Home Environment Influences on Overweight and Obesity Among 2-5-year-old Pre-schoolers in Ghana

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Declaration

*I, **Albert Lawrence Kwansa**, confirm that the Thesis is my own work. I am aware of the University's Guidance on the Use of Unfair Means (www.sheffield.ac.uk/ssid/unfair-means). This work has not previously been presented for an award at this, or any other, university.*

Dedication

To my loving wife, life partner, and best friend, Shivonn,

My lovely stepchildren, Zyon and Jahniah,

And my little heroes,

Xavier and Akilah

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List of Abbreviations

AOR – Adjusted Odds Ratio
BED – Binge Eating Disorder
BMI – Body Mass Index
BST – Behavioural Susceptibility Theory
CEBQ – Child Eating Behaviour Questionnaire
CFA – Confirmatory Factor Analysis
CFI - Comparative Fit Index
CFPQ – Comprehensive Feeding Practice Questionnaire
CHRPE – Committee for Human Research Publication and Ethics
CI – Confidence Interval
CINAHL - Cumulative Index to Nursing and Allied Health Literature
COR – Crude Odds Ratio
DD – Dietary Diversity
DNA – Deoxyribonucleic Acid
EA – Enumeration Area
EFA – Exploratory Factor Analysis
EMBASE - Excerpta Medica Database
FAO – Food and Agriculture Organisation
FGD – Focus Group Discussion
FTO - Fat Mass and Obesity-Associated Gene
GHS – Ghana Cedis
GLB - Growing Leaps and Bounds
GPAQ – Global Physical Activity Questionnaire
GWAS – Genome-wide Association Studies
HDDQ – Household Dietary Diversity Questionnaire
HDDS – Household Dietary Diversity Score
InFANT - Infant, Feeding, Activity and Nutrition Trial
JBI – Joanna Briggs Institute
KMO - Kaiser–Meyer–Olkin
KNUST – Kwame Nkrumah University of Science and Technology
LED - Light Emitting Diode
LMIC – Low- and Middle-Income Country
MC4R - Melanocortin-4 Receptor
MEDLINE -
MICS – Multi-Indicator Cluster Survey
miRNA - MicroRNA
MM – Mixed Methods
NOURISH - Nourishing Our Understanding of Role modelling to Improve Support and Health for Healthy Transitions
OR – Odds Ratio
PA – Physical Activity

PCA – Principal Component Analysis
PHC – Population and Housing Census
PRISMA - Preferred Reporting Items for Systematic review and Meta-Analysis
PROSPERO - International Prospective Register of Systematic Reviews
RMSEA - Root Mean Square Error of Approximation
SD – Standard Deviation
SES – Socioeconomic Status
SNP – Single Nucleotide Polymorphism
SPSS – Statistical Package for Social Scientists
SRMR - Standardised Root Mean-Square Residual
SSA – sub-Saharan Africa
STATA – Statistics and Data
TLI - Tucker-Lewis Index
TV - Television
UK – United Kingdom
UNICEF – United Nations Children's Education Fund
USA – United States of America
VIF – Variance Inflation Factor
WHO – World Health Organization
WHZ – Weight-to-height z-score

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General Abstract

Although childhood obesity is on the increase in Ghana (as observed all over sub-Saharan Africa), there is little that is known about how the home environment may be contributing to excessive increases in body weight among Ghanaian toddlers. This thesis seeks to address this research gap and contribute to the body of knowledge through its findings.

To fill this research gap, this thesis used a mixed method approach involving 4 studies – 1 systematic review, an analysis of nationally representative datasets (drawing data from the multi-indicator cluster survey for Ghana), one primary survey, and one qualitative study. The aim of the systematic review was to summarise the evidence on the home environment and overweight and obesity among preschoolers in sub-Saharan Africa. The review found that household dietary diversity and maternal body mass index (BMI) are the most consistent predictors of childhood overweight/obesity in SSA. The evidence for other aspects of the home environment, i.e., the home physical activity and the home media environments is either lacking or inconsistent. The aim of the secondary data analysis of the MISC datasets was to identify socioeconomic correlates of overweight and obesity in the home environment of Ghanaian preschoolers. The results of that study demonstrated no consistent relationships between the preschooler overweight or obesity and household socioeconomic factors. Additionally, there was no association between the home environment and overweight/obesity. Household wealth and education consistently predicted the availability of items in the home environment. The secondary data analysis was followed-up with a cross sectional survey of caregivers of pre-schoolers to examine the relationship between the home food environment (dietary diversity and caregiver food feeding practices), child eating behaviour, and child body weight. The findings from that study demonstrate/suggest that caregiver food restriction is predictive of child weight gain. Child eating behaviour, including an increase in the enjoyment of food and a reduction in satiety responsiveness was associated with excess child body weight. Bidirectional relationships between child eating behaviour and caregiver food feeding practices were also observed. The last study, i.e., the qualitative study, used focus groups and thematic analysis to explore the food feeding habits of caregivers of Ghanaian preschoolers. The results of the focus group revealed that child encouragement, monitoring, modelling, and food restriction were common caregiver food feeding practices in Ghana. Overall, the findings of the mixed methods study suggest that in Ghana, caregiver food feeding practices (especially food restriction) may be contributing to population increases in excessive paediatric body weight. The findings also suggest that the access and availability of items in the home environment alone are inadequate to account for the population increases in paediatric overweight and obesity, and that the social interaction between caregivers and their preschoolers may play a more influential role in paediatric weight gain. However, further research is needed to expand on these findings. Future work may consider examining caregiver food feeding practices in more detail, exploring its bidirectional relationship with preschooler eating behaviour using longitudinal or experimental designs in order to confirm causation for excessive preschooler weight gain.

Structure of the Thesis

This thesis follows the monograph style format for the faculty of Medicine, University of Sheffield, presented as traditional chapters in combination with individual studies as either published or yet-to-be-published manuscripts. Chapter 1 introduces the study and the justification for conducting it. Chapter 2 presents the philosophical underpinnings of research methodology and a justification for why a mixed methods approach was adopted for this project. Chapter 3 (study 1) presents the findings from a systematic review of the literature that sought to identify aspects of the home environment that are associated with overweight and obesity among Sub-Saharan African (SSA) children (published). Chapter 4 (study 2) reports the findings from the analysis of secondary data drawn from the Multi-Indicator Cluster Survey (MICS) for Ghana, to assess household sociodemographic factors associated with overweight and obesity among Ghanaian preschoolers aged 2-4 years (prepared for submission to *BMC Nutrition*). This is followed by Chapter 5 (study 3), which presents findings from a survey conducted among Ghanaian Pre-schoolers aged 2-5 years-old to assess the Ghanaian home food environment and how it relates to overweight and obesity (prepared for publication in the journal of *Public Health Nutrition*). Chapter 6 (study 4) is a qualitative study exploring the food feeding practices of caregivers of Ghanaian pre-schoolers. Chapter 7 represents a general discussion of the PhD study findings, bringing all the findings of the 4 studies together, and situating these within the wider literature. The general limitations of the study, as well as the strengths of using mixed methods to collect and analyse data to address the research questions are also discussed. Finally, the implications of the research findings for policy, practice, and future research are discussed.

Chapter 1 – Introduction

This chapter presents an overview of childhood obesity, globally and in Ghana. Prevalence estimates, risk factors, and interventions for overweight and obesity among children are first presented. A justification for examining the home environment of Ghanaian pre-schoolers is presented next, as a setting that has received little or no attention in improving overweight and obesity among Ghanaian children. The chapter concludes with a description of the different objectives that were considered for this project.

1.1. Prevalence of Childhood Obesity

Advancements in technology in the past few decades have served to improve human lives and well-being; however, they may have imposed unintended negative consequences (Coccia, 2021).

These unintended negative consequences have included a general global shift, from high levels of acute infectious diseases to high levels of chronic/non-infectious diseases (Omran, 1971; Zuckerman et al., 2014). This shift in disease burden, i.e., the epidemiologic transition, has frequently been accompanied/characterised by changes in nutrition, physical activity, and sleep (Omran, 1971; Zuckerman et al., 2014). Changes to nutrition have included a gradual reduction in the consumption of traditional, non-processed or minimally processed foods, to an increase in the consumption of highly processed/ultra processed foods (Poti et al., 2017), while changes that have resulted in increased sedentary behaviour/reduced physical activity have included an increase in the reliance on automation and a reduction in physically demanding tasks (Guthold et al., 2018). In addition to poor nutrition and reduced physical activity, sleep quality and sleep duration have also generally been negatively impacted (Chattu et al., 2019).

Increasing levels of chronic or non-infectious diseases have also been linked to global increases in overweight and obesity as a risk factor (Field et al., 2001), and this is true for both adult and child populations (Chooi et al., 2019). Examples of some of these diseases include haemorrhagic strokes (Curioni et al., 2006), other cardiovascular conditions such as heart failure, and arrhythmias (Powell-Wiley et al., 2021), and some cancers (De Pergola & Silvestris, 2013; Preuss et al., 2004). Other

conditions include mental health disorders such as depression, low self-esteem, and anxiety (Avila et al., 2015; K. M. Scott et al., 2008), which are all on the rise.

The World Health Organisation (WHO) reports that for children and adolescents aged 5-19 years, the combined prevalence of overweight and obesity is 18%, a significant increase from 4% in 1975 (WHO, 2020). For children below the age of 5 years, the WHO estimates that approximately 39 million were overweight or obese in 2019/2020 (https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight).

Initially thought to be a major public health concern for developed countries alone, overweight and obesity among children has evidently emerged in many developing, low- and middle- income countries (S. R. Shrivastava et al., 2016). In Africa alone, the WHO has observed a significant increase in the prevalence of overweight and obesity among children post-year 2000 (https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight). Recent reports from the WHO have indicated that in 2019, 24% of the world's overweight and obese children under the age of 5 years were from Africa (https://www.afro.who.int/news/obesity-rising-africa-who-analysis-finds). A detailed discussion of the child obesity situation in the Ghanaian context (the study setting) is presented in section 1.6.

1.2. Health and Economic implications of childhood obesity

A recent review of fifteen studies involving a total of 200,777 participants followed prospectively from childhood and adolescence (7-18 years) into adulthood (>20 years) showed that, compared to normal weight children, obese or overweight children and adolescents were five times more likely to be overweight or obese in adulthood (Simmonds et al., 2016). The study posited that approximately more than half (55%) of obese children would become obese in adolescence, and a large proportion (80%) of obese adolescents would carry obesity into adulthood. The study also suggests that approximately 70% of obese adolescents would remain obese after 30 years. As childhood obesity becomes more prevalent, a substantial amplification of obesity-related complications in adults should be anticipated (Litwin, 2014).

Overweight and obesity in children has been linked to the early symptoms of the metabolic syndrome, inflammation, dyslipidaemia, and coronary disorders (Gupta et al., 2012). The past decade has

especially had more children being diagnosed with type 2 diabetes mellitus cases (Bhupathiraju & Hu, 2016). Rapid weight gain in infancy and overweight and obesity in early childhood (Feldman-Winter et al., 2018) have been linked to an increase in the blood pressure of young adults (Howe et al., 2014). Early adiposity has been associated with elevated Blood Pressure (BP), with distinct weight trajectories from as early as 5 years (Munthali et al., 2016). Between birth and age 17, adiposity trajectories have also been associated with an increased risk of hypertension/prehypertension in adolescence (Huang et al., 2015). Focusing on the prevention or treatment of fat tissue storage within the pre-schooler years may be helpful in preventing hypertension and other related disorders in later childhood and adolescent years (Huang et al., 2015).

Overweight and Obesity in children significantly affects not only their physical health, but also their mental and psychosocial development (Pizzi & Vroman, 2013). For example, there is some evidence based on data from the National Longitudinal Study of Adolescent Health in the US, that suggests that children who are obese find some difficulty in transitioning from high school to college, or to even more advanced levels of education as a result of psychological trauma from stigmatization and bullying (Ryabov, 2018).

Considering varied components of cost and different age groups, it is difficult to conclude on the economic burden of childhood obesity (John et al., 2012). There is the need for an agreement of standard methods for the cost evaluation of obesity in order to improve comparability (Tremmel et al., 2017). However, most studies generally report higher direct and excess health care costs for children who are obese or overweight, compared with their normal-weight peers (Hamilton et al., 2018). Analysis of indirect lifetime costs of children who are overweight or obese, also shows that this remains high as these children continue into adulthood. In the United States, for example, it has been estimated that the lifetime healthcare costs of 10-year old child who is overweight or obese are approximately $16,310 to $39,080, while that for a normal weight child of the same age who will develop obesity or overweight later in adulthood will have to pay approximately $12,660 to $19,630 (Finkelstein et al., 2014). In 2016, the estimated excess lifetime cost of overweight and obesity during childhood was €4,209 for men and €2,445 for women in Germany, resulting in a total healthcare expenditure of €145 billion (Sonntag et al., 2016). A recent review of the lifetime costs of childhood/adolescent overweight

and obesity in both Europe and the US, incorporating both direct and indirect costs, reported that the total lifetime healthcare cost was approximately €150,000, with direct healthcare costs representing an eighth of total expenditure (Hamilton et al., 2018).

In Ghana and in Africa, the costs and economic consequences of childhood obesity have not been adequately documented. However, among adults it has been shown that the healthcare costs associated with overweight and obesity have increased steadily from $122 million in 2014 to $216 million in 2020 (World Obesity Federation, 2017). These costs have further been projected to an estimated figure of $294.6 million in 2025, with a cumulative amount of $2086.5 million expected to have been spent between 2014 and 2025 (World Obesity Federation, 2017). With teeming obesity-related healthcare costs, it cannot be overemphasised that prevention strategies against childhood obesity in Africa are urgently needed (Malik et al., 2013).

1.3. Interventions against childhood obesity

1.3.1. Antenatal lifestyle changes

There is no consistent and conclusive evidence to show that antenatal lifestyle interventions, including diet and physical activity interventions have positive and long-term effects on reducing or preventing excess weight gain among infants and children, although improvements in maternal outcomes have been noted. For example, a recent behavioural trial involving 185 mothers (regardless of weight status) and their children born between 2008 and 2010 and followed up for 2 to 6 years, showed that although mothers in the intervention group reported less gestational diabetes post-intervention, there were no notable decreases in overweight or obesity among their children compared to the control group (Mustila et al., 2018). Another recent trial of antenatal dietary and lifestyle interventions for obese mothers did not improve infant growth and adiposity outcomes, 6 months post-intervention (Dodd et al., 2018). Prenatal physical activity interventions, although protective of macrosomia (babies that are abnormally large at birth), have also shown no related effects on infant or child weight gain (Davenport et al., 2018). It appears that even in some instances, there are no substantive improvements in offspring metabolic profiles in the long-term (almost 3 months after lifestyle interventions) among obese pregnant mothers (Tanvig et al., 2015).

1.3.2. Postnatal interventions – breastfeeding and complementary feeding

The long-term effect of breastfeeding on weight reductions in children is unclear (Marseglia et al., 2015). In some instances, it has been shown to have modest or significant protective effects (Gibson et al., 2017; Giugliani et al., 2015; Yan et al., 2014), while in others the evidence to support this association is weak (Lefebvre & John, 2014). In those studies that have demonstrated a positive link with a reduction in obesity risk in children and adolescents, the mechanisms underlying this association also remain unclear (Marseglia et al., 2015). It is likely that the positive effects of breastfeeding on child weight gain may be modulated by taste preferences that may lead to increased dietary intake of fruits and vegetables in early childhood (Möller et al., 2013; Ventura, 2017). Most studies however agree that an extended period of exclusive breastfeeding is protective against rapid weight gain in infancy, which is a potent risk factor for overweight and obesity among children (Patro-Gołąb et al., 2019; Yan et al., 2014), as against formula feeding practices which have consistently been found to be associated with rapid infant weight gain (Appleton et al., 2018).

Breastfeeding and complementary feeding are the earliest exposure of children to feeding behaviour, postnatally. The timing and duration of these, presents the child with the opportunity to learn healthy eating behaviours. For breastfeeding, it has been recommended that a long duration of exclusive breastfeeding may be protective of the risk of rapid weight gain among infants (Carling et al., 2015). For complementary feeding, the current consensus is that children should not be weaned too early (Pearce et al., 2013), parental feeding should be responsive (Wardle & Carnell, 2007), and that children should be exposed to a repeated variety of healthy foods (Ahern et al., 2019). A recent review has suggested that late weaning, or starting complementary feeding from about 4 – 6 months, seems to reduce the risk for excessive weight increase in infancy and early childhood (Pearce et al., 2013). This appears to be true for both developing and developed countries (Caulfield et al., 1999). Up until very recently, the agreement on what makes up healthy foods for complementary feeding has been a cause of great debate (English et al., 2019). Health professionals currently suggest that repeated exposure to a variety of fruits and vegetables during complementary feeding may increase their taste preferences and acceptance to these over the life course (Barends et al., 2019; L. Chambers, 2016). A recent review has even suggested “how” to increase fruit and vegetable intake in infancy in support of the practice

among caregivers (Hodder et al., 2018). Currently, there is limited evidence that supports the efficacy of interventions for complementary feeding practices to improve growth outcomes in infants and young children, although they have shown some improvements in parental feeding (Arikpo et al., 2018).

1.3.3. Interventions to improve Parent feeding practices.

Parent feeding practices that have been suggested for the improvement of nutritional and health outcomes in infants and young children are those that promote responsive feeding (Dalrymple et al., 2018). These are practices utilise that the child's own ability to control feeding, and promote healthy foods (Dalrymple et al., 2018). These practices should also be guided by positive parenting styles administered through authoritative feeding with some form of structure, and decreased caregiver control (Dalrymple et al., 2018). Some intervention studies have reported promising outcomes with respect to changes in parent feeding practices, for example, improvements towards more responsive feeding (Daniels et al., 2015; Fangupo et al., 2015; Holland et al., 2014; Savage et al., 2018). However, the effects of interventions for parental feeding practices on improvements in child weight and adiposity outcomes has been unclear (Matvienko-Sikar et al., 2018). For example, while the NOURISH (Nourishing Our Understanding of Role modelling to Improve Support and Health for Healthy Transitions) trial reported a downward trend in child BMI and rapid weight gain at 13-15 months, no effects were found at 2-5 years (Daniels et al., 2012). For other studies (e.g., InFANT (Infant, Feeding, Activity and Nutrition Trial) and GLB (Growing Leaps and Bounds) studies), significant reductions in BMI outcomes (Cameron et al., 2014; Schroeder et al., 2015) or adiposity (Tucker et al., 2019) after interventions for parent feeding practice had been administered were not demonstrated. Empowering parents to be interested in intervention design and implementation may be a useful approach to obesity prevention that is family-centred (Davison et al., 2013). Also, since a fairly accurate parental perception of weight gain among children is necessary for the prevention and treatment of overweight and obesity (Warkentin et al., 2018), it may be helpful for clinicians to assist parents in correctly evaluating their child's weight status.

1.3.4. Interventions to prevent or reduce sedentary behaviour.

Other intervention methods that have been explored to control weight gain in children include modifications to physical activity, sleep, and screen time. Many interventions for improvements in

physical activity have shown more benefits in the reduction (treatment) of weight and BMI among obese and overweight children and adolescents (Kelley et al., 2014; Kelley & Kelley, 2013; Reilly & McDowell, 2003; Stoner et al., 2016, 2019). In contrast, the prevention of overweight and obesity in children and adolescents using improvements in physical activity, have not shown any consistent results (Cesa et al., 2014; B. Metcalf et al., 2012). There have been some promising outcomes for interventions targeting sleep and screen time. In a recent review of the impacts of sleep interventions on obesity-related indicators, Yoong *et al.*, (2016) have suggested that, improvements in the sleep duration of children have been linked with notable changes in child BMI, nutrition, and physical activity. Limited evidence from screen time interventions also suggests significant benefits on BMI reduction in children and adolescents (L. Wu et al., 2016).

1.3.5. Policy interventions

Although many strategies have been recommended and formulated into policies, effective obesity prevention has been slow and inconsistent (Lyn et al., 2019; J. Martin et al., 2014). In the current obesogenic environment, expecting children and adults to make healthy food choices may not yield any significant positive results, and government intervention may be required to correct this (Lobstein, 2008; Moodie et al., 2006). Successfully establishing political commitment for obesity control requires a set of actions adapted to specific contexts (Baker et al., 2018). In every country, this will also require a set of actors that span various political, social, and cultural networks, and that also help encourage political commitment (Baker et al., 2018). Mechanisms of political action could include enabling a less obesogenic environment to increase preferences for healthy food choices, and helping to overcome barriers to the expression of healthy food choices (Hawkes et al., 2015). Based on this, there are a number of categories that have been identified for political action. These include, but are not limited to, the composition of food, labelling on food packages, and a review of food promotion and marketing strategies (Vandevijvere & Swinburn, 2014). Many recommendations, including policy changes to promote breastfeeding, to provide healthy and affordable food in community and child care settings, and to promote physical activity in child care settings have also been suggested (McPherson & Homer, 2011). Other policy options, such as taxation and subsidies, may have positive benefits, such as witnessed in countries like Mexico (Lyn et al., 2019). However, taxation and government subsidies have

generally not been favourably received, because they are perceived to be difficult to implement (González-Zapata et al., 2010). Effective food policy actions, including those that encourage healthy feeding and eating, must be specifically structured to support the people they are designed for in terms of food preference, cultural, socioeconomic and demographic characteristics, and must be implemented as part of a concerted efforts from relevant actors (Hawkes et al., 2015).

1.3.6. Multi-component interventions

Recent studies suggest that interventions that combine modifications to physical activity and nutrition represent the most effective ways to reduce overweight and obesity among children (Psaltopoulou et al., 2019). Behaviour change interventions conducted in young children, with active parent involvement, additionally suggest that multi-component behaviour change interventions may be beneficial in modulating weight change in children of all ages (Ells et al., 2018). Although interventions that are based solely on physical activity or nutrition education/counselling may be helpful in preventing obesity among children, they are even more effective when implemented together (Waldow Wolf et al., 2019). There is a need to merge various actors in many different networks, in order to observe any measurable effects (Malik et al., 2013). Continuously evaluating success or failure based on evidence from multi-component interventions, and comprehensively applying this knowledge with well-tailored health promotion campaigns, will help reduce the burden of childhood overweight or obesity (S. R. B. L. Shrivastava et al., 2015). Although widely recommended, there should be appreciable consideration of the fact that implementing childhood overweight and obesity prevention programs with collaboration at multi-sectoral and stakeholder levels remains a challenge (Specchia et al., 2018).

Among African children, there is very limited evidence of interventions against overweight and obesity, and existing ones have provided inconsistent results that cannot sufficiently inform overall effectiveness for future evidence-based policy-making (Adom et al., 2020).

1.4. Theories of Obesity

Obesity has generally been viewed as the result of an imbalance in energy intake over energy expenditure. Energy intake takes the form of food consumption, while energy expenditure takes the form of physical activity and the energy used by the human body during metabolic processes in the resting state (Roberts, 1995).

Several theories for the development of obesity or overweight have emerged. These theories include those that explain the development of obesity solely in biological terms, those that perceive the development of obesity from an environmental viewpoint, and those that approach the development of obesity with a psychological lens (The British Psychological Society, 2019).

Biological theories of the development of obesity (e.g., the Homeostatic and Set-point theories (Marks, 2015)), focus on the physiology and genetics of obesity. Biological theories stipulate that obesity may occur as a result of the heredity of specific genes, or physiologic events related to energy metabolism (The British Psychological Society, 2019).

The genetic basis of obesity has been evidenced in many ways. Through twin and genome-wide association studies (GWAS) (Jackson et al., 2020), for example, it is now known that identical twins who have similar genetic makeup, are more likely to have similar changes in body weight over time, especially if they lived in the same environment (Mărginean et al., 2018). Many obesity genes associated with appetite have also been identified. Examples include hypothalamic variants of the FTO gene (located on the long arm of chromosome 16) and the MC4R gene (located on chromosome 18), as well as those of extra-hypothalamic origins, including the genes for leptin, leptin receptors, insulin, and ghrelin (Mărginean et al., 2018). The origins of these genes are unknown, however they are thought of as resulting from single nucleotide polymorphisms (SNPs) in DNA encoding regions (Llewellyn & Wardle, 2015). SNPs may produce variants of individual genes that have been implicated in the monogenic heritability of specific and severe forms of obesity (Claudia et al., 2017). A higher effect size of SNPs at the population level have been linked to polygenic (more than one gene), rather than monogenic, heritability of obesity (Hinney et al., 2010). Epigenetic influences on obesity through appetite control are also evident (Thaker, 2017). These epigenetic influences result in the dysregulation of gene function, by altering their expression without directly changing their genetic codes. In obesity, changes in chromosomal methylation, or histone function for example, may essentially modify the expression of genes, exacerbating or masking certain effects related to appetite control (Andermann & Lowell, 2017).

The physiological basis of obesity has also been well studied. These studies have shown that the part of the human body primarily responsible for the control of appetite is the arcuate nucleus, situated within the hypothalamus, with afferent innervations from the central nervous and peripheral nervous systems (Ahima & Antwi, 2008; Timper & Brüning, 2017). It is within this region of the brain that feeding start and stop cues are integrated and responded to, and as a result of overlapping neural circuits, may be hunger-based or hedonic (pleasure eating, emotional eating, or eating in the absence of hunger) (Lowe & Butryn, 2007; Lutter & Nestler, 2009; Monteleone et al., 2013; Rossi & Stuber, 2018). These responses form part of a food-seeking, reward-based network in the body (mainly in the hypothalamus), which integrates with dopaminergic memory circuits in close proximity to the arcuate nucleus (Y. Chen & Knight, 2016; Timper & Brüning, 2017; Yoon & Baik, 2015). A continuous feedback loop with this memory circuit, either enhances hunger-based eating or hedonic eating (Rossi & Stuber, 2018).

Theories on the environmental influences on the development of obesity (e.g., Schachter's Externality Theory and the Ecological Theory of Obesity) (Kuriakose, 2012)) describe how obesity may develop as a result of the influence of extrinsic factors, such as the unlimited access of individuals to unhealthy foods (Richards et al., 2001).

Psychological causes of obesity may present in many forms, such as Binge Eating Disorder (BED), or, adverse childhood experiences such as stress, or family conflict (The British Psychological Society, 2019).

It is now widely held that overweight or obesity is a result of complex processes involving neither of these factors in isolation, and that they often interact with each other to produce excess body weight. More recently, the behavioural susceptibility theory (BST) as proposed by Wardle and Llewellyn (Llewellyn & Wardle, 2015), has attempted to explain the development of obesity based on an interaction between inherited genes and the environment. Their theory stipulates that genes influence obesity through appetite control in their interaction with the obesogenic environment. Genome-wide association studies have also shown that, where there is a high heritability of obesity genes including

those controlling appetite, people living in obesogenic environments tend to exhibit higher levels of overweight and obesity (S. Schrempft et al., 2018).

1.5. Risk Factors of Childhood Obesity

1.5.1. Prenatal and Postnatal Factors

The origins of health and disease at the beginning of the life course, represent the result of biological processes of developmental plasticity, and all children are affected by their *in utero* conditions (M. A. Hanson & Gluckman, 2014). Foetal programming as a result of placental and other endocrine cues is thus expected to affect the life and long-term health of the developing child (Hochberg et al., 2011). In particular, it has been shown that this programming may pose long-term consequences for later susceptibility of children to overweight and obesity (M. Hanson & Gluckman, 2011). It has previously been shown that genes and epigenetic mechanisms play a vital role in the expression of childhood overweight and obesity; prenatally, the intrauterine environment of mothers has the potential to alter genes in the growing foetus that are related to weight control. These include genes for appetite control, lipid metabolism and adipogenesis, energy expenditure, insulin signalling, and inflammation (Thaker, 2017). These intrauterine modifications may be in the form of DNA methylation, histone modification, miRNA expression, or the maternal production of "obesogens" (endocrine-disrupting chemicals) (Thaker, 2017). Assessments of potential associations of childhood obesity and maternal antenatal metabolic profiles also suggest that maternal obesity may influence the metabolism of branched chain amino acids and the processing of androgen metabolites in the growing foetus, leading to adiposity during mid-childhood (Perng et al., 2014). Other prenatal biological risk factors of childhood obesity that have been identified include maternal pre-pregnancy obesity (Heslehurst et al., 2019), weight gain during pregnancy, gestational diabetes, maternal psychosocial stress, maternal smoking, the intestinal microbiome of mothers, and maternal malnutrition (undernutrition and overnutrition) (Liao et al., 2019).

Postnatally, other risk factors such as short duration of breastfeeding (Arenz et al., 2004; Ma et al., 2020; Rito et al., 2019; Uwaezuoke et al., 2017), rapid growth or weight gain during infancy (Trandafir & Temneanu, 2016), and short sleep duration (Chen *et al.*, 2008; Li *et al.*, 2017; Miller *et al.*, 2018; Tuohino *et al.*, 2019) have been linked to childhood obesity. The evidence for the impact of

breastfeeding on overweight and obesity among children, although inconsistent, is largely in favour of the practice (Marseglia et al., 2015; Uwaezuoke et al., 2017).

1.5.2. Environmental factors

These constitute factors that are external to the child, and may either be proximal, such as the factors in the home environment, or distal, such as factors in the neighbourhood, community, or school environments (Davison & Birch, 2001). In terms of obesity, it is expected that these factors may be potent enough to undermine any capacity for self-regulatory behaviour when it comes to maintaining body energy balance (Hobbs & McKenna, 2019). These factors may, for example, take the form of an increase in the access, availability, and affordability of unhealthy, obesogenic foods (White, 2007), or, chronic reductions in physical activity (Hills et al., 2011), sleep time, or sleep quality (Broussard & Klein, 2022; Zimberg et al., 2012).

Many people live in environments that have made them more sedentary, while enabling increases in their consumption of unhealthy foods (Popkin, 1998). In terms of obesity, the current evidence suggests that, although modest progress has been made to improving physical activity by modifying the built environment to include developments such as gyms and parks (Sallis et al., 2012), the case for improving nutritional outcomes may not have achieved the same results (Ambikapathi et al., 2022).

The transition from the more traditional consumption of fruits and vegetables to ultra-processed foods began in the mid-1900s (Rao et al., 2018). These ultra-processed foods are generally available in many modern supermarkets and shops, and are also in close proximity to many consumers, including children (Du et al., 2018). Although there are some inconsistencies in available evidence, many studies have reported associations between the proximity of neighbourhood food environments, including supermarkets, restaurants, and other retail food outlets and increased BMI among children and adolescents (da Costa Peres et al., 2020; Jia et al., 2019). Very recent evidence also points to the assertion that the marketing /advertising of unhealthy foods has a strong potential to influence what foods children will like and eat after exposure to food adverts (Sadeghirad et al., 2016).

1.5.2.1. The Home environment

For children, the home environment is the most proximal of all environments that can influence excessive weight gain. This setting is often the first avenue for social interaction with caregivers, from which obesogenic behaviours may be learned and established early in life (Kininmonth, Smith, et al., 2021). Caregivers have the responsibility of providing their child the opportunities for adequate physical activity and less sedentary lifestyles at home, as well as healthy nutrition. Caregivers may achieve this through items that they make available in the home environment or the ways in which they interact with their child. These include for example, increasing the availability of outdoor play items and play spaces to the child, reducing their exposure to interactive media devices such as mobile phones, game tablets, computers, and televisions, or encouraging, modelling, or structuring the healthful consumption of fruits and vegetables. The home environment may be viewed in terms of food (home food environment), physical activity (home PA environment), or media (home media environment) (Kininmonth, Smith, et al., 2021; S. G. Schrempft, 2014).

1.5.2.1.1. The Home food environment

Caregivers may influence the way a child eats by what they give the child and how the child is fed. This is commonly evident through the foods available in the home environment as well as practices associated with child feeding (Kininmonth, Smith, et al., 2021).

In terms of the availability of food in the home environment and child weight outcomes, the current evidence is mixed (Frongillo & Bernal, 2014). A recent review of 120 studies to examine the relationships between household and individual level food insecurity (as a proxy measure of food availability) and nutrition indicators (including childhood obesity) has demonstrated a weak link between household food availability and child obesity (Maitra, 2018). In terms of feeding practices, caregiver restriction of the consumption of certain types of food, rewarding desirable behaviours with food, or pressuring a child to eat, have commonly been reported to be associated with childhood obesity (Shloim et al., 2015). In SSA, early research on caregiver feeding practices suggests that restriction may be strongly associated with an increase in child food approach behaviours (Gebru et al., 2021). Evidence from review studies e.g., Shloim *et al.* (2015), also suggests that the feeding practices of parents may be responsive to the eating behaviour/feeding habits of children. These studies suggest

that restriction, for example, is usually applied to children with a high BMI, or a child whose parents perceive them to be overweight or obese. Children with a lower BMI are also usually pressured to eat (Shloim et al., 2015; Spill et al., 2019). Intervention studies suggest that when parents are supported through targeting a range of positive feeding practices, the diets and eating behaviours of their children show considerable improvement (Peters et al., 2013).

1.5.2.1.2. The Home media, sleep, and physical activity environment

The home media environment has most consistently been associated with childhood obesity (Kininmonth, Smith, et al., 2021). There is evidence to support the impact of the excessive use of media devices, e.g., television-watching (watching TV >1–2 hours/day) on an increased risk of obesity in children and adolescents (Pérez et al., 2011; Poorolajal et al., 2020). An increase in screen time, apart from making children more sedentary, also increases their exposure to the unrestricted marketing of unhealthy foods (Pérez et al., 2011).

There is also more direct evidence linking the availability of media devices to child overweight/obesity. A recent study of Scottish children (n=2810), has also shown that having screens in the bedrooms of children is implicated in the increased risk of overweight and obesity (Parkes et al., 2020). This evidence is suggestive that excluding screens from mealtime environments in the home, may help in reducing childhood overweight and obesity (Parkes et al., 2020).

In terms of sleep, many reviews also support a link between short sleep duration among children and childhood obesity (Li et al., 2017; M. A. Miller et al., 2018). For example, in a recent review of 42 studies the authors concluded on how child BMI-z scores could be modified as a result of changes to sleep duration (M. A. Miller et al., 2018). Although insulin resistance-mediated mechanisms have been identified, the exact pathways by which lack of adequate sleep (quantity and quality) influences childhood obesity remains poorly understood (Felső et al., 2017).

In terms of physical activity, many cross-sectional studies have supported the assumption that physical inactivity and childhood obesity are linked (Dencker et al., 2006; Ekelund et al., 2004; Ness et al., 2007; Trost et al., 2001). However, emerging evidence from longitudinal studies appears to suggest some reverse causality (B. S. Metcalf et al., 2011; Richmond et al., 2014). For example, a three-year long study to ascertain whether physical inactivity is the cause or consequence of overweight/obesity among

children, reported that physical inactivity was more likely the result of fatness (B. S. Metcalf et al., 2011). The results of that study showed that a 10% increase in the body fat of children, by 7 years of age, was associated with a four-minute decrease in the daily amount of moderate-to-vigorous activity achieved when children were approximately 10 years old. Studies have failed to show consistent outcomes with respect to the exclusive effects of physical activity on the prevention or treatment of obesity in children; while some have shown significant reductions in body weight due to increases in physical activity, others have not (T. Brown et al., 2019). The key to this paradox may lie with the assumptions of an energy flux hypothesis which stipulates that obesity could occur over time as a result of decreasing levels of physical activity and an increase in the consumption of food (Swinburn et al., 2006), i.e. while energy intake goes up, energy expenditure is relatively lower and not commensurate. The energy flux hypothesis stipulates that the energy gap between energy intake and energy expenditure is positively correlated with weight gain and adiposity from childhood, through adolescence, to adulthood, and that adults are more likely to express even greater levels of weight gain compared to children (Swinburn et al., 2009). It also suggests that increasing energy expenditure, through physical activity, as well as lowering energy intake, may be beneficial to the maintenance or the reduction of weight gain in children and adults (Dietz, 2004).

1.5.3. Household socioeconomic status

The association between childhood obesity and socioeconomic status (SES) varies by country (Y. Wang & Lim, 2012), but in general, SES groups that exhibit a high consumption of energy-dense diets are at an increased risk of being obese or overweight, compared to those with reduced or limited access (Y. Wang & Lim, 2012). In industrialized countries, these groups are typically low-SES populations, while in developing countries these groups are predominantly high-SES populations (Y. Wang & Lim, 2012). Recent studies of the relationship between childhood obesity and socioeconomic status in developed countries show that, while there has been a general reduction in obesity prevalence and an inverse relationship between SES and obesity (Barriuso et al., 2015; Chung et al., 2016), these results are mixed. In most cases, this appears to reflect widening socioeconomic inequalities (Chung et al., 2016). In particular, in these developed countries, parents' education appears to be an important measure of SES that yields the highest proportion of inverse relationships (Barriuso et al., 2015). In developing

countries there is a strong and positive relationship between affluence and BMI, with those children from families of higher SES being more likely to be overweight or obese (Dinsa et al., 2012; Fruhstorfer et al., 2016).

