grown fruits and vegetables are those which are farmed in open areas relative to greenhouse-grown fruit and vegetables

Nakatti, spider plant, doodo, pumpkin leaves, malakwang, cow pea leaves, bean leaves, entula, okra fruit, okra leaves, pumpkin, ensusuti, mushroom and alayo (cooked by boiling, steaming or eaten raw)	Traditional vegetables boiled	These have been reported as traditional vegetable varieties in Uganda (Goode et al., 1989; Raschke et al.,2007; Oltersdorf, 1971). These vegetables were traditionally boiled or steamed or eaten raw as snacks at times (Goode, 1989; Raschke et al., 2007). African night shade, amaranth and spider plant are rich in protein and iron compared with newer vegetable varieties like kale and cabbage (Abukutsa, 2010). Traditional vegetables are also high in calcium, vitamin A, C and E (Yang, 2009). In terms of environmental impact, Ttraditional vegetables are largely field grown, and field grown vegetables have the lowest GHGE (Clune et al., 2017). Indigenous or traditional plants are still an important part of the rural Uganda food basket (Acipa et al., 2013). The continued consumption of traditional vegetables signals that some food components are keeping with traditional dietary patterns.	Low
Nakatti, spider plant, doodo, pumpkin leaves, malakwang, cow pea leaves, bean leaves, entula, okra fruit, okra leaves, pumpkin, ensusuti, mushroom and alayo (cooked by frying)	Traditional vegetables fried	The method of preparation is what signifies dietary changes associated with the nutrition transition, i.e. the frying of traditional vegetables with vegetable oils which were previously boiled or steamed or eaten raw.	Low
Tomatoes, chilli, cucumber, onions, garlic, avocado, carrots, green bell peppers, sukuma wiki, French beans, cabbage (cooked by boiling, steaming or eaten raw)	Non-traditional vegetables boiled	These have been reported as imported or exotic vegetables (Goode, 1989). The consumption of non-traditional vegetables in itself is a marker of changing dietary habits. While these have a lot to offer nutritionally, some are more inferior in terms of their nutrition profile compared with traditional vegetables.	Low

		Field grown vegetables have the lowest environmental impact (Clune et al., 2017).	
Tomatoes, chilli, cucumber, onions, garlic, avocado, carrots, green bell peppers, sukuma wiki, French beans, cabbage (cooked by frying with oil)	Non-traditional vegetables fried	The method of preparation is what signifies dietary changes associated with the nutrition transition, i.e. the frying of non-traditional vegetables with vegetable oils.	Low
White rice, brown rice, spaghetti, macaroni	Rice and pasta	Rice (particularly refined polished rice) may not offer as much nutritionally as some traditional cereals like millet and sorghum. Rice has the lowest protein content among cereals, and lowest dietary fibre (FAO, 1993) Rice has a moderately high environmental impact (compared with coarser traditional cereals) owing to methane production (Clune et al. 2017); and water footprint when grown in paddies.	Medium
Shea nut butter, omuzigo omuganda, groundnut paste, sesame paste, groundnut and sesame paste	Traditional fats, oils and spreads	Although sesame and groundnut pastes are not oils or fats in actual sense, they have a high fat content; and their inclusion in this category is based on their utilisation as an 'oil' to flavour food. Traditionally, plant oils, e.g. sesame, peanut, shea butter nut and red palm were used for cooking in East Africa (Rashke et al., 2007).	Medium
(Branded and unbranded) vegetable oil, margarine, hydrogenated vegetable cooking fat	Non-traditional fats, oils and spreads	Associated with the nutrition transition i.e. high fat. The health implications of trans fats, e.g. hydrogenated fat, margarines are well known.	Medium
Fresh milk, boiled milk, yoghurt, milk tea, eshabwe, sour milk	Milk and milk products	The nutritional value of milk and milk products is well known. Milk and therefore milk products (depending on processing method) have a moderate environmental	Medium

		impact, i.e. terms of global warming potential. Less environmental impact than green-house heated vegetables (Clune et al., 2017).	
Yam, sweet potato, irish potato, cocoyam, cassava, cassava: maize atap, cassava atap (cooked by boiling, steaming or eaten raw)	Boiled roots and tubers boiled	According to Callanan (1926) in EA, most staple foods in the past were cooked by either boiled, or occasionally roasted. Have been previously recognised as environmentally benign (Reynolds et al. 2015).	Low
Sweet potato, cassava (cooked by shallow or deep frying)	Fried roots and tubers fried	Although traditional staples may still be consumed, acculturation results in changes in food preparation as well. Therefore, deep-frying or frying of roots and tubers particularly with processed vegetable oils, is indicative of transitioning dietary behaviours.	Low
Katogo, nyoyo	Katogo	Traditional dishes. They are markers of cultural identity.	Low
Bottled beer, bottled wine, traditional beers and crude gin	Alcoholic beverages	Have been associated with some NCDs like stomach cancer.	Low
Maize atap, millet atap, sorghum atap, sorghum:cassava (2:1) atap (cooked by boiling or steaming)	Traditional cereals boiled	According to Rashke et al. (2007) in the past, the main cereal crops in the EA region were sorghum, finger and pearl millet. They were an important source of calories and micronutrients (vitamin B1, nicotinic acid, vitamin A, calcium and phosphorous). Have been previously recognised as environmentally benign (Reynolds et al., 2015).	Low
Popcorn, hard corn, roasted maize (cooked with oil or roasted)	Traditional cereals fried	The method of preparation is what signifies dietary changes associated with the nutrition transition, i.e. the frying of traditional cereals with vegetable oils.	Low

Soya porridge, maize porridge, millet porridge, TASO porridge, sorghum porridge, enturire	Porridge	This is what would constitute the 'traditional' Ugandan breakfast (Ruttishauser, 1963). Mainly made from traditional cereals, and a few tubers, so nutritional benefits of cereals and roots/tubers are assumed here; as well as environmental implications.	Low
Biscuits, candies, kabalagala, gulusa, doughnuts, mandazi, half cake, cake	Sweets	High fat and moderate sugar (EDNP). Sweets are not reported in the traditional Ugandan diet. Consumption associated with NCDs (Gill et al., 2015)	Medium
Samosas, rice balls	Savoury snacks	High fat, high salt. Consumption is associated with NCDs (Gill et al., 2015)	Medium
Homemade fruit juice with added sugar, soda, packaged fruit juices and sugar-sweetened drinks, soda, fruit-flavoured concentrate drinks	Sugar-sweetened drinks	These are important because they are EDNP foods which have been implicated in the rise of NCDs and are markers of the NT (Popkin and Ng, 2007; Caprio, 2012). They are also associated with the consumption of salty foods and fast foods (Caprio, 2012).	
Unsweetened black tea, unsweetened black coffee	Tea	The sugar content of these have been counted within the food group 'sugar and sweeteners' so are considered here simply as unsweetened tea	Low
Bean soup, beef soup, goat soup, chicken soup, pork soup, fish soup, tomato soup	Soups		Low
Pumpkin seeds, sunflower seeds, roasted groundnut seeds, roasted sesame seeds	Nuts and seeds	Grouped together because of how they are utilised. Soy bean, although a legume, is eaten as a nut in the study context. Nuts and seeds have lower environmental impact (Clune et al., 2017)	Low

Nambaale, yellow bean, white bean, black bean, kidney bean, adzuki bean, bean sauce, field pea, cowpea, pigeon pea, agira, bean sause, pea sauce	Legumes	They are good sources of protein as well as dietary fibre, zinc, potassium, magnesium, iron and B vitamins. They have lower environmental impact (Clune et al., 2017) as they require less water than many crops and animal production systems.	Low
Groundnut sauce, raw pounded groundnuts, sesame seed sauce	Groundnut sauce	Grouped separately from nuts and seeds primarily because of difference in preparation and utilisation.	Low
Chips, chaps, chips and liver, sausages, rolex	Fast food	Fast foods (transitioning food items) are increasingly being eaten in Uganda especially among the 'working' class particularly in Kampala (Ayo et al., 2012).	Medium
Boiled, steamed matooke ; fresh, green raw matooke, fresh, green roasted matooke	Matooke	Is a traditional food/ ethnic identifier – more strongly among the Baganda, but increasingly Uganda as a whole.	Low
	n= 35		

Appendix 15: Greenhouse Gas Estimates for Foods Consumed by Rural and Urban WRA

Food name	GHGE g100g	GHGE g_100kcal
cassava (fresh, deep-fried)	8.8	2.33422
cassava (fresh, boiled)	8.8	7.85714
cassava (fresh, boiled) with salt	8.8	7.85714
cassava (fresh, steamed)	8.8	7.85714
sweet potato (yellow-fleshed, boiled)	10	9.34579
sweet potato (white-fleshed, boiled)	10	9.34579
sweet potato (white-fleshed, steamed)	10	7.63359
sweet potato (yellow-fleshed, steamed)	10	7.29927
sweet potato (unknown colour, steamed)	10	7.29927
matooke (steamed)	72	53.7313
matooke (boiled)	72	62.069
mashed potato with butter	40.3077	39.5173
irish potato (fried) with onion, tomato, vegetable oil	11.7363	15.6484
irish potato (fried) with onion, tomato, carrot, vegetable oil	11.6129	15.4839
irish potato (fried) with onion, tomato, green pepper, carrot, vegetable oil	21.6687	28.8916
yam (boiled)	88	61.9718
yam (steamed)	88	61.9718
brown rice (boiled) with onion, vegetable oil	63.0116	35.802
white rice (boiled)	127.5	98.0769
white rice (boiled) with onion, salt	127.5	98.0769
white rice (boiled) with vegetable oil	141.667	71.1535
white rice (boiled) with onion, vegetable oil, salt	63.0116	31.6482
white rice (boiled) with onion, tomato, vegetable oil, salt	70.576	48.0109
white rice (boiled) with onion, tomato, vegetable oil, curry powder, salt	70.576	48.0109
pilau rice (fried) with onion, vegetable oil	101.439	54.8318
pilau rice (boiled) with onion, tomato, vegetable oil, salt	70.576	63.0143
white rice (boiled) with carrot, green peas	48.0389	34.5604
spaghetti (fried) with onion, tomato	42.2719	58.711
bread (wholewheat, brown, bun)	29.9022	12.255
bread (wholewheat, brown, sliced)	30.3384	12.383
bread (refined wheat, sweet yellow, sliced)	128.397	34.8906
bread (refined wheat, white, sliced)	30.3384	11.4054
bread (refined wheat, white, bun)	29.9022	11.2414
chapatti (oil-fried)	23.6364	8.59504
posho (refined maize flour, white)	15.98	10.7973
posho (refined maize flour, yellow)	15.98	4.33062
posho (unrefined maize flour, brown, grade 2)	15.4771	10.7108
posho (unrefined maize flour, brown, grade 3)	15.4771	10.9767
kalo (millet flour, atap)	21.0513	17.5428
kalo (50:50 cassava and sorghum flour, atap)	2.9876	2.57552
kwenongora (cassava flour, atap)	3.94152	2.1191
bushera (sorghum, cold)	9.4	10.3297