1.6. Childhood overweight and obesity situation in Ghana

Most African countries are experiencing an epidemiologic transition, and Ghana is no exception to this (Bosu, 2015). In Ghana, nearly half of all adults are overweight or obese, with more women than men who are overweight or obese (Ofori-Asenso et al., 2016). In terms of health and healthcare expenditure, the possible implications of the increasing prevalence of excessive weight gain among Ghanaian adults are likely to be severe for a country that is still experiencing a burden of communicable diseases (Ofori-Asenso et al., 2016). In Ghana, household healthcare expenditure is higher for members who are experiencing NCDs (non-communicable diseases), compared to those not experiencing NCDs (Tagoe, 2012). The positive association of body mass index with elevated blood pressure among young people and adults in urban Ghana, for example, also suggests the need for immediate health measures to tackle childhood and adolescent overweight and obesity and its related public health costs (Afrifa-Anane et al., 2015).

Although national data on overweight and obesity among children (>5 years) and adolescents are limited (Owusu *et al.*, 2017; Adom *et al.*, 2019), there is growing evidence that the prevalence of childhood and adolescent overweight and obesity in Ghana is on the increase (Amidu, Owiredu, Saaka, Quaye, Wanwan, Kumibea, Zingina, & Mogre, 2013; Annan-Asare et al., 2017; Mogre et al., 2015; Mohammed & Vuvor, 2012; Oppong, 2016). Pooled estimates from a recent review puts the overall prevalence of overweight and obesity in Ghanaian children (0-19 years) at 8.6% and 10.7% (Kobia-acquah & Akowuah, 2020), with overweight being more prevalent than obesity.

Data and evidence on risk factors for childhood obesity in Ghana is limited (Adom *et al.*, 2019). To date, risk factors that have been identified, especially among older Ghanaian children (e.g., school children and adolescents) are related to socioeconomic position (Adom et al., 2019; Kobia-acquah & Akowuah, 2020), nutrition, and dietary factors (Annan-Asare et al., 2017; Ogum Alangea et al., 2018), increased physical inactivity and sedentary patterns (Aryeetey et al., 2017; Obirikorang & Anto, 2015), reduced or

inadequate sleep, disordered eating, and increased screen time (Amidu, Owiredu, Saaka, Quaye, Wanwan, Kumibea, Zingina, & Mogre, 2013; Mogre et al., 2013).

There are no significant age and sex differences among children and adolescents that put them at risk for obesity or overweight in Ghana (Adom et al., 2019), although more girls than boys tend to be overweight or obese (Adom et al., 2019; Annan-Asare et al., 2017; Kobia-acquah & Akowuah, 2020). In Ghana, attendance of a child to a private school is directly linked to an increased risk of overweight/obesity (Agbozo, Atito and Abubakari, 2016; Adom *et al.*, 2019, Amidu *et al.*, 2013; Ganle, Boakye and Baatiema, 2019). This is more so for those living in urban communities than in rural settings, and significantly higher child obesity prevalence estimates have been found in urban settings compared to rural settings (17.4% vs. 8.9%) (Kobia-acquah & Akowuah, 2020). Children who are overweight/obese also tend to come from homes with high levels of parental education (Ganle, Boakye and Baatiema, 2019; Adom *et al.*, 2019). This socioeconomic gradient is in stark contrast to that which has been observed in more developed countries, such as the UK, where children from low socioeconomic households are more likely to be obese or overweight (Y. Wang & Lim, 2012).

In terms of dietary factors, a recent evaluation of the dietary patterns of Ghanaian children showed that, those who consumed more ultra-processed and energy-dense foods had higher odds of being obese or overweight, compared to children who consumed more vegetables (Ogum Alangea et al., 2018). This evidence suggests that differences in nutrition patterns and dietary diversity may be contributing to overweight and obesity prevalence among Ghanaian children. In major Ghanaian cities, children typically consume more sweetened foods and beverages up to seven times more than they consume fruit and vegetables (Bosu, 2015). Very frequent consumption of fast foods has also been associated with excessive BMI among adolescents (Annan-Asare et al., 2017). Innovative ways to improve the consumption of fruits and vegetables among children in Ghana are needed (Steiner-Asiedu et al., 2012), and enhancing dietary diversity may play a crucial role in achieving nutrient-adequate meals (Agbozo et al., 2018).

In terms of feeding practices there is no direct evidence linking suboptimal breastfeeding or complementary feeding practices to weight gain among Ghanaian children. However, there are reports

that they could be a potential risk factor for obesity and weight gain in children (Asare et al., 2018; Issaka et al., 2015; S. et al., 2014).

Reduced physical activity has also been shown to be strongly related to overweight among adolescent students, suggesting the need to closely monitor the physical activity of Ghanaian children (Nyawornota et al., 2013; Obirikorang et al., 2015). Because physical inactivity appears to be one of the drivers of obesity among Ghanaian children, efforts to reduce the problem of obesity should include the promotion of physical activity (Aryeetey et al., 2017).

A number of other modifiable risk factors (television watching time and decreased sleep duration) have also been associated with overweight and obesity among children in Ghana (Adom et al., 2019; Mogre et al., 2013). For example, exposure to television screen time for more than 2 hours a day, or playing computer/video games, (Amidu, Owiredu, Saaka, Quaye, Wanwan, Kumibea, Zingina, & Mogre, 2013) has been shown to increase the likelihood of overweight and obesity (Adom et al., 2019).

1.7. Justification for the study

Up until very recently, childhood obesity was not considered a problem in Ghana (Haggblade et al., 2016). In Ghana, although some weight gain is preferred, it only becomes noteworthy of attention when it is extremely excessive (Appiah et al., 2016). Attention to weight gain, rather than weight maintenance or weight loss may be preferred because many households, especially those of high SES status, view weight gain to be a sign of well-being (Appiah et al., 2016).

Obesity or overweight in the preschool years have been shown to track into adolescence and adulthood; however, this population remains understudied in Ghana. The preschool years are also particularly important because this is when children exhibit unique behaviours such as food fussiness and food neophobia that may influence the way parents feed their children and what foods they provide to them.

The home environment of pre-schoolers has been previously shown to be a significant contributor to childhood obesity, exerting its influence through changes in child eating and physical activity behaviour. However, the evidence for how the home environment may influence childhood obesity in Ghana is lacking.

Child eating behaviour has been linked with child obesity in the wider literature. However, little is known in the Ghanaian context about which eating behaviours, in particular, could be considered more obesogenic. Also lack in the literature, is established constructs of caregiver food feeding practices in the home environment, such as restriction and pressure to eat, although some evidence seems to suggest that these could influence child eating behaviour, and consequently weight gain.

To the best of our knowledge, this is the first study among Ghanaian pre-schoolers to examine how the home environment may influence childhood behaviour and overweight and obesity. This study also trialled newly developed, but validated, tools (which have not been used before to study this population) to examine the home environment and its relationship with child behaviour in Ghana.

1.8. Study aims.

1. Aim 1: summarise the available evidence on the risk factors for childhood overweight and obesity within the home environment of pre-schoolers (2-4 years) in Sub-Saharan Africa

   Aim 1 was achieved by conducting a systematic review of the influence of the home environment on overweight/obesity among pre-schoolers (2-4 years) in Sub-Saharan Africa.
2. Aim 2: Identify household socio-economic trends in overweight and obesity prevalence among pre-schoolers in Ghana.

   Aim 2 was completed by exploring under-five overweight/obesity and household data from the Multiple Indicator Cluster Survey (MICS) in Ghana
3. Aim 3: Examine the relationship between household food availability, caregiver food feeding practices, child eating behaviour, and overweight/obesity among Ghanaian pre-schoolers.

   Aim 3 was achieved by conducting a cross-sectional study of household dietary diversity, parental feeding practices, child eating behaviour, and overweight/obesity among Ghanaian urban and peri-urban pre-schoolers.
4. Aim 4: Explore parental feeding practices in the home environment of Ghanaian pre-schoolers.

   Aim 4 was achieved through a qualitative study of caregiver food feeding practices and how these could be contributing to overweight/obesity among Ghanaian pre-schoolers.

Chapter 2 - General Methodology

This chapter describes the overall research approach - a mixed methods approach - adopted to collect and analyse data to address the overarching research questions. First, the philosophical underpinnings of mixed methods research are discussed, followed by a justification for using a mixed methods approach in this study. This is followed by a description of the tools and techniques used for data collection and data analysis. Also presented in this chapter is a consideration and discussion of the challenges associated with conducting mixed methods research, and finally, the ethical considerations for conducting this study. A reflection of my position as a researcher conducting a study in an environment in which I am very familiar with, and how this position may have influenced the research findings is also presented.

2.1. Philosophy of mixed methods research

Any positive change or improvements to how we live, requires a comprehensive understanding of the right set of relevant issues. Knowing what these issues really are, and how they interact with each other also requires re-examining them from different perspectives with as little bias as possible.

The theory of knowledge, also known as epistemology, describes the various ways in which knowledge may be acquired through our perceptions of reality (Dawadi et al., 2021; Schwandt, 2003). Traditionally, these perceptions have either been positivist, constructivist, or interpretivist (Dawadi et al., 2021). Positivists hold the view that reality should be measurable by logical or mathematical means, rejecting any metaphysical or theist claims (Dawadi et al., 2021). Constructivists and interpretivists researchers, on the other hand, are of the opinion that reality is subjective. They argue that reality is socially constructed and is interpreted differently by each person (Schwandt, 2003). The foundations of qualitative research designs are embedded in constructivist and interpretivist views, while quantitative designs lend their methods from the positivist ideology (Dawadi et al., 2021; Schwandt, 2003).

These different approaches to research however come with their strengths and limitations. For example, although quantitative designs aim to promote generalizable findings and facts, they fail to acknowledge that people may not appreciate or perceive these facts as part of their reality. This is suggestive that any intervention born only out of those facts, risks the possibility of failure if there is any perception of that fact that it does not exist (Noyes et al., 2019; Victora et al., 2004). Qualitative

designs, despite providing a wealth of evidence regarding the lived experience of people, are limited in generalizability by the mere nature of their small sample sizes and subjectivity (Dawadi et al., 2021). Thus, there is a general feeling that combining both quantitative and qualitative approaches may reduce the limitations of each other; in other words, fact and perception can reside together to produce a more practical outlook to enabling positive change. In the next section the concept of a mixed methods approach is further described.

2.2. Mixed Methods Approach and Designs

Mixed methods approach involves utilising both quantitative and qualitative research methods in a single study to address multiple research questions (Dawadi et al., 2021). This approach has gradually become popular among health and social scientists, and proponents of this worldview are known as pragmatists (Dawadi et al., 2021). Pragmatists believe that scientific facts alone are inadequate to facilitate practical changes, and recognise the significant input of the perceptions of people in intervention success. Designs based on this combination of quantitative and qualitative approaches are most commonly called mixed-methods (MM) designs (Dawadi et al., 2021). Mixed-methods designs are broadly classified based on the timing of the qualitative and quantitative studies (sequential or concurrent) (Dawadi et al., 2021). Sequential mixed-methods designs are those in which either quantitative or qualitative data collection and analysis precede each other. Concurrent mixed-methods designs are those in which qualitative and quantitative data collection and analysis occur at the same time (Almeida, 2018). Both designs may involve the same or different sets of study participants (Dawadi et al., 2021). The choice of which design to use depends entirely on the aims and objectives of one's study (Almeida, 2018).

There are three common designs that may be used: a convergent parallel mixed methods design, an explanatory sequential design, or an exploratory sequential mixed methods designs (Dawadi et al., 2021). In convergent parallel mixed methods designs, quantitative and qualitative data is collected concurrently, but separately analysed before findings are mixed and interpreted (Dawadi et al., 2021). Explanatory sequential designs are more useful when the study is more quantitatively aligned, or predominantly quantitative (Dawadi et al., 2021). These designs typically start with the implementation of its quantitative aspects, which subsequently inform its qualitative aspects. Exploratory sequential

designs commonly begin with qualitative studies which inform the development of quantitative measures or tools (Dawadi et al., 2021). These measures or tools are quantitively tested and the findings are interpreted with respect to how well the quantitative findings extend the qualitative findings (Dawadi et al., 2021). Since the quantitative component of this PhD is dominant to its qualitative component, i.e., 1 secondary data analysis of large datasets and 1 survey, and a small qualitative component conducted to complement the quantitative study, the MM design employed may best be described as an explanatory sequential design (Table 1).

Table 1. Summary of the mixed methods design used in this thesis.

Study	Objective	Methodology	Design/Method
Study 1	summarises the available evidence on the risk factors for childhood overweight and obesity within the home environment of pre-schoolers in Sub-Saharan Africa	Quantitative	Systematic Review
Study 2	Identify household socio-economic trends in overweight and obesity prevalence among pre-schoolers in Ghana	Quantitative	Analysis of Secondary data
Study 3	Examined the relationship between household food availability, caregiver food feeding practices, child eating behaviour, and overweight/obesity among Ghanaian pre-schoolers	Quantitative	Cross sectional survey

Study 4	Explore parental feeding practices in the home environment of Ghanaian pre-schoolers	Qualitative	Focus group interviews

2.3. Rationale for using mixed methods.

As previously stated, mixed methods designs may be implemented for many reasons, subject to the aims and objectives of the study. Greene et al., (1989) have attempted to consolidate the many varied reasons for conducting a MM study, under a common conceptual framework. Their conceptual framework details 5 major justifications for implementing MM designs, namely, expansion, complementarity, validation, initiation, and development (Dawadi et al., 2021; Tariq & Woodman, 2013). The authors provide the following explanations for each of these justifications (Dawadi et al., 2021; Tariq & Woodman, 2013):

- Expansion involves conducting one or more studies to provide depth or more details about the findings from another study.
- Complementarity involves conducting separate studies whose findings are expected to complement each other.
- Validation involves using different methods to answer the same research question and to find out if there is discordance or a confirmation of the findings of one study by the other.
- Initiation involves using the findings from both qualitative and quantitative studies to generate new insights, and,
- Development involves using the findings from one study to develop the methods of another study.

In general, for this PhD, while the survey was conducted to validate the findings from the secondary data analysis, the qualitative component of the PhD was designed to expand on selected findings from the survey. Specifically, this PhD progressively addressed the limitations of each study, through the validation and expansion of findings as the studies were conducted sequentially. The secondary data analysis was designed to find out if the findings from the study of overweight/obesity among toddlers in SSA could be replicated using the Ghana MICS datasets. The survey was subsequently designed to address some of the limitations of using the secondary data, i.e., the absence of variables related to social aspects of the home food environment such as caregiver food feeding practices. The survey also attempted to confirm some of the findings from the secondary data analysis, for example, those relating to household dietary diversity. Finally, the qualitative data was intended to provide depth about caregiver food feeding practices from the survey.

2.4. Challenges of Mixed Methods Approaches.

Mixed methods designs typically encounter one or more of 5 documented challenges (Dawadi et al., 2021). The first challenge is that, collating data and analysing data is a lengthy process and could be labour- and cost-intensive (Dawadi et al., 2021). The second challenge relates to achieving a high/adequate level of integration of quantitative and qualitative findings, since there is little guidance on how to merge both types of data (Dawadi et al., 2021). A third challenge is related to the reliability and validity of the methods chosen for either quantitative or qualitative aspects of the research (Dawadi et al., 2021). This can become particularly evident when the findings from both study types contradict each other. The fourth challenge relates to monitoring the extent to which either qualitative or quantitative studies influence each other. This is to ensure that the integrity of each study is maintained, and that a true integration of findings is achieved (Dawadi et al., 2021). The last challenge is choosing the right MM design for a study, and this mostly relies on the experience or expertise of the researcher (Dawadi et al., 2021). Early-career researchers who decide to implement an explanatory sequential MM design, for example, should expect difficulties in pre-specifying and justifying qualitative aspects of the

study, especially when ethical approval is required (Dawadi et al., 2021). For this study, challenges faced most likely relate to the time spent conducting it, the quality of integration, and selecting the right MM design as an early career researcher. To navigate through some of these challenges, the researcher received training in both quantitative and qualitative methods. Prior to starting this PhD, the researcher's expertise was in conducting quantitative research, with no prior knowledge on qualitative data collection or analysis. As a result, earlier on in the PhD, a training needs assessment was undertaken with my supervisors, who advised me to enrol on a qualitative course. The knowledge that I acquired from the training, equipped me with the requisite skillset to complete the qualitative component of the PhD. Furthermore, although I had some prior knowledge of quantitative data analysis, a further training I received during the PhD has also been very useful in enhancing my skills in statistical data analysis.

2.5. Participants for the mixed methods study

The qualitative study and survey involved caregivers and their pre-schoolers (2-5 years old) in urban Ghana. Among children, this age-group was the focus of this study because there is little evidence in Ghana on the development or establishment of overweight/obesity during the pre-school years. There is adequately documented evidence of the unique feeding behaviours exhibited by children at this stage of development, e.g., food neophobia and food fussiness, which may impact or influence caregiver feeding practices, for example (Paroche et al., 2017). For the systematic review in particular, since the authors of some relevant studies had considered the preschool age to include children aged 3-6 years, the age group was more broadly classified and extended to include children aged 6 years, i.e., 2-6 years instead of 2-5 years.

2.6. Recruitment for the mixed methods study

Participants were conveniently and purposefully sampled for the survey and qualitative studies respectively. Convenience sampling, a non-probability sampling method, was better suited to collect data for the survey and qualitative studies because of its benefits of being low cost, efficient, and ability to generate a homogenous collection of individuals who expressed interest to partake in the study

(Jager et al., 2017). Probability sampling was not chosen for this study because of one of its key limitations, which is that, sample sizes have to be large enough for it to be representative and generalisable; this often requires a lot of funding, effort, and time (Jager et al., 2017). Besides the above reasons, for the qualitative study, probability sampling is not applicable since the aim is not to sample for representation nor generate data for generalisation (Jager et al., 2017).

The primary points for recruitment of participants into the quantitative study were "Sunday schools". These are weekly classes organised by some churches for children. Eligible caregivers and their children were contacted with the help of trained field/research assistants from the Kwame Nkrumah University of Science and Technology (KNUST) and "Sunday school" teachers. To ensure that children who were recruited had established a considerable period of interaction with their caregivers in the home environment, those with less than a year of stay with their caregivers were excluded from the study. Children were generally not considered for participation in this study if they had any chronic health conditions that affected their body weight. If more than one child represented a household, caregivers were asked to nominate only one child for participation. Eligible children and their caregivers were then scheduled and invited by the study team to obtain consent to partake in the study.

For the qualitative study, a sub-sample of caregivers from the quantitative study was purposively selected. Purposive sampling allows the researcher to select only participants who have in-depth knowledge and experience of the topic being explored and are also willing to share those experiences (Renjith et al., 2021). For this PhD, caregivers were selected based on their willingness to share their experiences on feeding practices for their pre-schoolers. Caregivers were informed of the qualitative study, and those that expressed interest were included in focus group discussions (FGDs). Focus group discussions were the most preferred method for the qualitative study compared to other methods, such as expert in-depth interviews, since it enabled group dynamics that led to insights into the sources of complex caregiver behaviours and motivations around feeding in the home environment (Dimitriadis, 2004). FGDs have been shown to be more beneficial than other qualitative methods in the early exploration of complex concepts, especially because group dynamics empower the process of discovering underlying issues (Powell & Single, 1996). They also serve as the most preferred approach for broad exploratory topics (Powell & Single, 1996). When a discussion is conducted in a group format,

the interaction between participants helps to enlighten and enrich the discussion, helps participants to generate and share ideas, and also helps to draw out latent issues (Powell & Single, 1996).

2.7. Data collection - Materials and measures

A summary of the measures that were used for the survey study are presented here. Details of each of these measures are discussed in the respective studies in which they were used. Validated questionnaires that were used to collect data in the primary study included the Household Dietary Diversity Questionnaire (HDDQ), the Comprehensive Feeding Practices Questionnaire (CFPQ), and the Child Eating Behaviour Questionnaire (CEBQ).

The Comprehensive Feeding Practices Questionnaire (CFPQ) was designed by Musher-Eizenman & Holub (2007) for use among pre-schoolers. The CFPQ comprises 49 items that measure caregiver feeding domains such as monitoring, regulation of child's emotions, using food as a reward, child control, modelling of eating, restricting eating for the purposes of weight control, restricting eating for general health purposes, teaching about nutrition, encouraging food variety, pressuring children to eat, the home environment, and the levels of parental involvement in child feeding. The CFPQ was chosen because its domains have been identified to fall within 3 currently accepted categories of food feeding practices, namely. structure, autonomy support, and coercive control (Vaughn et al., 2016).

The Child Eating Behaviour Questionnaire (CEBQ) was designed by Wardle et al., (2001) as a 35-item instrument with extensive proof of validity and reliability to study the eating behaviour of pre-schoolers (de Lauzon-Guillain et al., 2012). Feeding behaviour that is measured by this tool includes food responsiveness, emotional undereating, the enjoyment of food, emotional overeating, slow eating, food fussiness, satiety responsiveness, and the desire to drink.

The Household Dietary Diversity Questionnaire was developed by the Food and Agriculture Organisation (FAO) for the study of dietary diversity at the household level (FAO, 2010). It has been recommended for the study of the household availability of 12 standardised food groups, namely, cereals, roots and tubers, vegetables, fruits, meat and poultry, eggs, fish and seafood, legumes and nuts, milk and milk products, fats and oils, sugary foods/sweets, and beverages (Swindale & Bilinsky, 2006). This questionnaire was adopted because of its strengths in utilising the 24-hour dietary recall

technique, which facilitates obtaining more information of foods consumed in the home environment, as compared to other measures such as food frequency questionnaires, which are more objective and less subjective. Thus, the HDDQ permitted the recall of a wide variety of specific foods that were available and had been consumed by pre-schoolers in the home environment.

For the qualitative study, a discussion guide containing open-ended questions adapted from the Comprehensive Feeding Practices Questionnaire (CFPQ) (Musher-Eizenman & Holub, 2007) was administered to caregivers. Based on their responses to the CFPQ, participants were asked to provide more details about their feeding practices in the home environment. A further description of how this process was undertaken is presented in the qualitative report.

2.8. Data Analysis

Separate analyses were conducted for the quantitative (secondary data analysis (study 2, Chapter 4) and the survey (study 3, Chapter 5)) and the qualitative studies, using STATA (version 14) and Nvivo (version 14) respectively.

Data for the quantitative study was first obtained after duplicate entry and validation. Duplicate entries and further validation of these entries ensured that the integrity of participants' responses had been preserved.

In this thesis, overweight/obesity was treated as a categorical outcome variable in the quantitative studies 2 and 3 (chapters 4 and 5), with "normal weight" serving as the control category in analyses. Additionally, in study 3 (the survey), uncategorised individual BMI z-scores were assessed as continuous outcomes of the analyses. The reason for doing this was to ascertain whether the findings were comparable after conducting separate analyses. When the study outcome was BMI z-scores categorised as overweight/obesity, logistic regression was used to identify home environment determinants of excessive pre-schooler body weight. A special type of logistic regression, i.e., the firth logistic regression was used when there was complete distribution of the outcome (overweight/obesity vs normal weight) towards one level of a predictor variable. This method ensured a reduction in the bias provided for by the maximum likelihood ratios of conventional logistic regression models, especially when the sample size was not very large. When BMI z-scores were analysed as a continuous

outcome, ordinary least squares, or simple linear regression was used to find associations with predictor variables.

In this study, confirmatory factor analysis (CFA) of the CFPQ and CEBQ was also necessary because they have been shown to be sensitive to different ethnic and cultural settings (Mallan et al., 2013). When CFA failed to show conformity of the sample responses to the original factors upon which the questionnaires were first designed, exploratory factor analysis (EFA) was conducted to evaluate which factors were relevant to the Ghanaian setting. Details of this process are presented in Chapter 5.

For the qualitative study, thematic analysis was used to obtain insight into the feeding practices of caregivers in the home environment. This method was most preferred because of its ability to identify underlying patterns in the opinions of food feeding practices shared by participants in the FGDs. Thematic analysis followed the recommendations by Braun & Clarke, (2006). This involved the production of transcripts of the discussions, followed by familiarisation of the researcher to the contents of the transcript, generation of themes, and reviewing of themes. Thematic analysis was conducted using Nvivo (version 14). Details of the thematic analysis process used for the qualitative study are presented in Chapter 6.

Triangulation of the findings from both qualitative and quantitative studies are discussed in Chapter 7.

2.9. Ethical Considerations

Where ethical approval was required during the course of the PhD, approval was jointly sought from the ethics committees of the University of Sheffield, UK, and the Committee for Human Research, Publication, and Ethics (CHRPE) in Kumasi, Ghana ((CHRPE Reference: CHRPE/AP/270/22).

Before recruitment into the study, participants were taken through an informed consent process, and caregivers were asked to sign or provide a thumbprint to confirm their participation. Participation in the studies was completely voluntary, and participants were continuously reminded of their right to withdraw from the study at any time without any negative consequences. Caution was taken to maintain participant anonymity in the reporting of findings, and this was articulated to interested participants during the informed consent process.

Details of the ethical approval process and ethical approval documents are provided in appendix 2.

2.10. Reflexivity and Positionality

Up until this PhD began, I was predominantly a quantitatively oriented researcher. Previous academic work that I have submitted has all been based on quantitative approaches. In addition to this, other research work that I was involved in was based solely on quantitative designs. Although my philosophies about generating knowledge have been based very much on "the scientific method", I have come to appreciate the importance of qualitative studies in complementing quantitative studies. However, because I still have a bias towards objective measures of research, my approach to some aspects of the study, in particular, the qualitative aspects, may have been slightly influenced towards using already established theoretical/conceptual frameworks. For example, the use of the conceptual framework for food feeding practices as proposed by Vaughn et al., (2016) in the thematic analysis of the FGDs.

Previous work experience coordinating an international research collaboration from Ghana helped to boost my confidence in conducting this study from the UK. This was especially important during the period when international travel restrictions were enforced because of the covid-19 pandemic of 2019 and 2020. The usefulness of my previous work experience came to play when I had to coordinate both quantitative studies and qualitative focus group discussions from here in the UK.

As previously mentioned, an already established conceptual framework was used as a guide during the design of the qualitative FGDs. This means that there is the possibility that if there were any other themes other than those related to that conceptual framework, they would not be identified.

Although I was conducting this study from the UK, being a Ghanaian proved useful during the FGDs, as I was able to play the role of a bilingual moderator. Participants were extremely forthcoming in sharing their opinions and appeared to engage with other participants in a relaxed and calm manner. I am however cognisant of the fact that being a Ghanaian could influence the discussion positively or negatively, and hence the overall findings. The FGDs were a success, albeit non-exempt from some technical challenges with the audio and video recordings.

When the data had to be analysed, being a Ghanaian also proved very useful, because the technical challenges mentioned previously meant that the contextual meaning of a participant's response could

be lost, if the transcription and translation from the local language (Twi) to English was not conducted by another Ghanaian with insider knowledge.

Although translation of the FGDs and transcript preparation process was a lot easier, I am aware that my experience in the health sciences as a positivist researcher could affect my interpretation of participants' viewpoints. To mitigate any potential pitfalls in translation, other Ghanaians from the collaborative team were involved to proofread the transcripts.

It is my expectation that the findings of this work are close to the true representation of the home environment of Ghanaian caregivers and their toddlers, and how it associates with excess weight gain.

Chapter 3 - Risk Factors for Overweight and Obesity within the Home Environment of Preschool children in Sub-Saharan Africa: A Systematic Review

This is a published report of the systematic review of the home environment and overweight and obesity among toddlers in sub-Saharan Africa.

Authors: Albert L. Kwansa (ALK), Robert Akparibo (RA), Joanne E. Cecil (JC), Gisele Infield Solar (GIS) and Samantha J. Caton (SJC)

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Author Contributions**:** ALK, RA and SJC conceived the study and were involved in the design of the work. ALK conducted the literature search, and ALK, SJC, JC and RA screened the search output to identify relevant studies. ALK, JC and RA assessed study quality. ALK and SJC performed data extraction. Synthesis and analysis of the data was completed by ALK, GIS and SJC. ALK and SJC produced the first draft of the manuscript, with contribution from GIS, JC and RA. All authors read and approved the final manuscript.

Summary

This chapter presents the published findings of the systematic review of the home environment in relation to overweight and obesity in sub-Saharan Africa.

3.1. Abstract:

Sub-Saharan Africa (SSA) is experiencing an increasing prevalence of young children with overweight and obesity. Many feeding and physical activity-related behaviours are established at home during preschool years, yet the precise factors which contribute to preschool overweight and obesity have not been fully elucidated. This review aims to identify factors in the home environment associated with overweight and or obesity in preschool children in SSA. Ovid MEDLINE, EMBASE, CINAHL, Scopus, Web of Science, Africa Journals Online (AJOL) and the African Index Medicus databases were systematically searched for qualitative and quantitative studies published between 2000-2020. Eleven studies (ten quantitative, one qualitative) met the inclusion criteria. Overall, the results highlight the paucity of studies exploring factors in the home environment associated with overweight and obesity in preschool children in Sub-Saharan Africa. The home food environment and maternal BMI appear to be important factors associated with overweight and obesity in preschool children, however the information for all other factors explored remains unclear due to the lack of evidence. For successful obesity prevention

and treatment interventions to be developed, more research in this area is required to understand how different aspect of the home environment contribute to overweight and obesity in preschool Sub-Saharan African children.

3.2. Introduction

The dual burden of malnutrition, defined as the co-existence of overweight, obesity and undernutrition, is an ever-increasing problem in adults and paediatric groups in developing countries at the individual level through to the population level (Wells et al., 2020). Undernutrition is a persisting problem in low- and middle-income countries, and over the last decade many nutrition programs have focused on undernutrition. However, obesity is now a problem in low- and middle-income countries due to rapid urbanization and economic development (Drewnowski & Popkin, 1997). According to the World Health Organization, in Africa the number of preschool children under age five years with overweight has increased by around 24% since 2000 (WHO, 2020). Population level data demonstrates that the combined prevalence of overweight and obesity in Sub-Saharan African preschool children is approximately 6.8% (Gebremedhin, 2015), a public health crisis which is expected to worsen in the absence of successful population-wide interventions and government policies.

Children with excess bodyweight are more likely to have excess bodyweight in adulthood (Herman et al., 2009; Simmonds et al., 2016) and therefore increased likelihood of developing associated noncommunicable diseases (Y. C. Wang et al., 2011). Moreover, evidence suggests that children with overweight and obesity are more likely to report psychological ill health and stigmatising behaviours compared with individuals of normal weight (Latner et al., 2005; Lumeng et al., 2010).

The aetiology of obesity is complex involving an interaction between biological, social, environmental, and economic factors (Kopelman et al., 2007). The home environment, particularly in the early years, plays a key role in promoting or discouraging health-related behaviours in children and therefore provides a focal point for targeting interventions for overweight and obesity. Young children spend a large proportion of their time in the home where they consume the majority of their meals (Agricultural Research Service Community Nutrition Research Group, 2000; Nepper, 2015). Given that parents and caregivers are likely to share meals, engage in physical activity and screen-based sedentary activates together, children's behaviours are often associated with behaviours of parents and caregivers (Dong et al., 2016; Fogelholm et al., 1999; Olvera et al., 2011; Oude Groeniger et al., 2020; Y. Wang et al., 2011).

In a recent systematic review Kininmonth et al. (Kininmonth, Smith, et al., 2021) used a conceptual model of the "obesogenic" home environment originally proposed by Gattshall et al. (Gattshall et al., 2008) and modified by Schrempft et al. (S. Schrempft et al., 2015) to examine the relationship between the home environment and adiposity in children less than 12 years old. Their findings demonstrated

that the home media environment, notably greater access to electronic devices, was most consistently associated with excess adiposity in children, with less consistent findings for the home food and physical activity environments.

For the purpose of the current review, we have further expanded this conceptual model of the "obesogenic home environment" (S. Schrempft et al., 2015) to include other potential important socioeconomic and sociodemographic influences on energy balance (Figure 1). Socioeconomic and sociodemographic factors such as household income and wealth status, maternal education and maternal BMI are factors with the capacity to influence food intake, physical activity and sedentary behaviours (S. Schrempft et al., 2015; Youfa et al., 2012). In higher-income countries social gradients are observed for weight status and diet quality, with less affluent populations being more predisposed to developing overweight and obesity and consuming less nutrient-dense and more energy-dense diets compared with higher income populations (Craig et al., 2010; Darmon & Drewnowski, 2015; Nelson, 2000; Northstone & Emmett, 2010). Similar patterns for physical activity (L. Johnson et al., 2018) and sedentary screen time activity in children have also been observed (Oude Groeniger et al., 2020). Importantly, mothers are often the primary caretakers of children in SSA, and are responsible for the purchasing, preparation and allocation of food in the home environment (Berhane et al., 2018). Maternal characteristics such as maternal education (Pongou et al., 2006; Steyn et al., 2005) and household demographics such as household size have previously been associated with poor infant and young child feeding practices in Africa (Mamabolo et al., 2004), with the potential for these to extend throughout the preschool years. Further, cultural beliefs surrounding feeding practices and perceived child size are also implicated in infant and child feeding (Karmacharya et al., 2017). A recent systematic review and meta-analysis including studies from 79 international settings reported significantly increased odds of childhood overweight or obesity for mothers with overweight and obesity (Heslehurst et al., 2019).

It is currently unknown to what extent the home environment is associated with overweight and obesity in pre-schoolers in SSA thus hindering the development of successful interventions for the prevention and treatment of paediatric excess adiposity. Therefore, the aim of this systematic review is to explore which aspects of the modified obesogenic home environment model are associated with overweight and obesity in preschool children in SSA.

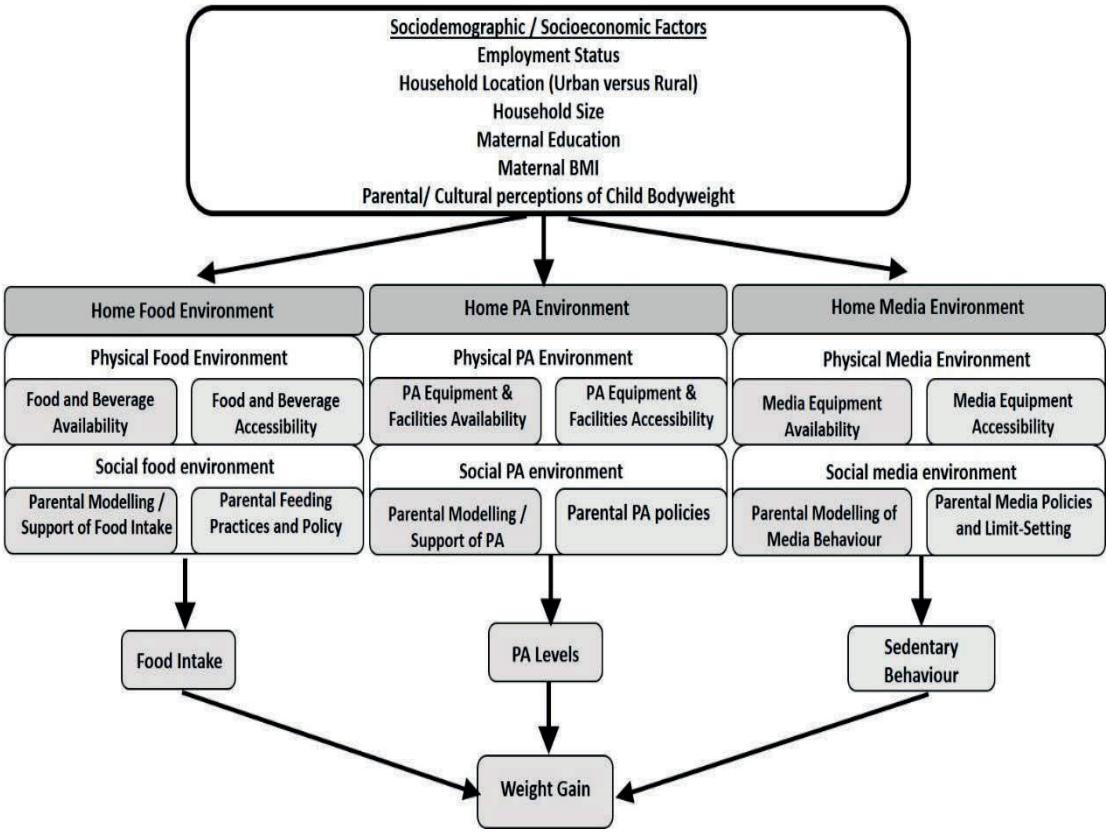

Figure 1. Adapted conceptual model of the obesogenic home environment (S. Schrempft et al., 2015). Added components: Sociodemographic and socioeconomic factors.