Food name	GHGE g100g	GHGE g_100kcal
porridge (millet)	6.6317	16.5793
porridge (millet) with sugar	1.35	1.48352
porridge (rice flour, white) with skim milk, sugar	17.4467	18.4426
porridge (refined maize flour, white), no sugar	5.74065	15.8581
porridge (refined maize flour, white) with sugar, full-fat milk	16.0967	12.4012
porridge (refined maize flour, white) with sugar	5.30165	5.64006
porridge (refined maize flour, yellow) with sugar	5.30165	5.64006
sausages (beef)	466.996	209.415
pork (roasted)	577	191.694
offal (boiled) with onion, tomato, coatmeal, salt, curry powder	1487.1	1582.02
beef (smoked) boiled with onion, tomato	772.389	426.734
beef (fresh) boiled with onion, tomato, green pepper, carrot, garlic	976.431	581.209
beef (fresh) boiled with onion, tomato, green pepper, carrot, royco, salt	535.09	318.506
beef (fresh) deep-fried with vegetable oil	920.84	113.237
beef (fresh) fried with onion, tomato, carrot, garlic, vegetable oil, salt	1198.58	568.855
beef (fresh) fried with onion, tomato, eggplant, vegetable oil, curry powder, royco	509.759	241.936
beef (fresh) fried with onion, tomato, vegetable oil	1146.26	544.024
goat meat (fresh) boiled with onion, tomato	356.86	205.092
chicken (grilled)	3650	1600.88
chicken (deep-fried)	3650	1159.1
egg (chicken, boiled)	3460	2232.26
omelette	224.89	81.8676
fish (tilapia, fresh) steamed	349	70.7911
fish sauce (tilapia, smoked) with onion, tomato, groundnut sauce	76.7438	23.2557
fish sauce (mukene) boiled	349	172.772
fish sauce (mukene) boiled with tomato, salt	28.1411	15.6339
fish sauce (mukene) boiled with onion, tomato, green pepper	69.7784	38.7658
fish sauce (mukene) fried with onion, vegetable oil	305.545	67.9139
fish sauce (mukene) fried with vegetable oil, onion, tomato,curry powder, salt	57.6875	57.6299
fish sauce (mukene) fried with onion, tomato, eggplant, vegetable oil, royco	73.3163	73.2431
fish sauce (mukene) fried with onion, tomato, eggplant, green pepper, vegetable oil	73.3163	82.6565
fish sauce (mukene) fried with onion, tomato, entula, vegetable oil, curry powder	73.3163	82.6565
fish sauce (ngege, dried) boiled with onion, tomato, green pepper, salt	151.972	84.429
fish sauce (unspecified) fried with vegetable oil, tomato, onion, curry powder, salt	113.02	44.5662
pea sauce (cowpea, dried) fried with onion, tomato, vegetable oil	44.6528	28.8641
pea sauce (green pea, fresh) fried with onion, tomato, vegetable oil	37.0139	44.8653
pea sauce (green pea, fresh) fried with onion, tomato, green pepper, vegetable oil, salt	37.0139	44.8653
pea sauce (pigeonpea, dried) fried with onion, tomato, vegetable oil	91.904	77.8847

Food name	GHGE g100g	GHGE g_100kcal
agira (Nambaale, no cover, boiled)	32.5872	22.7883
bean sauce (black, dried) boiled with onion	28.05	21.25
bean sauce (black, fresh) boiled with groundnut paste	11.5909	3.2197
bean sauce (black, dried) fried with onion, vegetable oil	14.7237	23.7479
bean sauce (black, dried) fried with onion, tomato, carrot, vegetable oil	19.0202	30.6777
bean sauce (other kidney, dried) boiled with onion, tomato	28.05	22.0866
bean sauce (yellow, dried) fried with onion, vegetable oil	14.8716	11.3871
bean sauce (yellow, dried) fried with onion, tomato, vegetable oil	14.8716	11.3871
bean sauce (yellow, dried) fried with onion, tomato, green pepper, garlic, vegetable oil, curry powder	14.8716	11.3871
bean sauce (yellow, dried) fried with onion, tomato, green pepper, carrot, vegetable oil, curry powder, royco	14.8716	11.3871
bean sauce (red kidney, dried) fried with onion, tomato, vegetable oil	14.8716	11.3871
bean sauce (red kidney, dried) boiled with simsim paste	11.5909	3.25131
bean sauce (Kanyebwa, fresh) boiled with onion, tomato	27.1218	23.1415
bean sauce (Kanyebwa, fresh) boiled with onion, tomato, green pepper	27.1218	23.1415
bean sauce (Kanyebwa, fresh) boiled with onion, tomato, ginger, salt	27.1218	23.1415
bean sauce (Kanyebwa, fresh) fried with onion, tomato, vegetable oil, salt	26.3466	41.82
bean sauce (Kanyebwa, fresh) fried with onion, tomato, entula, carrot, vegetable oil, royco	26.3466	37.5575
bean sauce (Kanyebwa, dried) fried with tomato, vegetable oil, curry powder, salt	14.8716	23.6057
bean sauce (Nambaale, fresh) boiled with onion	27.1218	16.7419
bean sauce (Nambaale, fresh) fried with onion, tomato, vegetable oil	26.3466	41.82
bean sauce (Nambaale, dried) boiled with onion, tomato, salt	40.15	34.2577
bean sauce (Nambaale, dried) fried with onion, vegetable oil, salt	21.0751	33.4525
bean sauce (Nambaale, dried) fried with onion, tomato, vegetable oil	21.0751	33.4525
bean sauce (Nambaale, dried) fried with onion, tomato, entula, vegetable oil	21.0751	30.0429
bean sauce (Nambaale, dried) fried with onion, tomato, vegetable oil, curry powder, royco, salt	21.0751	33.4525
bean sauce (Nambaale, dried) fried with onion, tomato, green pepper, vegetable oil,curry powder, salt	21.0751	33.4525
bean sauce (Nambaale, dried) fried with onion, tomato, entula, vegetable oil, salt	21.0751	30.0429
groundnut paste	83	14.1156
groundnut sauce (boiled)	83	27.8523
groundnut sauce (boiled) with salt	83	27.8523
groundnut sauce (boiled) with tomato	16.6	2.92769
groundnut sauce (boiled) with entula	8.39387	5.04136
groundnut sauce (boiled) with onion, egg plant	13.9309	8.36689
groundnut sauce (boiled) with onion, tomato, salt	16.6	2.92769
groundnut sauce (boiled) with onion, tomato, curry powder, salt	16.6	2.92769
groundnut sauce (boiled) with onion, tomato, curry powder, entula	19.3011	6.41233

Food name	GHGE g100g	GHGE g_100kcal
groundnut sauce (boiled) with onion, tomato, green pepper, entula, salt	19.3011	6.41233
groundnut sauce (boiled) with mushroom, onion, tomato	41.1663	35.1848
groundnut sauce (boiled) with mushroom, onion, salt	37.7807	32.2912
simsim paste	88	15.0171
tomato	45	250
tomato (small, local tomatoes)	45	214.286
onion	17	42.5
ginger	88	98.8764
carrot (fresh)	20	48.7805
green pepper	66	330
cucumber	23	209.091
cabbage (fresh, white); Tanzania (2008)	23	92
cabbage (fresh, white) boiled	23	100
cabbage (fresh, white) fried with vegetable oil	16.0178	37.2506
cabbage (fresh, white) fried with onion, vegetable oil	16.0178	16.0178
mushroom sauce	11.754	27.3349
gyobyo (boiled) with onion, tomato	37.5185	156.327
spinach (boiled)	54	192.857
nakatti (steamed)	37	132.143
nakatti (boiled)	37	154.167
nakatti (boiled) with onion, salt	28.4557	118.565
nakatti (boiled) with onion, tomato	36.146	682
nakatti (fried) with vegetable oil	37	94.8718
nakatti (fried) with onion, vegetable oil	37	94.8718
nakatti (fried) with onion, tomato, vegetable oil	37	42.9733
bugga (boiled)	37	176.19
bugga (boiled) with onion, salt	23.0828	109.918
bugga (boiled) with onion, tomato	23.0828	435.524
bugga (steamed)	37	137.037
doodo (steamed)	37	137.037
doodo (steamed) with onion, salt	37	137.037
doodo (steamed) with onion, tomato, salt	37	698.113
doodo (boiled)	37	176.19
doodo (boiled) with onion	23.0828	109.918
doodo (boiled) with onion, tomato	23.0828	435.524
doodo (fried) with vegetable oil	19.7226	53.3044
doodo (fried) with onion, tomato, vegetable oil	33.427	38.8235
sukuma wiki (boiled)	23	82.1429
sukuma wiki (boiled) with onion	16.1	57.5
sukuma wiki (fried) with vegetable oil	30.8469	57.124
sukuma wiki (fried) with onion, tomato, vegetable oil	30.8469	57.124
eggplant (boiled)	135	385.714
eggplant sauce (fried) with onion, tomato, carrot, vegetable oil	87.4477	113.128
entula (boiled)	135	385.714

Food name	GHGE g100g	GHGE g_100kcal
entula (fried) with onion, tomato, vegetable oil	38.7821	50.1708
katunkuma (steamed)	45	204.545
kachumbari (tomato, onion, cucumber, red chilli peppers)	20.7267	74.5563
salad (watermelon, cucumber, carrot, green pepper)	35.25	59.7458
mbogga (steamed)	37	264.286
avocado	130	81.25
lemon	26	89.6552
apple (red)	29	50.8772
banana (bogoya)	72	80.8989
watermelon (ripe)	32	106.667
jackfruit (ripe)	45	47.8723
pawpaw (ripe)	30	76.9231
pineapple (ripe)	50	111.111
fruit juice (orange, unsweetened, fresh)	105.6	251.429
fruit juice (orange, unsweetened, DelMonte)	105.6	251.429
fruit juice (orange, sweetened, home-made)	44.4	246.667
fruit juice (passion fruit, unsweetened)	54.6	56.875
fruit juice (passion fruit, sweetened)	24	21.7984
fruit juice (pineapple, unsweetened)	112.5	229.592
fruit juice (mango, unsweetened)	45	83.3333
fruit juice (carrot)	46	102.222
fruit juice (pineapple, orange, mango cocktail, unsweetened)	137.625	305.833
fruit juice (passion fruit, orange, carrot cocktail, sweetened)	126.055	280.123
fruit juice (passion fruit and orange cocktail, sweetened)	34.2	53.3958
fruit drink (mango, sweetened, ready-to-drink, Minute Maid)	22.8834	61.8469
katogo ('irish' potato, matooke, onion, tomato)	35.1196	36.7745
katogo (cassava, beans, onion, tomato, vegetable oil, salt)	5.10938	4.21218
cashew nuts (roasted)	144	23.5679
blueband margarine (original)	84.6	13.6013
ghee	925	105.594
kimbo (hydrogenated vegetable fat)	120	19.2926
potato crisps	16.7442	3.06109
cake (banana)	186.421	58.2566
cake (vanilla)	303.632	94.885
cake (chocolate)	320.299	73.1276
cake (muffin, vanilla)	89.7556	24.7261
mandazi	27.125	6.36737
kabalagala (cassava flour, small desert bananas) fried	37.6522	14.8237
cake (unknown type)	288.54	90.1688
popcorn	58.0588	11.1437
samosa (cowpea)	39.0538	8.27412
rolex (onion, tomato, egg, chapatti)	55.1203	20.0547
milk tea (full-fat) with sugar	88.5198	285.548
soda (Mirinda fruity)	0.9	1.875

Food name	GHGE g100g	GHGE g_100kcal
soda (Mountain Dew)	0.9	1.875
soda (Krest bitter lemon)	0.9	1.875
soda (Pepsi Cola)	0.9	1.875
sugarcane	100	16.6667
black tea with honey	9	0
black tea with sugar	0	0
black tea, no sugar	0	0
black coffee with sugar	0	0
peppermint tea	0	0
sugar (cane, white)	0	2.32558
sugar (cane, brown)	9	2.32558
honey	9	32.8947

Appendix 16: Nutrient Density Scores for Foods Consumed by Rural and Urban WRA

Food name	NRF11.3 100g	NRF11.3 100kcal
cassava (fresh, deep-fried)	5.1086975	1.3550922
cassava (fresh, boiled)	27.243588	24.324632
cassava (fresh, boiled) with salt	28.732024	25.653593
cassava (fresh, steamed)	27.243588	24.324632
sweet potato (yellow-fleshed, boiled)	75.6715	70.721028
sweet potato (white-fleshed, boiled)	73.771408	68.945241
sweet potato (white-fleshed, steamed)	78.775681	60.134108
sweet potato (yellow-fleshed, steamed)	102.85441	75.076209
sweet potato (unknown colour, steamed)	136.96883	99.977245
matooke (steamed)	45.678289	34.088275
matooke (boiled)	39.403503	33.968537
mashed potato with butter	35.086608	34.398635
irish potato (fried) with onion, tomato, vegetable oil	6.0619135	8.0825513
irish potato (fried) with onion, tomato, carrot, vegetable oil	6.0619135	8.0825513
irish potato (fried) with onion, tomato, green pepper, carrot, vegetable oil	6.0619135	8.0825513
yam (boiled)	62.519351	44.027712
yam (steamed)	62.519351	44.027712
brown rice (boiled) with onion, vegetable oil	38.912213	22.109212
white rice (boiled)	14.60429	11.234069
white rice (boiled) with onion, salt	14.60429	11.234069
white rice (boiled) with vegetable oil	18.77753	9.4312054
white rice (boiled) with onion, vegetable oil, salt	18.77753	9.4312054
white rice (boiled) with onion, tomato, vegetable oil, salt	11.168115	7.5973571
white rice (boiled) with onion, tomato, vegetable oil, curry powder, salt	11.168115	7.5973571
pilau rice (fried) with onion, vegetable oil	14.483119	7.8287127
pilau rice (boiled) with onion, tomato, vegetable oil, salt	23.689683	21.151503
white rice (boiled) with carrot, green peas	62.665388	45.083013
spaghetti (fried) with onion, tomato	7.9042169	10.978079
bread (wholewheat, brown, bun)	87.485898	35.854876
bread (wholewheat, brown, sliced)	71.82166	29.314963
bread (refined wheat, sweet yellow, sliced)	33.885227	9.207942
bread (refined wheat, white, sliced)	72.160293	27.12793
bread (refined wheat, white, bun)	65.793965	24.734573
chapatti (oil-fried)	57.671691	20.971524
posho (refined maize flour, white)	49.161386	33.217153
posho (refined maize flour, yellow)	55.006258	14.906845
posho (unrefined maize flour, brown, grade 2)	48.215439	33.367086
posho (unrefined maize flour, brown, grade 3)	47.269492	33.524462
kalo (millet flour, atap)	104.7644	87.303664
kalo (50:50 cassava and sorghum flour, atap)	44.350318	38.233033
kwenongora (cassava flour, atap)	44.379104	23.859733

Food name	NRF11.3 100g	NRF11.3 100kcal
bushera (sorghum, cold)	-1.1142916	-1.224496
porridge (millet)	24.870043	62.175109
porridge (millet) with sugar	-3.3047698	-3.631615
porridge (rice flour, white) with skim milk, sugar	-11.631931	-12.29591
porridge (refined maize flour, white), no sugar	14.449601	39.916025
porridge (refined maize flour, white) with sugar, full-fat milk	-1.4731158	-1.134912
porridge (refined maize flour, white) with sugar	-4.1826262	-4.449602
porridge (refined maize flour, yellow) with sugar	-4.1826262	-4.449602
sausages (beef)	70.408424	31.573284
pork (roasted)	73.187291	24.314715
offal (boiled) with onion, tomato, coatmeal, salt, curry powder	49.614784	52.781686
beef (smoked) boiled with onion, tomato	127.02764	70.181014
beef (fresh) boiled with onion, tomato, green pepper, carrot, garlic	47.338313	28.177567
beef (fresh) boiled with onion, tomato, green pepper, carrot, royco, salt	47.338313	28.177567
beef (fresh) deep-fried with vegetable oil	-29.558208	-3.634802
beef (fresh) fried with onion, tomato, carrot, garlic, vegetable oil, salt	29.734664	14.112323
beef (fresh) fried with onion, tomato, eggplant, vegetable oil, curry powder, royco	29.734664	14.112323
beef (fresh) fried with onion, tomato, vegetable oil	29.734664	14.112323
goat meat (fresh) boiled with onion, tomato	162.05791	93.136732
chicken (grilled)	69.9738	30.690263
chicken (deep-fried)	2.9820061	0.9469692
egg (chicken, boiled)	67.773365	43.724751
omelette	27.637148	10.060848
fish (tilapia, fresh) steamed	80.940343	16.417919
fish sauce (tilapia, smoked) with onion, tomato, groundnut sauce	73.100768	22.151748
fish sauce (mukene) boiled	70.834634	35.066651
fish sauce (mukene) boiled with tomato, salt	63.167671	35.093151
fish sauce (mukene) boiled with onion, tomato, green pepper	63.167671	35.093151
fish sauce (mukene) fried with onion, vegetable oil	188.42744	48.728036
fish sauce (mukene) fried with vegetable oil, onion, tomato, curry powder, salt	181.09076	180.90985
fish sauce (mukene) fried with onion, tomato, eggplant, vegetable oil, royco	181.09076	180.90985
fish sauce (mukene) fried with onion, tomato, eggplant, green pepper, vegetable oil	68.199113	68.156334
fish sauce (mukene) fried with onion, tomato, entula, vegetable oil, curry powder	64.865779	64.398348
fish sauce (ngege, dried) boiled with onion, tomato, green pepper, salt	63.167671	35.093151

Food name	NRF11.3 100g	NRF11.3 100kcal
fish sauce (unspecified) fried with vegetable oil, tomato, onion, curry powder, salt	103.73225	40.903885
pea sauce (cowpea, dried) fried with onion, tomato, vegetable oil	140.60533	90.889028
pea sauce (green pea, fresh) fried with onion, tomato, vegetable oil	74.848934	90.72598
pea sauce (green pea, fresh) fried with onion, tomato, green pepper, vegetable oil, salt	74.848934	90.72598
pea sauce (pigeonpea, dried) fried with onion, tomato, vegetable oil	60.791918	51.518575
agira (Nambaale, no cover, boiled)	113.97413	79.70219
bean sauce (black, dried) boiled with onion	106.89049	80.977643
bean sauce (black, fresh) boiled with groundnut paste	131.31984	36.477734
bean sauce (black, dried) fried with onion, vegetable oil	33.664875	54.298186
bean sauce (black, dried) fried with onion, tomato, carrot, vegetable oil	33.664875	54.298186
bean sauce (other kidney, dried) boiled with onion, tomato	120.45467	94.846194
bean sauce (yellow, dried) fried with onion, vegetable oil	68.989013	52.824665
bean sauce (yellow, dried) fried with onion, tomato, vegetable oil	68.989013	52.824665
bean sauce (yellow, dried) fried with onion, tomato, green pepper, garlic, vegetable oil, curry powder	68.989013	52.824665
bean sauce (yellow, dried) fried with onion, tomato, green pepper, carrot, vegetable oil, curry powder, royco	68.989013	52.824665
bean sauce (red kidney, dried) fried with onion, tomato, vegetable oil	68.989013	52.824665
bean sauce (red kidney, dried) boiled with simsim paste	238.79575	66.983381
bean sauce (Kanyebwa, fresh) boiled with onion, tomato	78.641105	67.099919
bean sauce (Kanyebwa, fresh) boiled with onion, tomato, green pepper	78.641105	67.099919
bean sauce (Kanyebwa, fresh) boiled with onion, tomato, ginger, salt	78.641105	67.099919
bean sauce (Kanyebwa, fresh) fried with onion, tomato, vegetable oil, salt	37.132182	58.939971
bean sauce (Kanyebwa, fresh) fried with onion, tomato, entula, carrot, vegetable oil, royco	127.21983	146.40507
bean sauce (Kanyebwa, dried) fried with tomato, vegetable oil, curry powder, salt	37.132182	58.939971
bean sauce (Nambaale, fresh) boiled with onion	77.34686	47.744975
bean sauce (Nambaale, fresh) fried with onion, tomato, vegetable oil	37.132182	58.939971
bean sauce (Nambaale, dried) boiled with onion, tomato, salt	78.641105	67.099919
bean sauce (Nambaale, dried) fried with onion, vegetable oil, salt	37.132182	58.939971
bean sauce (Nambaale, dried) fried with onion, tomato, vegetable oil	37.132182	58.939971
bean sauce (Nambaale, dried) fried with onion, tomato, entula, vegetable oil	127.21983	146.40507
bean sauce (Nambaale, dried) fried with onion, tomato, vegetable oil, curry powder, royco, salt	37.132182	58.939971
bean sauce (Nambaale, dried) fried with onion, tomato, green pepper, vegetable oil, curry powder, salt	37.132182	58.939971
bean sauce (Nambaale, dried) fried with onion, tomato, entula, vegetable oil, salt	127.21983	146.40507
groundnut paste	155.7492	26.487959
groundnut sauce (boiled)	92.289819	30.969738
groundnut sauce (boiled) with salt	92.289819	30.969738