3.3. Materials and Methods

The review was conducted according to the Preferred Reporting Items for Systematic review and Meta-Analysis Protocols (PRISMA-P) 2020 guidelines (Page et al., 2021), and was registered with PROSPERO (CRD42020220314). A mixed methods approach was used to gather and summarise the evidence (qualitative and quantitative) for this review. This method was preferred for its usefulness and unique value in providing the completeness and contextual understanding of complex topics in public health studies (Cerigo & Quesnel-Vallée, 2020; Hong et al., 2020), such as those relating to the home environment of preschool children. An adapted and expanded version of the home environment model (S. Schrempft et al., 2015) was employed to guide reporting of the study outcomes.

3.3.1. Literature Search

An initial search strategy was developed to scope the extent of the available literature and to identify synonyms related to the population (pre-schoolers in SSA) and outcomes (overweight and obesity) of interest. Using that initial search strategy, a scoping search was conducted in Ovid MEDLINE (Appendix 1). The results of that scoping search were used to test and refine the search strategy for a comprehensive search of literature in seven electronic databases (Ovid MEDLINE, EMBASE, CINAHL,

Scopus, Web of Science, Africa Journals Online (AJOL) and the African Index Medicus). A complete list of search terms for all databases is provided with the supplementary information (Appendix 1) to this review. Search terms in the search strategy included those related to preschool, overweight, obesity, and Sub-Saharan Africa, and combined with Boolean operators for literature published in English between January 1, 2000, and December 31, 2021. It was decided *a priori* to restrict the search to studies published from 2000, to reflect the increase in prevalence of child obesity in Africa from that time (Akparibo et al., 2021; Muthuri et al., 2014; Onyango et al., 2019). Searches were conducted in March 2022. The reference lists of studies that were selected were also screened for other potentially relevant literature that may have been missed. The outputs of the comprehensive searches were transported into Mendeley (version 1.19.5) for deduplication.

3.3.2. Selection of Studies

Studies identified from the literature search were screened to ascertain their relevance after duplicates had been removed. Only published and accessible studies/papers were considered. Studies were first filtered for relevance by one reviewer (ALK), by title and then by abstract, in accordance with inclusion/exclusion criteria (Table 2). Studies focusing on preschool children aged two to six years old were selected for inclusion. At around the age of two years, children become more independent eaters, are more likely to display food neophobia (Dovey et al., 2008), become more food fussy (Caton et al., 2014) and begin to respond to external food cues in the environment (Borzekowski & Robinson, 2001; Reale et al., 2019), compared with younger children. Due to potential differences in eating behaviours, studies focusing on children younger than two years old were excluded from the current review. Studies were included if age specific data could be extracted. Key primary outcomes are factors in the modified obesogenic home environment model (Figure 1) that are associated with overweight/ obesity in preschool sub-Sharan African children. A sample of relevant abstracts (10%) was independently reviewed and verified by two authors (SJC, RA) to eliminate selection bias. Three authors (ALK, RA, JC) independently screened all potentially relevant full texts, and the final decision on article inclusion/exclusion were made by consensus. Any discrepancies were overseen by a fourth reviewer (SJC).

Table 2.Inclusion and exclusion criteria.

Component of Research Question	Inclusion criteria	Exclusion criteria
Population	Studies focused on preschool children aged 2-6 years of age, attending nursery or kindergarten schools, or their parents/caregivers Studies where age specific data could be extracted.	Studies conducted among infants and children aged below 2 years, and those above 6 years Studies that included children with diagnosed eating /feeding disorders or long-term illnesses Child age not reported
Exposure	Included any measurements of components of the home environment (e.g. socioeconomic status, food security, dietary diversity, parent feeding styles/practices)	Studies conducted in healthcare or school settings
Context	Conducted in a sub-Saharan African country	Studies conducted outside the sub-Saharan Africa region, for example those including African immigrants resident in Europe
Outcome	Reported on overweight and obesity among pre-schoolers	Nutritional status, overweight, or obesity was studied as a predictor of other outcomes such as infections, cognitive behaviour, or illness Nutritional status was measured based on the daily consumption of micronutrients Studies that measured and reported solely on other forms of nutritional status such as "underweight", "wasting", "stunting", or individual-level "stunting with obesity" Studies that measured overweight and obesity as an outcome among sub-Saharan pre-schoolers, but did not measure any associations with any component of the home environment, e.g., prevalence studies of obesity and overweight among sub-Saharan pre-schoolers
Study design	Cross-sectional or cohort studies	Case studies, case-series, case control studies, or trials Systematic or Narrative Reviews Grey literature Non-English language publications Conference abstracts/ paper with no full text

3.3.3. Assessment of Study Quality

The quality of studies was independently assessed and collectively verified by three authors (ALK, RA, JC), using the Joanna Briggs Institute (JBI) critical appraisal checklists for cross-sectional (Moola et al., 2017) and qualitative studies (Lockwood et al., 2015). The JBI checklist for cross-sectional studies assesses study quality based on 8 criteria, including bias, confounding, validity of measurement of exposures and the outcome, and the validity of methods of analyses. The checklist for qualitative studies assesses study quality based on 10 criteria, including the congruity of philosophical perspective, congruity of research methodology with different aspects of the data and research question, researcher influence on study outcome, and analyses approaches. For this review, each criterion was assigned a score of 1, with a maximum score of 8 indicating the highest quality of evidence for quantitative studies, 3-5 for medium quality, and 0-2 for low quality; for qualitative studies, a score of 8-10 represented a high-quality study, 5-7 for medium quality studies, and 0-4 for low quality studies.

3.3.4. Data Extraction

The main outcome of all included primary studies was overweight or obesity among SSA pre-schoolers. Data were extracted from the studies that met the review inclusion criteria. ALK used a data extraction form to extract key data, which was verified by a second reviewer (SJC). Relevant information extracted were the publication year, author(s), country of origin of the study, study design, population, setting, methods, and key findings.

3.3.5. Data Synthesis

Data were analysed by first grouping all home environment variables into themes, guided by the home environment framework (Figure 1). These themes represented the physical and social aspects of the home food environment, the home physical activity environment, and the home screen/media environment, as well as other relevant measures of the home environment that have been adopted for this review. After grouping these measures of exposure, the direction of the evidence relating to the home environment and obesity/overweight among SSA pre-schoolers was examined based on the results or main findings from the included primary studies.

3.4. Results

The search yielded a total of 2174 studies. 708 duplicates were removed (Figure 2). Title and abstract screening of the remaining 1466 studies further eliminated 1451 studies. Thus, 15 full-text papers were assessed for eligibility. Three studies were further excluded for not meeting the age requirements for the study population (Gebremedhin, 2015; Sserwanja et al., 2021; Tchoubi et al., 2015) and one for not having an appropriate study design (Mushonga et al., 2017). A total of 11 full-text studies, comprising 10 quantitative studies and 1 qualitative study, were included in this review (Tables 3 and 4).

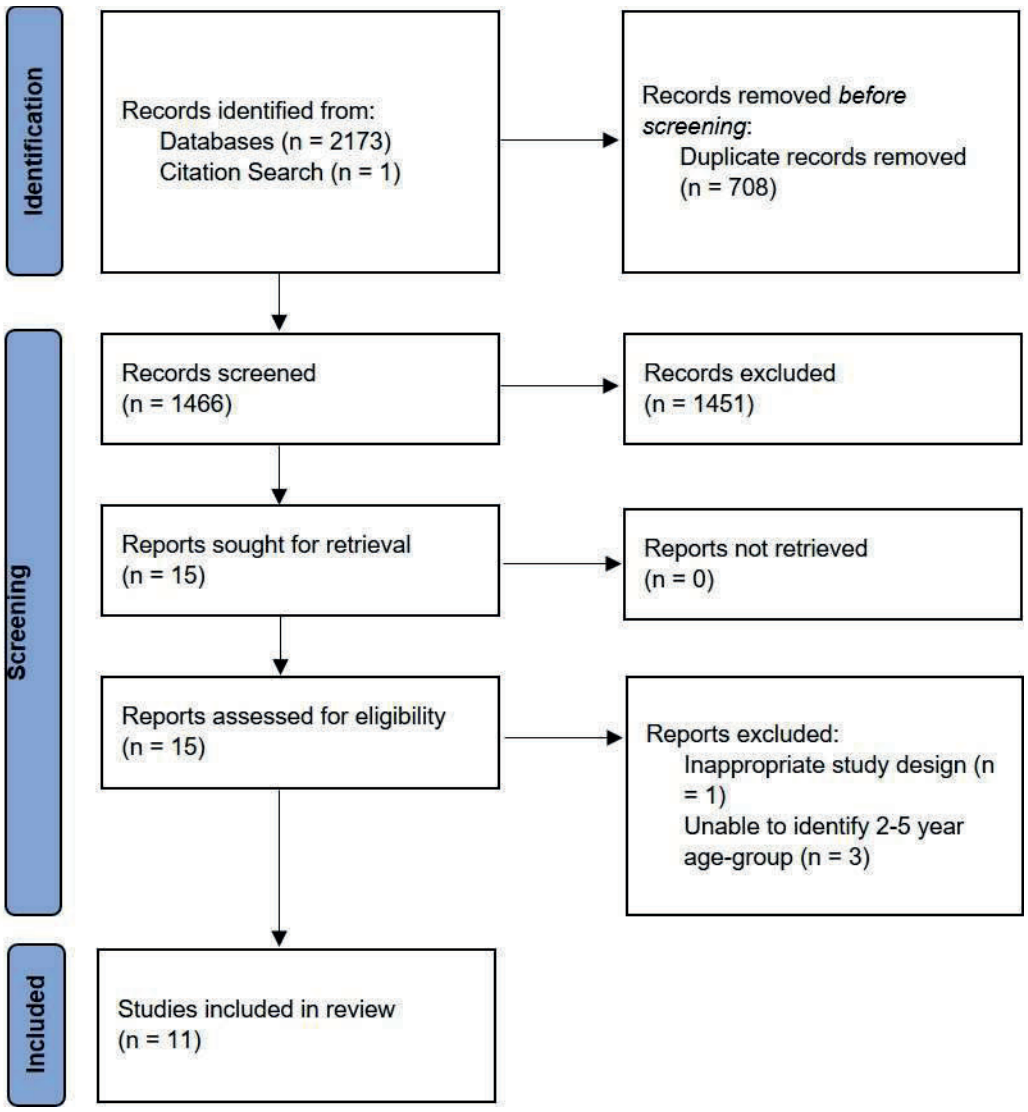

Figure 2. PRISMA Flow Diagram Showing the Process of Study Selection (Page et al., 2021).

3.4.1. Study characteristics

The included studies were published between 2005 and 2020. The eleven studies that were found were conducted in 6 sub-Saharan African countries (Ethiopia – 3 (Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a), Kenya – 2 (Gewa, 2010; Wandia et al., 2014), Nigeria – 2 (Okoye & Hart, 2015; Senbanjo & Adejuyigbe, 2007), South Africa – 2 (Klingberg et al., 2020; Mamabolo et al., 2005), Cameroon – 1 (Said-Mohamed et al., 2009a), and Ghana – 1 (Kumordzie et al., 2020)). The 11 studies included 10 cross-sectional quantitative studies (Gewa, 2010; Kumordzie et al., 2020; Mamabolo et al., 2005; Okoye & Hart, 2015; Said-Mohamed et al., 2009a; Senbanjo & Adejuyigbe, 2007; Sorrie et al., 2017a; Tadesse et al., 2017a; Wandia et al., 2014; Wolde & Belachew, 2015a), and 1 qualitative study (Klingberg et al., 2020). Overall, all studies contributed 4,857 participants, with the sample size of individual studies ranging from 16 to 1,495. The qualitative study included parents of pre-schoolers

aged 3-5 years (Klingberg et al., 2020). Six of the 11 studies included in the review measured child dietary intake within the home environment (Kumordzie et al., 2020; Okoye & Hart, 2015; Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a). Three of the 11 studies included in this review explored the home physical activity environment (Kumordzie et al., 2020; Sorrie et al., 2017a; Wolde & Belachew, 2015a) and three studies explored the home media environment (Okoye & Hart, 2015; Sorrie et al., 2017a; Wandia et al., 2014). With regards to socio-economic and sociodemographic variables, three studies (Gewa, 2010; Kumordzie et al., 2020; Said-Mohamed et al., 2009a) examined the relationship between the BMI of mothers and overweight and obesity. Six studies reported on compositely measured household wealth index or SES scores based solely on the possession of pre-specified household assets (Gewa, 2010; Kumordzie et al., 2020; Said-Mohamed et al., 2009a; Senbanjo & Adejuyigbe, 2007; Sorrie et al., 2017a; Wolde & Belachew, 2015a) while two studies reported on ownership of specific assets such as TV or computer (Wandia et al., 2014) or a car (Tadesse et al., 2017a). Eight studies investigated maternal education (Gewa, 2010; Kumordzie et al., 2020; Mamabolo et al., 2005; Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Tadesse et al., 2017a; Wandia et al., 2014; Wolde & Belachew, 2015a). Six studies explored the employment status of mothers/ caregivers (Mamabolo et al., 2005; Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Tadesse et al., 2017a; Wandia et al., 2014; Wolde & Belachew, 2015a). Six studies explored the relationship between household size (Gewa, 2010; Mamabolo et al., 2005; Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a) and one study explored the relationship between location (rural/ urban) and overweight and obesity (Gewa, 2010). The impact of parental perception of their child's bodyweight on overweight or obesity was explored in two studies (Klingberg et al., 2020; Said-Mohamed et al., 2009a). In all studies overweight and obesity were defined using the World Health Organization growth standards (*Child Growth Standards*, n.d.) (Overweight: BMI ≥85 to ≤ 95 centile, and obesity: BMI ≥ 95th centile) Study characteristics and summary of findings are presented in Tables 3 and 4.

Table 3. Characteristics and study quality of studies included in the review.

Study Author(s)	Year	Country	Study Design	Sample	Sample Age	Total Sample Size	Study quality
Gewa (Gewa, 2010)	2009	Kenya	CS[1]	Children	3-5 years	1495	High
Okoye et al. (Okoye & Hart, 2015)	2015	Nigeria	CS[1]	Children	2-5 years	220	High
Sorrie et al. (Sorrie et al., 2017a)	2017	Ethiopia	CS[1]	Children	3-5 years	500	High
Wolde et al. (Wolde & Belachew, 2015a)	2014	Ethiopia	CS[1]	Children	3-5 years	358	High
Tadesse et al. (Tadesse et al., 2017a)	2017	Ethiopia	CS[1]	Children	3-6 years	462	High
Senbanjo et al. (Senbanjo & Adejuyigbe, 2007)	2007	Nigeria	CS[1]	Children	0-5 years*	270	High
Said-Mohamed et al. (Said-Mohamed et al., 2009a)	2009	Cameroon	CS[1]	Children	2-5 years	165	Medium
Kumordzie et al. (Kumordzie et al., 2020)	2019	Ghana	CS[1]	Children	4-6 years	889	High
Mamabolo et al. (Mamabolo et al., 2005)	2005	South Africa	CS[1]	Children	3 years	162	Medium
Klingberg et al. (Klingberg et al., 2020)	2020	South Africa	Qualitative study	Parents of pre-schoolers (3-5 years)	3-5 years	16	High
Wandia et al. (Wandia et al., 2014)	2014	Kenya	CS[1]	Children	3-6 years	320	Low

[1]CS – Cross-sectional Study. *data for children with overweight/ obesity was available for children aged 2-5 years old.

3.4.2. Quality appraisal

No study was excluded based on the quality of evidence. However, studies with low quality were interpreted with caution. Eight studies were of high quality (Gewa, 2010; Klingberg et al., 2020; Kumordzie et al., 2020; Okoye & Hart, 2015; Senbanjo & Adejuyigbe, 2007; Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a), two were of medium quality (Mamabolo et al., 2005; Said-Mohamed et al., 2009a), and one was of low quality (Wandia et al., 2014) (Table 3). In six of the eleven studies (Gewa, 2010; Mamabolo et al., 2005; Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Wandia et al., 2014; Wolde & Belachew, 2015a), the most frequent issues that compromised on study quality were related to the non-disclosure or inadequate consideration of confounding. In the studies by

Wandia et al. (2014), Okoye et al. (2015), and Senbanjo et al. (2007) (Okoye & Hart, 2015; Senbanjo & Adejuyigbe, 2007; Wandia et al., 2014), the exposure of interest was not measured using standard tools that have been validated for use in this age group across different geographical locations. Table 3 provides a summary of the quality of all studies that were included in this review.

Table 4. Summary of findings of studies included in the review

Study Author(s)	Home Environment Variables Studied (Exposure)	Exposure measures / tools of measurement	Summary of studies
Gewa et al. (Gewa, 2010)	Maternal BMI	BMI (kg/m^2)	Increase in maternal BMI is significantly associated with an increase in obesity/overweight among pre-schoolers (maternal overweight: OR = 1.83, 95% CI: 1.2, 2.81), maternal obesity: OR = 2.12, 95% CI (1.11, 4.07)).
	Maternal Education	Researcher-defined categories of Education level (No school/preschool, primary school, secondary school, post-secondary)	Increasing maternal education is significantly associated with an increase in obesity/overweight among pre-schoolers; maternal attainment of primary school (OR = 1.79 95% CI: 1.09, 2.93) and secondary school (OR 1.91 95%CI: 1.05, 3.45). No significant effect of post-secondary levels of education (p> 0.05).
	Socioeconomic status: Household wealth index	Researcher-generated socio-economic index scores based on Principal Component Analysis	No difference in household wealth index between children with obesity/overweight and non-obese/non-overweight children (p>0.05)
	Household size	Survey data	Increasing household size is inversely associated with obesity/overweight among pre-schoolers. 7% reduction in odds of overweight/ obesity with each addition person (p<0.05, exact data not shown)
	Household location	Survey data: rural versus urban living	A higher percentage of preschool children with overweight or obesity lived in urban areas compared to rural areas (21.83% (SE 2.83) versus 14.85% (SE1.15), p<0.01)
Okoye et al. (Okoye & Hart, 2015)	Daily consumption of sugar-sweetened beverages	Researcher-defined categories (>1 bottle in 2 days, ≤1 bottle in 2 days)	Increased consumption of sugar-sweetened beverages is significantly associated with an increase in obesity/overweight among pre-schoolers (crude OR = 18.98, 95% CI: 7.6, 47.40). Out of those children consuming > 1 bottle in 2 days, 88.46% had overweight/ obesity (Chi^2 =55.34, p <0.001).
	Daily total screen time	Researcher-defined categories (>1 hour of TV, ≤1 hour of TV)	No association between daily screen time (more than an hour or less) and obesity/overweight among pre-schoolers. (p>0.05)
	Food type	Researcher-defined categories (fruits/vegetables; grains, cereals, fried/fatty foods)	Increased consumption of fried/fatty foods is significantly associated with an increase in obesity/overweight among pre-schoolers (Crude OR = 2.16, 95% CI: 1.01, 4.61). Out of those children consuming more fatty foods 28% had overweight/ obesity compared to 15.28% who were of normal weight (Chi^2 = 3.97, p<0.05).
Sorrie et al. (Sorrie et al., 2017a)	Maternal education	Researcher-generated, Structured interviewer-administered questionnaire	Children of highly educated mothers were less likely to be overweight or obese. Children of mothers with secondary education were 65% less likely to be overweight and obese compared with children from mothers with no formal education (AOR = 0.35, 95% CI: 0.12, 0.96)).
	Food consumption pattern	Food Frequency Questionnaire (FFQ)/past week	Increased consumption of sweet foods is significantly associated with overweight and obesity in pre-schoolers. Pre-schoolers who consumed sweet foods were 2.69 times more likely to be overweight/obese compared with children who did not consume sweet foods (AOR = 2.69, 95% CI: 1.21, 5.98).

	Dietary diversity	Dietary Diversity Score (DDS) (low, medium, high)/past 24 hours	High dietary diversity is significantly associated with overweight/ obesity among pre-schoolers. Preschool children with high dietary diversity scores were 3.73 times more likely to be overweight or obese, compared with those with low dietary diversity scores (AOR = 3.73, 95%CI:1.15, 12.54)).
	Physical activity	WHO Global Physical Activity Questionnaire (GPAQ)/past week/month	Physical activity components of the GPAQ measured but results not reported as predictor of overweight/ obesity in preschool children
	Daily total screen time	WHO Global Physical Activity Questionnaire (GPAQ)/past week/month	Watching TV >2hrs/day is significantly associated with an increase in overweight/ obesity among pre-schoolers (AOR = 4.01, 95%CI: 2.22, 7.28).
	Socioeconomic status	Questionnaire; Possession or ownership of specified household assets	SES was not significantly associated with overweight or obesity among pre-schoolers (p>0.05)
	Parental/ caregiver employment	Questionnaire: Housewife, private, merchant, government employee, other	Variable measured but no association reported in results
	Household size	Questionnaire	Variable measured but no association reported in results
Wolde et al. (Wolde & Belachew, 2015a)	Socioeconomic status	Researcher-generated, Structured interviewer-administered questionnaire; based on the possession of household assets	Preschool children with wealthier parents are approximately 3.5 times more likely to be overweight/obese than those with parents with low SES (AOR = 3.51, 95% CI: 1.30, 9.50).
	Food frequency consumption	Food Frequency Questionnaire (FFQ)/past month	Consumption of ice-cream (AOR = 3.84, 95% CI: 1.62, 7.09), sweet foods (AOR = 6.36, 95% CI: 1.88, 12.33) and fast foods (AOR = 8.69, 95% CI: 1.11, 13.50) is significantly associated with obesity/overweight compared with children who do not consume these foods.
	Dietary diversity	Dietary Diversity Score (DDS) (low, medium, high)/past 24 hours	High dietary diversity is significantly associated with an increase in obesity/overweight among pre-schoolers (AOR = 3.48, 95% CI: 1.50, 8.10).
	Physical Activity Level	WHO Global Physical Activity Questionnaire (GPAQ)/past week/month	No significant association between total physical activity measures and obesity/overweight among pre-schoolers (p>0.05)
	Maternal education	Researcher-generated, Structured interviewer-administered questionnaire	Variable measured but no association reported in results
	Maternal employment	Researcher-generated, Structured interviewer-administered questionnaire	Variable measured but no association reported in results
	Household size	Researcher-generated, Structured interviewer-administered questionnaire	Variable measured but no association reported in results
Tadesse et al. (Tadesse et al., 2017a)	Socioeconomic status: ownership of family car	Researcher-generated, Structured interviewer-administered questionnaire	Ownership of a family car is significantly associated with an increase in obesity/overweight among pre-schoolers (AOR = 3.43, 95% CI: 1.02, 11.49)
	Dietary diversity	Dietary Diversity Score (DDS) (poor, medium, high)	High dietary diversity is significantly associated with an increase in obesity/overweight among pre-schoolers (AOR = 5.12, 95% CI: 1.42, 18.47).

	Household size	Researcher-generated, Structured interviewer-administered questionnaire	Family size of less than five is associated with overweight and obesity in preschool children (AOR = 4.76, 95% CI: 1.84, 12.31).
	Maternal education	Researcher-generated, Structured interviewer-administered questionnaire	Variable measured but no association reported in results
	Maternal employment	Researcher-generated, Structured interviewer-administered questionnaire	Variable measured but no association reported in results
Senbanjo et al. (Senbanjo & Adejuyigbe, 2007)	Socioeconomic status	Researcher-generated, Structured interviewer-administered questionnaire	No significant association between socioeconomic status and obesity/overweight among 2-5 year old children (p>0.05)
Said-Mohamed et al. (Said-Mohamed et al., 2009a)	Socioeconomic status: Household economic index	Researcher-defined categories from PCA (low, middle, and high)	No significant association between household economic index and overweight among pre-schoolers (p>0.05)
	Food frequency consumption	Adapted Food Frequency Questionnaire (FFQ)/past month	No significant association between food frequency and overweight among pre-schoolers (p>0.05)
	Perception of child's height and weight	Researcher-defined categories; Weight grades (very thin, thin, average, fat, plump) and height grades (very short, short, average, tall, very tall)	Under-evaluation of child body weight by mothers is significantly associated with overweight among pre-schoolers (OR = 6.52, 95% CI: 2.34, 18.09). 79.5% of mothers of pre-schoolers with overweight underestimated their child's weight
	Dietary diversity	Dietary Diversity Score (DDS)/past 24 hours	No difference in dietary diversity between overweight and non-overweight children (p>0.05)
	Maternal education	Interviewer-administered Questionnaire	Maternal education is not associated with overweight in preschool children (p>0.05)
	Maternal employment	Interviewer-administered Questionnaire	No association of maternal employment status with childhood overweight (p>0.05)
	Household size	Interviewer-administered Questionnaire	No significant differences in number of household members between overweight and normal weight pre-schoolers (p>0.05)
	Maternal BMI	BMI (kg/m2)	No significant differences in maternal BMI between overweight and normal weight children (p>0.05)
Kumordzie et al. (Kumordzie et al., 2020)	Dietary pattern	Food Frequency Questionnaire (FFQ)/past week	No significant association between snacking or cooked food dietary patterns and obesity/overweight among pre-schoolers (p>0.05)

	Physical Activity	ActiGraph wGT3X-BT triaxial Accelerometery/1-week period	No significant association between physical activity and obesity/overweight among pre-schoolers when the model adjusted for sex, since male children had higher levels of physical activity and lower percentage body fat. (p>0.05)
	Maternal BMI	BMI (kg/m2)	An increase in maternal BMI is significantly associated with an increase in child fatness among pre-schoolers (standardized β = 0·10 (95 % CI) (0·04, 0·16)
	Maternal Socioeconomic status	Open Data Kit (ODK) software-administered questionnaire	No significant direct association between maternal education or maternal household asset score and obesity/overweight among pre-schoolers (p>0.05)
	Maternal education	Years spent in education	No significant direct association between maternal education and obesity/overweight among pre-schoolers (p>0.05)
Mamabolo et al. (Mamabolo et al., 2005)	Maternal occupational status	Researcher-developed, interviewer-administered structured questionnaire	Having a working mother was significantly associated with overweight among pre-schoolers (OR 17.87, 95% CI: 8.24, 38.78).
	Housing structure	Researcher-developed, interviewer-administered structured questionnaire	The type of house of residence (traditional mud, brick, or shack) was not significantly associated with overweight among pre-schoolers (p>0.05)
	Household size	Researcher-developed, interviewer-administered structured questionnaire	No significant association between household size and overweight in preschool children (p>0.05)
	Maternal education	Researcher-developed, interviewer-administered structured questionnaire	Maternal education was not significantly associated with overweight among pre-schoolers (p>0.05)
Klingberg et al. (Klingberg et al., 2020)	Parental Perceptions of Childhood Obesity	Semi-structured in-depth interviews	Parents of pre-schoolers had varied perceptions of child body size and weight which were unrelated to health, e.g. comparisons and differences in appearances to peers, or weight stigma. Three themes represented the perceptions of parents about their child's weight, and these included "Growing Differently", "The Right Way to Be", "Weight is not Health"
Wandia et al. (Wandia et al., 2014)	Socioeconomic status: Household possession of TV	Researcher-developed, interviewer-administered structured questionnaire	Possession of a TV in the household is associated with obesity in preschool children (Chi^2=7.15, p=0.006)
	Household ownership of a computer	Researcher-developed, interviewer-administered structured questionnaire	Possession of a computer in the household is associated with overweight (Chi^2=3.95, p= 0.047) and obesity in preschool children (Chi^2=7.12, p=0.008)
	Mother's education level	Primary, secondary, college or no education categories	Maternal education is significantly associated with obesity in preschool children (Chi^2=20.4, p=0.005). This factor was not entered into the logistical regression model by the authors
	Parental occupation status	Researcher-developed, interviewer-administered structured questionnaire	Obesity among pre-schoolers is associated with paternal occupation (Chi^2=14.68, p=0.002)

3.4.3. Measures of the Home Environment and Overweight/Obesity among SSA Pre-schoolers

3.4.3.1. Home Food Environment

Of the 11 included studies, 6 studies (Kumordzie et al., 2020; Okoye & Hart, 2015; Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a) with a total sample size of 2,593 pre-schoolers, measured child dietary intake within the home environment. Of these six studies, four (Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a) measured food intake using standard or adapted Food Frequency Questionnaires (FFQs) and dietary diversity scores (DDSs). The remaining two studies reported on child food consumption using unvalidated or novel methods of measurement, such as the evaluation of different dietary patterns by factor analysis (Kumordzie et al., 2020) or researcher-defined classification of food types (Okoye & Hart, 2015). Four of the six studies that measured child food intake (comprising 1,540 of the 2,593 pre-schoolers) reported that the consumption of sugar-sweetened foods and beverages, and increased dietary diversity is related to an increase in overweight and obesity among SSA pre-schoolers (Okoye & Hart, 2015; Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a). Two of the six cross-sectional studies (Kumordzie et al., 2020; Said-Mohamed et al., 2009a) made up of 1,053 pre-schoolers, found no associations between dietary intake measured by food frequency, dietary diversity, or dietary patterns and child BMI: (Table 4).

3.4.3.2. Home Physical Activity Environment

Physical activity in the home environment was measured in three of the 11 studies included in this review (Kumordzie et al., 2020; Sorrie et al., 2017a; Wolde & Belachew, 2015a). Comprising 1,747 pre-schoolers, physical activity was subjectively measured using the GPAQ in two studies (Sorrie et al., 2017a; Wolde & Belachew, 2015a), and objectively by accelerometery in one study (Kumordzie et al., 2020). No association was established between child physical activity or physical inactivity and obesity or overweight among SSA pre-schoolers (Kumordzie et al., 2020; Wolde & Belachew, 2015a). Sorrie et al. (Sorrie et al., 2017a) reported descriptive statistics for the GPAQ, however these data were not used to explore association with overweight/ obesity: (Table 4).

3.4.3.3. Home Media/Screen Time Environment

The home media environment was explored in three studies (Okoye & Hart, 2015; Sorrie et al., 2017a; Wandia et al., 2014). Daily screen time access was evaluated in two studies, with a combined sample size of 720 pre-schoolers (Okoye & Hart, 2015; Sorrie et al., 2017a). Screen time was measured in the studies as >1hr/day (Okoye & Hart, 2015) or >2hrs/day (Sorrie et al., 2017a). In their study, Sorrie et al. (Sorrie et

al., 2017a) found that 3-5 year-old urban pre-schoolers in Ethiopia who spent more than 2 hours a day watching television or playing games were 4 times more likely to be overweight or obese, compared to those who spent less than 2 hours. Conversely, Okoye et al. (Okoye & Hart, 2015) reported that a minimum screen time of one hour per day was not associated with overweight/obesity among 2-5 year-old Nigerian pre-schoolers. An exposure of >2hrs/day rather than an exposure of >1hr/day was shown to be associated with overweight and obesity among SSA pre-schoolers. Wandia (Wandia et al., 2014) assessed the availability but not the duration of use of computers/ TV in the home and reported an association between the ownership of a computer/ TV with obesity among pre-schoolers: (Table 4).

3.4.3.4. Household Sociodemographic and Socioeconomic Factors

3.4.3.4.1. Household Income and Wealth Status

There was no unifying and standard definition of household SES across all the selected studies. Of the 11 selected studies, 6 reported on compositely measured household wealth index or SES scores based solely on the possession of pre-specified household assets (Gewa, 2010; Kumordzie et al., 2020; Said-Mohamed et al., 2009a; Senbanjo & Adejuyigbe, 2007; Sorrie et al., 2017a; Wolde & Belachew, 2015a). Compositely measured household wealth indices/asset scores were grouped as either tertiles (Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Wolde & Belachew, 2015a) (e.g. low, middle/medium, and high) or quintiles (Gewa, 2010; Senbanjo & Adejuyigbe, 2007) (e.g. 1st, 2nd, 3rd, 4th, and 5th). One study (Kumordzie et al., 2020) measured household SES using asset scores without assigning them to any SES categories. With the exception of one study, Wolde et al. (Wolde & Belachew, 2015a) who reported that children who were categorized in the high socioeconomic status tertiles were 3.5 times more likely to be overweight or obese compared to low socioeconomic status tertiles., there was no association between compositely measured SES (based on the possession of household assets) and overweight and obesity among SSA pre-schoolers in all other studies.

Although household assets were commonly evaluated as a composite measure in most studies, two studies reported a positive and significant association between the ownership of particular household assets, i.e. a family car (Tadesse et al., 2017a) or a TV/computer (Wandia et al., 2014) and excessive weight gain among SSA pre-schoolers: (Table 4).

3.4.3.4.2. Maternal Body Mass Index

Three studies (Gewa, 2010; Kumordzie et al., 2020; Said-Mohamed et al., 2009a) examined the relationship between the BMI of mothers and overweight and obesity among a total of 2,549 SSA pre-schoolers. All studies measured the BMI of mothers using the standard methodology of a height-corrected weight score

(kg/m^2). One study that measured body fatness of children using the deuterium method (Kumordzie et al., 2020), while the remaining two studies (Gewa, 2010; Said-Mohamed et al., 2009a) measured overweight and obesity among pre-schoolers using standard BMI-for-age scores. Two studies (Gewa, 2010; Kumordzie et al., 2020) reported an association between maternal BMI and overweight and obesity among SSA pre-schoolers. Gewa et al. (Gewa, 2010) report that maternal overweight and obesity is associated with increased odds of child overweight. Similarly, Kumordzie et al. study (Kumordzie et al., 2020) reported a significant association between maternal BMI and child percentage body fat. However, Said-Mohammed et al. (Said-Mohamed et al., 2009a) reported no significant difference in maternal BMI between children of normal weight and those with overweight: (Table 4).

3.4.3.4.3. Maternal education

Eight studies investigated the association of the level of education of mothers/caregivers with overweight or obesity among SSA pre-schoolers (Gewa, 2010; Kumordzie et al., 2020; Mamabolo et al., 2005; Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Tadesse et al., 2017a; Wandia et al., 2014; Wolde & Belachew, 2015a). Five studies (Kumordzie et al., 2020; Mamabolo et al., 2005; Said-Mohamed et al., 2009a; Tadesse et al., 2017a; Wolde & Belachew, 2015a) found no association or did not report any association between the level of formal education of mothers/caregivers and overweight and obesity among SSA pre-schoolers. For example, Mamabolo et al. (Mamabolo et al., 2005) reported that a maternal education of either primary, secondary, or higher (post-secondary education) was not associated with weight gain among 162 3-year-old rural South African pre-schoolers. In the Wolde et al. (Wolde & Belachew, 2015a) and Tadesse et al. (Tadesse et al., 2017a) studies it was unclear whether maternal education was considered in the analysis since maternal education was measured but not discussed in the results. Although the majority of studies reported no association between maternal education and child overweight or obesity, three studies (Gewa, 2010; Sorrie et al., 2017a; Wandia et al., 2014) did report an association although the results are conflicted. Wandia et al. (Wandia et al., 2014) reported that maternal education is significant factor associated with child obesity but not overweight. However, despite this being identified as a significant predictor this was not entered into the final logistic regression. This paper was deemed low quality and the results should be interpreted with caution. The study by Sorrie et al. (Sorrie et al., 2017a) demonstrated that the odds of having a child who was overweight or obese was reduced by 65% if mothers had attained secondary education. On the other hand, Gewa (Gewa, 2010) showed that compared to mothers with no education, attaining primary or secondary education was positively associated with a 72% to 91% increase in the odds of having an overweight child: (Table 4).

3.4.3.4.4. Occupational/ Employment status

Six studies of the 11 included studies in this review explored the occupation or employment status of mothers/ caregivers (Mamabolo et al., 2005; Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Tadesse et al., 2017a; Wandia et al., 2014; Wolde & Belachew, 2015a). Two of the six studies reported that preschool children of working parents (Mamabolo et al., 2005; Wandia et al., 2014) were more likely to be overweight or obese compared with children of non-working caregivers. In their study of 162 South African three-year-old children, Mamabolo et al. (Mamabolo et al., 2005) reported that having a working mother increased the risk of overweight by 17.87 times. Similarly, Wandia et al. (Wandia et al., 2014) reported an association between paternal occupational status and obesity in preschool children, however paternal occupation was not a significant predictor of obesity when entered in to the logistic regression. This study was deemed low quality and the results should be interpreted with caution. No relationship was reported for all other studies (Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a) : (Table 4).