Food name	NRF11.3 100g	NRF11.3 100kcal
groundnut sauce (boiled) with tomato	181.57102	32.023108
groundnut sauce (boiled) with entula	58.177868	34.941662
groundnut sauce (boiled) with onion, egg plant	58.177868	34.941662
groundnut sauce (boiled) with onion, tomato, salt	181.57102	32.023108
groundnut sauce (boiled) with onion, tomato, curry powder, salt	181.57102	32.023108
groundnut sauce (boiled) with onion, tomato, curry powder, entula	102.81847	34.15896
groundnut sauce (boiled) with onion, tomato, green pepper, entula, salt	102.81847	34.15896
groundnut sauce (boiled) with mushroom, onion, tomato	72.726819	62.159674
groundnut sauce (boiled) with mushroom, onion, salt	72.726819	62.159674
simsim paste	350.47017	60.944853
tomato	35.875306	199.30725
tomato (small, local tomatoes)	40.570061	193.19077
onion	33.066884	82.667211
ginger	91.082997	102.34045
carrot (fresh)	129.62399	189.8688
green pepper	122.21356	264.40112
cucumber	26.019185	236.53805
cabbage (fresh, white); Tanzania (2008)	76.274878	242.43284
cabbage (fresh, white) boiled	69.03907	219.01045
cabbage (fresh, white) fried with vegetable oil	94.113356	188.63571
cabbage (fresh, white) fried with onion, vegetable oil	39.18817	39.18817
mushroom sauce	91.351273	183.24585
gyobyo (boiled) with onion, tomato	88.363547	368.18144
spinach (boiled)	115.48867	412.45955
nakatti (steamed)	112.00062	400.0022
nakatti (boiled)	87.933888	366.3912
nakatti (boiled) with onion, salt	87.933888	366.3912
nakatti (boiled) with onion, tomato	33.640497	406.79135
nakatti (fried) with vegetable oil	117.73736	301.89066
nakatti (fried) with onion, vegetable oil	117.73736	301.89066
nakatti (fried) with onion, tomato, vegetable oil	149.03279	156.94865
bugga (boiled)	180.94939	714.95177
bugga (boiled) with onion, salt	180.94939	714.95177
bugga (boiled) with onion, tomato	33.640497	406.79135
bugga (steamed)	189.57484	656.74398
doodo (steamed)	189.57484	656.74398
doodo (steamed) with onion, salt	189.57484	656.74398
doodo (steamed) with onion, tomato, salt	33.640497	406.79135
doodo (boiled)	180.94939	714.95177
doodo (boiled) with onion	180.94939	714.95177
doodo (boiled) with onion, tomato	33.640497	406.79135
doodo (fried) with vegetable oil	191.40855	438.94202
doodo (fried) with onion, tomato, vegetable oil	149.03279	156.94865
sukuma wiki (boiled)	165.15273	356.89466

Food name	NRF11.3 100g	NRF11.3 100kcal
sukuma wiki (boiled) with onion	165.15273	356.89466
sukuma wiki (fried) with vegetable oil	182.38611	268.82202
sukuma wiki (fried) with onion, tomato, vegetable oil	184.38611	272.52572
eggplant (boiled)	24.065916	68.759761
eggplant sauce (fried) with onion, tomato, carrot, vegetable oil	129.6408	138.34515
entula (boiled)	24.065916	68.759761
entula (fried) with onion, tomato, vegetable oil	129.6408	138.34515
katunkuma (steamed)	47.52131	214.99585
kachumbari (tomato, onion, cucumber, red chilli peppers)	45.721074	164.46429
salad (watermelon, cucumber, carrot, green pepper)	23.631806	40.053908
mbogga (steamed)	30.691098	216.04753
avocado	80.801777	50.501111
lemon	86.199147	194.1733
apple (red)	10.044904	17.622638
banana (bogoya)	32.435437	36.444311
watermelon (ripe)	12.588091	41.960303
jackfruit (ripe)	37.11452	39.483532
pawpaw (ripe)	108.16286	201.27229
pineapple (ripe)	26.8438	59.652888
fruit juice (orange, unsweetened, fresh)	70.47847	127.59424
fruit juice (orange, unsweetened, DelMonte)	70.47847	127.59424
fruit juice (orange, sweetened, home-made)	89.555857	202.47081
fruit juice (passion fruit, unsweetened)	51.036854	53.16339
fruit juice (passion fruit, sweetened)	-13.328421	-12.10574
fruit juice (pineapple, unsweetened)	30.028659	61.282978
fruit juice (mango, unsweetened)	30.335258	56.176404
fruit juice (carrot)	135.56759	179.03909
fruit juice (pineapple, orange, mango cocktail, unsweetened)	53.286487	118.41441
fruit juice (passion fruit, orange, carrot cocktail, sweetened)	53.286487	118.41441
fruit juice (passion fruit and orange cocktail, sweetened)	38.113718	59.506195
fruit drink (mango, sweetened, ready-to-drink, Minute Maid)	-8.2942858	-22.41699
katogo ('irish' potato, matooke, onion, tomato)	22.732708	23.803883
katogo (cassava, beans, onion, tomato, vegetable oil, salt)	48.1163	39.667189
cashew nuts (roasted)	149.00697	24.387393
blueband margarine (original)	12.630886	2.030689
ghee	-38.816471	-4.431104
kimbo (hydrogenated vegetable fat)	48.186441	26.057127
potato crisps	11.292726	2.0644838
cake (banana)	-21.161888	-6.61309
cake (vanilla)	-21.161888	-6.61309

Food name	NRF11.3 100g	NRF11.3 100kcal
cake (chocolate)	-20.354934	-4.647245
cake (muffin, vanilla)	-22.644644	-6.238194
mandazi	5.6673044	1.3303532
kabalagala (cassava flour, small desert bananas) fried	68.804454	27.088368
cake (unknown type)	-21.161888	-6.61309
popcorn	55.250222	10.604649
samosa (cowpea)	-28.839468	-6.110057
rolex (onion, tomato, egg, chapatti)	42.043309	15.29682
milk tea (full-fat) with sugar	9.3539011	30.173875
soda (Mirinda fruity)	-8.0652794	-16.80267
soda (Mountain Dew)	-8.0652794	-16.80267
soda (Krest bitter lemon)	-8.0652794	-16.80267
soda (Pepsi Cola)	-10.219869	-21.29139
sugarcane	17.787774	32.940322
black tea with honey	3.9205567	11.075019
black tea with sugar	-10.550083	-29.8025
black tea, no sugar	1.8006586	90.032928
black coffee with sugar	-10.612049	-29.97754
peppermint tea	1.3889863	138.89863
sugar (cane, white)	-107.47863	-27.77226
sugar (cane, brown)	-107.47863	-27.77226
honey	6.0404548	1.9869917

Appendix 17: Intermediate Foods consumed by Rural and Urban WRA

Healthy and higher environmental impact_100g (n=38)
yam (boiled)
yam (steamed)
white rice (boiled) with carrot, green peas
sausages (beef)
beef (smoked) boiled with onion, tomato
goat meat (fresh) boiled with onion, tomato
egg (chicken, boiled)
fish sauce (mukene) boiled
fish sauce (mukene) boiled with onion, tomato, green pepper
fish sauce (mukene) fried with vegetable oil, onion, tomato, curry powder, salt
fish sauce (mukene) fried with onion, tomato, eggplant, vegetable oil, royco
fish sauce (mukene) fried with onion, tomato, eggplant, green pepper, vegetable oil
fish sauce (mukene) fried with onion, tomato, entula, vegetable oil, curry powder
fish sauce (ngege, dried) boiled with onion, tomato, green pepper, salt
pea sauce (cowpea, dried) fried with onion, tomato, vegetable oil
pea sauce (green pea, fresh) fried with onion, tomato, vegetable oil
pea sauce (green pea, fresh) fried with onion, tomato, green pepper, vegetable oil, salt
pea sauce (pigeonpea, dried) fried with onion, tomato, vegetable oil
bean sauce (Nambaale, dried) boiled with onion, tomato, salt
groundnut sauce (boiled) with mushroom, onion, tomato
groundnut sauce (boiled) with mushroom, onion, salt
ginger
gyobyo (boiled) with onion, tomato
spinach (boiled)
nakatti (steamed)
nakatti (boiled)
nakatti (fried) with vegetable oil
nakatti (fried) with onion, vegetable oil
nakatti (fried) with onion, tomato, vegetable oil
bugga (steamed)
doodo (steamed)
doodo (steamed) with onion, salt
doodo (boiled)
eggplant sauce (fried) with onion, tomato, carrot, vegetable oil
entula (fried) with onion, tomato, vegetable oil
avocado
fruit juice (orange, unsweetened, DelMonte)
fruit juice (orange, sweetened, home-made)

Unhealthy and lower environmental impact_100g (n=65)
cassava (fresh, deep-fried)
bread (wholewheat, brown, bun)
bread (wholewheat, brown, sliced)

bread (refined wheat, white, sliced)
bread (refined wheat, white, bun)
chapatti (oil-fried)
posho (refined maize flour, yellow)
bean sauce (black, fresh) boiled with groundnut paste
bean sauce (red kidney, dried) boiled with simsim paste
groundnut sauce (boiled) with tomato
groundnut sauce (boiled) with onion, tomato, salt
groundnut sauce (boiled) with onion, tomato, curry powder, salt
groundnut sauce (boiled) with onion, tomato, curry powder, entula
groundnut sauce (boiled) with onion, tomato, green pepper, entula, salt
potato crisps
mandazi
sugar (cane, white)
sugar (cane, brown)
honey
cassava (fresh, boiled)
cassava (fresh, boiled)
cassava (fresh, boiled) with salt
cassava (fresh, steamed)
irish potato (fried) with onion, tomato, vegetable oil
irish potato (fried) with onion, tomato, carrot, vegetable oil
irish potato (fried) with onion, tomato, green pepper, carrot, vegetable oil
posho (refined maize flour, white)
posho (unrefined maize flour, brown, grade 2)
posho (unrefined maize flour, brown, grade 3)
kalo (50:50 cassava and sorghum flour, atap)
kwenongora (cassava flour, atap)
bushera (sorghum, cold)
porridge (millet)
porridge (millet) with sugar
porridge (rice flour, white) with skim milk, sugar
porridge (refined maize flour, white), no sugar
porridge (refined maize flour, white) with sugar, full-fat milk
porridge (refined maize flour, white) with sugar
porridge (refined maize flour, yellow) with sugar
bean sauce (black, dried) fried with onion, vegetable oil
bean sauce (black, dried) fried with onion, tomato, carrot, vegetable oil
bean sauce (Kanyebwa, fresh) fried with onion, tomato, vegetable oil, salt
bean sauce (Kanyebwa, dried) fried with tomato, vegetable oil, curry powder, salt
bean sauce (Nambaale, fresh) fried with onion, tomato, vegetable oil
bean sauce (Nambaale, dried) fried with onion, vegetable oil, salt
bean sauce (Nambaale, dried) fried with onion, tomato, vegetable oil
bean sauce (Nambaale, dried) fried with onion, tomato, vegetable oil, curry powder, royco, salt
bean sauce (Nambaale, dried) fried with onion, tomato, green pepper, vegetable oil,curry powder, salt
onion

cabbage (fresh, white) fried with onion, vegetable oil
bugga (boiled) with onion, tomato
doodo (boiled) with onion, tomato
kachumbari (tomato, onion, cucumber, red chilli peppers)
apple (red)
watermelon (ripe)
fruit juice (passion fruit and orange cocktail, sweetened)
fruit drink (mango, sweetened, ready-to-drink, Minute Maid)
katogo (cassava, beans, onion, tomato, vegetable oil, salt)
soda (Mirinda fruity)
soda (Mountain Dew)
soda (Krest bitter lemon)
soda (Pepsi Cola)
black tea with honey
black tea with sugar
black coffee with sugar

Appendix 18: Intermediate Foods consumed by Rural and Urban WRA

Healthy and higher environmental impact_100kcal (n=61)
yam (boiled)
yam (steamed)
offal (boiled) with onion, tomato, coatmeal, salt, curry powder
beef (smoked) boiled with onion, tomato
goat meat (fresh) boiled with onion, tomato
egg (chicken, boiled)
fish sauce (mukene) fried with vegetable oil, onion, tomato, curry powder, salt
fish sauce (mukene) fried with onion, tomato, eggplant, vegetable oil, royco
fish sauce (mukene) fried with onion, tomato, eggplant, green pepper, vegetable oil
fish sauce (mukene) fried with onion, tomato, entula, vegetable oil, curry powder
pea sauce (green pea, fresh) fried with onion, tomato, vegetable oil
pea sauce (green pea, fresh) fried with onion, tomato, green pepper, vegetable oil, salt
pea sauce (pigeonpea, dried) fried with onion, tomato, vegetable oil
bean sauce (Kanyebwa, fresh) fried with onion, tomato, vegetable oil, salt
bean sauce (Nambaale, fresh) fried with onion, tomato, vegetable oil
tomato
tomato (small, local tomatoes)
onion
ginger
carrot (fresh)
cabbage (fresh, white)
cabbage (fresh, white) boiled
gyobyo (boiled) with onion, tomato
spinach (boiled)
nakatti (steamed)
nakatti (boiled)
nakatti (boiled) with onion, salt
nakatti (boiled) with onion, tomato
nakatti (fried) with vegetable oil
nakatti (fried) with onion, vegetable oil
nakatti (fried) with onion, tomato, vegetable oil
bugga (boiled) with onion, salt
bugga (boiled) with onion, tomato
bugga (steamed)
doodo (steamed)
doodo (steamed) with onion, salt
doodo (steamed) with onion, tomato, salt
doodo (boiled)
doodo (boiled) with onion
doodo (boiled) with onion, tomato
sukuma wiki (boiled) with onion
sukuma wiki (fried) with vegetable oil
sukuma wiki (fried) with onion, tomato, vegetable oil

eggplant (boiled)
eggplant sauce (fried) with onion, tomato, carrot, vegetable oil
entula (boiled)
entula (fried) with onion, tomato, vegetable oil
katunkuma (steamed)
kachumbari (tomato, onion, cucumber, red chilli peppers)
mbogga (steamed)
avocado
lemon
watermelon (ripe)
pawpaw (ripe)
pineapple (ripe)
fruit juice (orange, unsweetened, DelMonte)
fruit juice (orange, sweetened, home-made)
fruit juice (passion fruit, unsweetened)
fruit juice (pineapple, orange, mango cocktail, unsweetened)
fruit juice (passion fruit, orange, carrot cocktail, sweetened)
fruit juice (passion fruit and orange cocktail, sweetened)

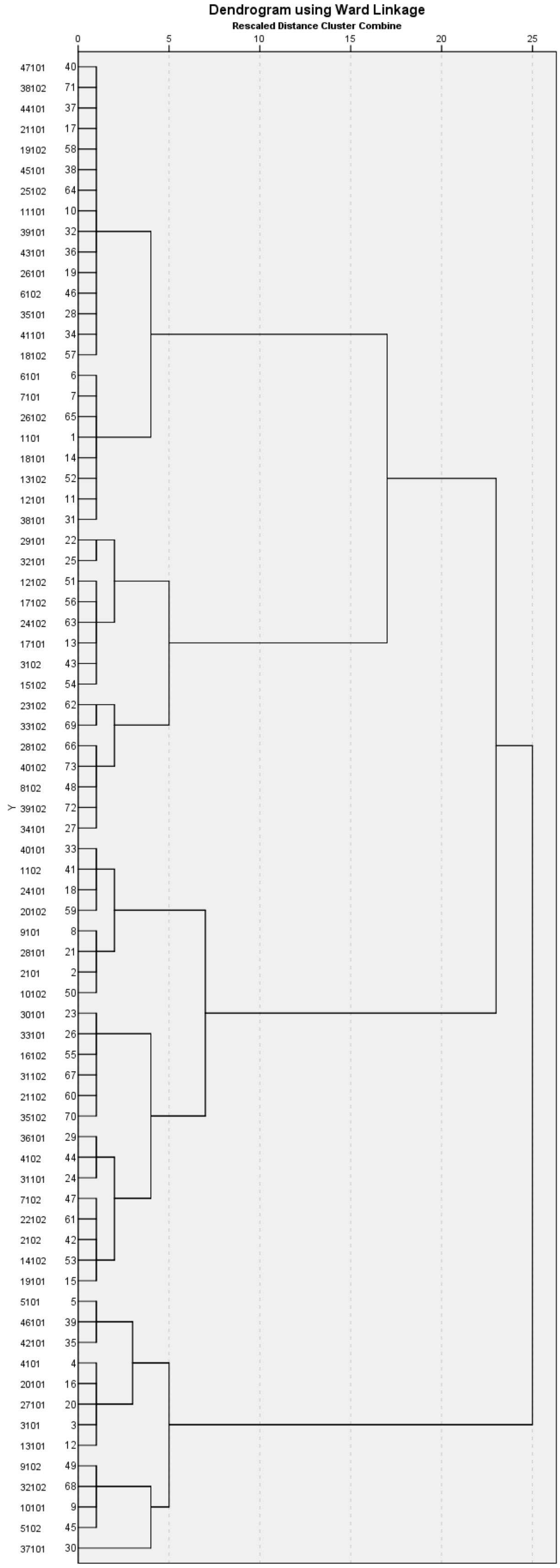
Unhealthy and lower environmental impact_100kcal (n=36)
bean sauce (red kidney, dried) boiled with simsim paste
simsim paste
cassava (fresh, boiled)
cassava (fresh, boiled) with salt
cassava (fresh, steamed)
irish potato (fried) with onion, tomato, vegetable oil
irish potato (fried) with onion, tomato, carrot, vegetable oil
irish potato (fried) with onion, tomato, green pepper, carrot, vegetable oil
brown rice (boiled) with onion, vegetable oil
white rice (boiled) with onion, vegetable oil, salt
posho (refined maize flour, white)
posho (unrefined maize flour, brown, grade 2)
posho (unrefined maize flour, brown, grade 3)
kalo (50:50 cassava and sorghum flour, atap)
kwenongora (cassava flour, atap)
bushera (sorghum, cold)
porridge (millet) with sugar
porridge (rice flour, white) with skim milk, sugar
porridge (refined maize flour, white), no sugar
porridge (refined maize flour, white) with sugar, full-fat milk
porridge (refined maize flour, white) with sugar
porridge (refined maize flour, yellow) with sugar
fish sauce (mukene) boiled with tomato, salt
groundnut sauce (boiled) with entula
groundnut sauce (boiled) with onion, egg plant
cabbage (fresh, white) fried with onion, vegetable oil
katogo ('irish' potato, matooke, onion, tomato)
katogo (cassava, beans, onion, tomato, vegetable oil, salt)
soda (Mirinda fruity)

soda (Mountain Dew)
soda (Krest bitter lemon)
soda (Pepsi Cola)
sugarcane
black tea with honey
black tea with sugar
black coffee with sugar

Appendix 19: Agglomeration Schedule for Cluster Analysis of the Dietary Intake of Rural and Urban WRA

Agglomeration Schedule									
		Cluster Combined					Stage Cluster First		
Stage	Number of clusters	Cluster 1	Cluster 2	Coefficients	Differences (in moving from one stage to another	Proportionate increase in heterogeneity	Cluster 1	Cluster 2	Next Stage
1	72	40	71	0.000	0.000	0.000	0	0	5
2	71	62	69	0.000	0.000	0.000	0	0	61
3	70	38	64	0.000	0.000	0.000	0	0	6
4	69	51	56	0.000	0.000	0.000	0	0	23
5	68	37	40	0.000	0.000	0.000	0	1	48
6	67	10	38	0.000	0.000	0.000	0	3	8
7	66	32	36	0.000	0.000	0.000	0	0	8
8	65	10	32	0.000	0.000	0.000	6	7	9
9	64	10	19	0.000	0.000	0.000	8	0	26
10	63	6	7	0.000	0.054	0.000	0	0	13
11	62	47	61	.054	0.063	115.831	0	0	18
12	61	33	41	.117	0.063	54.112	0	0	46
13	60	6	65	.180	0.064	35.495	10	0	36
14	59	55	67	.243	0.084	34.355	0	0	49
15	58	28	34	.327	0.086	26.336	0	0	32
16	57	60	70	.413	0.088	21.258	0	0	49
17	56	22	25	.501	0.097	19.423	0	0	59
18	55	42	47	.598	0.102	17.119	0	11	40
19	54	5	39	.701	0.103	14.738	0	0	41
20	53	29	44	.804	0.105	13.063	0	0	39
21	52	4	16	.909	0.109	11.984	0	0	35
22	51	13	43	1.018	0.112	10.953	0	0	38
23	50	51	63	1.130	0.115	10.148	4	0	52
24	49	17	58	1.244	0.134	10.796	0	0	44
25	48	8	21	1.379	0.143	10.400	0	0	54
26	47	10	46	1.522	0.146	9.614	9	0	44
27	46	66	73	1.669	0.154	9.254	0	0	51
28	45	14	52	1.823	0.159	8.717	0	0	47
29	44	11	31	1.982	0.171	8.643	0	0	47
30	43	18	59	2.153	0.188	8.711	0	0	46
31	42	48	72	2.341	0.194	8.278	0	0	43
32	41	28	57	2.535	0.246	9.721	15	0	55
33	40	2	50	2.781	0.281	10.122	0	0	54
34	39	23	26	3.062	0.361	11.776	0	0	58
35	38	4	20	3.423	0.377	11.003	21	0	57
36	37	1	6	3.800	0.408	10.747	0	13	53
37	36	3	12	4.208	0.415	9.859	0	0	57
38	35	13	54	4.623	0.430	9.301	22	0	52
39	34	24	29	5.053	0.458	9.062	0	20	60
40	33	42	53	5.511	0.521	9.462	18	0	50
41	32	5	35	6.032	0.533	8.829	19	0	63
42	31	49	68	6.565	0.536	8.161	0	0	56
43	30	27	48	7.100	0.550	7.740	0	31	51
44	29	10	17	7.650	0.618	8.081	26	24	48
45	28	9	45	8.268	0.677	8.187	0	0	56
46	27	18	33	8.945	0.682	7.622	30	12	62
47	26	11	14	9.627	0.690	7.171	29	28	53
48	25	10	37	10.317	0.714	6.924	44	5	55
49	24	55	60	11.032	0.781	7.082	14	16	58
50	23	15	42	11.813	0.813	6.881	0	40	60
51	22	27	66	12.626	1.049	8.305	43	27	61
52	21	13	51	13.674	1.114	8.147	38	23	59
53	20	1	11	14.788	1.153	7.800	36	47	66
54	19	2	8	15.942	1.275	8.000	33	25	62
55	18	10	28	17.217	1.463	8.499	48	32	66
56	17	9	49	18.681	1.659	8.883	45	42	64
57	16	3	4	20.340	1.685	8.284	37	35	63
58	15	23	55	22.025	2.294	10.414	34	49	65
59	14	13	22	24.319	2.352	9.673	52	17	67
60	13	15	24	26.671	3.040	11.400	50	39	65
61	12	27	62	29.711	3.417	11.501	51	2	67
62	11	2	18	33.128	4.131	12.470	54	46	69
63	10	3	5	37.260	6.270	16.829	57	41	68
64	9	9	30	43.530	6.634	15.240	56	0	68
65	8	15	23	50.164	6.773	13.501	60	58	69
66	7	1	10	56.937	8.269	14.524	53	55	70
67	6	13	27	65.206	9.493	14.558	59	61	70
68	5	3	9	74.699	14.129	18.915	63	64	72
69	4	2	15	88.828	34.227	38.532	62	65	71
70	3	1	13	123.055	45.105	36.654	66	67	71
71	2	1	2	168.160	50.840	30.233	70	69	72
72	1	1	3	219.000			71	68	0

Appendix 20: Dendrogram from Cluster Analysis of Dietary Intake of Rural and Urban WRA



Appendix 21: Example SPSS Output for Validating the Stability of Dietary Clusters among Rural and Urban WRA

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Object scores dimension 1 is the same across categories of Ward Method .	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of Object scores dimension 2 is the same across categories of Ward Method .	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
3	The distribution of Object scores dimension 3 is the same across categories of Ward Method .	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Symmetric Measures

		Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Measure of Agreement	Kappa	.809	.072	8.994	.000
N of Valid Cases		43			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Appendix 22: Photovoice Training Manual

PHOTOVOICE TRAINING MANUAL – WOMEN'S DIETARY PRACTICES IN CONTEMPORARY UGANDA

PART 1: INTRODUCTIONS

- ❖ Introduce myself and then ask each of the research assistants and participants to introduce themselves. Stand in a circle format (use the ball game we used in Nairobi).
- ❖ Once everyone has done so, move to spaces and introduce PhotoVoice.