3.4.3.4.5. Household size

Six studies measured household size (Gewa, 2010; Mamabolo et al., 2005; Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a). Two of these studies measured this variable but did not report its association with overweight and/ or obesity to preschool children (Sorrie et al., 2017a; Wolde & Belachew, 2015a). Two out of six studies (Gewa, 2010; Tadesse et al., 2017a) demonstrated that larger household family sizes reduced the risk of overweight and obesity in preschool children. Tadesse et al. (Tadesse et al., 2017a) in their study of Ethiopian preschool children, reported that children living in a household of less than five were more likely to have overweight or obesity compared to those living in a family containing five or more members. Similarly, Gewa (Gewa, 2010) reported that Kenyan pre-schoolers living in large household sizes had lower odds of overweight and obesity. A 7% reduction in odds of being overweight or obese was reported for each additional household member. Mamabolo et al. (Mamabolo et al., 2005) and Said-Mohammed et al. (Said-Mohamed et al., 2009a) reported no significant differences in number of household members between overweight and normal weight pre-schoolers: (Table 4).

3.4.3.4.6. Location: urban versus rural living

One study explored the relationship between location (rural/ urban) and overweight and obesity (Gewa, 2010). Gewa (Gewa, 2010) reported that a significantly higher percentage of Kenyan preschool children with overweight and obesity lived in urban areas, whilst a higher percentage of children who were not overweight or obese lived in rural areas: (Table 4).

3.4.3.5. Parental Perception of Child Body Weight

Parental perception of child bodyweight was identified as a relevant social aspect of the home environment in two studies (Klingberg et al., 2020; Said-Mohamed et al., 2009a). Evidence for this aspect of the home environment was demonstrated in one qualitative study of the perceptions and attitudes of parents of SSA pre-schoolers to overweight and obesity (Klingberg et al., 2020). In this study, caregivers often had varied perceptions of the body size and weight of their children, which were unrelated to health. Examples of these perceptions included comparisons and differences in appearances to their peers, or the potential cultural stigma attached to weight gain only when it was considered as excessive. Similarly in the quantitative study by Said-Mohamed et al. (Said-Mohamed et al., 2009a) reported that mothers who underestimated their child's weight were more likely to have a child with overweight or obesity.

3.5. Discussion

The aim of the current review was to explore which aspects of the modified obesogenic home environment model are associated with overweight and obesity in preschool children in Sub-Saharan preschool children. Eleven studies from 6 sub-Saharan countries were identified, including ten quantitative papers and one qualitative paper. Overall, the results demonstrate that the home food environment, through the types of foods offered to pre-schoolers, and sociodemographic factors, through maternal BMI, are key aspects contributing to overweight and obesity among SSA pre-schoolers. The media home environment, physical activity, and household socioeconomic status, (income, education, and employment) were not identified as factors associated with preschool overweight and obesity in the current review.

3.5.1. Home Food Environment

The evidence from this review suggests that dietary intake plays an important role in the development and maintenance of overweight and obesity in preschool children. In the current review, four out of six studies reported an association between dietary intake and overweight and obesity among SSA pre-schoolers (Okoye & Hart, 2015; Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a). Specifically, these studies found that an increased intake of fried/fatty foods (Okoye & Hart, 2015), fast foods (Wolde & Belachew, 2015a), sweet foods (Sorrie et al., 2017a; Wolde & Belachew, 2015a) and sugar-sweetened drinks/beverages (Okoye & Hart, 2015) were associated with overweight and obesity among the population of 2-6 year-old pre-schoolers. These findings are consistent with those reported in other studies (C. L. Brown et al., 2015; Poorolajal et al., 2020; Porter et al., 2018) that have shown that the consumption of energy-dense and nutrient-poor foods is associated with weight gain in children. In our review, Mezie-Okoye et al. (Okoye & Hart, 2015) reported an association between the consumption of sugar-sweetened

beverages and an increased likelihood of overweight or obesity in 2-5 year old Nigerian urban pre-schoolers. Sorrie et al. (Sorrie et al., 2017a) also found that those who were frequently offered sweet, high-energy dense foods at home were 2-3 times more likely to be overweight/obese compared to those who were not offered these foods. Wolde et al. (Wolde & Belachew, 2015a) also demonstrated that 3-5 year-old urban Ethiopian children who were offered ice cream and sweet foods at home were 4 to 7 times more likely to develop overweight and obesity respectively, compared to those who did not. Those who were frequently offered fast foods were also 8-9 times more likely to develop overweight and obesity compared to those who were not.

Contrary to evidence of an inverse relationship between dietary diversity and excessive weight gain in many "western" or developed countries (Salehi-Abargouei et al., 2016), our review showed that increased dietary diversity was associated with overweight and obesity in children (Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a). Specifically, Sorrie et al. (Sorrie et al., 2017a) demonstrated that the likelihood of developing overweight and obesity was 3-4 times higher for 3-5 year-old urban Ethiopian pre-schoolers with a high dietary diversity score than those with a low dietary diversity score. Wolde et al. (Wolde & Belachew, 2015a) also showed that children with a high dietary diversity score were 3-4 times more likely to be overweight or obese. This finding was also confirmed in the Tadesse et al. (Tadesse et al., 2017a) study which also demonstrated that 3-6 year-old Ethiopian pre-schoolers with a high dietary diversity were 5 times more likely to be overweight or obese. This unexpected finding may reflect an overconsumption of certain food groups over other food groups, such as the consumption of more processed high-energy dense, nutrient-poor foods over fruits and vegetables. There are also suggestions that even though dietary diversity scores may be high among some child populations, the overconsumption of certain foods over others may reflect cultural or seasonal dietary patterns (Ruel, 2003a). This finding may also be the result of the consumption of large portion sizes of different food groups, a feature which the dietary diversity score assessment from these studies may not have captured, as suggested by Sorrie et al. (2017) (Sorrie et al., 2017a).

Despite the majority of studies demonstrating an association between food consumption and overweight and obesity, two studies did not show this association (Kumordzie et al., 2020; Said-Mohamed et al., 2009a). In their study, Kumordzie et al. (Kumordzie et al., 2020) reported that a snacking dietary pattern or one consisting mainly of home cooked foods was not important in contributing to overweight/ obesity among Ghanaian pre-schoolers aged 4-6 years. Said-Mohamed et al. (Said-Mohamed et al., 2009a) also found that dietary diversity scores for overweight and non-overweight 2-4 year-old Cameroonian pre-schoolers were similar. One possible reason for this inconsistency could be the cross-sectional nature of the studies

identified. Obesity develops over time (Swinburn et al., 2009), and significant weight gain over a protracted period of time may not always be detectable in a single snapshot of time. Also, for these studies, considerable variations exist in the measurement tools and analysis of dietary intake. For example, the study by Kumordzie et al. (Kumordzie et al., 2020) state that their dietary data collection tool was not designed specifically to capture the energy density of meals served to children.

3.5.2. Home Physical Activity Environment

This review identified three studies that examined the role of the home physical activity environment (Kumordzie et al., 2020; Sorrie et al., 2017a; Wolde & Belachew, 2015a). Among these studies, Wolde et al. (Wolde & Belachew, 2015a) measured the physical activity levels (classified as either low, moderate, or high) of 3-5 year-old pre-schoolers in urban Ethiopia using the Global Physical Activity Questionnaire (GPAQ) and found no association between physical activity and overweight and obesity. Kumordzie et al. (Kumordzie et al., 2020) examined the physical activity of 4-6 year-old urban pre-schoolers in Ghana using accelerometers and found that vector magnitude counts, which represent the intensity of body movements, were not associated with adiposity when accounting for age and sex.

It has been suggested in a recent review of the home environment and adiposity in children that inconsistencies in the relationship between physical activity and child BMI are to be expected, in part because of weaknesses in the tools that have been used for the measurement of physical activity in children (Kininmonth, Smith, et al., 2021). However, despite the identified issues, further work is required in the SSA context to further explore the relationship between physical activity and bodyweight in young children. Sedentary behaviour can also be due to lack of access to outdoor spaces (Eisenberg et al., 2014; Maitland et al., 2013). This was not explored in any of the identified papers in the current review and would be an interesting area for future research, particularly in urban dwelling children with limited access to outdoor spaces. Further, the interaction between the home media environment and physical activity in SSA children is unclear.

3.5.3. Home Media Environment

Only three studies were identified in the current review that explored the role of the home media environment and excess weight in preschool children, though with inconclusive findings (Okoye & Hart, 2015; Sorrie et al., 2017a; Wandia et al., 2014). Sorrie et al. showed that a minimum screen time of two hours per day was associated with increased risk of overweight/obesity in 3–5-year-old urban Ethiopian pre-schoolers (Sorrie et al., 2017a). Conversely Okoye et al. (Okoye & Hart, 2015) reported no association between minimum screen time of one hour per day and risk of overweight/ obesity among 2-5 year-old

Nigerian pre-schoolers. When the availability of media devices such as television and computers in the home environment was explored, an association with obesity was observed in Kenyan preschool children aged 3-6 years old (Wandia et al., 2014). However, in that study, only access was measured and not the duration of exposure. It is likely that the overall results are unclear due to the limited number of studies identified that focused specifically on the home media environment. These current findings contrast with the recent systematic review by Kininmonth et al. (Kininmonth, Smith, et al., 2021), who reported that the home media environment, specifically access to electronic devices was most consistently associated with excess adiposity in children. Despite these inconsistencies, the home media environment is an important area for future investigations in SSA if technology continues to diversify and children start to gain access to media devices in the home environment.

3.5.4. Sociodemographic and Socioeconomic factors

3.5.4.1. Maternal BMI

Evidence for the relationship between maternal BMI and childhood obesity reported in two studies with the largest sample sizes showed a positive association (Gewa, 2010; Kumordzie et al., 2020), consistent with findings from other studies (Danielzik et al., 2002; Williams et al., 2014). Evidence from the Kenyan Demographic and Health Survey of children aged 3-5 years (Gewa, 2010) found that children with overweight or obesity were approximately twice as likely to have mothers who were also overweight or obese, compared with children who had normal weight. Similarly Kumordzie et al. (Kumordzie et al., 2020) reported positive relationship between maternal and child BMI in Ghanaian 4-6 year-olds, adjusting for age and sex. The relationship between maternal BMI and child overweight/obesity could result from the influence of non-genetic factors such as parental modelling of feeding behaviour (Thompson, 2013). Behaviour is learned, and it is possible that obese and overweight mothers exhibit obesogenic dietary patterns that children learn (Thompson, 2013). Mothers with overweight or obesity may be more likely to consume high energy-dense and less nutrient-dense foods themselves, resulting in these foods being more available and accessible to children (Amuta et al., 2015; Couch et al., 2014; Nepper, 2015; Vereecken et al., 2010; Wyse et al., 2011). Obese mothers may also exert their influence on obesity and feeding behaviour in children through feeding practices (Hetherington et al., 2011; Thompson, 2013) such as restriction, pressure to eat (Loth, 2016), or using food as a reward (Entin et al., 2014). Since mothers are often the nutritional gatekeepers (Berhane et al., 2018) more research is needed to explore the relationship between parental bodyweight, dietary provision, parental feeding practices and styles, and child bodyweight in the SSA context. Contrary to these findings, one study included in the review, Said Mohamed et al. (Said-Mohamed et al., 2009a) reported that mothers of overweight and non-overweight children did not differ

in terms of BMI. However, the sample sizes in this study are most likely too small to detect any real differences between the study groups (n=36 for mothers of children with overweight and n=37 for mothers of non-overweight children).

3.5.4.2. Household Income and Wealth Status

The evidence for the relationship between household income or wealth status and excess weight among SSA pre-schoolers remains unclear. Wolde et al. (Wolde & Belachew, 2015a) demonstrated that 3-5 year-old Ethiopian pre-schoolers in high SES households were 3-4 times more likely to be overweight or obese, which is similar to findings from other studies that have shown that higher income households in developing countries are more likely to have children who are overweight or obese (Youfa et al., 2012). Similarly, Tadesse et al. (Tadesse et al., 2017a) and Wandia et al. (Wandia et al., 2014) reported that possession of a car, and a tv/ computer respectively, is associated with overweight and obesity in preschool children. However, the remaining included studies which included some measure of income or wealth reported no association, suggesting that the income and wealth status of households may not be reliable predictors of overweight and obesity among preschool children in sub-Saharan Africa (Gewa, 2010; Kumordzie et al., 2020; Said-Mohamed et al., 2009a; Senbanjo & Adejuyigbe, 2007; Sorrie et al., 2017a). This finding must, however, be interpreted with caution since potential issues with the assessment/measurement of wealth may account for this discrepancy. It has been suggested that the choice of household assets and analyses methods for evaluating household wealth varies between studies and could potentially obscure the wealth status of a household (Howe et al., 2009).

3.5.4.3. Maternal Education

Evidence suggests that excessive weight gain in children is associated with lower levels of maternal education, as shown in studies conducted in Western countries (Cribb et al., 2011; Ruiz et al., 2016), with the assumption that this mediates the relationship between nutrition knowledge, the mother's perception of child body weight, maternal feeding styles (Saxton et al., 2009), maternal feeding practices (Ayine et al., 2020), as well as maternal modelling of nutrition and physical activity behaviour. However, this association was not evidenced in our review. One study (Gewa, 2010) reported that higher maternal education is associated with increased odds of pre-schooler overweight, while another study (Sorrie et al., 2017a) demonstrated the opposite effect, i.e., an increased odds of overweight and obesity among SSA pre-schoolers with decreasing levels of education among their mothers/caregivers. The remaining six studies (Kumordzie et al., 2020; Mamabolo et al., 2005; Said-Mohamed et al., 2009a; Tadesse et al., 2017a; Wandia et al., 2014; Wolde & Belachew, 2015a) either did not clearly report the results (Tadesse et al., 2017a; Wandia et al., 2014; Wolde & Belachew, 2015a) or reported no notable relationships between the level of

formal education of mothers/caregivers and overweight and obesity among SSA pre-schoolers (Kumordzie et al., 2020; Mamabolo et al., 2005; Said-Mohamed et al., 2009a). These inconsistencies might be due to different study designs and inconsistent reporting of results. Alternatively, these inconsistencies might suggest that the distribution of maternal education level may be similar across obese and non-obese groups, or that maternal education might not be a strong predictor of overweight or obesity among SSA pre-schoolers.

3.5.4.4. Occupational/ Employment status

Most studies (Said-Mohamed et al., 2009a; Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a) included in this review did not report any relationship between caregiver occupational status and overweight and obesity in preschool children. It is important to note that three studies examined caregiver occupational or employment status but did not explicitly report the association to overweight or obesity in the results section (Sorrie et al., 2017a; Tadesse et al., 2017a; Wolde & Belachew, 2015a). However, two studies reported a relationship between parental occupational status and child overweight and obesity (Mamabolo et al., 2005; Wandia et al., 2014). The findings from the current review support recent work of Oddo et al., (Oddo et al., 2017) who reported no association between maternal employment and overweight in preschool children in low- and middle-income countries when data across 45 LMICs were pooled. However, Oddo et al. (Oddo et al., 2017) reported several interesting findings specific to SSA. For example, increased odds of overweight were associated with formal maternal employment in Ghana and Kenya, and increased odds of overweight associated with informal maternal employment in Cameroon and Chad. It is unclear why these inconsistencies occur. The general low prevalence of overweight and obesity in some areas compared to others may be a factor. Oddo et al. reported that maternal education moderated the association between employment status and child overweight and obesity (Oddo et al., 2017). Children of formally employed mothers with higher education had higher odds of overweight compared to non-employed mothers who were highly educated. Mixed results regarding this association is also observed in high-income countries, with some studies from Europe reporting limited evidence (Gwozdz et al., 2013) whilst other from the UK and USA report a strong relationship (Fitzsimons & Pongiglione, 2019; M. A. Martin et al., 2018).

The relationship between child weight, maternal/ caregiver occupational status and maternal education is complex and appears to be further related to other factors such as socioeconomic status, cultural norms and values, access, and availability of particular foods. Future research would benefit from comprehensive consideration of related factors, some of which have been discussed in, but not limited to those in the

current review. For example, access to childcare, type of work carried out, working hours and the number of jobs parents have.

3.5.4.5. Household size

Our findings with regard to the association between household/family size and obesity in pre-schoolers were mixed with evidence reporting no association (Mamabolo et al., 2005; Said-Mohamed et al., 2009a) and evidence supporting a protective effect of larger families on the risk of overweight and obesity (Gewa, 2010; Tadesse et al., 2017a). The relationship between family size and risk of overweight/ obesity was previously reported in a 2014 review by Keino et al. (Keino et al., 2014). They suggested that increasing numbers per household were associated with reduced prevalence of overweight in young children and adolescent due to increased competition for available food. A USA-based study (Datar, 2017) reported similar findings. Eating together as a family at home, reduced maternal work, and increased adult supervision of children are potential mechanisms through which family size may be protective of childhood obesity (Datar, 2017). Understanding how family size may impact on child overweight/obesity specifically in SSA is warranted.

3.5.4.6. Location: urban versus rural living

Evidence to support the association between location (urban versus rural) and overweight and obesity in urban preschool children was supported in our review (Gewa, 2010). Rapid urbanisation has previously been identified as a key driver for overweight and obesity (Jiang et al., 2014; Popkin et al., 2012). Steyn et al. reported the prevalence of childhood overweight using the South African National Food Consumption Survey; these data demonstrated that the highest prevalence of overweight was observed in urban children and the lowest prevalence of overweight in rural children living on farms (Steyn et al., 2005). However, a recent study by Madisse & Letamo (2017) examined the prevalence of overweight in SSA females and reported that rural African women were at increased or higher risk of having overweight or obesity compared to urban dwelling women (Madise & Letamo, 2017). The authors note that simple dichotomy of urban/ rural living is insufficient to understand overweight in SSA and that the relation between weight status and place of residence is highly complex with many studies failing to take in to account household wealth (Madise & Letamo, 2017).

3.5.5. Parental Perception of Child Body Weight

Qualitative evidence from this review suggests that culturally motivated perspectives of body weight in sub-Saharan Africa may be critical in influencing the food choices and feeding practices of SSA parents and caregivers (A. Scott et al., 2013). Parents of pre-schoolers had varied perceptions of child body size and body weight which were unrelated to health (Klingberg et al., 2020). Excess weight was rarely reported as

a concern and parents rarely reported an association between what their children ate and their child's bodyweight. Excess weight was only seen as a concern if it resulted in child immobility and the development of chronic diseases such as diabetes. Interestingly, despite the positive connotations of excess weight being identified the link between obesity stigma and bullying was discussed by some participants: highlighting the key role played by parents in the home environment and how they might influence bodyweight. Similarly, the current review provided evidence that mothers who underestimate their child's weight were more likely to have a child with excess weight (Said-Mohamed et al., 2009a) Very little is known about parental feeding practices and feeding styles in the SSA context and how different social and cultural norms regarding eating behaviours might impact upon the development of excess weight in young children.

3.6. Limitation of study and Recommendations

Our review followed a rigorous approach, adhering to standard practices for accessing and reporting research, however, there are some limitations that need to be acknowledged. The studies identified represented data from 6 out of approximately 46 sub-Saharan African countries. Similarly, regional differences in the components of the modified home environment model were not explored in the current review and should be considered in future investigations. All the studies that were identified were of a cross-sectional nature, limiting the interpretation of the effect of home environment factors on child behaviour and weight gain to a single point in time. Our review also identified only one qualitative study, limiting our understanding of the depth of the relationship between the home environment and child overweight and obesity. Finally, wide variations existed in the measurement of key exposure variables such as food intake/dietary intake or physical activity limited aggregation of the data into a meta-analysis.

3.7. Conclusions

Overall, the results of the current review highlight the paucity of studies exploring factors in the home environment associated with overweight and obesity in preschool children in Sub-Saharan Africa. Important key contributors to overweight and obesity identified in the current review include the home food environment and maternal BMI. However, the evidence for all other factors explored is mixed and remains unclear due to the lack of evidence. It is important that further work is conducted in this under-researched area using standardized, validated measures of important aspects such as food intake, physical activity, parental feeding practices and styles. Longitudinal work would also help establish associations over time. Until a strong evidence-base is established, effective interventions cannot be developed thus highlighting the need for this critical work to be undertaken.

Chapter 4 - Household Socio-demographic Determinants of Overweight and Obesity Among 2–4-year-old Ghanaian Pre-schoolers: An Analysis of the Ghana Multi-Indicator Cluster Survey (MICS) (2006 – 2018).

This chapter presents the findings of the secondary data analysis, drawing data from three rounds of the Ghana MICS survey (2006, 2011, and 2017/2018) to assess sociodemographic factors associated with overweight and obesity in the home environment of Ghanaian toddlers.

4.1. Abstract

Introduction

Childhood overweight and obesity is a public health issue in Ghana. Among toddlers in particular, little work has been done to understand why more children are becoming overweight and obese. It is known that overweight and obesity established in these early years track into adolescence and adulthood, and is more difficult to treat and manage in the later years. The home environment is generally the first and most important setting for interaction between caregivers and preschoolers, and it is here that caregivers may pass on obesogenic lifestyle traits. Social determinants of overweight and the home environment may be helpful in identifying household demographic and economic factors that may predispose children to weight gain in the home environment. However, to date, little is known about the sociodemographic determinants of the home environment and overweight/obesity among children in this age-group. Therefore, the aim of this aspect of the PhD study was to identify household sociodemographic correlates of overweight/obesity in the home environment of Ghanaian preschoolers.

Methods

The analysis used pre-exiting/secondary data from the Ghana Multi-indicator Cluster Survey – 2006 (MICS 3), 2011 (MICS 4), and 2017/2018 (MICS 6). Regression analyses were performed to evaluate associations between household sociodemographic and home environment (home food environment, home physical activity environment, and home media environment) factors and child BMI z-scores were analysed. The sample analysed consisted of 1285, 2967, and 3507 pre-schoolers for the MICS 3, MICS4, and MICS 6, respectively.

Results

There were no consistent household socio-demographic predictors or determinants of overweight/obesity. The analysis also showed no significant associations between overweight/obesity and the physical activity home environment, the home food environment, or the home media environment. Further analysis of the sociodemographic variables showed that the education level of the household head or child's mother/caregiver, and increased household wealth were consistent determinants of the home food, physical activity, and media environment across the study years.

Conclusion

The results of this study highlight inconclusive evidence on the sociodemographic determinants of weight gain among Ghanaian pre-schoolers aged 2-4 years. Future work on the sociodemographic determinants of the physical and social aspects of the home environment is recommended.

4.2. Background

Obesity is a major public health issue in Ghana, particularly because while undernutrition remains a problem, there have been recent population increases in overweight and obesity (Agyei-Mensah & De-Graft Aikins, 2010; Doku & Neupane, 2015; Kushitor et al., 2020). This is particularly true for Ghanaian children (Kobia-acquah & Akowuah, 2020). Since obesity or overweight among children is more likely to extend into adolescence and adulthood (Geserick et al., 2018), it is expected that population increases in excessive childhood weight gain will impact on future obesity-related healthcare costs if the situation continues without early intervention.

Environmental contributions to overweight and obesity far outweigh genetic causes (Albuquerque et al., 2017), and these environmental factors in turn impress their effects through changes in behaviour (Kremers et al., 2006). In childhood, the development of unhealthy weight gain is proximally linked to behaviours that increase energy intake and reduce energy expenditure (Romieu et al., 2017).

Much of a child's eating behaviour or physical activity/sedentary behaviour is related to the care that is provided in the home environment. Since the home environment is usually the child's first setting for social interaction with their caregivers, it is expected that obesogenic behaviours would be learned through the home environment that caregivers create or establish around the child. Home environment factors that have been shown to influence the behaviour of children towards weight gain include the physical and social aspects of the home food environment (e.g., food insecurity and non-responsive parent feeding practices), the home physical activity environment (e.g., the absence of play equipment/play spaces and parent sedentary behaviours), and the home media environment (e.g., the availability of media devices such as TVs and laptops) (Kininmonth, Smith, et al., 2021; Kwansa et al., 2022).

The home environment is a reflection of the social and demographic status of members within the household, and these are important factors to consider when studying the pathways and mechanisms of early excessive weight gain among children (Akram et al., 2018). These factors help shape the home environment through interactions that modify the knowledge and attitudes of caregivers with respect to energy intake and expenditure (Pigeyre et al., 2016). This in turn influences the practice of obesogenic or

non-obesogenic behaviours in the home. Examples of these social and demographic factors include education level, employment, and income or wealth status. Studying these socio-demographic factors also provides the added advantage of helping to identify households and children at risk of unhealthy weight gain in intervention efforts.

Although many studies on childhood obesity in Ghana exist (Aduama, 2004; Aryeetey et al., 2017; Ganle et al., 2019; Kobia-acquah & Akowuah, 2020; Kumah et al., 2015; Mohammed & Vuvor, 2012; Obirikorang et al., 2015) there is a lack of evidence on how a critical setting such as the home environment may be contributing to increases in excessive weight gain among Ghanaian pre-schoolers. To understand the home environment and how its different aspects map on to weight gain among Ghanaian children, it is important to study the socio-demographic determinants that help establish and maintain them. To the best of our knowledge, no studies have explored these determinants in relation to the home environment and overweight/obesity among Ghanaian children. The preschool years in particular have been identified as critical periods in child development during which obesity may be firmly established and track into adolescence and adulthood (Dietz, 1997; Evensen et al., 2016; Glavin et al., 2014; Singh et al., 2008). In terms of the home environment and excessive weight gain in childhood, this age-group represents an understudied population in Sub-Saharan Africa (SSA). In addressing these research gaps, this study aims to focus on Ghanaian pre-schoolers aged 2-4, specifically examining the household social and demographic factors that may be associated with the home environment and the development of overweight and obesity.

Specifically, the objectives of this study are to:

1. Identify household socio-demographic factors (e.g., household wealth, caregiver education) that are associated with overweight or obesity among 2–4-year-old Ghanaian children.
2. Identify home environment factors that are associated with overweight or obesity among 2-4-year-old Ghanaian children.

4.3. Methods

4.3.1. Data Sources

The study analysed data drawn from the Multi-Cluster Indicator Survey (MICS) of Ghana. The MICS is routinely conducted by many countries and serves as a useful data source for tracking the progress of the Sustainable Development Goals (SDGs). In Ghana, there have been 4 MICS studies, i.e., MICS 1 (1995), MICS 3 (2006), MICS 4(2011), and MICS 6 (2017/2018). This study will focus on MICS 3, 4, and 6, that were carried out between 2006 and 2018. MICS1 is not considered for this study because reports have suggested that although excessive weight among pre-schoolers was not a problem in sub-Saharan African (SSA) as at the year 2000 (Martorell et al., 2000), there have been significant increases in the prevalence of paediatric obesity since then (Klingberg et al., 2019; Muthuri et al., 2014; Onyango et al., 2019). The datasets for these surveys alongside the survey instruments are publicly available and easily accessible. They can be downloaded (after permission has been granted) from the MICS website hosted by United Nations Children Fund (UNICEF) (https://mics.unicef.org/surveys). In Ghana, the conduct of the MICS has been led by the Ghana Statistical Service (GSS) in collaboration with UNICEF, and supported by the Ghana Health Service (GHS) and the Ghana Education Service (GES).

4.3.2. Participants, Sampling, and Sample Size

The survey units for the MICS were households, which were selected using a two-stage cluster sampling process. This process involved the selection of census enumeration areas (EAs) and household listing, followed by a random sampling of households within each cluster.

In the MICS 3 (2006), households were sampled using the enumeration areas and housing listing information from the Ghana Living Standards Survey 5 (GLSS5), conducted between September 2005 and September 2006 (Ghana Statistical Service, 2006). Overall, 300 out of 600 enumeration areas and 6302 households (approximately 20 per EA) from the GLSS5 were selected for the MICS 3. Data were obtained from 3466 children under the age of 5 (0-4 years) from 5939 households.

The MICS 4 (2011) was based on enumeration areas and household listing information that had been used for the 2010 Ghana Population and Housing Census (PHC). A total of 810 enumeration areas were chosen from the 2010 PHC, from which 12,150 households were selected (approximately 15 per EA). Data were obtained for 7,550 children aged 0-4 years from 11,925 households (Ghana Statistical Service, 2011).

Sampling in the MICS 6 (2017/2018) was also based on the distribution of enumeration areas according to the 2010 PHC. Briefly, 660 EAs were selected from which 13,202 households (approximately 20 per EA) were listed. Data were obtained for 8,879 children aged 0-4 years from 12,886 households (Ghana Statistical Service, 2018).

4.3.3. Data analysis

4.3.3.1. Data processing

The data in the MICS 3, 4, and 6 were captured using the Census and Survey Processing System (CSPro) software, and these were subsequently processed and analysed in SPSS using the syntax files and tabulation plans that were developed by UNICEF. Household data for children aged 0-4 years were stored in two separate datasets: ch.sav that contained under-five-specific data, and hh.sav that contained additional household data for each participant, including children listed in the survey.

4.3.3.2. Data Management

All variables from each dataset were initially exported from SPSS into STATA (version 17) for cleaning. Exported household (hh.sav) and child under-five (ch.sav) datasets for each survey year were appended using the MICS-recommended combinations of key variables such as cluster numbers or line numbers. This approach involved the exact matching of child and household records based on shared line and cluster numbers (the key variables for both datasets). This was then followed by limiting the appended file (the file containing matched child and household data) by age to only include children aged 2-4 years. This process was subsequently verified by cross-tabulating age-group variables with the actual recorded age values. Where there were any discrepancies between entries or responses, their corresponding dates of birth were used to resolve these differences.

The MICS dataset for children 2-4y (ch.sav) contains anthropometric calculations for nutritional status. Since weight-for-height, and BMI-for-age z-scores are the only recommended units of measurement for studies of overweight or obesity among children (World Health Organization, 2008), others such as weight-for-age and height-for-age which are more useful for studies of underweight and stunting were excluded from the analyses. WHZ and BMI-Z scores that had been flagged as having potential issues such as errors in measurement or were biologically implausible entries (e.g., z scores more than 5 and less than -5 (Freedman et al., 2015, 2016)) were also removed.

The final sample size for this age group included 1285, 2967, and 3507 pre-schoolers for the MICS 3, MICS4, and MICS 6, respectively.

4.3.3.3. Coding and description of variables

Across all the study years, variables were chosen or generated based on a combination of 3 criteria: the obesogenic home environment conceptual framework (S. Schrempft et al., 2015), the MICS indicator lists

from UNICEF (https://mics.unicef.org/tools), and any other relevant factors identified from published literature.

4.3.3.3.1. Household Sociodemographic Variables

Household sociodemographic variables that were used for the analyses included the location of household, the number of household members, the number of children aged below 5 years, the number of rooms for sleeping, the age of the household head, the religion of the household head, the education level of the household head, the education level of the child's mother, and the household wealth quintile (Table 5).

Table 5. Household Sociodemographic Variables, Coding, and Justification for Inclusion in the Analysis

Household Sociodemographic Variable	Type of Variable	Levels and coding of variable	References to justify selection
Location of Household	Categorical, nominal	Urban=1; Rural=2	(Kwansa et al., 2022). Johnson & Johnson, (2015)
Number of Household members	Numerical, discrete	N/A	Kwansa et al., (2022). Mamabolo et al., (2005)
Number of children less than 5 years	Numerical, discrete	N/A	Mamabolo et al., (2005)
Number of rooms for sleeping	Numerical, discrete	N/A	Bertrand, (2018) Chambers et al., (2010)
Age of Household Head	Numerical, continuous	N/A	Mphekgwana et al., (2022) Kimani-Murage et al., (2013)
Sex of Household Head	Categorical, nominal	Male=1; Female=2	Masibo, (2013); Sserwanja et al., (2021)

*Religion of Household Head	Categorical, nominal	No Religious Affiliation=0; Religious Affiliation=1	(Kim et al., 2003; Lycett, 2015; Marini, 2020; Spence et al., 2022; Yeary et al., 2017)
Education level of Household Head	Categorical, ordinal	None=1, Primary=2, Middle School=3, Secondary School+=4, Higher Education=5	Ogden et al., (2010)
Education level of Mother	Categorical, ordinal	None=1, Primary=2, Middle School=3, Secondary School+=4, Higher Education=5	Kwansa et al., (2022
Household Wealth Index	Categorical, ordinal	Poorest=1, Second=2, Middle=3, Fourth=4, Richest=5	(Dinsa et al., 2012

**re-categorised from the detailed listing of religious affiliations, e.g., Christian, Muslim, etc. in the original MICS*

The MICS 3 dataset contained all available variables except for the age and sex of the household head, while the MICS 4 contained all variables except the age of the household head. All household sociodemographic variables were present in the MICS 6 (Table 6).

Table 6. Availability of Variables Across the Survey Years

Household Sociodemographic Variables	MICS 3 (2006)	MICS 4 (2011)	MICS 6 (2017/2018)
Location/Area of Household	available	available	available
Number of Household Members	available	available	available
Number of children aged <5 years	available	available	available
Number of Rooms for Sleeping	available	available	available
Age of Household Head	*not available*	*not available*	available
Sex of Household Head	*not available*	available	available
Religion of Household Head	available	available	available
Education Level of Household Head	available	available	available
Education Level of Mother	available	available	available
Household Wealth Index	available	available	available

4.3.3.3.2. Home Environment Variables

The MICS datasets do not contain variables for the home food environment, home physical activity environment, and home media environments, and so it was necessary to generate proxy variables for the home environment from other relevant/available ones that had been measured for each study year/dataset. Household dietary diversity scores (HDDS), representing the physical availability of food in the home environment (Table 7) were calculated and utilised in analysis as recommended by the Food and Agriculture Organisation (FAO, 2010) based on the caregiver 24hr-recall of 12 food groups eaten by the child (cereals, roots and tubers, vegetables, fruits, meat and poultry, eggs, fish and seafood, legumes and nuts, milk and milk products, fats and oils, sugary foods/sweets, and beverages). The raw scores for each household were used in analysis as recommended by the guidelines of the FAO (FAO, 2010). The availability of play items i.e., the availability of items or equipment in the home environment that encourage physical activity (Table 7), was generated from a combination of caregiver responses to what the child plays with when they are at home (homemade toys, toys from a shop, or household objects). Caregiver encouragement of physical activity (Table 7), representing the social aspect of the home physical activity

environment, was generated from MICS responses to whether the mother, father, or other adult members of the household (including caretakers) had played with the child in the past 3 days. Finally, the availability of screens (Table 7), representing the physical aspect of the home media environment, was generated from a combination of responses to the household possession of screen/media assets including either black and white TVs, colour TVs, LED Plasma TVs/Smart TVs, Desktop computers, or laptop computers.

Table 7. Home Environment Variables, Coding, and Justification for Inclusion in the Analysis

Home Environment Variable	Type of Variable	Levels and coding of variable	References to justify selection
Household Dietary Diversity Score	Numerical, discrete	N/A	(Kwansa et al., 2022
Availability of play items	Categorical, nominal	No=0, Yes=1	(Kininmonth, Smith, et al., 2021)
Caregiver engagement in play activities with child	Categorical, nominal	No=0, Yes=1	(Kininmonth, Smith, et al., 2021)
Home availability of screens	Categorical, nominal	No=0, Yes=1	(Kininmonth, Smith, et al., 2021)

The MICS 3 and MICS 6 datasets did not contain data for the calculation of household dietary diversity scores, and the availability of play items was absent from the MICS 3. The MICS 4 however had data for all other available home environment variables for this analysis (Table 8).

Table 8. Availability of Home Environment Variables across the Survey Years

Home Environment Variable	MICS 3 (2006)	MICS 4 (2011)	MICS 6 (2017/2018)
Household Dietary Diversity Score	*not available*	available	*not available*
Availability of play items	*not available*	available	available
Caregiver engagement in play activities with child	available	available	available
Home availability of screens	available	available	available

4.3.3.3.3. Variables for Overweight/obesity

BMI-for-age and weight-for-age measurements were categorised into 7 classes as recommended by the WHO (https://www.who.int/toolkits/child-growth-standards/standards/body-mass-index-for-age-bmi-for-age), i.e., underweight (-5<z<-3) wasted (-3<z<-2) at-risk of wasting (-2<z<-1), normal (-1<z<1), at-risk of overweight (1<z<2), overweight (2<z<3), and obese (3<z<5). The “Overweight” and “Obese” categories were retained as “exposed” groups, while the “Normal” category was retained as a “control” or “comparison” group. To minimise the limitations of using either BMI-for-age alone or weight-for-height alone in studies related to child obesity research (C. L. Ogden & Flegal, 2010), only weight-for-height and BMI-for-age z-score categories that were in agreement with each other were retained for the analysis. These were then coded as "0" for Normal weight and "1" for obese/overweight.