PART 2: INTRODUCTION TO PHOTOVOICE

What is PhotoVoice?

- ❖ A method where people who do not usually have a voice in the community are involved in the research process[1].
- ❖ Allows people to speak and tell their own stories

Why use PhotoVoice?

- ❖ Using photos can help people who look at your photographs to understand what is happening in your life or in your community

PART 3: INTRODUCTION TO RESEARCH PROJECT

What is this research all about?

- ❖ This is the second part of the research project for which you attended an interview last week where you were asked about the things you eat, when you eat, places you eat and who you eat with.
- ❖ Now that we have an idea of what you eat, the aim of this PhotoVoice exercise is to understand what adolescent girls and women in Kampala and feel influences what and how they eat.
- ❖ We are interested in how the places where you live and work; the people you live with and work with or just the people around influence what and how you eat
- ❖ We are also interested in any other thing which you feel makes you eat the way you eat

How does PhotoVoice fit in? What will you be doing?

- ❖ You will be given a digital camera
- ❖ You will be asked to take 5 photographs that answer 5 questions which will be provided to you. We shall now go through the questions:

1a. What do you consider as food? (You can think of this as you like, but as an example, you can include photos of items that you consider as food, whether cooked or uncooked etc. and those you do not consider as food)
1b. Emmere kye ki okusinzira ku ggwe? (Wano osoboola oku lowozwa ku luno kibuzo nga bwoyagala naye oba ng'oyagala osoboola okutwala ebifananyi eb'ye mere gy'olya oba nsiike oba mbisi. Wano osobola n'okutwala kutwaala ebifananyi eb'yebintu byo'talowoza nti meera okusinzira ku ggwe).

2a. Where does your food come from? How do you get it? (Here you can take pictures of things like your garden if you farm the food yourself; the things you use to grow the food; or the market if you buy the food; the price of the food; even the road to the market/garden etc. Anything that touches on where your food comes from according to you)
2b. Emmere zzo ozijja wa? Ozifunila wa? (Wano osobola okubba ebifananyi eky'ennimiro oba nga ye ggwe azilima, oba osobola okutwala akafanayi eky'akatale oba ng'ofunila emmere wano; wadde akaguddo akagenda ku katale, oba ku nnimiro, oba ebeeyi egy'emmere osobola kutwala ezo zifananyi wano. Byonna ebintu ezi kwata ku emmere w'ezijja okusinzira ku ggwe)

3a. How do you prepare your food? (Here you can take pictures of where the preparing happens; who you do it with; what you use etc.)
3b. Emmere ggyo ozifumbira atya? (Wano osobola okutwala ebifananyi eziraga w'ofumbira emmere; ani ggw'okolagana mu bufumbi; biki ebintu by'okoseza mu bufumbi; n'ebintu ebirara by'oyagala tu laga)

4a. Where do you have meals or from where do you eat your food? (Photographs could be of food eaten within your home or outside you home – at the office, restaurant, on the street etc. Anywhere you eat from. It is up to you to choose how to tell your story.)
4b. Okulya emmere ogikola wa? (Ebifananyi osobola ozitwala ewaka oba ewabweru oba ku luguudo; byonna ebifo emmere gy'olya. Kisinzira ku ggwe gy'oyagala okugamba ku olugero ggyo.)

5a. With whom do you eat or have your meals? (You can have here photos of family; friends if you eat with them or anyone whom you feel influences what and how you eat; but you do not have to include any other people in your photos if you have your meals alone or if you do not wish to or if the people you eat with do not want to be photographed. You can also take a photo of yourself if you eat alone.)
5b. Emmere ozilya n'ani? (Wano osoboala tulaga emikwano ggyo oba ng'olya na bo, amaka ggwo oba wadde omuntu gwowuliira nti omuntu ono y'ankolola okulya bwendya. Oba ng'olya ggwe wekka ate oba ng'abantu tebakirizibwa obalaga mu kifananyi tewali mutawana. Osobola n'okutwala ekafanayi ng'oli munda ggwe wekka.)

PART 4: INTRODUCTION TO PHOTOGRAPHY

- Ask how many people have experience in taking photos. What did they use to take the photos?

Parts of the digital camera:

- Front of camera and back; on and off button, display screen
- How to turn the camera ON and OFF: ask each participant to TURN ON the camera. What do they see in the display screen? Ask them to now TURN OFF the camera. Can they see the difference between the display window when the camera is on and when it is off. This is how you will know that you have switched on the camera.
- Switch ON the camera again and check each person to see that all have understood the on and off function

Taking photographs:

- Hold camera in front of you with both hands.
- Keep elbows to your side (demonstrate using yourself)
- Check that camera is not over the lens
- Press the shutter (big button at the top) and release
- As an example, ask all participants to take photograph of a prop placed somewhere in training room. Are they confident of their ability to take a photo?
- Go through process of checking for photos that have been taken using the photo of the prop that they have just taken
  (NOTE: We will not go through the delete function)

Photography Tips

- Take photos with the sun at your back or at your side
- Always check that camera is ON before you take a photograph
- Before you take the photo, look in the display window to be sure that the photo has everything that you want to capture
- Turn OFF camera when you have finished taking photos to save the battery

PART 5: ETHICS OF PHOTOGRAPHY

- Get permission from anyone before you take his or her photograph or that of his or her private property. If it is a child, ask the parents. All people you take photos of (or their private property) will have to sigh Form B (Foomu B).
  At this stage, point out that if the face of a person is not captured, they do not have to sign form B and pass round example of photograph of either case.
- Do not go where you would not usually go. If you have to go, take someone you trust with you.
- Do not take photographs in the road where a car or a boda could knock you
- Beware of your surroundings
- Be polite and respectful
- If attacked for the camera and you feel threatened, let it go.
- Do not take photographs of someone doing something wrong (like a crime) or risky

PART 6: RECAP

- Go through the main points of the training and ask if participants have any questions on anything.
- Participants will be given cameras and handed the photographing guide. We will go through the photographing guide to check that they understand what is in it.

PART 7: END

- Participants will be given contact details of whom they can call in case they have any further questions
- Thank participants for taking part in the training and in the research project
- Emphasise that participation is voluntary and if they feel at any point in the PhotoVoice exercise that they do not want to participate any more, they are free to drop out. All they have to do is inform either the RAs or myself.
- Notify them that they we will check on them halfway through the programme to see how things are moving. If photographs are completed in less than 7 days, they can hand over the camera to Henry or Mike.

Appendix 23: Participant Photography Guide (English)

Participant Photographing Guide – PhotoVoice

Dear participant,

Thank you once again for taking part in this study about food and eating among Ugandan adolescent girls and women. In this part of the study, you have been provided with a digital camera. Over the next two weeks I would like you to take photographs that address the following areas of interest for this study. Please use the digital camera that I have provided to take as many photographs as you would like, but at the end of the two weeks I would like you to select ***5 of your favourite photographs*** *which you feel best represent the themes of the research. You will talk about with the researcher at the second discussion.*

As we have discussed in the previous discussion we have had, the photographs that you take can include answers to each of the following questions:

1. ***What do you consider as food?*** (*You can think of this as you like, but as an example you can include photos of items that you consider as food, whether cooked or uncooked etc. and those you do not consider as food*)

2. ***Where does your food come from? How do you get it?*** (*Here you can take pictures of things like your garden if you farm the food yourself; the things you use to grow the food; or the market if you buy the food; the price of the food; even the road to the market/garden etc. Anything that touches on where your food comes from according to you*)

3. ***How do you prepare your food?*** (*Here you can take pictures of where the preparing happens; who you do it with; what you use etc.*)

4. ***Where do you have meals or from where do you eat your food?*** (*Photographs could be of food eaten within your home or outside you home – at the office, restaurant, on the street etc. Anywhere you eat from. It is up to you to choose how to tell your story.*)

5. ***With whom do you eat or have your meals?*** (*You can have here photos of family; friends if you eat with them or anyone whom you feel influences what and how you eat; but you do not have to include any other people in your photos if you have your meals alone or if you do not wish to or if the people you eat with do not want to be photographed. You can also take a photo of yourself if you eat alone.*)

If there are other things which have not been mentioned which you feel touches on the topic of food and eating in your life or your community, please feel free to take a photograph of this as well. (*This could also be anything about food within your environment*)

Some things to remember as you take photographs:

i. Remember to be respectful and ask someone's permission before you take a photograph of them, their children or their private property like shop, supermarket, home etc. (*They* ***must sign the consent form*** *you have been provided with. This is labelled* ***form* B.**
If the faces of the people (or private properties) in the photograph are showing clearly, you must get their permission and sign the form. If their faces(or

properties) cannot be seen or are hidden, you do not have to ask them to sign the form. If you take photos of parts of their body like hands or feet, you do not have to get them to sign the form.)
Remember to discuss with anyone whose photos that you take how the photographs will be used. Also let them know that if the photos in which they appear are used for the research report, their identity will be protected if they do not wish for their faces to be shown in the report.

ii. If possible, you can make notes in the notebook you have been provided with during this two-week period (*Notes can include anything which can help you to remember things about the photos you took or to say more about the photos you have taken or things you have noticed about the surroundings or how you felt taking the photos. Use the notebook to write down things you may want us to talk about in the discussion. You do not have to write any notes in the notebook if you do not want to.*)

iii. Be careful! (*Do not go to places you do not know. If you go there, go with someone you trust. Do not take photographs standing in the middle of the road or in the way of cars and boda-bodas. If someone tries to steal the camera off you and your life is in danger, let them have it. Do not risk fighting.*)

If you have any other questions about this project and your participation, please contact the researcher on the project, Carol Auma

Appendix 24: Participant Photography Guide (Luganda)

Endagiriro e'sokutwala ebifananyi mu projekiti ya PhotoVoice

Gyebale kko nnyabo,

Webale nnyo okukirizibwa okubeera mu researchi eno eli kwaata ku emmere n'ebyokulya mu bavubuka bawaala n'abakazi. Kati we tu tuuse ku researchi eno, bakuwadde kamera. Mbadde nsaaba nti mu wiiki biri, okozese kamera otwale ebifananyi byonna by'osobala okutwaala ezi kwata ku bitundu bino. Nga wiiki zi wezze, tujja tuula awamu olonde ebifananyi bitano gy'oyagala nnyo era gy'owulira zi fananyi zino zigamba mu bujuvu olugero lwo. Tu ggya ku sisinkana tuteese ku bifananyi bino mu meetingi eyo'okubiiri.