4.3.3.4. Statistical Analysis

Although the surveys had large sample sizes, they were analysed separately because they constitute three cross-sectional studies that sampled unrelated participants or recruited participants with no follow-up over the period of the 3 sampling/survey years. Descriptive statistical methods were first used to summarize and observe the distribution of the data, while bivariate and multivariate logistic regressions were used to identify sociodemographic risk factors for overweight/obesity within the households of Ghanaian pre-schoolers.

4.3.3.4.1. Descriptive Statistics

Categorical variables were measured and reported as frequencies and proportions, while numerical variables were measured and reported as means with standard deviations.

4.3.3.4.2. Bivariate and Multivariate Logistic Regressions

Bivariate and multivariate logistic regressions were used to assess the association between household sociodemographic variables, obesogenic home environment variables and overweight/obesity.

Variables were fitted using an automated Firth Logistic Regression method in STATA (version MP/17 for Windows) that utilises a penalised likelihood ratio estimate rather than the conventional maximum likelihood ratio estimate of a simple logistic regression (Firth, 1995). The method was chosen because of its unique ability to reduce the bias generated by maximum likelihood ratios in data which exhibits complete or quasi-separation, i.e., complete distribution of the outcome towards one level of a predictor variable (often generating data with low cell counts or zero-count cells), or datasets with a small number of events-per-variable, characteristic of the MICS datasets for this study. This method guaranteed narrower and closer-to-accurate estimates of standard errors and 95% confidence intervals compared to those of a simple logistic regression when the number of events-per-variable was less than 10 (reference). The Firth Logistic regression also reported the Wald's chi-squared test statistic which compared how the model with added candidate predictor variables, i.e., household sociodemographic and home environment variables, were significantly associated with the outcome and differed from the null model with no candidate predictor/independent variables.

Bivariate associations were reported as crude odds ratios (COR) with their 95% confidence intervals (CIs) and their level of significance measured at $p<0.05$. Multivariate associations were reported as odds ratios that had been adjusted (AOR) for all other variables included in the analysis, with their 95% confidence intervals (CIs) and their level of significance measured at $p<0.05$. Odds ratios and 95% CIs less than 1 were described as significantly associated with a reduction in the odds of the outcome, while odds ratios and 95% CIs more than 1 were described as significantly associated with an increase in the odds of the outcome. Odds ratios and 95% CIs equal to 1 were described as not significantly associated with the outcome.

4.3.3.4.3. Collinearity and Confounding

Collinearity among the candidate predictors/independent variables was tested by examining the variance inflation factor (VIF) of each independent variable in STATA using the *collin* command. For household

sociodemographic factors and home environment factors, the cut-off VIF value for exclusion from the firth logistic regression was 3.5.

4.3.4. Ethical Consideration

No ethics approval was required for this study. The request for use of the survey datasets was granted by MICS-UNICEF. However, UNICEF has stated that these datasets are not to be used for purposes other than for those expressed by researchers, and that datasets should not be redistributed or passed on in any form to others.

4.4. Results

A total of 1285, 2967, and 3507 2–4-year-old Childrens' data for the MICS 3, 4, and 6 respectively were included in the analysis after cleaning. In all the survey years, there was an even distribution of the sample of children across 10 administrative regions, except for the MICS 4 which included a significantly high number of children from three northern regions (Northern, Upper East, and Upper West) and the Central region (Figure 3). The prevalence of childhood overweight/obesity among the 2-4-year-age-group was 0.86% for the MICS 3, 1.92% for the MICS 4, and 1.60% for the MICS 6.

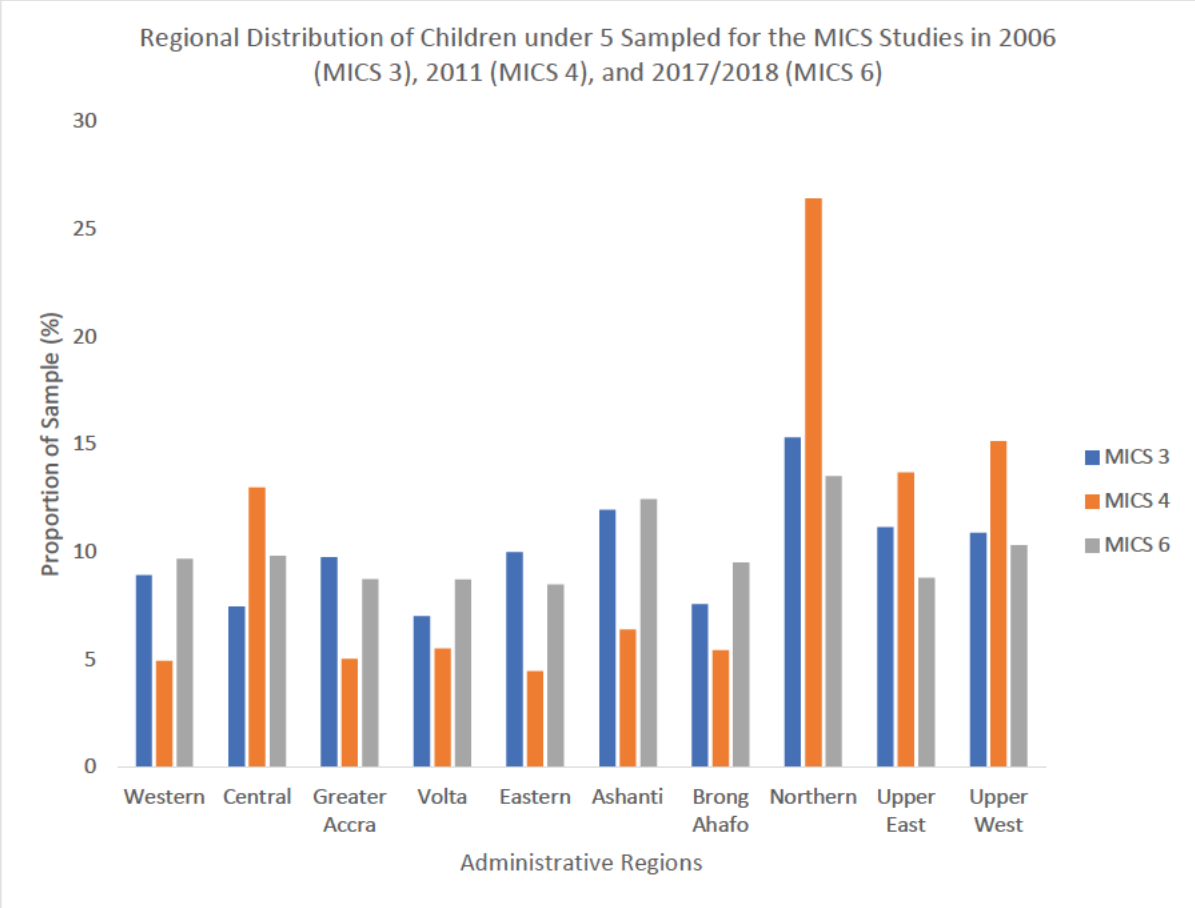

Figure 3. Regional Distribution of Study Sample

4.4.1. Household Sociodemographic Characteristics

Table 9 below illustrates the distribution of household sociodemographic characteristics in the MICS 3, 4, and 6. Among both normal and overweight/obese groups across all the 3 survey years, most households were in rural areas, had an average of 7 members (with a range of 4-10 per household), an average of 2 children aged below 5 years (with a range of 1-3 per household), and an average of 3 rooms for sleeping (minimum 1 room and a maximum of 5 rooms per household). In the MICS 6, the average age of a household head was approximately 45 years. Most household heads were male and affiliated to a religious group. Approximately half of all household heads and half of all mothers did not have any formal education or had only attained primary education, and most households were within the poorest to second wealth quintiles.

4.4.2. Home Environment Characteristics

In the MICS 4, household dietary diversity score ranged between 4 and 8 (household average of 6) (Table 10). Play items or toys were available in most households in the MICS 4 and 6, and most caregivers were involved in the play activities of their preschool children (Table 10). Most households in the MICS 3 and 4 did not possess tv, laptops, or computers. However, in the MICS 6, a larger proportion of households claimed ownership of a screen or media device such as a tv, laptop, or computer (Table 10).

Table 9. Household Sociodemographic Characteristics for 2-4-year-old Ghanaian Children across the MICS 3, 4, and 6

Household Sociodemographic Characteristics	MICS 3 (2006)			MICS 4 (2011)			MICS 6 (2017/2018)		
	Normal (n=1274)	Obese/Overweight (n=11)	Total (N=1285)	Normal (n=2910)	Obese/Overweight (n=57)	Total (N=2967)	Normal (n=3,451)	Obese/Overweight (n=56)	Total (N=3,507)
Area (n, %)									
Urban	401 (31.48)	2 (18.18)	403 (31.36)	809 (27.80)	19 (33.33)	828 (27.91)	1,364 (39.52)	24 (42.86)	1,388 (39.58)
Rural	873 (68.52)	9 (81.82)	882 (68.64)	2,101 (72.20)	38 (66.67)	2,139 (72.09)	2,087 (60.48)	32 (57.14)	2,119 (60.42)
Number of Household Members (mean ± SD)	6.35 ± 2.82	7.18 ± 2.79	6.36 ± 2.82	6.91 ± 3.37	6.53 ± 2.65	6.91 ± 3.36	6.65 ± 3.24	6.61 ± 3.23	6.65 ± 3.24
Number of children aged <5 years (mean ± SD)	1.68 ± 0.81	1.72 ± 0.65	1.68 ± 0.81	1.76 ± 0.87	1.74 ± 0.79	1.76 ± 0.87	1.75 ± 0.91	1.91 ± 1.08	1.75 ± 0.92
Number of Rooms for Sleeping (mean ± SD)	2.15 ± 1.43	2.55 ± 1.92	2.16 ± 1.43	2.46 ± 1.63	2.21 ± 1.32	2.46 ± 1.62	2.22 ± 1.49	2.13 ± 1.10	2.22 ± 1.48
Age of Household Head (mean ± SD)	not available			not available			45.00 ± 14.33	46.54 ± 15.07	45.02 ± 14.34
Sex of Household Head (n, %)	not available								
Male				2,462 (84.60)	41 (71.93)	2,503 (84.36)	2,465 (71.43)	37 (66.07)	2,502 (71.34)
Female				448 (15.40)	16 (28.07)	464 (15.64)	986 (28.57)	19 (33.93)	1,005 (28.66)
Religion of Household Head (n, %)									
No Religion	94 (7.38)	0 (0.00)	94 (7.32)	167 (5.74)	6 (10.53)	173 (5.83)	138 (4.00)	4 (7.14)	142 (4.05)
Affiliation to Religious Group	1180 (92.62)	11 (100.00)	1191 (92.68)	2,743 (94.26)	51 (89.47)	2,794 (94.17)	3,313 (96.00)	52 (92.86)	3,365 (95.95)
Education Level of Household Head (n, %)									
None	527 (41.43)	5 (45.45)	532 (41.47)	1,465 (50.34)	30 (52.63)	1,495 (50.39)	1,214 (35.22)	16 (28.57)	1,230 (35.11)
Primary	190 (14.94)	3 (27.27)	193 (15.04)	424 (14.57)	11 (19.30)	435 (14.66)	583 (16.91)	9 (16.07)	592 (16.90)
Middle School/JHS	404 (31.76)	2 (18.18)	406 (31.64)	706 (24.26)	8 (14.04)	714 (24.06)	1,060 (30.75)	16 (28.57)	1,076 (30.72)
Secondary School*	151 (11.87)	1 (9.09)	152 (11.85)	315 (10.82)	8 (14.04)	323 (10.89)	344 (9.98)	4 (7.14)	348 (9.93)
Higher Education	not available			not available			246 (7.14)	11 (19.64)	257 (7.34)
Education Level of Mother (n, %)									
None	615 (48.27)	6 (54.55)	621 (48.33)	1,615 (55.50)	33 (57.89)	1,648 (55.54)	1,235 (35.79)	17 (30.36)	1,252 (35.70)
Primary	245 (19.23)	2 (18.18)	247 (19.22)	513 (17.63)	11 (19.30)	524 (17.66)	649 (18.81)	11 (19.64)	660 (18.82)
Middle School/JHS	338 (26.53)	2 (18.18)	340 (26.46)	596 (20.48)	10 (17.54)	606 (20.42)	1,102 (31.93)	18 (32.14)	1,120 (31.94)
Secondary School*	76 (5.97)	1 (9.09)	77 (5.99)	186 (6.39)	3 (5.26)	189 (6.37)	310 (8.98)	2 (3.57)	312 (8.90)
Higher Education	not available			not available			155 (4.49)	8 (14.29)	163 (4.65)
Household Wealth Index (n, %)									
Poorest	352 (27.63)	5 (45.45)	357 (27.78)	1,369 (47.04)	28 (49.12)	1,397 (47.08)	1,049 (30.40)	13 (23.21)	1,062 (30.28)
Second	331 (25.98)	4 (36.36)	335 (26.07)	569 (19.55)	13 (22.81)	582 (19.62)	682 (19.76)	11 (19.64)	693 (19.76)
Middle	222 (17.43)	0 (0.00)	222 (17.28)	425 (14.60)	6 (10.53)	431 (14.53)	627 (18.17)	9 (16.07)	636 (18.14)
Fourth	187 (14.68)	1 (9.09)	188 (14.23)	313 (10.76)	2 (3.51)	315 (10.62)	573 (16.60)	6 (10.71)	579 (16.51)
Richest	182 (14.29)	1 (9.09)	183 (14.24)	234 (8.04)	8 (14.04)	242 (8.16)	520 (15.07)	17 (30.36)	537 (15.31)

**in the MICS 3 and MICS 4 the secondary education category includes all education from secondary and beyond*

Table 10. Home Environment Characteristics for 2-4-year-old Ghanaian Children across the MICS 3, 4, and 6

Home Environment Factors	MICS 3 (2006)			MICS 4 (2011)			MICS 6 (2017/2018)		
	Normal (n=1274)	Obese/Overweight (n=11)	Total (N=1285)	Normal (n=2910)	Obese/Overweight (n=57)	Total (N=2967)	Normal (n=3,451)	Obese/Overweight (n=56)	Total (N=3,507)
Household Dietary Diversity Score (mean ± SD)	not available			5.99 ± 1.93	5.89 ± 2.08	5.99 ± 1.93	not available		
Availability of Play Items/Toys (n, %)									
No	not available			264 (9.07)	4 (7.02)	268 (9.03)	135 (3.91)	3 (5.36)	138 (3.93)
Yes				2646 (90.93)	53 (92.98)	2699 (90.97)	3,316 (96.09)	53 (94.64)	3,369 (96.07)
Caregiver Engagement in Play Activities with child (n, %)									
No	110 (8.63)	1 (9.09)	111 (8.64)	1253 (43.06)	30 (52.63)	1283 (43.24)	1,019 (29.53)	19 (33.93)	1,038 (29.60)
Yes	1164 (91.37)	10 (90.91)	1174 (91.36)	1657 (56.94)	27 (47.37)	1684 (56.76)	2,432 (70.47)	37 (66.07)	2,469 (70.40)
Availability of Screens (Television / Computer) (n, %)									
No	915 (71.82)	10 (90.91)	925 (71.98)	2002 (68.80)	43 (75.44)	2045 (68.92)	1,577 (45.70)	22 (39.29)	1,599 (45.59)
Yes	359 (28.18)	1 (9.09)	360 (28.02)	908 (31.20)	14 (24.56)	922 (31.08)	1,874 (54.30)	34 (60.71)	1,908 (54.41)

4.4.3. Household Sociodemographic Determinants of Overweight/Obesity among Ghanaian Pre-schoolers (2-4 years)

In the MICS 3, there were no independent associations between overweight/obesity and household sociodemographic characteristics such as the location of household, the number of household members, the number of children below the age of 5 years, the number of rooms for sleeping, the religion of the household head, the education level of the household head, the education level of the mother, and the household wealth quintile (Table 11). After adjusting for the combined effects of all household sociodemographic variables in the MICS 3, none proved to be significant predictors of overweight/obesity among pre-schoolers or contributed to a reliable model of excess child body weight among Ghanaian pre-schoolers (Wald's chi-squared = 0.98) (Table 11).

In the MICS 4, the sex of the household head was the only household sociodemographic characteristic that was independently associated with overweight/obesity (Table 11). Female household headship was significantly associated with an increase in the odds of overweight/obesity, compared to male household headship (COR=2.18, p=0.01, 95% CI=1.22-3.90) in the unadjusted model. This association remained significant even after adjusting for the effects of other sociodemographic factors (AOR=2.35, p=0.01, 95% CI=1.24-4.45). Although female household headship was a significant predictor of child body weight in the MICS 4, it was inadequate alone or by itself to account for all household sociodemographic determinants needed to model overweight/obesity among children (Wald's chi-squared p=0.09) (Table 11).

In the MICS 6, overweight/obesity among pre-schoolers was independently associated with the education level of the household head, the education level of the child's mother, and the household wealth index. Higher education level of the household head was significantly associated with an increase in the odds of overweight/obesity (COR=3.43, p=0.00, 95% CI=1.60-7.38), compared to no formal education attained by the household head. Higher education level of mother was also significantly associated with a 3.86 increase in the odds of overweight/obesity (COR=3.86, p=0.00, 95% CI=1.67-8.91) compared to no formal education attained by the child's mother. Residing in a rich household was associated with a significant increase in the odds of overweight/obesity (COR=2.61, p=0.01, 95% CI=1.28-5.36), compared to residing in a poor household. When adjusted for the effects of other sociodemographic variables, these associations however became insignificant (higher education level of household head (AOR=3.19, p=0.07, 95% CI=0.90-11.32); higher education level of mother (AOR=0.99, p=0.99, 95% CI=0.27-3.66); and households in the richest wealth quintile (AOR=2.75, p=0.07, 95% CI=0.91-8.36). Interestingly, in the MICS 6, the adjusted model which considered the interaction of all household socio-demographic variables demonstrated modest potential in predicting child body weight (Wald's chi-squared = 0.04) (Table 11).

Table 11. Household Sociodemographic Determinants of Overweight/Obesity among Ghanaian Pre-schoolers (2-4 years) across the Study Years

Household Sociodemographic Characteristics	MICS 3 (2006)						MICS 4 (2011)						MICS 6 (2017/2018)					
	COR	p-value	95% CI	AOR	p-value	95% CI	COR	p-value	95% CI	AOR	p-value	95% CI	COR	p-value	95% CI	AOR	p-value	95% CI
Area																		
Rural	1.75	0.43	0.43-7.07	0.96	0.97	0.11-8.39	0.76	0.33	0.44-1.32	0.57	0.15	0.27-1.21	0.87	0.60	0.51-1.47	1.31	0.45	0.65-2.62
Urban (reference)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of Household members	1.11	0.25	0.93-1.32	1.09	0.57	0.80-1.49	0.97	0.44	0.89-1.05	1.01	0.89	0.88-1.17	1.00	0.97	0.92-1.09	0.97	0.69	0.84-1.13
Number of children <5 years	1.15	0.69	0.58-2.28	0.89	0.79	0.39-2.06	0.99	0.92	0.73-1.33	1.06	0.76	0.73-1.55	1.20	0.14	0.94-1.53	1.36	0.09	0.96-1.94
Number of rooms for sleeping	1.21	0.24	0.88-1.67	1.04	0.88	0.62-1.75	0.90	0.30	0.75-1.09	0.88	0.39	0.66-1.18	0.97	0.73	0.80-1.17	0.86	0.33	0.65-1.16
Age of Household Head	not available						not available						1.01	0.40	0.99-1.03	1.02	0.07	0.99-1.04
Sex of Household Head																		
Female	not available						2.18	**0.01**	1.22-3.90	2.35	**0.01**	1.24-4.45	1.30	0.35	0.75-2.26	1.44	0.24	0.79-2.62
Male (Reference)							-	-	-	-	-	-	-	-	-	-	-	-
Religion of Household Head																		
Religious affiliation	1.84	0.67	0.11-31.49	2.04	0.62	0.12-35.22	0.48	0.09	0.21-1.11	0.45	0.06	0.19-1.04	0.49	0.15	0.18-1.30	0.44	0.11	0.16-1.21
No religious affiliation (reference)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Education level of Household head																		
Primary	1.76	0.41	0.46-6.80	2.48	0.24	0.55-11.23	1.30	0.45	0.66-2.59	1.25	0.58	0.57-2.77	1.20	0.66	0.54-2.68	1.18	0.72	0.48-2.95
Middle School/JSS	0.59	0.50	0.13-2.66	1.02	0.98	0.17-6.18	0.58	0.16	0.27-1.24	0.68	0.43	0.26-1.78	1.15	0.70	0.58-2.28	1.22	0.67	0.49-3.02
Secondary+	0.95	0.96	0.16-5.83	1.14	0.92	0.08-16.23	1.29	0.51	0.60-2.80	1.69	0.35	0.56-5.09	0.96	0.94	0.34-2.75	1.33	0.66	0.38-4.67
Higher Education	not available						not available						3.43	**0.00**	1.60-7.38	3.19	0.07	0.90-11.32
No education (reference)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Education level of Mother																		
Primary	0.96	0.96	0.22-4.18	1.24	0.80	0.23-6.73	1.08	0.82	0.55-2.13	0.91	0.81	0.41-2.03	1.25	0.56	0.59-2.65	0.97	0.95	0.42-2.28
Middle School/JSS	0.70	0.63	0.16-3.03	1.54	0.64	0.25-9.32	0.85	0.65	0.42-1.71	0.78	0.60	0.30-2.02	1.18	0.61	0.61-2.29	0.84	0.68	0.36-1.94
Secondary+	1.86	0.50	0.31-11.13	5.03	0.24	0.34-75.26	0.91	0.86	0.30-2.75	0.34	0.18	0.07-1.66	0.57	0.41	0.15-2.15	0.30	0.12	0.07-1.36
Higher Education	not available						not available						3.86	**0.00**	1.67-8.91	0.99	0.99	0.27-3.66
No education (reference)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Household Wealth Index																		
Second	0.87	0.83	0.25-3.05	0.92	0.90	0.24-3.50	1.14	0.70	0.59-2.19	0.91	0.79	0.44-1.89	1.31	0.50	0.59-2.89	1.28	0.57	0.56-2.94
Middle	0.14	0.19	0.01-2.62	0.15	0.23	0.01-3.28	0.73	0.48	0.31-1.73	0.53	0.23	0.19-1.49	1.18	0.70	0.51-2.72	1.19	0.72	0.47-3.02
Fourth	0.51	0.47	0.08-3.15	0.49	0.57	0.04-5.92	0.38	0.15	0.10-1.40	0.28	0.09	0.06-1.23	0.88	0.79	0.34-2.26	1.05	0.93	0.34-3.23
Richest	0.53	0.49	0.09-3.23	0.27	0.45	0.01-7.90	1.74	0.16	0.80-3.79	1.44	0.59	0.38-5.36	2.61	**0.01**	1.28-5.36	2.75	0.07	0.91-8.36
Poorest (reference)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				Wald's Chi = 0.98						***Wald's Chi = 0.09***						***Wald's Chi = 0.04***		

Table 12. Summary of Household Sociodemographic Predictors of Overweight/obesity among Ghanaian Pre-schoolers (2-4 years) across the Survey Years

Household Sociodemographic Variables	MICS 3 (2006)	MICS 4 (2011)	MICS 6 (2017/2018)
Location/Area of Household	Not a significant predictor	Not a significant predictor	Not a significant predictor
Number of Household Members	Not a significant predictor	Not a significant predictor	Not a significant predictor
Number of children aged <5 years	Not a significant predictor	Not a significant predictor	Not a significant predictor
Number of Rooms for Sleeping	Not a significant predictor	Not a significant predictor	Not a significant predictor
Age of Household Head	Not a significant predictor	Not a significant predictor	Not a significant predictor
Sex of Household Head	Not a significant predictor	***Female Household Headship***	Not a significant predictor
Religion of Household Head	Not a significant predictor	Not a significant predictor	Not a significant predictor
Education Level of Household Head	Not a significant predictor	Not a significant predictor	Not a significant predictor
Education Level of Mother (n, %)	Not a significant predictor	Not a significant predictor	Not a significant predictor
Household Wealth Index (n, %)	Not a significant predictor	Not a significant predictor	Not a significant predictor

4.4.4. Home Environment determinants of Overweight/Obesity among Pre-schoolers (2-4 years)

In the MICS 3, there were no independent associations between overweight/obesity and home environment variables such as caregiver engagement in play activities with child (COR=0.66, p=0.64, 95% CI=0.12-3.72; AOR=0.72, p=0.71, 95% CI=0.13-4.05) or the availability of TVs/computers (COR=0.37, p=0.25, 95% CI=0.07-2.05; AOR=0.36, p=0.25, 95% CI=0.07-2.02) (Table 13). The adjusted model also failed to significantly predict overweight/obesity among pre-schoolers (Wald's chi-squared p=0.47) (Table 13).

Household dietary diversity (COR=0.97, p=0.70, 95% CI=0.85-1.11; AOR=0.99, p=0.87, 95% CI=0.86-1.14), the availability of play items in the home environment (COR=1.19, p=0.73, 95% CI=0.45-3.14; AOR=1.24, p=0.67, 95% CI=0.47-3.27), the engagement of the caregiver in the play activities with the child (COR=0.68, p=0.15, 95% CI=0.41-1.15; AOR=0.69, p=0.16, 95% CI=0.41-1.15), and the availability of TVs or computers (COR=0.73, p=0.31, 95% CI=0.40-1.34; AOR=0.74, p=0.35, 95% CI=0.40-1.38) were not associated with overweight/obesity among pre-schoolers in the MICS 4 (Table 13). The home environment variables modelled for that survey year could not also significantly predict overweight/obesity among pre-schoolers (Wald’s chi-squared=0.52) (Table 13).

In the MICS 6, there was no association between overweight/obesity and the availability of play items (COR=0.62, p=0.40, 95% CI=0.21-1.87; AOR=0.65, p=0.44, 95% CI=0.22-1.95), caregiver engagement in play activities (COR=0.81, p=0.44, 95% CI=0.46-1.40; AOR=0.79, p=0.41, 95% CI=0.45-1.38), or the availability of screens (COR=1.29, p=0.35, 95% CI=0.76-2.20; AOR=1.31, p=0.32, 95% CI=0.77-2.25) in the home environment. Similar to the results in reported for the MICS 3 and MICS 4, the home environment variables available in the MICS 6 adjusted model did not predict overweight/obesity among Ghanaian pre-schoolers (Wald’s chi-squared=0.53) (Table 13).

Table 13. Home Environment determinants of Overweight/Obesity among Pre-schoolers (2-4 years) across the Study Years

Home Environment Factor	MIC 3 (2006)						MICS 4 (2011)						MICS 6 (2017/2018)					
	COR	p-value	95% CI	AOR	p-value	95% CI	COR	p-value	95% CI	AOR	p-value	95% CI	COR	p-value	95% CI	AOR	p-value	95% CI
Household Dietary Diversity Score (HDDS)	not available						0.97	0.70	0.85-1.11	0.99	0.87	0.86-1.14	not available					
Availability of Play items/Toys																		
Yes							1.19	0.73	0.45-3.14	1.24	0.67	0.47-3.27	0.62	0.40	0.21-1.87	0.65	0.44	0.22-1.95
No (reference)	not available						-	-	-	-	-	-	-	-	-	-	-	-
Caregiver engagement in play activities with child																		
Yes	0.66	0.64	0.12-3.72	0.72	0.71	0.13-4.05	0.68	0.15	0.41-1.15	0.69	0.16	0.41-1.15	0.81	0.44	0.46-1.40	0.79	0.41	0.45-1.38
No (reference)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Availability of Screens (TV/Computer) in household																		
Yes	0.37	0.25	0.07-2.05	0.36	0.25	0.07-2.02	0.73	0.31	0.40-1.34	0.74	0.35	0.40-1.38	1.29	0.35	0.76-2.20	1.31	0.32	0.77-2.25
No (reference)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				Wald's chi-squared = 0.47						Wald's chi-squared = 0.52						Wald's chi-squared = 0.53		

4.5. Discussion

The current study sought to identify household socio-demographic factors that are associated with overweight/obesity among Ghanaian pre-schoolers aged 2-4 years using secondary data (the MICS surveys dataset- spanning 2006 to 2018). The study was also aimed to identify any obesogenic home environment factors that are associated with the weight status of pre-schoolers.

The results demonstrate that, across the survey years, there were no consistent household socio-demographic predictors or determinants of overweight/obesity. The analysis also showed no significant associations between overweight/obesity and the physical activity home environment, the home food environment, or the home media environment. A further analysis of the sociodemographic variables showed that the education level of the household head or child's mother/caregiver, and increased household wealth were consistent determinants of the home food, physical activity, and media environment across the study years. These findings are discussed in more details below.

4.5.1. Household Socio-demographic Risk Factors for Overweight/Obesity

4.5.1.1. Location of Household

The results of this study show that there is no association between the rural/urban location of households and overweight/obesity among children. This is in contrast to findings from a recent review examining sociodemographic determinants of childhood obesity in sub-Saharan Africa in which the authors reported that urbanicity is a significant predictor of increased child body weight (Kwansa et al., 2022). The findings of this current study are also in contrast with reports from a systematic review and meta-analysis conducted in the United States (Johnson & Johnson, 2015). The analysis included 10 studies (5 for the meta-analysis) in which 74,168 participants aged 2–19 were pooled and found that rural children had a 26% increase in the odds of obesity, compared to urban children (odds ratio=1.26; 95% confidence interval, 1.21–1.32).

In examining the relationship between urbanisation and obesity in low-and-middle income countries such as those in sub-Saharan Africa, it appears that the rate of urban development (rapid urbanisation) has resulted in an imbalance in urban exposures in favour of those factors that increase dietary intake, reduce physical activity, or impact on stress-related physiology (Congdon, 2019). These include, for example, greater proximity to fast foods and supermarkets that promote the consumption of processed foods, and improved transport systems that facilitate easier and faster access between places without the need for much physical body movement (Congdon, 2019). Although there has been some heightened awareness to improve access to healthy foods through national food policy changes, and a restructuring of the urban environment to promote physical activity (e.g., increase in the availability of parks, green spaces, and gym facilities), these have been inadequate to match the current trend of rapid urbanisation (Congdon, 2019).

The relationship between rural residence and obesity remains unclear. However, there are suggestions that in some rural economies, increased in household incomes, increased access to processed foods as a result of extended food marketing services, and mechanisation of farming activities are leading to significant increases in rural adiposity compared to urban adiposity (Bixby et al., 2019). It is suggestive of an increase in the risk factors for weight gain in rural areas, and an increase in protective factors and successful obesity prevention programmes in urban areas. However, this is yet to be evidenced.

Unlike in previous studies, this study found no association between rural/urban residence and overweight/obesity. This could be because, in this population of 2-4-year-old children, the exposure for obesity among both rural and urban households may be similar/or not significantly different. It may also suggest that the rural/urban gap could be narrowing/closing up with areas that were formerly classified as "rural" gradually progressing towards some form of urbanisation. It also suggests a progressive revision of the classification of geographical areas as "rural" or "urban" in obesity research, as some authors have noted that maintaining this dichotomous classification over time may result in the misidentification of households and invalid analyses (J. A. Johnson & Johnson, 2015).

4.5.1.2. Household Size

This study found no evidence in support of an association between household/family size and obesity among children. Inconsistencies remain in the association between household size and excessive child body weight (Kwansa et al., 2022). Mamabolo et al., (2005), for example, in their study of 162 3-year-old black South African children, showed that there was no association between household density and overweight/obesity even when the number of household members was increased from 5-8 (AOR=5.35, 95% CI=0.72-9.81) or 9 and beyond (AOR=7.61, 95% CI=0.70-12.21). Conversely, Tadesse et al., (2017) reported in their study exploring the factors associated with overweight/obesity among private kindergarten school children in Northwest Ethiopia that, having a family/household size of less than 5 was significantly associated with an increase in the odds of overweight/obesity (COR=3.44, 95% CI=1.45-8.12; AOR=4.76, 95% CI=1.84-12.31). Possible mechanisms for the protective influence of increasing family/household size on overweight/obesity have been suggested. These include the possibility of increased competition/sharing for/of food resources, increased family mealtime social structures, and increased caregiver dietary supervision (Datar, 2017). Further research in this area is needed to fully understand the dynamics between family size/household size and overweight/obesity among children.

4.5.1.3. Number of Children Less than 5 years

The results of this study showed that the number of children in the household aged less than 5 years had no association with overweight/obesity. Although evidence in this area of research are limited, the few existing studies have reported similar outcomes, i.e., no significant associations between the number of children aged 5 or less and overweight/obesity among pre-schoolers. For example, Mamabolo et al., (2005) in their study examining the determinants of weight gain among 3-year-old South African children found no association between under-five household density and child overweight (COR=2.62, 95% CI=0.63-10.85).

The number of children less than 5 years in the household is a specific measure of household density that focuses more on children under 5 years. It has been suggested from studies assessing malnutrition among pre-schoolers, that the number of children less than 5 years who reside in a household may influence the household distribution of resources related to care (Bertrand, 2018). In terms of childhood obesity, it is possible that this distribution of resources that relate to caregiving may impact on food choices and feeding practices employed by caregivers in the household. This suggests that households with a smaller number of children aged 5 or less, may provide greater access to toddler food resources for example, compared to households that have a larger number of children aged 5 years or less. However, much more evidence in support of this idea is needed.

4.5.1.4. Number of Rooms for Sleeping

The results of this study demonstrate no association between the number of rooms for sleeping and child body weight. The number of rooms for sleeping is another measure/derivative of household density (Bertrand, 2018), which may provide insight into living conditions within the household. Differences in living conditions have also been suggested to contribute to weight gain. In particular, it is thought that a reduction in the number of rooms for sleeping is indicative of overcrowding, and overcrowding could potentially create barriers to health, leading to excessive body weight (E. C. Chambers et al., 2010). An association between the number of rooms for sleeping and overweight/obesity is however yet to be evidenced.

4.5.1.5. Age of Household Head

The age of the household head was not associated with child body weight in this study. In the wider literature, the evidence in support or otherwise of a relationship between the age of the household head and overweight/obesity among children is limited and inconsistent. For example, Mphekgwana et al., (2022) investigated the household head sociodemographic determinants of overweight/obesity among 294

adolescents in South Africa, and reported a significantly increase in the odds of overweight/obesity with older household heads (45-54 years) (OR=3.72, p=0.02, 95% CI=1.20, 11.50). Conversely, in exploring the risk factors for obesity among 4000 children is South Africa (1-20 years), Kimani-Murage et al., (2013) found no associations between the age of the household head and child obesity. An increase in the age of the household head may reflect a higher level of experience in caregiving and resource distribution compared to younger household heads. However, there is little evidence in support of any significant associations with overweight/obesity, and more research in this area is recommended.

4.5.1.6. Sex of Household Head

The findings of this study showed that sex of the household head was not a predictor of excess child body weight across the 3 surveys. This is consistent to the evidence from several studies reporting similar findings. For e.g., in SSA, Masibo, (2013) and Sserwanja et al., (2021) have shown that there may not be a strong relationship between the sex of household head and overweight/obesity. Sserwanja et al., (2021) examined the risk factors for overweight and obesity among 0-5-year-old children in Uganda using nationally representative data, and reports that the sex of the household head was not associated with child body weight (COR=0.76, 95% CI=0.53-1.08); AOR=0.74, 95% CI=0.48-1.15). Masibo, (2013) also examined the trends in overweight and obesity among Kenyan children aged 0-59 months using national surveys from 1993 - 2008/2009. Their findings suggest no significant differences in the association between overweight and obesity among children and male-household/female-household headship across the survey years (1993 (AOR=1.00, 95% CI=0.7-1.5), 1998 (AOR=0.8, 95% CI=0.5-1.1), 2003 (AOR=1.1, 95% CI=0.8-1.6), 2008-2009 (AOR=1.0, 95% CI=0.7-1.5)). It is noteworthy to mention that female household headship remained a significant predictor of child body weight only in the MICS 4, providing some form of confirmation to the evidence from Ghana that household headship may be shifting from males to females (Shandorf-Ardayfio, 1995).

Household headship is a function of household leadership in decision-making and resource distribution. In Ghana, more women are engaged in more viable income activities as a result of governmental and non-governmental interventions, challenging the traditional idea of decision-making and resource allocation in the household being dominated by males/men (Shandorf-Ardayfio, 1995). There is evidence to support the idea that Ghanaian women who gain access to strategic resources also become key managers of property and their decision-making functions are largely enhanced (Shandorf-Ardayfio, 1995). It has been shown that for female household heads, the level of decision-making is a function of her education level, implying that the higher her education level, the higher her influence on decision-making in the household

(Shandorf-Ardayfio, 1995). Additionally, there is some evidence to suggest that in these households, children tend to be the major beneficiaries of household resources (Shandorf-Ardayfio, 1995). However, since the findings of this study with respect to the sex of the household head are inconsistent across the study years, further studies examining this association are recommended.