Nga we twogedde mu meetingi eyo'kusooka ne mu training ebifananyi gyo'genda okutwaala bisobola oku kwata ku bitundu bino:

1. ***Emmere kye ki okusinzira ku ggwe***? (*Wano osoboola oku lowozwa ku luno kibuzo nga bwoyagala naye oba ng'oyagala osoboola okutwala ebifananyi eb'ye mere gy'olya oba nsiike oba mbisi. Wano osobola n'okutwala kutwaala ebifananyi eb'yebintu byo'talowoza nti meera okusinzira ku ggwe*).

2. ***Emmere zzo ozijja wa? Ozifunila wa?*** (*Wano osobola okutwala ebifananyi eky'ennimiro oba nga ye ggwe azilima, oba osobola okutwala akafanayi eky'akatale oba ng'ofunila emmere wano; wadde akaguddo akagenda ku katale, oba ku nnimiro, oba ebeeyi egy'emmere osobola kutwala ezo zifananyi wano. Byonna ebintu ezi kwata ku emmere w'ezijja okusinzira ku ggwe)*

3. ***Emmere ggyo ozifumbira atya?*** (*Wano osobola okutwala ebifananyi eziraga w'ofumbira emmere; ani ggw'okolagana mu bufumbi; biki ebintu by'okoseza mu bufumbi; n'ebintu ebirara by'oyagala tu laga)*

4. ***Okulya emmere ogikola wa?*** (*Ebifananyi osobola ozitwala ewaka oba ewabweru oba ku luguudo; byonna ebifo emmere gy'olya. Kisinzira ku ggwe gy'oyagala okugamba ku olugero ggyo.)*

5. ***Emmere ozilya n'ani?*** *(Wano osoboala tulaga emikwano ggyo oba ng'olya na bo, amaka ggwo oba wadde omuntu gwowuliira nti omuntu ono y'ankolola okulya bwendya. Oba ng'olya ggwe wekka ate oba ng'abantu tebakirizibwa obalaga mu kifananyi tewali mutawana. Osobola n'okutwala ekafanayi ng'oli munda ggwe wekka.)*

Oba wali wo ebitundu ebirala nga si by'empandikidde wano naye ng'owulira bilambulula ku emmere n'ebyokulya mu bulamu bbyo oba mu obunene kyo; olina eddembe okutwala zino zifananyi. Esobola ku bera wade akantu eri kwata ku mmere kumpi ne ggwe gy'osuula oba wala gy'osuula).

Ebintu ebimu okujjukira ng'otwala ebifananyi:

i. *JJukira o'kola n'ekitiibwa. Oba ng'ogenda okutwala ekifananyi ng'a mulimu omuntu munda wadde ng'abana bbo oba eky'obugagga by'abwe nga amaduka, ekifo awatundibwa ebintu eby'enjawulo oba ennyumba, bambi basabe olukusa (Tosubwa okujjukira nti balina okukilizibwa ba wandiike mu foomu gy'ebakuwadde* <u>*Ewandikiddwa foomu B.*</u> ***<u>Oba nga abantu balabisa mu bifananyi nga osobola balaba mu'omumaso, oba otadde mu eky'obugagga by'abwe balina okuwandika mu foomu B. Oba nga tosobola</u>***

balaba mu'omumaso oba nga eky'obugagga by'abwe tezirabika bulungioba z'ekweese, tebalina okuwandiika mu foomu B. Bw'otwala ebifananyi eby'omubiri z'abwa nga tekuliko omumaso ng' omukono oba ekigere kokka, tebalina okuwandiika mu foomu B).

Tosuubwa okujjukira oku nnyonyola abanti nti ebifananyi bw'etujja bikozesa. Bannonyole nti oba nga tu tekka ebifananyi nga bazilimu mu alipoota, te tujja ku kozesa elinnya ly'abwe. Atte nga oba tebayagala omumaso gy'abwe ogilaga mu alipoota, tewali mutawana tujja bi jamu).

ii. ***Oba kisoboka , osobola okuwandiika mu kitabo ky'ebyakuwadde mu kiseera kino gy'ogenda okutwala ebifananyi.*** (*osobola okuwandiika ebintu ebilambulula ku bifananyi gy'ewatute, oba ebintu by'olabye mu makati ggyo gy'olabye oba ekintu kyowulira mumubiri nga wabadde ng'otwala ebifananyi. Kozesa ekitabo okuwandiika ebintu by'oyagala t'wogele ko mu meetingi egi dda ko. Oba nga toyagala ku wandiika, tewali mutawana.*)

iii. ***Wegendereza***! (*Togenda awaffo awatamanyi yyo. Oba ng' ogenda eyo, bambi genda n'omuntu omwesigwa. Totwala amafanayi mu makati oba kumpi n'oluguddo oba mu makati oba kumpi ne ze taxi oba ze boda. Oba waliwo omuntu ng'ayagala kamera zibba atte ng'owulila a Kabi, kamera zileke. Tolwana.)*

Oba ng'olina ebibuzo ku kunonyeresa kuno, tukirira omunonyereza ku projekiti, Carol Auma

Appendix 25: In-depth Interview Topic Guide (Luganda)

Omwagalwa nnyabo,

***Interviewer**: (Greetings and Welcome) Weabale okujja ku meeting eno nange.*

After the consent form and acknowledgement and release form are signed:
***Interviewer**: Leero tujja kwogeera ku ebifananyi gy'ewa tutte mu sabiiti biri nga wabadde n'e kamera. Bambi to ttya, wano osobola kwogela ku ebintu by'owuliira mumubiri ku bifananyi n'eddembe. Buli ky'oyegera njja kitwaala n'ekitiibwa atte sijja biddamu mu balala okujja ko n'abantu gy'enkoleera n'abo mu kunonyereza kuno. Bambi, kimanye nti tewali (answer) ntufu oba nffu. Mu okunonyereza kuno njagala kumanya nti ki ky'olowoza ku kitundu kino.*
Kakati ku kifananyi kinonomu nja kubuza ebibuzo ebijja tuyamba kw'ogela ko mu bujjuvu.

(***Notes for Interviewer**: The sharing and discussing of photos will use the* **PHOTO** *approach (adopted from Amos et al. 2012). Following from this approach, the following questions will guide the conversation:*

P: Osobola okulambulula ***kafananyi*** ko?
H: Ki ***ekibaade yo*** mu kifananyi kyo kino?
O: ***Lwaki*** gy'e wataala kano akafananyi k'enyini?
T: Kano akanafanayi, ***katugamba ki*** ku ekifo eky'emmere mu bulamu gyo oba mu kyalo kyo?
O: Kano kafananyi kasobola ***otuyamba*** atya o'kola ebintu bulungi mu b'yokulya oba mu emmere?

***Interviewer: Webaale nnyo.** Kano ka (discussion) ggye tumazze kati ka kutte ku byonna byobadde gy'oyagala kunonyola ku mmere n'ebyokulya mu bifanananyi gy'e watuute? Oba, nedda, waliwo by'oyagala kwongela ko?Does this conversation we have just had about how you eat describe everything that you wanted to say through your photographs? If NO, is there anything else you would like to add?*

Tu mazze meetingi eno. Webaale nnyo okumpa sawa z'o.

Appendix 26: In-depth Interview Topic Guide (English)

Dear participant,

(Greetings and Welcome) Thank you for coming to this follow-up interview with me.
(At this point, both the interviewer and the study participant, before the interview proceeds, will sign the consent form. The acknowledgement and release form for the photographs will also be signed.)

Today we shall discuss the photographs that you took over the ***two week*** *period during which you had the camera. Please understand that this a safe place where you can express your views. Whatever you say will be treated with respect and confidentiality. Also, please remember that there is no wrong or right answer. The aim of this research project is to get your opinion and understanding of the topic. For each of the photographs you took, I will ask a few questions that will help us to have a conversation.*

NOTES FOR INTERVIEWER: *The sharing and discussing of photos will use the* **PHOTO** *approach (adopted from Amos et al. 2012). Following from this approach, the following questions will guide the conversation:*

P: Could you describe/ talk about your ***photograph(s)***?
H: What is ***happening*** in your photograph?
O: Why did you take a photograph ***of*** this?
T: What does this photo ***tell*** us about food in your life (about food in your community)?
O: How can this picture provide ***opportunities*** for us to improve life? (*What opportunities for improvement or change does this photo present?*)

Interviewer: *Thank you. Does the conversation we have just had about how you eat describe everything that you wanted to say through your photographs? If NO, is there anything else you would like to add?*

We have now come to the end of this interview. Thank you for your time.