4.5.1.7. Religion of Household Head

Among pre-schoolers aged 2-4 years, parents' religion was not a significant predictor of body weight. Although studies examining the relationship between religion and obesity have been conducted among adults in developed countries, the results of this study appear to align with findings by Spence et al., (2022). In their study, the researchers examined associations between aspects of religious affiliation, such as religious service attendance, among 35,547 female nurses in the Nurses' Health Study II cohort in the USA, and reported no significant associations with obesity or weight change. Conversely, Lycett (2015) using the 2012 Health Survey data for England to establish the association between religious affiliation and obesity among adults aged 16 and over, reported that religious affiliation was significantly associated with a 0.91kg/m^2 increase in BMI. Additionally, a recent systematic review of quantitative studies examining the association between religion and overweight/obesity has shown that religiosity was consistently associated with higher body weight in cross-sectional analyses (Yeary et al., 2017).

It appears that religious affiliation could have either protective or predisposing influences on obesity, and that the direction of the association remains unclear. On one hand, it has been suggested that religious guidance on eating, such as fasting or abstaining from certain foods, may help in controlling body weight (Marini, 2020). For example, in Islam and Judaism, fasting is a regularly mandated practice, while in Catholicism, gluttony is abhorred. This suggests that religion may impact on body weight through moderation or some level of restriction in food consumption. There are also other suggestions that the availability of social groups and support networks within religious groups may provide individuals with overweight/obesity with options for weight loss or prevent weight gain among normal-weight individuals through physical activity programmes for example (Lycett, 2015).

On the other hand, there are suggestions that religion may impact on body weight through the promotion of food consumption and increased sedentary behaviour (Yeary et al., 2017).

It is unclear why no relationship was found between religion and obesity in the households of Ghanaian pre-schoolers from the current study. More studies on the relationship between religion and body weight are recommended, especially in developing countries where large proportions of the population remain

religious (Amuna & Zotor, 2008), and are experiencing rapid epidemiologic/nutrition transitions (Amuna & Zotor, 2008).

4.5.1.8. Education Level of Household Head/Mother

This study did not find a consistent association across the survey years between the education level of mothers or household heads and overweight and obesity among children. In the wider literature, this association appears to vary depending on the level of economic development or the geographical region where the household is located.

In most developed countries, increasing levels of caregiver education have been shown to be protective of adiposity in children. In the USA, for example, Ogden et al., (2010) in their study of obesity and socioeconomic status among children and adolescents using data from the 2003-2008 National Health and Nutrition Examination Surveys (NHANES) concluded that children and adolescents residing in households in which the head of household had a college degree were less likely to be obese/overweight compared with those living in households where the household head had less education.

In developing countries such as in sub-Saharan Africa (SSA), Kwansa et al., (2022) have demonstrated that the evidence in support of an association between maternal education and child adiposity has been inconsistent. Gewa, (2010), for example, examined the association between overweight/obesity among 1495 3-5-year-old Kenyan pre-schoolers and maternal and early child nutritional factors, and found that compared to mothers with no education, attaining primary or secondary education was positively associated with a 72% to 91% increase in the odds of having an overweight or obese child. (Sorrie et al., 2017b) on the other hand, showed that among 504 Ethiopian children aged 3-5 years, overweight or obesity was reduced by 65% if their mothers had attained secondary education.

The education level of caregivers may influence the home environment of pre-schoolers through modifications in caregiver knowledge and attitudes about dietary intake, physical activity, screen time, and sleep. There is also a possible interaction between the education of caregiver, the income level of caregiver and cultural perceptions of overweight and obesity that may impact on home environment characteristics such as parent feeding practices and parent food choices. These may in turn result in child adiposity. Incontrovertible evidence in support of this interaction is needed, and an assessment of this interaction across different geographical settings may provide more insight into how the risk of excess child body weight is elevated as a result of increasing levels of education of caregivers.

4.5.1.9. Household Wealth

The results of this study also show inconsistent associations between household wealth and overweight/obesity among Ghanaian pre-schoolers. In the literature, the evidence in most developed countries has shown a social gradient in overweight/obesity among children towards poorer households, while in developing countries findings suggest that childhood obesity is a problem of the rich (Dinsa et al., 2012).

In the USA, using nationally representative data from the Panel Study of Income Dynamics from 1994 to 2013, Boen et al., (2021) confirmed that increasing household wealth is negatively associated with increases in child BMI. Another study by Jo, (2014) using data from the Early Childhood Longitudinal Study Kindergarten Class of 1998-1999 (ECLS-K) in the USA has reported a consistently strong but negative association between family income (household wealth) and excessive child body weight.

In contrast, in LMICs, (Dinsa et al., 2012) have shown that regardless of the measure of obesity or overweight used, household income or wealth status was a significant risk factor for increased child adiposity. For example, in sub-Saharan Africa, Wolde & Belachew, (2015) examined factors associated with overweight and obesity among 358 3-5-year-old Ethiopian pre-schoolers, and demonstrated that child adiposity was 3-4 times more likely to occur in rich households than in poorer households.

Household wealth is an indicator of the purchasing ability and ownership of assets among working members of the household. In more developed countries, it has been suggested that the inverse association between child adiposity and household wealth among low income/poorer households is indicative of reduced household spending on healthier food options and reduced opportunities for physical activity, as well as family stress processes (Boen et al., 2021). Poorer households in these settings tend to have increased access to low-cost energy-dense foods and increased sedentary behaviour, which subsequently lead to weight gain among children.

In LMICs however, wealthier households have greater access to energy-dense and processed foods (Y. Wang & Lim, 2012) which are more expensive and are marketed on many media outlets as products for the affluent. In addition, there are also observations of increased sedentary behaviour among more affluent households (Y. Wang & Lim, 2012), with increased availability and access to more expensive household assets/items such as cars, TVs, computers, smartphones, and electronic tablets. This suggests that regardless of geographic location, household socio-economic dynamics which predispose population sub-groups (based on the allocation and use of financial resources) to energy-dense foods and reduced physical activity may be partly responsible for weight gain among children.

Recent studies of household wealth and child BMI in LMICs suggest a gradual reversal in trends from a positive relationship to an inverse relationship, as most developing countries transition from low- to middle- and high-income status (Templin et al., 2019). Further monitoring of this relationship, especially among pre-schoolers in LMICs, is recommended.

4.5.2. Home Environment Determinants of Overweight/Obesity

4.5.2.1. Home Food Environment - Dietary Diversity

The results of this study suggest that there is no relationship between dietary diversity and overweight/obesity among Ghanaian pre-schoolers. This is in contrast to findings in a recent review which has demonstrated strong links between dietary diversity and pre-schooler weight status in SSA (Kwansa et al., 2022).

In Ethiopia, Tadesse et al., (2017) assessed the factors associated with adiposity among 3-6-year-old kindergarten children and found that the odds of overweight or obesity was higher among children with high dietary diversity (AOR=5.12, 95% CI (1.42, 18.47)). In similar studies conducted in Ghana and Cameroon, no association was observed between body weight and dietary diversity among pre-schoolers (Kumordzie et al., 2020; Said-Mohamed et al., 2009b).

Dietary diversity has been used as an indicator of household food security. However, the way in which it impacts on body weight and the nutritional status of children is yet to be fully elucidated. Among low-income households, one possible suggestion is that because members in these households are more likely to be food-insecure or at risk of low dietary diversity because of reduced food purchasing options, they may be compensating for this by increasing their consumption of low-cost, but high-caloric, energy-dense foods. They may also be compensating for this lack of food security by increasing their consumption of large portion sizes of whatever limited food options may be available in their home environments. This could ultimately account for increases in obesity or overweight among members from these households, including children/pre-schoolers.

In high-income households, it is expected that high household dietary diversity results in an increase in the consumption of a healthy variety of foods, leading to protection against weight gain. In low-income households however, the relationship between high dietary diversity and overweight/obesity has been unclear. There are suggestions that among low-income households, the relationship that has been observed between high dietary diversity and adiposity is partly mediated by an increase in dietary consumption or an increase in portion size intake (Sorrie et al., 2017b).

More recently, some authors have suggested that dietary diversity is a better indicator for micronutrient adequacy, rather than body weight or obesity (Zhao et al., 2017a). It is recommended that future studies identify or consider other standard measurements of household food availability that may provide more consistent relationships with body weight, especially among children.

4.5.2.2. Home Physical Activity Environment – Availability of Play Items and Caregiver Involvement in Child's Play Activities

Data from this study is not supportive of an association between the home physical activity environment and overweight/obesity among Ghanaian pre-schoolers. In the wider literature, a few high-quality studies, mainly from high income countries , have examined the impact of the availability of play items or caregiver physical activity (PA) support on pre-schooler adiposity (Kininmonth, Smith, et al., 2021). These studies however, overall, show no consistency in the relationship between the home physical activity environment and childhood overweight/obesity (Kininmonth, Smith, et al., 2021). Among older children (8-10 years) in Canada for example, Fitzpatrick et al., (2019) conducted a longitudinal analysis using data from the Quebec Adipose and Lifestyle Investigation in Youth study (QUALITY) to examine the associations between the availability of play items and adiposity. They found that an increase in the variety of indoor play items was related to low adiposity. Within the same study however, the authors observed no association between the later child BMI z-scores and the play environment, similar to our findings.

One possible reason for observing no associations between the home physical activity environment and child weight outcomes could be the inherent limitations posed by the MICS datasets, i.e., no original variables measuring the home PA environment. This limitation however necessitated the creation of home PA variables from other related variables for use in this analysis. Further studies in this area are recommended.

4.5.2.3. Home Media Environment – Availability of Screen Devices

Our analysis shows that, across all the survey years, no association between the home media environment and excessive child body weight was found. This is in contrast with findings from a recent review that reported that among children spanning the pre-school years, the home media environment has most consistently been associated with overweight/obesity (Kininmonth, Smith, et al., 2021). The availability and access of screens in the home environment for example appear to have an influence on child BMI through the amount of daily screen time exposure, the location of the screen in the child's bedroom, and the type of screens available and accessible by the child (e.g., TVs, computers, smartphones, tablets, and game

consoles). There are also suggestions that home media/screen time availability may influence body weight through dietary changes resulting from an increased exposure to advertising and marketing of obesogenic foods, a reduction in sleep duration, and an increase in sedentary behaviour/reduced physical activity.

Findings from earlier studies have also been consistent regarding the association between home media environment and excessive child body weight. For instance, Sijtsma et al., (2015) examined the interaction between screen time, having a television in the bedroom, the number of televisions at home, and child body mass index (BMI) among 759 preschool children (3–4 years old) who were part of the Groningen Expert Centre for Kids with Obesity (GECKO) Drenthe birth cohort study. They found that a television in the bedroom, or more televisions at home resulted in a higher screen time, which had an impact on children sleep duration and increased BMI (indirect effect=0.0115, 95 % bootstrap interval=0.0016; 0.0368 and indirect effect=0.0026, 95 % bootstrap interval=0.0004;0.0078, respectively).

Schrempft et al., (2015) have suggested in their work assessing the obesogenic quality of the home environment, that children are more likely to associate eating with watching TV as a result of TV advertisements. TV advertisements essentially influence the types of foods desired, requested, and eaten by children, suggesting that branding strategies used for TV adverts have strong influences on child eating behaviour (Boyland & Halford, 2013).

In this current study, it remains unclear why no associations between the home media environment and child obesity were identified in this study. This could presumably result from limitations in generating valid home media environment data for the analysis. Further studies in this area of research are needed.

4.5.2.4. Sociodemographic Determinants of the Home Environment

Our analysis also sought to find out whether there were any associations between household sociodemographic characteristics and the home food environment, the home physical activity environment, and the home media environment. The results suggests that that across all the survey years, the education level of the household head/child's mother and household wealth were consistent determinants of the home environment.

There is scanty information about the sociodemographic determinants of the home environment in the wider literature. This is perhaps because research into overweight/obesity and the home environment using the current conceptual framework is still in its early phase of development. However, there is evidence to suggest that caregiver's education and household income may be related (Turčínková & Stávková, 2012) and thus may represent the capacity to acquire items such as food, play equipment, and media devices into the home environment. There are also some indications that in low-income countries

the relationship between caregiver's education, household income, and paediatric overweight/obesity may be mediated by the acquisition of these items into the home environment (Dinsa et al., 2012).

As shown in 1.5.1.8 and 1.5.1.9 above, the education level of the mother or caregiver and household wealth were not consistent predictors of pre-schooler weight gain. However, these remained significant determinants of the availability of food, play equipment, and media devices in the home environment. These findings are suggestive that in terms of child overweight/obesity, although households may not differ significantly in caregiver education level and household income, they may differ significantly in caregiver spending preferences. However, these spending preferences for the home environment may also not be contributing significantly to child overweight/obesity, as evidenced in this study in 1.5.2. Since the majority of these spending preferences are in relation to the availability of items in the home environment, the other aspects of the home environment that are limited or lacking in this study, i.e., social aspects of the home environment are recommended for future studies on excessive body weight among Ghanaian pre-schoolers. Further research on the social and economic determinants of both the physical and social aspects of the home food, home PA, and home media environments are needed.

4.6. Strengths and Limitations of the Study

Because the MICS data was originally collected for other purposes other than for the objectives of this study, relevant socioeconomic variables such as the employment status and the income of caregivers were unavailable for analysis. There is also the possibility that more than one child per household was sampled in the surveys, since the under-five questionnaires were administered to mothers or caregivers of all children under five in each household. However, it is assumed that the very large sample sizes across each survey provides enough statistical power to detect any important statistical estimates. The generation of home environment variables from some of the MICS variables is not standard practice and may have introduced limitations that altered the outcome of the analysis.

4.7. Conclusions and Recommendations

The results of this study highlight inconclusive evidence on the sociodemographic determinants of weight gain among Ghanaian pre-schoolers aged 2-4 years. Further studies are required to gain more understanding of how household sociodemographic characteristics are related to pre-schooler obesity through modifications in the home environment.

Chapter 5 Home Food Environment Factors Influencing Overweight and obesity among Ghanaian Pre-schoolers aged 2-5 years.

Summary

This chapter builds on the previous chapter and presents yet-to-be-published findings on the home food environment of Ghanaian pre-schoolers. The study attempts to confirm or otherwise, the association between household dietary diversity and child overweight/obesity as evidenced from chapters 3 and 4. Additional home food environment factors such as caregiver food feeding practices not previously identified in the data from the systematic review and the analysis of the Ghana MICS survey data were included here for analysis. Child eating habits were also examined as possible mediators between caregiver food feeding practices and paediatric overweight/obesity.

5.1. Abstract

Introduction

In Sub-Saharan Africa (SSA), there appears to be a strong association between the home food environment and child body weight. The home food environment consists of both physical and social aspects. The physical aspects deal with the physical availability of items such as food, while the social aspects deal with the manner in which eating and feeding occur. In the wider literature, there are reports of potential associations between household dietary diversity, a proxy measure of the availability of food in the home, and overweight and obesity among children. There are also reports of feeding practices including caregiver restriction of food intake linked to weight gain in children. SSA, and Ghana in particular, is experiencing an increase in the prevalence of paediatric obesity. However, little attention has been given to the home food environment as a potential area of study to understand how this may act as a risk or protective factor for paediatric obesity. Children aged 2-5 years in particular constitute a sub-population of interest because it has been shown that the presence of obesity or overweight at this developmental stage is commonly associated with later adolescent and adult weight gain. Children within this age group have also been shown to exhibit unique behaviours related to food and feeding. It is unclear how interactions with food in the home environment is associated with the early development or establishment of excessive body weight among Ghanaian pre-schoolers. To fill this research gap, this study sought to examine how household dietary diversity and caregiver feeding practices may influence child body weight among Ghanaian pre-schoolers.

Methods

A cross sectional survey was conducted with caregivers of pre-schoolers in Kumasi in the Ashanti region of Ghana. The Household Dietary Diversity Q (HDD) and the Comprehensive Feeding Practices (CFP) Questionnaires were administered to 209 caregiver-preschooler dyads in Kumasi, Ghana, between July and September 2022, to examine the association between the access and availability of foods in their homes, the feeding practices employed by caregivers, and BMI z-scores of their pre-school children. The Child Eating Behaviour Questionnaire (CEBQ) was additionally administered to participants to understand how the home food environment could influence the eating behaviours of pre-schoolers. Confirmatory factor analysis (CFA) and Exploratory Factor Analysis (EFA) was performed on the CFPQ and the CEBQ to obtain setting-specific measures of caregiver feeding practices and child eating behaviour, while household dietary diversity scores were generated from participant responses to the HDDQ.

Results

The study found that restrictive caregiver feeding practices, a reduction in child satiety responsiveness, and an increase in the child's enjoyment of food were significant predictors of overweight/obesity and increasing child BMI z-scores. Household dietary diversity had no associations with excessive child body weight. Additionally bi-directional relationships between caregiver feeding practices (including restriction, pressure to eat, encouragement of balance/variety, and emotion regulation) and child eating behaviour (food responsiveness, enjoyment of food, desire to drink, and slow eating) were identified.

Conclusion

This study provides further confirmation of the relationship between child eating behaviour and child body weight, in particular that an increase in food approach and/or a reduction in satiety responsiveness is linked to overweight/obesity. Social aspects of the home food environment (caregiver food feeding practices), appear to be more influential than its physical aspects (Household dietary diversity) in increasing the body weights of Ghanaian toddlers. Restrictive caregiver food feeding practices in particular may have the potential to shape the eating behaviour and body weight of Ghanaian pre-schoolers.

5.2. Introduction and Rationale for Study

The environment is generally recognised as a significant contributor to overweight and obesity (Albuquerque et al., 2017; Silventoinen et al., 2016), and it is believed to exert its influence through changes in behaviour that promote energy imbalance in favour of energy intake (Kremers et al., 2006).

The home environment in particular appears to be a crucial setting for the development of excessive weight during childhood (S. G. Schrempft, 2014; Strauss & Knight, 1999a). Different aspects of the home environment have been identified as potential contributors to childhood weight gain, and these include the home food, home physical activity, and home media environments (Kwansa et al., 2022; Kininmonth et al., 2021; Pinard et al., 2012; Rosenkranz & Dzewaltowski, 2008). In Sub-Saharan Africa (SSA), there appears to be a strong association between the home food environment and child body weight, although there is currently limited evidence for the other aspects of the home environment, i.e., the home physical activity and home media environments (Kwansa et al., 2022). Recommendations have been made for further studies into how the home food environment may influence early childhood weight gain in SSA (Kwansa et al., 2022).

The home food environment consists of both physical and social aspects (Kininmonth, Smith, et al., 2021). The physical aspects deal with the physical availability of items such as food, while the social aspects deal with the manner in which eating and feeding occur (Kininmonth, Smith, et al., 2021). In the wider literature, there are reports of potential associations between household dietary diversity, a proxy measure of the availability of food in the home, and overweight and obesity among children (Salehi-Abargouei et al., 2016; Sorrie et al., 2017a; Tadesse et al., 2017b). There are also reports of feeding practices including caregiver restriction of food intake linked to weight gain in children (Clark et al., 2007; Fisher & Birch, 1999). Food approach (expression of an avid appetite, e.g. enjoyment of food or emotional overeating) and food avoidance behaviours (expression of smaller appetites, e.g. food fussiness or slowness in eating) exhibited by children also appear to be associated with weight gain (Carnell & Wardle, 2007). Additionally, bidirectional relationships between caregiver feeding practices and child eating behaviours, i.e., child eating behaviours influencing caregiver feeding practices, e.g., caregiver restriction of food intake in response to child food approach behaviours, and caregiver feeding practices influencing child eating behaviours, e.g., slowness in eating in response to caregiver pressure feeding (Costa & Oliveira, 2023), may be implicated in the development of paediatric overweight/obesity. Caregiver feeding practices and child

eating behaviours are key aspects of the home food environment that are modifiable and therefore serve as potential targets for parent/home interventions against excessive childhood weight gain.

SSA, and Ghana in particular, is experiencing an increase in the prevalence of paediatric obesity (Ayele et al., 2022; Kobia-acquah & Akowuah, 2020). However, little attention has been given to the home food environment as a potential area of study to understand how this may act as a risk or protective factor for paediatric obesity. Children under the age of five in particular constitute a sub-population of interest because it has been shown that the presence of obesity or overweight at this developmental stage is commonly associated with later adolescent and adult weight gain (Dietz, 1997; Evensen et al., 2016; Glavin et al., 2014; Singh et al., 2008). Children within this age group have also been shown to exhibit unique behaviours related to food and feeding (Paroche et al., 2017). It is unclear how interactions with food in the home environment is associated with the early development or establishment of excessive body weight among Ghanaian pre-schoolers.

To fill this research gap, this study sought to examine household dietary diversity, caregiver feeding practices and child eating behaviour, and how they associate with child body weight among Ghanaian pre-schoolers.

Specifically, the primary aims of this study were to:

1. Evaluate the relationship between child overweight/obesity and culturally relevant child eating behaviours in the home environment of Ghanaian pre-schoolers aged 2-5 years.
2. Evaluate the relationship between child overweight/obesity and culturally relevant caregiver feeding practices in the home environment of Ghanaian pre-schoolers aged 2-5 years.
3. Evaluate the relationship between child overweight/obesity and household dietary diversity in the home environment of Ghanaian pre-schoolers aged 2-5 years.
4. Examine the relationship between pre-schooler eating behaviours and caregiver feeding practices in Ghanaian households.

5.3. Materials and methods

5.3.1. Study Setting

This study was carried out in Kumasi, the major city of the Ashanti Region in Ghana (74% of the total population of the Ashanti Region (Acheampong et al., 2017)). The Ashanti Region is also the most populous region, with one of the highest prevalence of childhood obesity in Ghana (12.5% (Kobia-acquah & Akowuah, 2020)). Within the city, early research indicates that this prevalence may be influenced by sociodemographic and dietary factors such as increasing household wealth, and fast food intake (Obirikorang & Anto, 2015). Population-level reductions in physical activity have also been reported among children (Aryeetey et al., 2017).

5.3.2. Study Design

This study was a community-based, cross-sectional study.

5.3.3. Participants

Participants for this study were caregivers and their pre-schoolers aged 2-5 years attending Sunday schools (classes that are organised by some churches for children) in Kumasi, Ghana. Sunday schools were chosen for this study because apart from most of these children attending mainstream or private nursery schools, the available literature from Ghana has not shown consistent or significant associations of religion with excessive weight gain among children. Children were included in the study if they had resided with their caregivers for a minimum of one year in the same household. This criterion ensured that caregiver-toddler dyads who were recruited into the study had fairly consistent experiences of the home food environment. For example, any period that was less than 1 year, e.g., 6 months, was not considered to be adequate proof of consistency in the child's home food environment. Participants were excluded if they had any conditions that could affect their body weight such as having a physical disability. If more than one pre-schooler was available for each household, caregivers were given the opportunity to select one child to represent that household.

5.3.4. Participant Recruitment

Recruitment took place in churches with Sunday school sessions that were run as part of church services. Ten churches were conveniently selected for their members meeting the criteria for recruitment into the study. The recruited of eligible pre-schoolers and their mothers took place between July and September 2022, after gaining permission from the church leaders to do so. The sample size for the study was calculated using Cochran's (Cochran, 1977) formula:

$$n = {Z^2 p(1-p)}/{d^2},$$

Where **n** represents the sample size, **Z** represents the standard normal probability statistic at the desired confidence level, **p** is the expected prevalence of obesity or overweight among pre-schoolers aged 2-5 years in the Ashanti region, and **d** is the expected level of precision or margin of error. Prevalence estimates for overweight and obesity among Ghanaian children aged 5 years and below have been reported to be approximately 2% (Atsu et al., 2017). For this study, a confidence level of 95% and an error margin of 0.02 were chosen *a priori*. Thus, for this study, a **Z** statistic of 1.96, a prevalence (**p**) of 0.02, and an error margin (**d**) of 0.02 were used to calculate the sample size.

$$n = {1.96^2 . 0.02(1-0.02)}/{0.02^2}$$

$$n = 188$$

This number was subsequently adjusted by 10% to 207 to accommodate for any non-responses. The 10% adjustment was chosen for this study based on my expectations of drop-out/non-response rates from obesity research that I had conducted for my previous postgraduate studies in Ghana.

5.3.5. Data Collection

Paper questionnaires were administered by the study team to the selected participants, with the aim of seeking to find out more about the access and availability of foods in their homes, the feeding practices employed by caregivers, and the eating behaviours of their pre-school children. To ensure rigor and quality control in the collection of the study data, I organised and supervised online training sessions for the study team from KNUST. These sessions involved training on questionnaire administration and the collection of anthropometric measurements. Over the duration of data collection by the study team in Ghana, I also requested the weekly transfer of completed study forms/questionnaires via a secure server at the University of Sheffield, in order to check/ensure that they had accurately/adequately been filled.

5.3.5.1. Assessment of Household food availability

The access and availability of food in the home environment was measured using the Household Dietary Diversity Questionnaire (FAO, 2010). This questionnaire has previously been used for the qualitative measurement of household food consumption of 12 food groups: cereals, roots and tubers, vegetables, fruits, meat and poultry, eggs, fish and seafood, legumes and nuts, milk and milk products, fats and oils, sugary foods/sweets, and beverages (Swindale & Bilinsky, 2006). This questionnaire was adopted because of its strengths in being open-ended (allowing the recall of a wide variety of specific foods consumed in the

past 24 hours) and being standardised by the Food and Agriculture Organisation (FAO) for use in many cross-border or international studies.

5.3.5.2. Assessment of caregiver feeding practices

This was measured using the Comprehensive Feeding Practices Questionnaire (CFPQ) that was designed by Musher-Eizenman & Holub (2007) and has been validated by many researchers for use among pre-schoolers. The CFPQ consists of 49 items that measure caregiver feeding domains including monitoring, regulation of child's emotions, using food as a reward, child control, modelling of eating, restricting eating for the purposes of weight control, restricting eating for general health purposes, teaching about nutrition, encouraging food variety, pressuring children to eat, the home environment, and the levels of parental involvement in child feeding and food choices. The CFPQ was chosen for its strengths in examining a broad range of parent-specific feeding practices that fall within 3 currently accepted categories of food feeding practices, namely. structure, autonomy support, and coercive support (Vaughn et al., 2016).

5.3.5.3. Assessment of child eating behaviour

The Child Eating Behaviour Questionnaire (CEBQ) (Wardle et al., 2001) was administered to caregivers to measure the eating behaviour of children. This is a 35-item instrument that has been extensive validity and reliability for use among pre-schoolers (de Lauzon-Guillain et al., 2012) to measure aspects of feeding behaviour such as food responsiveness, emotional undereating, enjoyment of food, emotional overeating, slow eating, food fussiness, satiety responsiveness, and the desire to drink.

5.3.5.4. Anthropometry assessment of children nutritional status

Child anthropometric indices (height and weight) were measured to evaluate their nutritional status. The heights of children were measured using a portable stadiometer, while their body weights were measured with a Seca® Digital weighing scale. Light or minimal clothing with shoes off was recommended to participants prior to taking body weight measurements. Weight was measured in kilograms (kg) while height was measured in centimetres (cm) with the help of two study staff; one designated team member took the body measurements of participants, while another team member recorded the measurements while observing the process to ensure that measurements were being accurately taken.

5.3.6. Data analysis

Questionnaire items for the CEBQ and CFPQ were first scored and a confirmatory test of the underlying factor structure/latent variables of the instruments using confirmatory factor analysis (CFA) was performed. Confirmatory factor analysis of the CEBQ and CFPQ was necessary for the purposes of

confirming whether or not the factor structures from the original design studies had been replicated in this sample. Confirmation of the underlying factor structure of the instruments was necessary for two reasons; firstly, because there is evidence of a high sensitivity of both instruments to ethnic and cultural differences (Loh et al., 2013; Mallan et al., 2013); secondly, this was the first time that these questionnaires have been applied to a sample of Ghanaian pre-schoolers. Exploratory factor analysis (EFA) was performed if the original factors were not replicated. Household dietary diversity scores were generated for each household using the guidelines for scoring from the Food and Agriculture Organisation (FAO, 2010). Logistic regression analysis was used to identify independent associations between child overweight/obesity, caregiver food feeding practices, household dietary diversity, and child eating behaviour. STATA/MP version 17 for Windows was used for all logistic and linear regression analysis.

Details of these tests and calculations are presented below.

5.3.6.1. Evaluation of child overweight/obesity

Child BMI z-scores were calculated from child weight (kg) and height (m) measurements using WHO AnthroPlus, and categorised based on WHO recommendations into 6 groups, i.e., <-3 (Extremely wasted), -3 to -2 (Wasted), -2 to 1, (Normal Weight), 1 to 2 (At Risk of Overweight/Obesity), 2 to 3 (Overweight), and >3 (Obese). Child body weight was utilised as both continuous and categorical dependent variables in the identification of independent associations with child eating behaviour, parent feeding practices, and household dietary diversity. In particular, this analysis utilised the "Overweight/Obese" subgroup as the exposure group, and "Normal weight" and as the comparison group in logistic regression analyses. BMI z-score categories were coded as "0" for "Normal Weight" and "1" for "Obese/Overweight".

For logistic regression analyses, the Firth Logistic Regression method was used. This method was preferred because of its unique ability to reduce the bias generated by maximum likelihood ratios in data which exhibits complete or quasi-separation, i.e., complete distribution of the outcome towards one level of a predictor variable, which was likely to occur in this analysis based on the expected prevalence of overweight/obesity and the size of the sample. Firth logistic regressions were reported as crude odds ratios (COR) with their 95% confidence intervals (CIs) and their level of significance measured at $p<0.05$. Multivariate firth logistic regressions were reported as adjusted odds ratios (AOR), with their 95% confidence intervals (CIs) and their level of significance measured at $p<0.05$. Odds ratios and 95% CIs less than 1 were described as a significant reduction in the odds of occurrence of the predictor, while odds ratios and 95% CIs more than 1 were described as a significant increase in the odds of the predictor. Odds ratios and 95% CIs equal to 1 were described as not significantly associated with overweight/obesity.

When BMI was analysed as a continuous dependent variable, simple linear regressions with feeding practices scores, child eating behaviour scores, and household dietary diversity scores were performed. The results of the simple linear regressions were reported in terms of their beta coefficients (positive or negative), p-values (significance at <5%), and 95% confidence intervals.

5.3.6.2. Confirmatory Factor Analysis (CFA) and Exploratory Factor Analysis (EFA) for Child Eating Behaviour and Caregiver Feeding Practices

5.3.6.2.1. Analysis of child eating behaviour

Following the recommendations from the study by Wardle et al., (2001), five items from the CEBQ were first reverse-coded as follows: 5 = *Never*, 4=*Rarely*, 3=*Sometimes*, 2=*Often*, 1=*Always*. These items included *"My Child has a big appetite", "My child finishes his/her meals quickly", "My child enjoys tasting new foods", "My child enjoys a wide variety of foods",* and *"My child is interested in tasting foods that he/she has never tasted before"*. The remaining thirty questionnaire items were coded as "1" for "*Never*", "2" for "*Rarely*", "3" for "*Sometimes*", "4" for "*Often*", and "5" for "*Always*".

Items were first matched to their original latent factors as suggested by Wardle et al., (2001) in a Structural Equation Model (SEM) diagram that was designed in STATA. Goodness-of-fit (GOF) indices for the sample responses were then calculated and interpreted. These included the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and Standardised Root Mean-Square Residual (SRMR). For the RMSEA and SRMR, values less than 0.06 denoted good fit, while for the CFI and TLI, values more than 0.90 denoted good fit.

A Kaiser–Meyer–Olkin (KMO) test was performed, as part of the exploratory factor analysis, to find out if the sample or size of the item responses was adequate for factor analysis. KMO estimates of more than 50% denoted good sample adequacy for factor analysis. The analysis was run using a varimax orthogonal rotation method for factors with eigen values of more than 1, as recommended by Wardle et al., (2001). This was followed by an inspection of the factor loading of items. Items with loadings of less than 0.50 and items with cross-loadings of more than 50%, i.e., loadings of more than 50% on more than 1 factor were removed from the analysis. The analysis was re-run until items with single factor loadings of 50% or more

remained. The resulting factor matrix was then sorted to group items with similar factor loadings (>0.50). Finally, the new item groupings were checked for internal consistency, and factors with Cronbach's alpha values of more than 50% were retained, and those with values less than 50% were dropped.

5.3.6.2.2. Analysis of caregiver feeding practice

The Comprehensive Feeding Practices questionnaire has three items *(item 16 - "I keep a lot of snack food (potato chips, Doritos, cheese puffs) in my house", item 37 - "I keep a lot of sweets (candy, ice cream, cake, pies, pastries) in my house", and item 42 - "I tell my child what to eat and what not to eat without explanation")* from the 49-item questionnaire were first reverse-coded as follows: 5 = Disagree, 4 = Slightly Disagree, 3 = Neutral, 2 = Slightly Agree, and 1 = Agree. The remaining items 45 items were coded as follows: *1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Mostly, 5 = Always* for items 1–13, and *1 = Disagree, 2 = Slightly Disagree, 3 = Neutral, 4 = Slightly Agree, and 5 = Agree* for items 14–49.

To assess child caregiver feeding practices, a CFA was initially performed on items in the CFPQ, followed by an EFA if the original factor structure was not replicated. This was done to identify the relevant caregiver feeding practices representative of this sample.

For the CFA, a structural equation model diagram of the items and their original underlying factors was first designed in STATA. Following this, the Goodness-of-Fit of the sample responses with the original structure of items and feeding practices was evaluated and interpreted. Goodness-of-fit indices that were evaluated included the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and Standardised Root Mean-Square Residual (SRMR). Interpretation of these indices were based on comparison with recommended cut-off values, i.e., RMSEA<0.06, SRMS<0.06, CFI>0.90, and TLI>0.90 for good or acceptable fit.

EFA was carried out if the sample responses demonstrated poor fit with the original model. In particular, a KMO test was first conducted to evaluate the adequacy of the sample responses for factor analysis. Next, factor analysis with varimax orthogonal rotation was conducted on the coded and reverse-coded item responses as recommended by Musher-Eizenman & Holub, (2007). Factors with eigen values of more than 1 automatically selected and rotated in STATA. Factor loadings were then inspected, and items with loadings less than 0.40 (Musher-Eizenman & Holub, 2007) or items with loadings of 0.40 or more on more than one factor (cross-loading) were removed. The analysis was re-run until items with single factor loadings of 40% or more had been retained. The resulting factor matrix was sorted to group items that had loaded unto the same factor, and the internal consistency of the grouped items for each factor was

evaluated by calculating Cronbach's alpha. Factors with Cronbach's alpha values of more than 50% were retained, and those with values less than 50% were dropped.

5.3.6.3. Analysis of household dietary diversity (HDD)

Household dietary diversity scores (HDDS) were calculated as recommended by the Food and Agriculture Organisation (FAO, 2010). First, responses for household dietary consumption of the food groups were coded as "0" for "No" and "1" for "Yes". New variables representing fruit, vegetable, and meat consumption were then generated, bringing the total number of food groups from 16 to 12. Vegetable consumption was calculated by combining the individual responses for Vitamin A-rich vegetables and tubers, dark green leafy vegetables, and other vegetables. Fruit consumption was calculated based on the responses for Vitamin A-rich fruits and other fruits, while meat consumption was calculated based on the responses for organ meat, and flesh meat consumption. Household dietary diversity scores were computed for each household by summing the responses for the 12 food groups. The expected minimum HDDS was 0 and the expected maximum HDDS was 12.

The FAO recommends that the mean score or the distribution of HDD scores are used for analytical purposes, since there are no established cut-off points for the number of food groups that can indicate adequate or inadequate household dietary diversity (FAO, 2010; Kennedy et al., 2010). HDDS was thus used as a continuous independent variable in linear regression analysis for the association between household dietary diversity and child body weight.

5.3.7. Ethical Approval

Ethical approval for this study was granted by the Committee for Human Research, Publication, and Ethics (CHRPE), Kumasi Ghana, and the Ethics Review Committee of the School of Health and Related Research (ScHARR), the University of Sheffield.

5.4. Results

5.4.1. General Characteristics of Study Sample

The prevalence of overweight/obesity in this sample was 8.29% (N=209). The average age of children in the study was 3.42 years, and the majority were females. There were more overweight/obese male children than female children, and most caregivers were middle-aged females. The majority of caregivers were married and either employed or self-employed. Most caregivers had also attained education up to either Junior High School, Senior High School, or Undergraduate tertiary levels. Additionally, most households had an average of 5 members (3-7), were located in urban areas, and had an estimated monthly income of GHS

2000 and above (Table 14). The average household diversity score for each household in the study was 7, with a household minimum score of 1 and a maximum score of 12 ((Table 14).

Table 14.Descriptive Characteristics of Study Sample

Variable/Outcome	Total (n=209) *	Severely Wasted (n=6)	Wasted (n=12)	Normal Weight (n=148)	At Risk of Overweight/Obese (n=22)	Overweight (n=9)	Obese (n=8)
Age of Child (years) (mean ± SD)	3.46 ± 0.97	4.00 ± 0.89	3.67 ± 1.16	3.40 ± 0.95	3.46 ± 0.96	3.67 ± 1.12	3.63 ± 1.06
Sex of Child (%)							
Male	48.29	50.00	58.33	47.30	36.36	66.67	62.50
Female	51.71	50.00	41.67	52.70	63.64	33.33	37.50
Age of Caregiver (mean ± SD)	38.16 ± 7.76	42.5 0 ± 13.10	41.33 ± 8.98	37.59 ± 7.21	38.41 ± 6.56	40.13 ± 7.64	36.50 ± 9.09
Sex of Caregiver (%)							
Male	16.10	0.00	33.33	15.54	18.18	22.22	0.00
Female	83.90	100.00	66.67	84.46	81.82	77.78	100.00
Marital Status of Caregiver (%)							
Married / Living as Married	83.90	66.67	91.67	83.78	90.91	66.67	87.50
Divorced / Separated	2.93	0.00	0.00	2.70	0.00	22.22	0.00
Single	9.27	16.67	0.00	10.14	9.09	11.11	0.00
Widowed	3.41	0.00	8.33	3.38	0.00	0.00	12.50
Refused to Answer	0.49	16.67	0.00	0.00	0.00	0.00	0.00
Highest level of Education of Caregiver (%)							

No formal education/Primary School	2.93	0.00	0.00	4.05	0.00	0.00	0.00
Middle School	5.37	0.00	16.67	4.73	4.55	11.11	0.00
Junior High School	23.90	33.33	8.33	24.32	18.18	44.44	25.00
Senior High School	16.59	33.33	25.00	16.22	13.64	11.11	12.50
Vocational Degree	5.37	16.67	0.00	4.73	9.09	11.11	0.00
Bachelor's Degree	33.66	16.67	50.00	33.11	36.36	11.11	50.00
Graduate / Advanced Professional Degree	12.20	0.00	0.00	12.84	18.18	11.11	12.50
Employment Status of Caregiver (%)							
Unemployed	9.27	16.67	16.67	8.78	9.09	0.00	12.50
Self-employed	49.76	50.00	50.00	50.68	31.82	77.78	50.00
Employed	40.98	33.33	33.33	40.54	59.09	22.22	37.50
Estimated Monthly Household Income (%)							
Less than 500	2.44	0.00	0.00	2.03	0.00	22.22	0.00
500 - 1000	11.22	16.67	16.67	10.14	18.18	0.00	12.50
1000 - 1500	12.20	33.33	8.33	10.81	9.09	33.33	12.50
1500 - 2000	15.61	33.33	16.67	16.22	13.64	0.00	12.50
More than 2000	38.54	16.67	25.00	40.54	40.91	33.33	37.50
Don't Know	16.59	0.00	25.00	18.24	9.09	11.11	12.50

Refused to Answer	3.41	0.00	8.33	2.03	9.09	0.00	12.50
Household Size (mean ± SD)	5.00 ± 2.00	6.00 ± 1.00	4.00 ± 1.00	5.00 ± 2.00	5.00 ± 2.00	5.00 ± 2.00	6.00 ± 2.00
Location of Household (%)							
Rural	1.95	0.00	8.33	2.03	0.00	0.00	0.00
Urban	71.22	50.00	83.33	71.62	68.18	55.56	87.50
Peri-urban	26.83	50.00	8.33	26.35	31.82	44.44	12.50
Household Dietary Diversity Score (mean ± SD)	7.20 ± 1.92	6.83 ± 2.14	7.08 ± 1.44	7.27 ± 1.93	6.59 ± 1.62	7.89 ± 1.27	7.38 ± 2.26

*BMI z-score information unavailable for 4 respondents

5.4.2. Child Eating Behaviour among Ghanaian Pre-schoolers (2-5 years)

Results of the confirmatory factor analysis of the sample responses for child eating behaviour showed poor fit to the original 8-factor structure (RMSEA=0.07, CFI=0.84, TLI=0.82, SRMR=0.11). Therefore, an exploratory factor analysis (EFA) of the response items was conducted to identify the underlying factors that were relevant to the study sample. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) for the CEBQ was 0.866 (>0.50), indicating that the sample was appropriate for factor analysis. After running the initial factor analysis, items that were removed for not meeting the minimum factor-loading requirements of 0.50 included "My child has a big appetite", "My child is difficult to please with meals", and "My child eats more when s/he is happy". Subsequently, the factor analysis was re-run yielding 8 factors. Of these 8 factors, one factor was dropped for having an internal consistency of less than 50%. Cronbach's alpha for the remaining 7 factors ranged from 0.66 – 0.87 (Table 15). Although 7 factors remained, emotional overeating (EOE) and food responsiveness (FR) items had loaded together as a new factor in this sample, and this new factor was renamed "Food Responsiveness" (Table 15).

Table 15. Factor Analysis of the Child Eating Behaviour Questionnaire Showing Factor Loadings of Items

Variable label/description	Original Factor Label	Food responsiveness (α=0.86)	Slow Eating (α=0.80)	Food Fussiness (α=0.79)	Enjoyment of Food (α=0.87)	Desire to Drink (α=0.84)	Satiety Responsiveness (α=0.75)	Emotional Undereating (α=0.66)
My child eats more when anxious	EOE	0.7827						
Given the chance, my child will eat often	FR	0.6976						
My child eats more when annoyed	EOE	0.6969						
My child eats more when worried	EOE	0.6956						
If allowed, my child will eat too much	FR	0.663						
My child eats more when s/he has nothing else to do	EOE	0.6216						
If given the chance, my child will always have food in their mouth	FR	0.5871						
Even when my child is full, s/he finds room to eat/for their favourite food	FR	0.5425						
My child eats more slowly during the course of a meal	SE		0.7897					
My child eats slowly	SE		0.7734					
My child finishes his/her meal quickly	SE		0.7415					

My child takes more than 30 minutes to finish a meal	SE	0.6522				
My child enjoys tasting new foods	FF		0.8274			
My child is interested in tasting new foods	FF		0.7914			
My child enjoys a wide variety of foods	FF		0.7063			
My child refuses new foods at first	FF		0.6398			
My child is interested in food	EF			0.5992		
My child loves food	EF			0.593		
My child looks forward to mealtimes	EF			0.559		
My child is always asking for food	FR			0.5349		
My child enjoys eating	EF			0.5302		
If given the chance, my child will always be having a drink	DD				0.9009	
If given the chance, my child would drink continuously all day	DD				0.8688	
My child is always asking for a drink	DD				0.7809	
My child leaves food on the table at the end of a meal	SR					0.8351
My child gets full before his/her meal is finished	SR					0.6808
My child gets full up easily	SR					0.5749

My child eats less when angry	EUE	0.7856
My child eats less when upset	EUE	0.7548
My child eats less when s/he is tired	EUE	0.6821

Table 16. Child Eating Behaviour Factor Scores for Normal Weight and Obese/Overweight Children

	Normal Weight (n=148)		*Obese/Overweight (n=17)*	
Factor Scores	*Mean*	*SD*	*Mean*	*SD*
Food Responsiveness	0.00	0.98	0.02	1.21
Slow Eating	0.00	1.01	0.04	0.91
Food Fussiness	0.03	0.96	-0.26	1.33
Enjoyment of Food	-0.05	0.97	0.41	1.18
Desire to Drink	0.00	1.00	0.01	0.99
Satiety Responsiveness	0.07	1.01	***-0.57***	0.71
Emotional Undereating	0.02	0.98	-0.22	1.17

5.4.3. Feeding Practices among Caregivers of Ghanaian Pre-schoolers (2-5 years)

The original 12-factor model of the CFPQ was not replicated in this sample after confirmatory factor analysis (RMSEA=0.07, CFI=0.76, TLI=0.74, SRMR=0.10). The test for the adequacy of the sample for factor analysis yielded a favourable KMO estimate of 0.79 (>0.50). Subsequent Exploratory Factor Analyses identified 11 candidate items for exclusion for failing to meet the minimum factor-loading requirement of 0.40. These items are listed below.

1. "Do you let your child eat whatever s/he wants?",
2. "Do you allow this child to eat snacks whenever s/he wants?",
3. "Do you allow this child to leave the table when s/he is full, even if your family is not done eating?",
4. "My child should always eat all of the food on his/her plate",
5. "I allow my child to help prepare family meals",
6. "If my child says, ''I'm not hungry,'' I try to get him/her to eat anyway",
7. "I keep a lot of snack food (potato chips, Doritos, cheese puffs) in my house",
8. "I keep a lot of sweets (candy, ice cream, cake, pies, pastries) in my house",
9. "A variety of healthy foods are available to my child at each meal served at home",
10. "I encourage my child to participate in grocery shopping", and
11. "I tell my child what to eat and what not to eat without explanation".

Four (4) other items were excluded on the basis of significant cross-factor loadings. These included

1. "I offer sweets (candy, ice cream, cake, pastries) to my child as a reward for good behaviour",
2. "I encourage my child to try new foods",
3. "I have to be sure that my child does not eat too much of his/her favourite foods", and
4. "I discuss with my child the nutritional value of foods".

Nine (9) factors remained after removal of these items. Of the remaining 9 factors, 3 were dropped for having unacceptable/low internal consistency. Cronbach's alpha for the remaining 6 factors ranged from 0.56 -0.93 (Table 17). The remaining 6 factors were re-labelled based on their item groupings and their original factor labels (Table 17). The analysis did not identify the following factors from the original model: "Environment", "Food as a reward", "Involvement", and "Teaching about nutrition". "Modelling" and "Encouragement" items from the original model merged as one factor in this sample, while "Pressure" and "Child Control" items from the original model also grouped as one factor.

Table 17. Factor Analysis of the Comprehensive Feeding Practices Questionnaire Showing Item Factor Loadings

Variable Label/Description	Original Factor Label	Modelling and Encouragement (α=0.93)	Restriction (Weight Control) (α=0.85)	Monitoring (α=0.84)	Emotion Regulation (α=0.78)	Restriction (Health) (α=0.66)	Pressure and Child Control (α=0.56)
I try to show enthusiasm about eating healthy foods	Modelling	0.9201					
I show my child how much I enjoy eating healthy foods	Modelling	0.9054					
I model healthy eating for my child by eating healthy foods myself	Modelling	0.8957					
I try to eat healthy foods in front of my child, even if they are not my favourite	Modelling	0.8098					
I tell my child that healthy food tastes good	Encourage balance and Variety	0.8035					
I encourage my child to eat a variety of foods	Encourage balance and Variety	0.7312					
Do you encourage this child to eat healthy foods before unhealthy ones	Encourage balance and Variety	0.7132					

I discuss with my child why it's important to eat healthy foods	Teaching about Nutrition	0.6685	
I have to be sure that my child does not eat too many high-fat foods	Restriction for Weight Control	0.5719	
I restrict the food my child eats that might make him/her fat	Restriction for Weight Control		0.8104
I give my child small helpings at meals to control his/her weight	Restriction for Weight Control		0.7565
I encourage my child to eat less so he/she won't get fat	Restriction for Weight Control		0.7397
I don't allow my child to eat between meals because I don't want him/her to get fat	Restriction for Weight Control		0.7079
There are certain foods my child shouldn't eat because they will make him/her fat	Restriction for Weight Control		0.6751
I often put my child on a diet to control his/her weight	Restriction for Weight Control		0.6598

How much do you keep track of the sweets (candy, ice cream, cake, pies, pastries) that your child eats?	Monitoring	0.8174		
How much do you keep track of the snack food (potato chips, Doritos, cheese puffs) that your child eats?	Monitoring	0.8147		
How much do you keep track of the high-fat foods that your child eats?	Monitoring	0.7735		
How much do you keep track of the sugary drinks (soda/pop, Kool-Aid) this child drinks?	Monitoring	0.7733		
Do you give this child something to eat or drink if s/he is bored even if you think s/he is not hungry?	Emotion Regulation		0.8824	
Do you give this child something to eat or drink if s/he is upset even if you think s/he is not hungry?	Emotion Regulation		0.8603	
When this child gets fussy, is giving him/her something to eat or drink the first thing you do?	Emotion Regulation		0.6617	
I offer my child his/her favourite foods in exchange for good behaviour.	Food as a Reward		0.6224	
If I did not guide or regulate my child's eating, he/she would eat too many junk foods	Restriction for Health			0.8407

If I did not guide or regulate my child's eating, s/he would eat too much of his/her favourite foods	Restriction for Health	0.7609	
If my child eats more than usual at one meal, I try to restrict his/her eating at the next meal	Restriction for Weight Control	0.5159	
If my child eats only a small helping, I try to get him/her to eat more	Pressure		0.7411
When he/she says he/she is finished eating, I try to get my child to eat one more (two more, etc.) bites of food	Pressure		0.6604
If this child does not like what is being served, do you make something else?	Child Control		0.6429

Table 18. Factor Scores for Caregiver Feeding Practices among Normal Weight and Overweight/Obese Children (mean/ SD)

	Normal Weight (n=148)		Overweight/Obese (n=17)	
Caregiver Feeding Practice	Mean	SD	Mean	SD
Encouragement and Modelling	0.02	1.02	-0.14	0.95
Restriction for Weight	-0.09	0.94	***0.57***	1.17
Monitoring	0.00	1.04	0.04	0.65
Emotion Regulation	0.00	1.00	0.01	0.98
Restriction for Health	-0.04	1.01	0.15	0.76
Pressure and Control	0.02	1.01	-0.26	0.97

5.4.4. Objective 1 – Associations between Child Body Weight and Child Eating Behaviour

Overweight/obesity among pre-schoolers was significantly associated with a 46% reduction in satiety responsiveness (COR=0.54, p=0.02, 95% CI (0.32, 0.89), and this association remained significant even after controlling for the effects of food responsiveness, slow eating, food fussiness, enjoyment of food, desire to drink, and emotional undereating (AOR=0.53, p=0.02, 95% CI (0.32, 0.89) (Table 19). Conversely, linear regression showed that an increase in satiety responsiveness was significantly associated with a reduction in BMI z-score, while enjoyment of food was significantly associated with an increase in BMI z-score (Table 20).

Table 19. Logistic Associations between Child Overweight/Obesity and Child Eating Behaviour

Child Eating Behaviour	COR	95% CI	p-value	AOR	95% CI	p-value
Food responsiveness	1.04	0.64 - 1.71	0.87	1.05	0.68 - 1.64	0.82
Slow Eating	1.04	0.64 - 1.72	0.86	1.01	0.61 - 1.68	0.96
Food Fussiness	0.75	0.45 - 1.25	0.27	0.77	0.47 - 1.25	0.29
Enjoyment of Food	1.56	0.95 - 2.56	0.08	1.59	0.96 - 2.63	0.07
Desire to Drink	1.00	0.61 - 1.64	0.99	1.07	0.65 - 1.79	0.78
Satiety Responsiveness	0.54	0.32 - 0.89	**0.02**	0.53	0.32 - 0.89	**0.02**
Emotional Undereating	0.79	0.46 - 1.34	0.38	0.83	0.51 - 1.36	0.46

Table 20. Linear Associations between Child BMI z-score and Child Eating Behaviour

BMI z-score	Coefficient	95% CI	P>t
Food Responsiveness	-0.06	-0.28 - 0.16	0.59
Slow Eating	0.01	-0.20 - 0.23	0.90
Food Fussiness	-0.14	-0.35 - 0.08	0.22
Enjoyment of Food	**0.28**	**0.06 - 0.50**	**0.01**
Desire to Drink	-0.04	-0.26 - 0.18	0.73
Satiety Responsiveness	**-0.33**	**-0.55 - -0.11**	**0.00**
Emotional Undereating	0.10	-0.11 - 0.32	0.34
Constant	-0.02	-0.24 - 0.20	0.86

5.4.5. Objective 2 – Associations between Child Body Weight and Caregiver Feeding Practices

Child overweight/obesity was significantly associated with an 89% increase in restriction for weight (COR=1.89, p=0.01, 95% CI (1.15, 3.10), and this relationship continued to remain significant even after controlling for the effects of other parent feeding practices such as modelling and encouragement, monitoring, emotion regulation, restriction for health, and pressure and control (AOR=1.85, p=0.01, 95% CI (1.13, 3.01)) (Table 21). Linear regression analysis also demonstrated that an increase in restriction for both weight and health was significantly associated with increases in child BMI z-scores (Table 22).

Table 21. Logistic Associations between Child Overweight/Obesity and Caregiver Feeding Practices

Parent Feeding Practice	COR	95% CI	p-value	AOR	95% CI	p-value
Modelling and Encouragement	0.86	0.53 - 1.38	0.53	0.83	0.48 - 1.43	0.49
Restriction for Weight	1.89	1.15 - 3.10	**0.01**	1.85	1.13 - 3.01	**0.01**
Monitoring	1.02	0.62 - 1.68	0.93	1.06	0.61 - 1.82	0.85
Emotion Regulation	1.01	0.61 - 1.67	0.96	0.98	0.59 - 1.63	0.93
Restriction for Health	1.21	0.74 - 1.99	0.45	1.29	0.75 - 2.22	0.35
Pressure and Child Control	0.76	0.47 - 1.25	0.28	0.75	0.45 - 1.24	0.26

Table 22. Linear Associations between Child BMI z-score and Caregiver Feeding Practices

BMI z-score	Coefficient	95% CI	P>t
Encouragement and Modelling	0.03	-0.18 - 0.24	0.77
Restriction for Weight	**0.42**	**0.20 - 0.64**	**0.00**
Monitoring	0.09	-0.13 - 0.30	0.43
Emotion Regulation	0.05	-0.27 - 0.16	0.63
Restriction for Health	**0.23**	**0.02 - 0.45**	**0.03**
Pressure and Control	0.16	-0.37 - 0.05	0.14
Constant	0.01	-0.22 - 0.21	0.94

5.4.6. Objective 3 – Association between Child Body Weight and Household Dietary Diversity

This study found no association between household dietary diversity and child overweight/obesity (COR=1.10, p=0.47, 95% CI (0.85, 1.44.)). Household dietary diversity scores also failed to predict the BMI z-scores of children (Table 23).

Table 23. Linear Associations between Child BMI z-score and Household Dietary Diversity Scores

BMI z-score	Coefficient	95% CI min	95% CI max	P>t
Household Dietary Diversity Score	0.01	-0.11 - 0.13		0.87
Constant	-0.09	-0.98 - 0.80		0.84

5.4.7. Objective 4 – Associations between Child Eating Behaviour and Caregiver Feeding Practices

An increase in child enjoyment of food was associated with an increase in caregiver encouragement to eat a variety of foods. An increase in satiety responsiveness and the desire to drink were also associated with caregiver feeding as a means to regulate the child's emotions. Increased child food responsiveness, enjoyment of food, and increased desire to drink predicted caregivers' restriction of food intake with the purpose of decreasing or maintaining body weight. Finally, the child's slowness in eating predicted caregivers' use of pressure to eat during mealtimes (Table 24).

Table 24. Child Eating Behaviours that Predicted Caregiver Feeding Practices

Caregiver Feeding Practice	B	95% CI	P>t
Restriction for Weight			
Food Responsiveness	0.05	-0.10 - 0.20	0.55
Slow Eating	-0.09	-0.25 - 0.06	0.22
Food Fussiness	0.03	-0.12 - 0.18	0.70
Enjoyment of Food	-0.14	-0.29 - 0.01	0.07
Desire to Drink	-0.12	-0.27 - 0.03	0.13
Satiety Responsiveness	-0.05	-0.20 - 0.10	0.48
Emotional Undereating	0.07	-0.08 - 0.22	0.38
Encourage Balance and Variety			
Food Responsiveness	0.00	-0.15 - 0.15	0.98
Slow Eating	0.10	-0.05 - 0.25	0.20
Food Fussiness	-0.11	-0.26 - 0.04	0.14
Enjoyment of Food	0.29	0.14 - 0.44	0.00
Desire to Drink	0.04	-0.11 - 0.19	0.57
Satiety Responsiveness	0.08	-0.07 - 0.23	0.28
Emotional Undereating	-0.08	-0.23 - 0.07	0.28
Monitoring			
Food Responsiveness	0.03	-0.12 - 0.19	0.66
Slow Eating	-0.13	-0.28 - 0.03	0.11
Food Fussiness	-0.03	-0.19 - 0.12	0.66

Enjoyment of Food	0.10	-0.06 - 0.25	0.21
Desire to Drink	-0.08	-0.23 - 0.08	0.34
Satiety Responsiveness	0.07	-0.09 - 0.22	0.41
Emotional Undereating	-0.04	-0.19 - 0.12	0.62
Emotion Regulation			
Food Responsiveness	0.09	-0.05 - 0.23	0.22
Slow Eating	0.12	-0.02 - 0.26	0.09
Food Fussiness	-0.08	-0.22 - 0.06	0.24
Enjoyment of Food	0.10	-0.04 - 0.24	0.17
Desire to Drink	0.36	0.22 - 0.50	**0.00**
Satiety Responsiveness	0.17	0.03 - 0.31	**0.02**
Emotional Undereating	0.05	-0.09 - 0.19	0.49
Restriction for Health			
Food Responsiveness	0.27	0.14 - 0.41	**0.00**
Slow Eating	-0.04	-0.17 - 0.09	0.56
Food Fussiness	0.04	-0.10 - 0.17	0.57
Enjoyment of Food	0.32	0.18 - 0.45	**0.00**
Desire to Drink	0.25	0.11 - 0.38	**0.00**
Satiety Responsiveness	-0.13	-0.27 - 0.00	0.05
Emotional Undereating	-0.02	-0.15 - 0.11	0.76
Pressure and Child Control			
Food Responsiveness	0.01	-0.13 - 0.16	0.86

Slow Eating	0.31	0.16 - 0.46	**0.00**
Food Fussiness	0.07	-0.08 - 0.22	0.33
Enjoyment of Food	-0.08	-0.23 - 0.07	0.28
Desire to Drink	0.08	-0.07 - 0.22	0.31
Satiety Responsiveness	0.12	-0.03 - 0.27	0.11
Emotional Undereating	0.06	-0.09 - 0.21	0.42

The results (Table 25) further demonstrate that an increase in caregivers' use of food restriction for the purposes of maintaining or improving health was significantly associated with an increase in the child's responsiveness to food. An increase in pressure over child's dietary intake during mealtimes was also significantly associated with an increase in child's slowness in eating. Increasing caregiver use of restriction in dietary consumption for the purpose of maintaining or improving health as well as encouragement to consume a variety of foods predicted child enjoyment of food. Increasing caregiver feeding to regulate the child's emotions and restriction for health predicted an increase in the child's desire to drink. Finally, an increase in caregiver feeding to regulate the child's emotions predicted increasing child satiety responsiveness (Table 25).

Table 25. Caregiver Feeding Practices that Predicted Child Eating Behaviour

Child Eating Behaviour	B	95% CI	P>t
Food Responsiveness			
Encourage Balance and Variety	0.00	-0.15 - 0.15	0.98
Restriction for Weight	0.06	-0.10 - 0.21	0.48
Monitoring	0.03	-0.12 - 0.18	0.70
Emotion Regulation	0.08	-0.07 - 0.23	0.28
Restriction for Health	0.28	0.13 - 0.43	**0.00**
Pressure and Child Control	0.01	-0.14 - 0.16	0.86

Slow Eating			
Encourage Balance and Variety	0.09	-0.05 - 0.24	0.21
Restriction for Weight	0.10	-0.25 - 0.05	0.18
Monitoring	0.13	-0.27 - 0.02	0.09
Emotion Regulation	0.13	-0.02 - 0.27	0.09
Restriction for Health	-0.04	-0.19 - 0.10	0.55
Pressure and Child Control	0.30	0.16 - 0.45	**0.00**
Food Fussiness			
Encourage Balance and Variety	-0.11	-0.26 - 0.05	0.17
Restriction for Weight	0.03	-0.12 - 0.19	0.67
Monitoring	-0.03	-0.19 - 0.12	0.67
Emotion Regulation	-0.09	-0.24 - 0.07	0.28
Restriction for Health	0.04	-0.11 - 0.20	0.60
Pressure and Child Control	0.07	-0.08 - 0.23	0.36
Enjoyment of Food			
Encourage Balance and Variety	0.28	0.15 - 0.42	**0.00**
Restriction for Weight	0.13	-0.27 - 0.01	0.07
Monitoring	0.09	-0.04 - 0.23	0.18
Emotion Regulation	0.09	-0.05 - 0.23	0.19
Restriction for Health	0.32	0.18 - 0.46	**0.00**
Pressure and Child Control	0.08	-0.22 - 0.06	0.25
Desire to Drink			

Encourage Balance and Variety	0.03	-0.10 - 0.17	0.62
Restriction for Weight	-0.12	-0.26 - 0.02	0.09
Monitoring	-0.08	-0.22 - 0.05	0.23
Emotion Regulation	0.37	0.23 - 0.51	**0.00**
Restriction for Health	0.25	0.10 - 0.39	**0.00**
Pressure and Child Control	0.07	-0.07 - 0.21	0.31
Satiety Responsiveness			
Encourage Balance and Variety	0.08	-0.07 - 0.23	0.31
Restriction for Weight	-0.07	-0.22 - 0.09	0.40
Monitoring	0.06	-0.09 - 0.21	0.40
Emotion Regulation	0.17	0.02 - 0.33	**0.03**
Restriction for Health	-0.14	-0.29 - 0.01	0.07
Pressure and Child Control	0.12	-0.03 - 0.27	0.13
Emotional Undereating			
Encourage Balance and Variety	-0.08	-0.24 - 0.07	0.30
Restriction for Weight	0.07	-0.09 - 0.23	0.41
Monitoring	-0.04	-0.20 - 0.11	0.61
Emotion Regulation	0.05	-0.11 - 0.21	0.53
Restriction for Health	-0.02	-0.18 - 0.14	0.81
Pressure and Child Control	0.06	-0.10 - 0.21	0.45

A summary of the bidirectional relationship between caregiver feeding practices and child eating behaviour found in this study is presented below.

Table 26. Summary of bi-directional associations between caregiver feeding practices and child eating behaviour

Child Eating Behaviour / Caregiver Feeding Practice	Food Responsiveness	Slow Eating	Food Fussiness	Enjoyment of Food	Desire to Drink	Satiety Responsiveness	Emotional Undereating
Restriction for Weight							
Encourage Balance and Variety				X			
Monitoring							
Emotion Regulation					X	X	
Restriction for Health	X			X	X		
Pressure and Control		X					

X = evidence of bi-directional association

5.5. Discussion

The current study aimed to examine the relationships between overweight/obesity among Ghanaian pre-schoolers and household dietary diversity, caregiver feeding practices, and child eating behaviour. The study found that restrictive caregiver feeding practices, a reduction in child satiety responsiveness, and an increase in the child's enjoyment of food were significant predictors of overweight/obesity and increasing child BMI z-scores. Household dietary diversity had no associations with excessive child body weight. Additionally bi-directional relationships between caregiver feeding practices (including restriction, pressure to eat, encouragement of balance/variety, and emotion regulation) and child eating behaviour (food responsiveness, enjoyment of food, desire to drink, and slow eating) were identified. The findings are discussed in more details below.

5.5.1. Association between Child Eating Behaviour and Child Overweight/obesity / Child BMI z-score

This study provided evidence in support of a relationship between an increase in child body weight and a reduction in child food avoidance behaviour and an increase in child food approach behaviour.

In this study, a reduction in satiety responsiveness was associated with overweight/obesity. Similarly, an increase in satiety responsiveness was associated with lower BMI z-scores. There have been fairly consistent

findings in the wider literature confirming an inverse association between satiety responsiveness and child overweight/obesity (Jansen et al., 2012; Mallan et al., 2014; Sleddens et al., 2008; Viana et al., 2008; Y. X. Wu et al., 2023). For example, a 2010 study of 240 Portuguese children aged 3-13 years by Viana et al., (2008) showed that increased satiety responsiveness was associated with a significant reduction in BMI z-score (β=-0.39, p<0.001). Another study by Wu et al., (2023) showed that among 1935 pre-schoolers aged 3-6 years an increase in satiety responsiveness consistently predicted a reduction in child BMI z-scores.

Satiety responsiveness is expected to influence child body weight by limiting or reducing energy intake (Mallan et al., 2014). Together with an increase in food approach behaviours, a reduction in satiety responsiveness is expected to lead to an increase in energy intake and child body weight (Wardle et al., 2001).

This study found additional evidence for an association between an increase in the enjoyment of food and an increase in child BMI. There is a considerable amount of evidence in the wider literature in support of this finding (Jansen et al., 2012; Mallan et al., 2014; Sleddens et al., 2008; Viana et al., 2008; Y. X. Wu et al., 2023). For example, using data from the Generation R Study that examined the relationship between eating behaviour and weight problems among 4987 pre-schoolers, Jansen et al., (2012) showed that the risk of overweight and obesity increased by 28% (OR=1.28; 95% CI (1.13, 1.45); p<0.001) and 74% (OR=1.74; 95% CI (1.30,2.33); p<0.001) respectively as a result of an increase in the enjoyment of food. In a another study, Sleddens et al., (2008) studied the relationship between eating behaviour and the body weight of 135 children aged 6-7 years and reported that an increase in the enjoyment of food significantly predicted child BMI (β=0.207, 95% CI (0.025, 0.389, p=0.03). An increase in the enjoyment of food or hedonic eating is indicative of an increase in energy intake (French et al., 2012), and it is expected that this increase in energy intake would contribute to child weight gain.

5.5.2. Association between Caregiver Feeding Practices and Child Overweight/obesity / Child BMI z-score.

This study found that the increased use of restrictive feeding practices among caregivers was associated with an increase in child BMI and overweight/obesity. Within the wider literature, there have been fairly consistent findings that support this finding (Freitas et al., 2019; Jansen et al., 2012; Rathuan et al., 2020). For example, Rathuan et al., (2020) reported in their study of 398 children aged 7-11 that increased caregiver use of restriction was associated with an 8% increase in child overweight and obesity (OR=1.08, p<0.05). Similarly, Freitas et al., (2019) reported in their study of maternal feeding practices among children aged 2-8 years that maternal restriction was significantly associated with a doubling of the odds of child overweight/obesity or severe obesity (OR=2.18, p<0.001).

Two possible explanations for the association between restrictive feeding practices and child BMI have been proposed. The first is that restriction may be applied by caregivers in response to an increase in child body weight. A systematic review of feeding practices and weight status among 4-12 year-old children by Shloim et al., (2015) lends support to the suggestion that the use of food restriction is likely to be a response to overweight/obesity among children. This association is also thought to be mediated by caregiver concerns related to child body weight. For example, an examination of maternal perceptions of child weight, maternal feeding practices, and child weight by Wang et al., (2022) showed that the association between restriction and child BMI z-score was mediated by maternal weight perceptions and concerns about child weight (β=0.022, $p<0.001$).

Food restriction has also been viewed as a cause of weight gain among pre-schoolers. The evidence for this causal relationship mostly comes from longitudinal and experimental studies that suggest that food restriction by caregivers may lead to decreases in the responsiveness to internal hunger and satiety cues, thereby influencing children's food intake and weight gain over time (Clark et al., 2007). Fisher & Birch, (2002) studied the eating behaviour of 192 girls and their caregivers over a 2-year period from age 5 to 7 years and reported that girls who consumed a large amount of snacks in the absence of hunger at age 5 were 4.6 times more likely to be overweight or obese at age 7 ($p<0.001$). They also found that this eating behaviour was associated with parental restriction at age 5. Experimental studies examining the effects of restriction on the consumption of palatable foods among 3-5 year-old children has additionally shown that restricting access to a palatable food is linked to an increase in the consumption of that food (Fisher & Birch, 1999).

The dual nature of the relationship between caregiver restriction and child body weight suggests that an intervention study will need to properly assess the nature of this relationship in the population where it will be implemented in order to enhance its effectiveness. Given the possibility of caregiver restriction as a response to, or as a cause of future child weight gain, future studies are encouraged to identify the precise nature of this relationship among Ghanaian pre-schoolers.

5.5.3. Association between Household Dietary Diversity and Child Overweight/obesity / Child BMI z-score.

This study found no association between household dietary diversity and child BMI or excessive body weight, confirming findings from earlier studies (Fernandez et al., 2016; Zhao et al., 2017b). For example, Zhao et al., (2017) showed that the dietary diversity scores for 1694 children aged between 3 years and 12 years had no significant correlations with child BMI scores, especially for pre-schoolers aged <6 years ($r=0.048$. $p>0.05$). However, findings for the association between dietary diversity and overweight/obesity have not been consistent. For example, Dogui et al., (2021) and Fernandez et al., (2016) have reported positive associations

between dietary diversity and child BMI, contrary to the findings from this study. Dogui et al., (2021) investigated the relationship between dietary diversity and child BMI among 1200 Tunisian children (3-9 years) and found that dietary diversity was associated with weight gain among children <6 years (AOR=1.37, 95% CI (1.03, 1.82).

These inconsistencies may be as a result of differences in the measurement of dietary diversity, as a number of different groupings, and classification systems have been reported in child obesity research (Ruel, 2003b). For example, although Dogui et al., (2021) mentioned measuring DD using FAO recommendations, 9 food groups from a modified 24-hour dietary recall questionnaire was used, rather than 12 from the HDDS questionnaire as reported in this study. Kennedy et al., (2010) has also suggested that the use of the FAO's HDDS questionnaire may have limitations in detecting differences in the average dietary diversity score between groups, especially when the sample size is not large. There are also suggestions that dietary diversity scores may be better utilised as an indicator of micronutrient deficiencies, rather than as an indicator of obesity or overweight among pre-schoolers (Zhao et al., 2017b).

5.5.4. Association between Child Eating Behaviour and Caregiver Feeding Practices

The current study also sought to find out if there were any child eating behaviours that could be explained by caregiver feeding practices, or vice versa. Our findings suggest that caregiver restriction was associated with child food approach behaviours such as food responsiveness, enjoyment of food, and the desire to drink. In other words, a child who was exhibiting these food approach behaviours was also likely to experience caregiver restriction of food intake. The study also found that caregiver use of pressure when feeding was associated with slowness in eating among children. Validation of these finding come from other studies that have examined the bidirectional relationship between caregiver feeding and child eating behaviour.

Webber et al (2010), for example, cross-sectionally examined maternal feeding practices and child appetitive traits among 531 children aged 7-9 enrolled in the UK, and found that maternal restriction significantly predicted food responsiveness among children ($p<0.001$). The researchers also observed that maternal pressure to eat significantly predicted slowness in eating among children ($p=0.03$) (ref).

Wang et al (2022) also recently conducted a meta-analysis of the effect of parental non-responsive feeding on child eating behaviour, and concluded that restrictive feeding significantly predicted child enjoyment of food (B=0.044, 95% CI (0.004 – 0.085). The researchers however observed in the same study that food-responsive behaviour of children significantly predicted caregiver restriction (B=0.04, 95% CI (0.02, 0.06), lending credence to the bidirectional nature of the relationship between caregiver feeding practices and child eating behaviour.

In this study there is evidence in support of a bidirectional relationship between restrictive feeding and child food approach behaviours e.g., food responsiveness, and pressure feeding and child food avoidance behaviours, e.g., slow eating.

Interestingly, this study also found bidirectional associations between emotion regulation feeding and the child desire to drink/satiety responsiveness, which have not been found elsewhere. Although this is not a common finding, it is likely to be a reflection of the cultural interaction between Ghanaian caregivers and children in which the desire to drink and satiety responsiveness may be linked to expressions of emotions among children, and for which caregivers may be more inclined to provide food primarily for the purposes of controlling the child's emotions. Another interesting finding was the bidirectional relationship between caregiver encouragement of balance and variety, and child enjoyment of food. Again, this could reflect the cultural interaction between Ghanaian caregivers and their children in which caregivers are motivated to encourage balance and variety in feeding when they see that their children enjoy their meals, or that children enjoy their meals as a result of caregiver encouragement of variety and balance.

Given the fact that bidirectional relationships between caregiver feeding and child eating may be complex, inconsistent, and culturally sensitive, future research must target the nature of this relationship in order to fully understand its usefulness and potential applications in intervention studies.