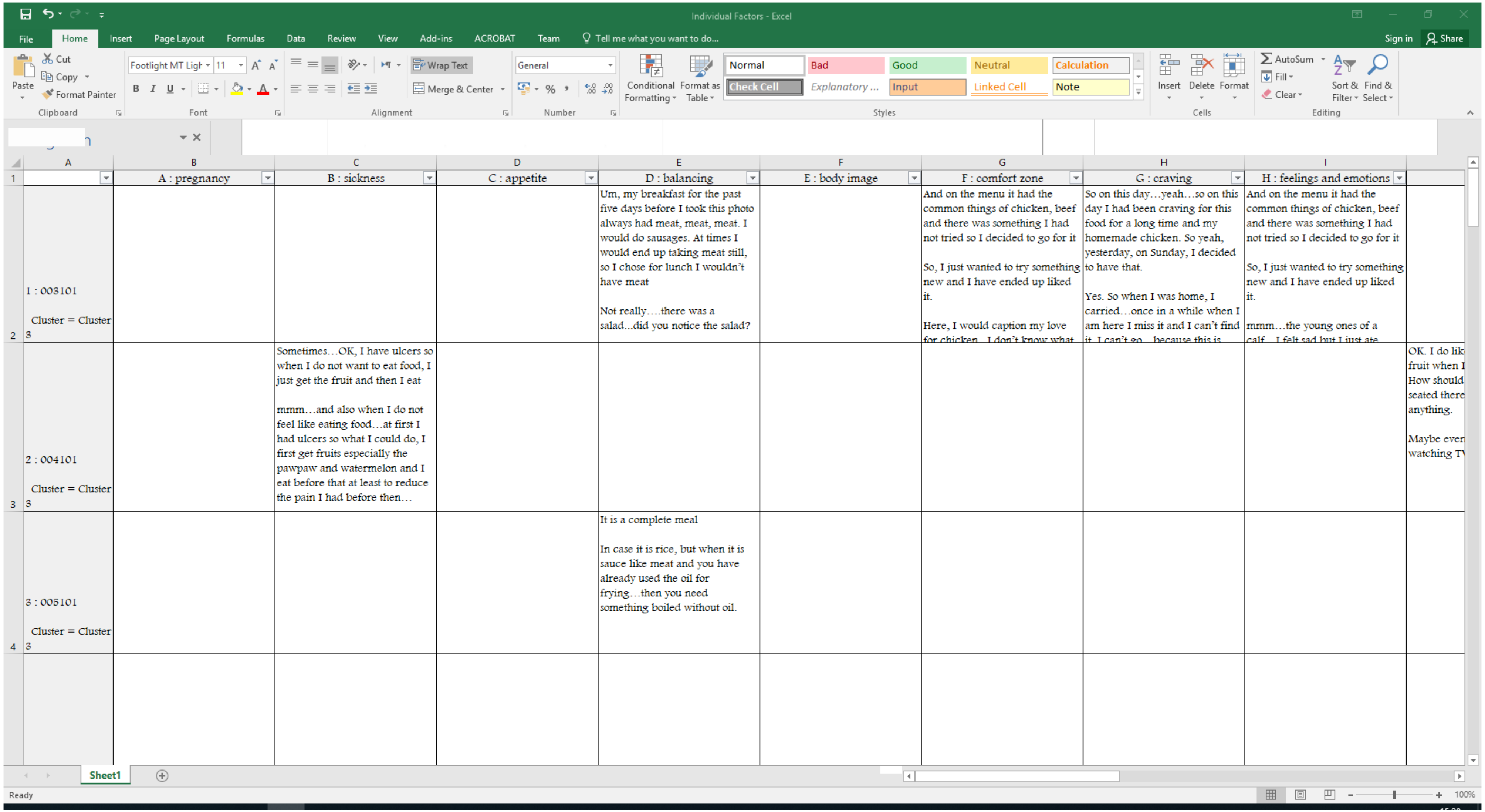
Appendix 27: Codebook for Analysis of Qualitative Data from Photovoice and In-depth Interviews

Themes and sub-themes	Description
Individual	Individual level factors - pertaining to the participants herself
Biological	
breast feeding	
pregnancy	
sickness	
Cognitions	To do with the mind; what the participant thinks
appetite	
balancing	
body image	gain weight/ become fat/ become big/ lose weight/ maintain weight
comfort zone	
craving	'i miss it'/ 'when you have to get it'
feelings and emotions	e.g. happy, sad, disgusted, grossed out, lazy, high/spike
mood	e.g. relaxed
perceptions	participant 's view or interpretation of the food, like a subjective assessment of the attributes of the food, e.g. perceived health benefits/ perceived sickness from consumption; aroma; tasty; bag; 'good food'; nice; balancing; colour; fresh
preference	what i like/love/enjoy/prefer/ what i eat when i do not want to eat/ what i eat in place of something else for one reason or another/ tolerate/ what i do not like
satisfaction	satisfaction, hunger, filling, not filling
Lifestyle	
big days	days of [national holiday] celebrations e.g. New Years, Christmas, Easter, 1 January + days which participant celebrates although not national holiday e.g. birthday
convenience	what is convenient for me/ easy
day of the week	weekend vs weekday
eating alone	
eating together	
snacking	
transitions	moving, e.g. from [parent's] home>school>work>own home [married or not]
Skills	
cooking skills	
Macro-environment	
Climate and soils	
Food display and advertising	
Media	magazines, Google
Packaging and branding	
Seasonality	
Transport infrastructure	
Photovoice Experience	
Challenges	
fear of camera	

forgetting	
photo restrictions	
suspicion	
Lessons Learnt	
questioning	
time	
Positives	
confidence	
easy	
fun	
interesting	
pleasant experience	
proud feelings	
reflection	
thankfulness	
Recommendations	
Physical environment	where partcipants live, work and study
Home	
Facilities available	e.g. fridge, kitchen
Proximity to garden	here food establishment means garden or other food source
Type of food available	in the garden or elsewhere
Neighbourhoods and communities	
Financial access	
Food adulteration	
Physical access to establishments	near, far. Here establishments means anything NOT a garden e.g. shop, market, supermarket, moving car
Type of food available	
Type of food establishments	
School and after school	within school premises/ around school premises/ on the way to and from school
Convenience	
Financial access	
Proximity to food establishments	
Type of food available	
Type of food establishments available	
Work	their workplaces - informal or formal
Convenience	
Financial access	

Proximity to food establishments	
Type of food available	
Type of food establishments available	
Social networks	interactions between partcipants and friends/ family/ peers/ other community members that might influence food choice through social norms, role modelling or social support
Community	
Community support	
Health workers	
Family	
child influence	what my child[ren] prefer to eat/ what they enjoy
family preferences	
household size	
husband influence	what husband prefers to eat/ what husband does not want to eat
parent influence	what mum/dad prefers to eat now
sibling influence	what brother/ sister/ cousin said participant should eat or what they prefer to eat/ what they said about a certain food that makes person not to eat them
the way I grew up	what parents/ grandparents/ uncle/ aunt [or other older relative] said was the right thing to eat as participant was growing up
Food establishments	here food establishments means those that sell all kinds of food - cooked/fresh/packaged etc.
Customer service	gives a lot of food; can buy now and pay later; friendliness of owners
Reputation and Trust	whether the establishment is trustworthy or not based on previous experience or what they have heard + reputed quality of food stuffs
Friends and peers	
dating	
friend preferences	what friends would like to eat
friends recommend	
sharing and hospitality	
Socio-cultural	'They' here refers to what participants hear around them i.e. what people in the wider community say. perception of what is the proper way to eat (in our culture)
Cultural norms	'this is our culture' or 'in our culture'
They say	'they say' or 'people say' or 'everyone around me says'

Appendix 28: Screenshot of Framework Matrix for Individual-level Factors by Dietary Cluster



	A : pregnancy	B : sickness	C : appetite	D : balancing	E : body image	F : comfort zone	G : craving	H : feelings and emotions	
1 : 003101 Cluster = Cluster 3				Um, my breakfast for the past five days before I took this photo always had meat, meat, meat. I would do sausages. At times I would end up taking meat still, so I chose for lunch I wouldn't have meat Not really….there was a salad…did you notice the salad?		And on the menu it had the common things of chicken, beef and there was something I had not tried so I decided to go for it So, I just wanted to try something new and I have ended up liked it. Here, I would caption my love for chicken…I don't know what	So on this day…yeah…so on this day I had been craving for this food for a long time and my homemade chicken. So yeah, yesterday, on Sunday, I decided to have that. Yes. So when I was home, I carried…once in a while when I am here I miss it and I can't find it. I can't go…because this is	And on the menu it had the common things of chicken, beef and there was something I had not tried so I decided to go for it So, I just wanted to try something new and I have ended up liked it. mmm…the young ones of a calf…I felt sad but I just ate	
2 : 004101 Cluster = Cluster 3		Sometimes…OK, I have ulcers so when I do not want to eat food, I just get the fruit and then I eat mmm…and also when I do not feel like eating food…at first I had ulcers so what I could do, I first get fruits especially the pawpaw and watermelon and I eat before that at least to reduce the pain I had before then…							OK. I do lik fruit when I How should seated there anything. Maybe even watching T
3 : 005101 Cluster = Cluster 3				It is a complete meal In case it is rice, but when it is sauce like meat and you have already used the oil for frying…then you need something boiled without oil.					

Appendix 29: Triangulation Matrix for Mixed Methods Studies in the PhD

Research question	Study 1	Study 2	Study 3	Study 4	Summary
What are the dietary practices of Ugandan women of reproductive age?	Four dietary patterns emerged, i.e. 'traditional, high fat, medium environmental impact', 'transitioning, processed, low environmental impact', 'plant-based, low environmental impact' and 'animal-based, high environmental impact' Findings suggest that WRA consume a low-impact, plant-based diet. Ugandan WRA are in the early-mid stages of the NT	Plant-based food groups were high in nutrients and lower in environmental impact. Most participants consumed these food groups. Some animal-based food groups, e.g. poultry, fish and eggs, milk and milk products and red meat were high in energy but higher in environmental impact. Only a small proportion of the WRA consumed these animal-based food groups. About 18.32% of profiled foods were healthy and lower impact. They were primarily plant-based (vegetables, legumes, some fruit). Only 6.45% of profiled foods were unhealthy and higher impact. These were primarily animal-based and confectionery products.	Three dietary patterns emerged, i.e. 'low-impact, plant-based, traditional' dietary pattern, 'low-impact, plant-based, mid-stage transition' dietary pattern and 'low-impact, plant-based, early-stage transition' dietary patterns Four dietary typologies emerged, i.e. 'urban, low-impact, early-stage transitioners', 'rural, low-impact, early-stage transitioners', 'urban, medium-impact, mid-stage transitioners' and 'rural, low-impact, traditionalists'. Findings suggestive of early-mid stage in the NT among WRA. Ugandan WRA consume a plant-based diet.	N/A	Findings from all studies mutually enforce each other to indicate that: Ugandan WRA are experiencing early-mid stages in the NT Ugandan WRA generally consume a diet that revolves around plant food groups that are lower in environmental impact (GHGE).
How do dietary practices differ between rural and urban Ugandan WRA in terms of	'Transitioning, processed, low environmental impact' dietary pattern and 'animal-based, high	More urban (30.00%) than rural (12.12%) WRA consumed 'unhealthy and lower impact foods' at any eating occasion.	The 'urban, low-impact, early-stage transitioners', and 'urban, medium-impact, mid-stage transitioners'	N/A	Findings collectively indicate that urban WRA consume a diet that is higher in

healthiness and environmental impact?	environmental impact' associated with urban residence. 'Plant-based, low environmental impact' dietary patter negatively associated with urban residence.	Odds of urban women consuming 'healthy and lower impact' foods were lower than those of rural WRA. Odds of urban women consuming 'unhealthy and higher impact' foods were lower than those of rural WRA.	dietary typologies are predominantly urban. The 'rural, low-impact, early-stage transitioners', and 'rural, low-impact, traditionalists' dietary typologies are predominantly rural.		food groups associated with the NT.
What influences the dietary practices of Ugandan women of reproductive age?	N/A	N/A	Eating events with family and friends have reduced odds of containing 'unhealthy and higher impact' foods. HLI foods significantly associated with education and SES. HLI foods were more likely eaten at lunch and dinner, at longer eating events and outside of the home. UHHI foods more likely eaten at home (mostly at breakfast) and at shorter eating events.	Individual level factors (convenience, day-to-day variations, feelings, meal balancing, perceptions). Social networks (parents, friends and family, reputation and trust). Also sociocultural norms and food production and transport. Friends and family (social networks), sociocultural norms and perceptions are closely linked as are	Although individual-level factors are important, social networks, i.e. family and friends play an important role in influencing dietary practices.

SES (individual) and economic access. Convenience and physical access are closely linked.