5.6. Strengths, Limitations, and Recommendations of Study

Part of this study constitutes the first validation of the CEBQ and CFPQ among pre-schoolers in Ghana. This validation forms a basis for future studies of child eating behaviour and caregiver feeding practices in Ghana, and further confirmation of the revised items for these questionnaires is recommended. There is also preliminary evidence of a bidirectional relationship between caregiver feeding practices and child eating behaviour in this population that needs to be further explored. Since the general findings for the association between household dietary diversity and child BMI are inconsistent, further research is required to ascertain the situation in Ghana. We have earlier highlighted some of the limitations of the measuring tools, for e.g., the Household Dietary Diversity Questionnaire by the FAO, in which the mean scores that are calculated for each household may not reveal between-group differences when the sample size is not very large. Re-evaluation of the use of this questionnaire among the paediatric population using a larger sample is needed. Future studies on caregiver feeding practices and child body weight are also encouraged to include maternal concerns and perceptions of child body weight.

5.7. Conclusion

This study provides further confirmation of the relationship between child eating behaviour and child body weight, in particular, that an increase in food approach and/or a reduction in satiety responsiveness is linked to overweight/obesity. Social aspects of the home food environment (rather than its physical aspects), which includes caregiver food feeding practices, appear to be more influential in increasing the body weights of Ghanaian toddlers. Restrictive caregiver food feeding practices in particular may have the potential to shape the eating behaviour and body weight of Ghanaian pre-schoolers. Further research may be required to provide a more contextual understanding of how caregiver feeding practices may impact on child body weight among Ghanaian pre-schoolers.

Chapter 6 A Qualitative Exploration of Caregiver Food Feeding Practices in the Home Environment of Ghanaian Pre-schoolers aged 2-5 years.

Summary

This chapter presents findings from a qualitative study carried out to explore food feeding practices and behaviours among caregivers of Ghanaian toddlers. The findings from this study provides insight into how and why feeding is practiced by caregivers in the home food environment.

6.1. Abstract

Introduction

In sub-Saharan Africa, it has been shown that the home food environment is a potent contributor to child overweight/obesity. A recent review of the influence of the home environment on child adiposity has shown that the evidence for social aspects of the home environment is lacking. Caregiver food feeding practices, which denote the caregiver-child food social interaction, are particularly important because they help shape the eating behaviour of children, which may in turn lead to excessive child body weight. In attempting to understand how food feeding practices may impact child weight gain, this study aimed to explore caregiver feeding practices in the home environment of 2-5-year-old Ghanaian children.

Methods

Six (6) focus group discussions (FGDs) comprising 29 caregivers (27 females and 2 males) of children aged 2-5 years were held in Kumasi between July and September 2022. Data was analysed using NVivo qualitative data analysis software version 14. Thematic analysis was used for this qualitative study. Codes were generated from the transcripts of the FGDs, and these were then organised into themes and sub-themes. Themes and sub-themes were obtained using a deductive process, i.e., based on the conceptual framework of food feeding practices proposed by Vaughn et al., (2016).

Results

Three themes based on the conceptual framework proposed by Vaughn et al., (2016) were reported: autonomy support, coercive control, and structure of the home food environment. In terms of autonomy support, the results show that caregivers frequently encouraged the consumption of a variety of foods and involved their children to some degree in the planning, shopping, and preparation of meals. Teaching their children about nutrition was a less common practice. In terms of coercive control, food restriction and instrumental feeding (rewarding the child for a desired behavioural outcome) were commonly practiced, while emotional feeding and pressuring the child to eat were seldom or sometimes practiced by caregivers. In terms of structure, most, if not all, caregivers ensured that food was available in the home environment, employing a variety of

techniques to maintain the supply of food. Parents also often served as effective role models of healthy eating, and the consumption of unhealthy foods by their children, particularly sweets and snacks was highly monitored.

Conclusion

Caregivers of Ghanaian toddlers employ a variety of food feeding practices, some of which may impact on child eating behaviour and may be counterproductive to maintaining a healthy body weight in the long-term. Future work could explore how these feeding practices relate to child body weight and child eating behaviour.

6.2. Introduction

For many children, the home environment is one of the most important settings for the development of excessive early weight gain (Strauss & Knight, 1999b). This environment is usually the first setting for social interaction between children and their caregivers (Bates et al., 2018). It is where behaviour that commonly precedes weight gain, e.g., overeating or engaging in less physical activity, may first be established among children (Bates et al., 2018; Golan, 2006). It is therefore expected that, as gatekeepers of the home environment, caregivers would be influential in shaping the growth trajectories of children (Golan, 2006).

In terms of childhood obesity, the home environment can be classified into three categories; the home physical activity environment, the home food environment, and the home media environment (Kininmonth, Smith, et al., 2021). Each category can further be described in physical and social terms (Kininmonth, Smith, et al., 2021). Physical aspects of the home environment refer to the availability of home items relating to physical activity and energy intake (for e.g., food availability, and the availability of play spaces and play items), while the social aspects of the home environment refer to the social interactions between the child and other members of the household, that relate to physical activity and nutrition (for e.g., parent food feeding practices, and the parental modelling of physical activity).

A recent review of the influence of the home environment on child adiposity has shown that the evidence for social aspects of the home environment is lacking (Kininmonth, Smith, et al., 2021). This is also true for children in sub-Saharan Africa, where the home food environment has been shown to be a potent contributor to child overweight/obesity (Kwansa et al., 2022). Caregiver food feeding practices, which denote the caregiver-child food social interaction, are particularly important because they help shape the eating behaviour of children (Kininmonth, Schrempft, et al., 2021), which may in turn lead to excessive child body weight.

Food feeding practices are the specific, goal-oriented activities that caregivers exhibit when feeding their children, e.g., encouragement to eat, caregiver modelling of feeding, control over feeding (Ventura & Birch,

2008). Various feeding practices have been identified to date, and attempts have been made to categorise them based on shared concepts and characteristics (Costa & Oliveira, 2023; Gevers et al., 2014; Vaughn et al., 2016).

Gevers et al., (2014) classified caregiver food feeding practices into 3 groups, namely, control, responsiveness, and structure. Control refers to feeding practices that are aimed at meeting parental demands for food consumption and include practices such as “pressure to eat”, “emotional feeding”, “instrumental feeding”, “monitoring”, “rule-setting”, and “permissiveness”. Pressure to eat involves applying force when feeding children, with the intention of achieving some dietary outcome, even when the child is not hungry. Emotional feeding involves providing snacks to the child, in response to some emotional behaviour such as sadness, or anger. Instrumental feeding is the use of food, especially snacks, to try to convince a child into doing something that they otherwise would not have done or do not immediately have any intentions of doing. Monitoring involves keeping track of the child’s consumption of snacks and sweets, while rules-setting involves providing strict guidance on the consumption of snacks or sweets. Permissiveness dictates the extent to which a child can eat snacks as they wish.

Responsiveness refers to the use of feeding practices that encourage self-regulation and the autonomy of feeding by the child. These feeding practices are usually associated with a caregiver attitude of warmth in interacting with their children. Examples of these practices include involvement of the child in the planning, shopping, and the preparation of food, educating the child about healthy food choices, encouraging the child to eat a variety of healthy foods, modelling healthy eating in the presence of the child, rewarding the child for healthy eating, and providing feedback when the child eats snacks.

Structure generally refers to the organisation of food and feeding in the home environment. This includes the availability and accessibility of healthy foods in the home environment, as well as mealtime routines.

More recently, Vaughn et al., (2016) have provided an alternate classification of food parenting practices, proposing three new constructs, namely, coercive control, structure, and autonomy support. Coercive control includes practices such as food restriction, pressure to eat, threats and bribery, and using food to control the negative emotions of a child. Structure includes such practices such as providing rules around eating, creating healthy eating routines, monitoring the child’s consumption of snacks, modelling of healthy eating in the presence of the child, and making healthy foods available and accessible to children in the home environment. Autonomy support encompasses caregiver food feeding practices such as nutrition education, involving the child in the planning, shopping, and preparation of foods, negotiation, and encouraging the child to adopt healthy eating habits.

In terms of the relationship between caregiver food feeding practices and child adiposity, the evidence from cross-sectional and prospective studies has generally been inconsistent (Beckers et al., 2021). However, among all documented food feeding practices, restriction has demonstrated the most consistent relationship between the two (Clark et al., 2007; Faith & Kerns, 2005).

It has been suggested that the relationship between food feeding practices and child obesity is partly mediated by child food approach behaviours (Birch & Fisher, 1998). It has also been observed that in some instances, this relationship appears to reflect caregiver responses to, or influences on child eating behaviour or child body weight (Costa & Oliveira, 2023; Jansen et al., 2014; Melbye & Hansen, 2015). For example, caregiver restriction of certain foods appears to be based on concerns about their child's body weight (Jansen et al., 2014) or in response to hedonic eating behaviour by their child (Costa & Oliveira, 2023).

Obesity among Ghanaian children has seen recent increases in prevalence (Kobia-acquah & Akowuah, 2020). Research into this area of public health in Ghana is gaining more attention; however, many gaps remain. For example, among all studies of childhood obesity in Ghana, a great deal of attention has focused on the school-aged years (Amidu, Owiredu, Saaka, Quaye, Wanwan, Kumibea, Zingina, Mogre, et al., 2013; Ganle et al., 2019; H. et al., 2012), and few studies have examined the pre-school/toddler years.

The pre-school years in particular are a developmentally distinct period in a child's life. It is during this period that children may approach food differently, and exhibit behaviours such as food neophobia and food fussiness (Dovey et al., 2008). These are likely to impact on caregiver food feeding practices (Kutbi, 2020; Tan & Holub, 2012), and may lead to excessive weight gain in children.

Although there have been efforts at improving the nutritional outcomes of Ghanaian pre-schoolers, i.e., complementary feeding interventions, their objectives have generally been to improve undernutrition and micronutrient deficiencies (Aaron et al., 2016; Glover-Amengor et al., 2016; Yawson et al., 2017), rather than overnutrition. This shows the potential to miss out on the early detection and prevention of childhood obesity, enabling the establishment of excessive early weight gain among Ghanaian children. It has also been well established in the literature that obesity during this life period, i.e., toddlerhood, may persist through adolescence into adulthood (Simmonds et al., 2016).

With respect to child obesity, few studies from Ghana have examined caregiver food feeding practices in the home environment. There is the need to examine how food feeding practices may systematically differ across socio-economic and racial groups (Birch & Fisher, 1998). Exploring food feeding practices in the Ghanaian home environment, with a focus on the early years/in the context of the early years, will thus help to provide insight

into why more Ghanaian children may be becoming overweight/obese and help to better inform any future intervention strategies.

6.2.1. Aim of study

The aim of this study was to explore caregiver food feeding practices in the home environment of 2-5-year-old Ghanaian children.

6.3. Design and Methods

The study employed qualitative methods with the primary aim of discovering the inherent richness in the data that was to be collected, by providing more insight into what, why, and how feeding is practiced among Ghanaian households with toddlers. Also, given that in child obesity research, constructs of caregiver food feeding practices have extensively been studied quantitatively, this posed as a unique opportunity to explore these constructs qualitatively as complementary evidence.

6.3.1. Participants

The study sample comprised of caregivers of 2-5-year-old children who attended "Sunday schools" in Kumasi, Ghana. Caregivers were recruited from a previous quantitative study sample, examining the relationship between the home food environment, child eating behaviour, and overweight/obesity (Chapter 5). Between July and September 2022, caregivers were provided the option of participating in this qualitative study to share more details about what, why, and how they feed their children. A total of 29 caregivers who expressed interest in participating in this study were selected.

6.3.2. Data Collection

Data was obtained through 6 focus group discussions (FGDs) conducted via Google Meetings. Due to limitations posed as a result of certain travel requirements and restrictions to Ghana, post Covid-19, it became necessary for me to conduct these focus group discussions electronically with participants in Ghana. A collaborative research team from the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana, was sourced to assist with the recruitment of participants and data collection.

Informed consent was obtained from caregivers prior to each FGD. At each FGD, participants were initially guided on how to engage with the discussions, in order to encourage the participation of other members. A question guide consisting of open-ended questions adapted from the Comprehensive Feeding Practices Questionnaire (CFPQ) (Musher-Eizenman & Holub, 2007) was used for all FGDs. The CFPQ had previously been used to quantitatively measure parent feeding practices in the home environment (Chapter 5), and participants were asked to recall their responses and to provide further details for why they chose those responses, for

e.g., “I allow my child to help prepare family meals” from the CFPQ was re-worded to “Do you allow your child to help in preparing family meals?”, and then followed up with questions such as “How do you involve your child in preparing family meals?”

Each FGD comprised of caregiver participants, a moderator for the discussions, and local interpreters from KNUST. The moderator for these discussions was a bilingual researcher, and the language for the discussions was Akan or Twi. The composition of each FGD was based on the recommendations of Quintanilha et al., (2015) for conducting FGDs in non-English-speaking settings. The authors have suggested that when conducting cross-lingual FGDs, it may be more beneficial to have the researcher play the role of moderator with the help of indigenous locals who may also play the role of interpreters. The role of the moderator is typically to guide the conduct of the discussions. It is even more useful to the FGD when the researcher can play the role of a bilingual moderator if they can speak, understand, and communicate with participants, as well as support the local interpreters. Having a researcher who also plays the role of bilingual moderator has the additional benefit of making the translation process (which is typically lengthy and arduous) much less of a difficult task (Quintanilha et al., 2015).

Each FGD lasted for approximately 1 hour and was video and audio recorded. All recordings were subsequently transferred/saved to a secure folder on the servers of the School of Health and Related Research (ScHARR) at the University of Sheffield, England.

Ethical approval for this study was obtained from the Committee for Human Research, Publication, and Ethics (CHRPE), KNUST (CHRPE Reference: CHRPE/AP/270/22)

6.3.3. Data Analysis

Data was analysed thematically, and followed the guidance/recommendations by Braun & Clarke, (2006). These recommendations included generating transcripts of the FGD, familiarising oneself with the contents of the transcripts, coding the transcripts, generating themes from the codes, reviewing the themes, and then preparing a report. Thematic analysis was the most preferred method for this study because of its strengths in helping to identify shared patterns or themes among caregiver reports of food feeding practices.

I began the analysis with a preparation of a transcript for each FGD. Transcriptions were non-verbatim as the local context of the recorded words of a participant’s response for example, had the potential of being lost in meaning when there were no known English synonyms for the written text. This meant that in the preparation of the transcripts, the discussions had to be translated by a bilingual translator from the source language (Akan) to the target language (English). To ensure that participants’ responses and the dialogue of the discussions had

been accurately captured in the transcripts, and to enhance their validity, copies were sent to 2 separate members of the Ghana team who read and reviewed the transcripts alongside the video/audio recordings. These copies were then returned to the researcher to review again to ensure that there were no major differences between the recorded dialogue and the written transcript. In line with the recommendations by Braun & Clarke, (2006), reading the transcripts several times afforded the researcher the opportunity to familiarise himself with its contents before proceeding to the coding phase.

I developed the codes with the help of NVivo (version 14). Descriptive coding (Castleberry & Nolen, 2018) was the preferred method for coding, as this ensured that the relevant responses from participants' were accurately represented with as little alteration in meaning as possible. This process involved highlighting participant responses from the transcript that were related to the aim of this study, and assigning key words or key phrases to those highlighted responses (Joffe & Lucy, 2004). Key words and key phrases were chosen directly from the highlighted responses.

Codes that were generated from the transcripts were then organised into themes and sub-themes using a deductive process. This involved organising the codes into clusters, and labelling these clusters using an adaptation of the constructs of food feeding practices put forward by Vaughn et al., (2016).

6.4. Results/findings

A total of 29 caregivers were involved in this study, comprising of 27 females and 2 males. Other sociodemographic characteristics were not collected for this study since they were not required for analysis.

6.4.1. Themes

Findings were grouped into themes of autonomy support, coercive control, and structure. For each theme, sub-themes were also identified based on the classification by Vaughn et al., (2016). Child involvement, child encouragement, and child nutrition teaching were grouped under autonomy support; emotional feeding, instrumental feeding, food restriction, and pressure to eat were sub-themes under coercive control, while food availability, the modelling of healthy eating, and monitoring, were grouped under structure (Table 27).

Table 27. Themes and Sub-themes identified from the Focus Group Discussions

Theme	Sub-theme
Autonomy Support	Child Involvement, Child Encouragement, Child Nutrition Teaching
Structure	Food Availability, Modelling of Healthy eating, Monitoring
Coercive Control	Emotional Feeding, Instrumental Feeding, Food Restriction, Pressure to Eat

6.4.1.1. Autonomy support

6.4.1.1.1. Child Involvement

The majority of participants reported that they involved their children in the planning of foods for the household. They reported that they frequently do this by asking their children about the foods they would like to have, before embarking on shopping trips. For example, one caregiver said,

"*...for me, before I will cook, I ask them what they will eat before I go shopping and come back to prepare it".*

For a small number of caregivers, involving children in the planning of meals was not a regular activity, i.e., only on some occasions were children involved by their caregivers in the planning of feeding. Representative submissions from caregivers included statements such as,

"Please, sometimes I can prepare food based on my own choices and when they come, they will eat it. Sometimes too, I also ask them, "today what will you eat?" if it is rice balls, I can make it for them".

"Sometimes it can be in favour of him, that for today, let us make what they have said."

Still, a few other caregivers believed that involving the child in the planning of meals for the household was counterproductive, because doing so would disrupt the food shopping and food preparation plans of the caregivers themselves:

"Even the planning, we don't involve them because we know what they like already, so it is not now that we are going to plan and call them to maybe ask them what they think we should prepare. No, we don't involve them because when you have a plan that you will prepare this today, they also have their own food they want for that day"

In terms of shopping, responses from caregivers were varied. Although a few caregivers reported taking their children along when shopping for foods, in particular, some believed that it was perhaps not safe to include children when shopping at the local markets. They were of the view that local markets were slightly or very chaotic for children. Rather, there was more of a preference for involving the child when shopping in an upscale supermarket. For example, one parent reported that,

"Here in Ghana, for our setting, the way we make the market, we cannot take the child to follow you to the market, it is not conducive at all, unless maybe you are going to some supermarket, as for that one, when we are going, we take him with us. But if it is not the supermarket, and it is the market in particular, as for that one he does not go along."

Many caregivers however frequently reported not involving their children in shopping for foods. Aptly articulated by one participant, *"for the shopping, they are not part".*

The majority of caregivers frequently reported that children were involved in the cooking of foods, but only to some extent. For example, many caregivers reported that their children were involved in cooking, insofar as they asked questions about the cooking process, to which caregivers would provide answers. Most children were not directly involved in the process of food preparation. As said by one caregiver,

"When you are preparing the food, they can come around and be asking, what are you cooking, what is going to be added, how are you doing it, for those things they can ask. We do not intentionally add them in preparing of the food."

One caregiver intimated that this was probably because the children were too young.

"He is young, so when he comes to where I am cooking, he asks me, "what do we use this for?", maybe tomatoes, "what do we use it for?". It is the older ones that I teach them."

A few caregivers reported that their children were involved in cooking, to the extent of helping with serving food, or helping with finding cooking items during food preparation. Examples of participant responses in support of this observation include:

"When I am making food in the kitchen, he is able to come there, so that when you ask him to take something, [he takes it for you].".

"Also, when you finish cooking, him, he can bring everybody's bowls, he can pick up everybody's bowl and bring it [for them to be served food]"

6.4.1.1.2. Child encouragement

Caregivers commonly used creative means to try to encourage healthy eating by their children, such as allowing the child to try a variety of foods or increasing their vegetable intake by pulverising/blending new or disliked vegetables into other foods that they liked or tolerated.

In terms of encouraging the consumption of a variety of foods, for example, one caregiver explained,

"...that is why I change the food, you see, for example, breakfast, you have made porridge today, the next morning they will say, "mummy, why is it that we had porridge yesterday and that you are giving us the same things today", even now that they have grown a bit more, they will ask questions why they had this yesterday and you are repeating it today, because they don't like food, so I have to see how or what I can do to make the children eat, so I try to all the time change it. Today, if this is the food that I will prepare, the next day, I will make something else, so that every time it will make them happy, so that they will eat a little for me."

The provision of food options to increase variety and encourage autonomy in children was recurrent, exemplified by participant statements such as:

"Sometimes they will show [you] something different, then I look at that food, and if they eat it at that moment, if it will help them, then I give it to them. "We encourage them and give them options".

In terms of encouraging the consumption of vegetables or new foods, caregivers commonly reported dicing or blending them into foods that they were sure the child would not refuse. This was best evidenced through caregiver submissions such as,

"I blend carrots and other vegetables. Then I cut the cabbage into very small pieces, so that he will not see them, then I mix them."

"I slice it into very small pieces, and I put it into the stew, by the time you are done, then it would have mixed it with it, so it will be hardly possible for them to pick them out and throw it away".

Some caregivers used other creative methods such as negotiation to encourage their children to eat, exemplified by statements such as,

"If it is food that I know that they will not like, I will intentionally prepare their minds that this evening we will eat this"

Other less common methods used by caregivers included telling the child about the perceived benefits of eating new foods in order to encourage them to eat. Notably, one caregiver was very particular about how their child would eat any food presented to him, once he was told it would "give him blood":

"As for my grandchild, if you tell him that it will give him blood, he will eat it".

6.4.1.1.3. Teaching the child about nutrition

Caregivers were less frequently involved in teaching about nutrition to their children, and most of them believed that this was the responsibility of the formal school system. As one parent noted,

"Normally, it is in the school."

Only a few caregivers reported teaching their children about benefits of healthy eating, or the harms of sweet consumption:

"*Please, I have this chart that we make at school, so normally, when I show him the chart, I can say that for example, this is a fruit, when we eat fruits, this is what we get from it, it will do this for us, when you eat vegetables, you'll get this, when you eat carbohydrates, you'll get this, so I explain it like this to him*"

"I have told them [that] things that are too sweet are not good, when you eat it often, you will get sick".

"[I tell them], when you eat, you will get energy, this is what will help the human body, then we tell them".

6.4.1.2. Coercive control

6.4.1.2.1. Pressure to eat

Caregivers were split in opinion over the level of force that was needed for toddlers when it came to feeding. While it appeared that some caregivers were more permissive to the amount of control their children had in terms of feeding and food choices, others felt that given the immense challenges and responsibilities of parenthood, it was impractical to cater to the whims of the child, and it was often necessary to be firm and insistent on the child eating what they had been presented with. Examples of caregiver submissions in support of this observation include:

"Please, me too, in my house, for me, what is available is what we will all eat. So, if I prepare rice, all of us will eat, you cannot say that I will not eat rice, I will eat "ampesi", no, the money that is available that will be enough/suffice, that is what we have used, so what I will prepare, that is what you will eat. So, for me, I have control over what the children eat".

"[For] me, when I have cooked/prepared food, you will eat. If you do not eat, I will beat you to eat, because that is what I have. I cannot also let you sleep hungry, so as long as if you eat and it goes and does not come out, then you have to eat"

6.4.1.2.2. Emotional Feeding / Feeding to control the child's emotions

Feeding to control the emotions of children was not very frequently practiced by caregivers. Many caregivers were of the view that this amounted to pampering the child, a practice which was, implied by one participant, not sustainable in the long-term:

"It is not like we don't do that, but it is not always. As in, every day they are crying, unless you give them something to pamper them. They are 5 years old and quite old, so if you say that you are training them like that, it can become a habit, so anytime they would love to be pampered with such stuff before they stop crying. So very rarely do we do it."

A few caregivers reported using food to calm their children when they were upset. For example, one parent shared her experience with emotion control feeding:

"With my child, when they are crying and you want to calm them down, they themselves request what they want. Maybe if it is chips that they have seen in your bag or in the room, they would request for that and when you give it to them, they calm down".

6.4.1.2.3. Instrumental feeding

Very frequently, caregivers used food and feeding to control child behaviour towards a desired outcome. This included the provision of drinks, sweets, snacks, or the child's favourite food. Perfect examples of this observation were found in caregiver reports such as:

"For me, when I tell them to clean [the] bowls, they will do it, but [they] will intentionally say that they won't do it. All they want is biscuit. I tell them, if they don't [do it], I will not buy biscuit for them, so if they finish, they worry me till the time I buy the biscuit for them."

"Let's say [that] you are preparing soup, they would be sitting by your side, when you stir the soup, then they [would] say, "give me meat", so when they do something and you tell them not to do [that], and you would give them [the meat] for that, they will stop."

On other occasions, caregivers reported providing food to children as a reward for good or desired behaviour, for example, good grades or some academic achievement. For example, one caregiver noted,

"I can reward them, say for example, today when you went to school, you are able to tell [me] the marks that you got, what you learned, so maybe in the evening, the food that they would eat, maybe I would add an egg."

"When they do something that is good, and you want them to continue to do it, as for that one, what you can do is, maybe their favourite something, something that they like, if they are going to school and other places, you can add it, so that it motivates them, and then for that thing they continue to do it."

Sometimes, instrumental feeding was food-oriented, such as when caregivers wanted children to eat certain meals that the child would otherwise dislike. This frequently involved the promise of a drink.

"Sometimes I give them a mineral or drink after, to encourage them to eat"

"All I say is that if you eat, I will give you [a] drink. [my child] likes to drink a lot, so that is what I use to encourage him to eat"

Caregivers were however unanimous in their opinions of not using food as a punitive measure for undesired behaviour by their children. They expressed the belief that doing so was counterproductive, and would affect the child negatively. Examples of statements in support of this include:

"If a child does something wrong, and you say that you are using food to punish the child, then it means that you are disturbing the child, his growth and everything, it will not go well."

"This my child, he does not already like food, how am I going to use food to [punish him], no, we don't do it that way."

6.4.1.2.4. Food restriction

Food restriction was commonly practiced by caregivers, and this was often reported by caregivers to be in response to concerns over child body weight, child eating behaviour, or both. Concerning child eating behaviour often took the form of overeating, and was most often related to foods that the child liked or enjoyed. In terms of child body weight, caregivers were particularly concerned with preventing excessive body weight. Restriction often took the form of reducing portion sizes. As put by some caregivers,

"I make sure he does not get overweight, so I pay attention to everything he eats very well, but it gets to the point [when] I realise his weight is increasing, then I tend to decrease his food portions"

"The one who came to stand here, who is going and coming, and going and coming, even when you look at the body, no one will tell you, you can see it, so I do not let him overeat. Just as the others would eat, that is the same way he should eat, but he eats more than them. But I make sure that it is not more than enough, because

he is becoming big. As for him, if you leave him to eat, he will really eat, so every time, I make sure that he does not overeat."

A few caregivers were specific with the kinds of foods that they restricted, preferring to limit their toddler's consumption of foods that they thought/believed were energy-dense. For example, one caregiver was of the opinion that excessive carbohydrate consumption by their child would lead to excessive weight gain:

"Because I don't want them to gain a lot of weight, I limit the amount of foods containing carbohydrates"

In terms of child health, caregiver concerns were widely varied, albeit done to prevent some perceived form of disease or disability to the child. For example, one parent intimated,

"I allow them to eat, but I do not let them overeat. With them, when they slightly overeat, they would vomit. So, I ensure that they would eat and not overeat is what I give to them. When they overeat, they would continuously vomit."

6.4.1.3. Structure

6.4.1.3.1. Food availability

Many caregivers reported providing their children with cooked food whenever it was possible to do so. Buying fast foods and already prepared meals from outside the home was not encouraged. Very frequently, caregivers reported providing cooked breakfast in the mornings, lunch in the afternoons, or supper in the evenings. Examples of caregiver submissions in support of this include:

"As for me, I am in the kitchen morning, afternoon, and evening. I myself prepare it for them, I do not like food from outside for my child"

"I try to make it a point that in the evening, if I am unable to make any foods from breakfast to the evening, as for the evening one, they must get the one with the balanced diet for them to eat."

Fruits and vegetables were frequently provided to children, although savouries, sweets, and snacks were sometimes also available or accessible to children.

"Every day when we cook, we add some vegetables to it. Bananas too are another favourite."

"They like cake, so as for the cake, honestly, my dad usually buys some and brings it home."

Caregivers also employed various food management techniques to ensure that food was always available in the home environment. Some caregivers preferred always eating fresh foods, and so would frequently buy

food ingredients from the markets. The benefits of regularly eating freshly made food ensured that food less often went bad in storage.

"I personally do not like to keep them in the fridge. I want it fresh always. I will buy those that are not fully ripe, so they do not go bad"

Other caregivers preferred to keep food ingredients purchased from the markets or other cooked food in cold storage, i.e., in a freezer or fridge. This practice also ensured that food did not go bad and could be kept for longer periods until they were needed. It also saved caregivers from frequently attending the markets to purchase food ingredients.

"For me, I do not frequent the market. Even if I do, I put it in there [the fridge]. When I prepare food, or when I prepare stew, I put it in my fridge. When I'm ready, I take it out, so I do not frequent the market"

"I do my things, every week, Saturdays, I make my stews and soups differently, all what I will use, I do it and put it in [the fridge], within the week, the following week, then I do it again."

Still, in addition to keeping food in cold storage, some caregivers also preferred buying foodstuff in bulk.

"My strategy is that I do buy in bulk, at least for two weeks. When I go to the market, I will buy foodstuff and everything, at least, that will last me two weeks, so that I will refrigerate them."

"It is on a monthly basis to buy the foods in bulk and put it there, but the perishable ones you will put it in a fridge."

6.4.1.3.2. Modelling of healthy eating

Modelling was highly recognised as an important feeding strategy frequently practiced by caregivers. There were numerous examples provided by caregivers of how they used modelling (eating in the presence of their child) to gradually motivate them to eat/try out new foods or disliked foods. Overall, caregivers understood the importance of modelling, and agreed that it was an effective feeding practice. Notable examples provided by caregivers include:

"With me, what I sometimes do is that, let us say if I buy mango, at first when I bought the mango, what I used to do was that I eat it in front of them, and I say that this mango is sweet. Then he says, "Mama, I don't like it". Then I say, "Come and give it a try, it is nice", so that he will become fond of it. And since I started doing that, I have realised that they have started eating some"

"If it is fruits [for example], we prepare it, we cut them up. Let's take it that for example, if it is watermelon, we would cut it up, we would peel it all over and put it in a bowl for us all to eat; this person eats, that person eats [me and the child]"

6.4.1.3.3. Monitoring of the consumption of unhealthy food

In terms of tracking the consumption of unhealthy foods, especially sweets and snacks, caregivers were split in their submissions on how they achieved this, or whether this was frequently practiced in their homes. While some caregivers were more permissive to the consumption of sweets and snacks, others were very restrictive. For example, for those who were more tolerant of sweet and snack consumption, one participant said,

"Okay, so sometimes, often, we black people, it does not come naturally to our minds, we know that as for sweets, every child likes it. It doesn't readily come to our minds that as for this, if he eats it, he will fall sick, so I shouldn't let him eat it. Sometimes we can allow them to eat it. Sometimes we bring it home and add something to it [the cake] to eat. It doesn't come to our minds that maybe they would be sick or something; sometimes you allow them to eat it"

For others, monitoring of their child's consumption of unhealthy food was of utmost importance, and caregivers frequently employed different strategies to limit or prevent their children from eating such foods. It also appeared that the level of restriction employed by caregivers corresponded to their perception of the degree of "un-healthiness" of the food. As an example, one caregiver who was especially particular about their child's unhealthy food consumption, and who appeared to frequently read the labels of food packages, said,

"For me, sometimes when I go shopping and they go to these big, big shops, some of these snacks they have, after reading the package and seeing things like monosodium in it, no matter what you [the child] says, I would not buy it for you"

Caregivers believed that the unavailability of these items was key to preventing consumption, in other words, children would eat these foods as long as they were available. As another participant added,

"So, you do not buy it for them. If it is available, they will eat it, so if it is not available, it is not available"

For other caregivers, limiting the consumption of unhealthy foods involved a range of creative techniques, such as reducing the frequency of consumption, or reducing the portion size. Examples of participant submissions include:

"With me, what I do is, especially these new drinks that have come, when I realise, they are drinking too much, because when they drink too much, they will run [have diarrhoea]. Something like "kalypo", I would not give them continuously for 3 times, because they will run."

"Too much of everything is bad, so we allow them, this is the only [special] thing they will eat. [If you say don't eat it], you have to give them a limit. You take some from their hands, and you give them a little"

"I have put it in the fridge in its original location. I have issued you [the children] a warning [that] if you take it, you have a problem. So, you cannot take it. Unless you are going to school, and I put each person's own in their lunchbox. So, me too, that is what I have put on them"

6.5. Discussion

The primary aim of this study was to explore the feeding practices of caregivers in the home environment of Ghanaian pre-schoolers/toddlers aged 2-5 years, to attempt to identify parental feeding practices that might be targeted in future home-based obesity prevention interventions.

Three themes based on the conceptual framework proposed by Vaughn et al., (2016) were reported: autonomy support, coercive control, and structure of the home food environment. In terms of autonomy support, caregivers frequently encouraged the consumption of a variety of foods, and involved their children to some degree in the planning, shopping, and preparation of meals. Teaching their children about nutrition was a less common practice. In terms of coercive control, food restriction and instrumental feeding (rewarding the child for a desired behavioural outcome) were commonly practiced, while emotional feeding and pressuring the child to eat were seldom or sometimes practiced by caregivers. In terms of structure, most, if not all, caregivers ensured that food was available in the home environment, employing a variety of techniques to maintain the supply of food. Parents also often served as effective role models of healthy eating, and the consumption of unhealthy foods by their children, particularly sweets and snacks was highly monitored.

6.5.1. Autonomy support

6.5.1.1. Child involvement

Findings from this study show that although caregivers may, to some extent, want to involve their children in the planning and preparation of food, many are very hesitant to fully engage their children in these activities. Participant responses imply a certain level of protection for their children, for example, protection from the perceived hustle and bustle of local African markets, or protection from the potential harms/health risks of the traditional methods of cooking that are still in practice in Ghana, i.e., the use of live cooking fires and very potent thermal conductors such as aluminium cooking ware and cooking oils. At other times, it appears that

for caregivers, the planning of foods for the household may be tied to very limited financial resources, making it difficult for a parent planning food on a budget to involve their child who may actively be exploring other food options.

Generally, studies on involving pre-schoolers in the planning, shopping, and preparation of food at home have shown some improvements in child eating behaviour and vegetable and fruit intake (McCurdy et al., 2022; Metcalfe & Fiese, 2018). For example, McCurdy et al., (2022) found that among low-income Hispanic families in the US, higher involvement in food preparation was associated with higher child enjoyment of food. Child involvement may also be protective of food fussiness among 2-4-year-old pre-schoolers (Broad et al., 2021; Holley et al., 2020). Metcalfe & Fiese, (2018) has also observed that among 497 caregiver-pre-schooler (3 year old) dyads, involving the child in the planning, shopping, and preparation of home meals was predictive of improvements in the consumption of fruits and vegetables a year later. Experimental studies also show that the benefits of child involvement in improving the consumption of fruits and vegetables may continue to persist even after the pre-school years (van der Horst et al., 2014).

Although child involvement may improve dietary outcomes among children, this study has shown that the extent to which children are involved by caregivers may vary widely among different households. It is necessary to find out whether these variations are wide enough to discontinue to produce favourable outcomes in child dietary choices and eating behaviour.

6.5.1.2. Child encouragement

In this study, encouragement was frequently practiced by caregivers, and their accounts were suggestive that this was beneficial to children, in terms of improvements to their eating behaviour and dietary intake. Caregivers frequently used techniques such as providing children with a variety of foods, or introducing healthy foods by blending them in with the child's food.

In the wider literature, encouragement has often taken the form of providing a variety of foods (Vaughn et al., 2016), or other creative methods such as hiding vegetables in the foods of pre-schoolers (Caton et al., 2011). The perceived benefits of hiding vegetables in the foods of children include improving the acceptability of disliked vegetables in the future, while benefitting from healthy eating (Caton et al., 2011).

A growing body of evidence suggests that child encouragement is associated with child food approach behaviours such as enjoyment of food, and that this relationship may be reciprocal in the long-term. For example, using the Gemini cohort, Kininmonth et al., (2023) have shown that prospectively, greater caregiver encouragement predicted child enjoyment of food, while child enjoyment of food also predicted caregiver

encouragement of healthy eating. Cross-sectional evidence has also been fairly consistent in showing that child encouragement is associated with improved dietary outcomes. For example, in assessing the impact of encouragement on the intake of core foods (fruits and vegetables) and non-core foods (snacks, sweets, and sweetened beverages) by 2-5-year-old toddlers in the UK, McGowan et al., (2012) observed positive and significant associations between child encouragement and child's vegetable intake. The evidence from experimental studies, e.g., Rotman et al., (2020) have also been in support of a relationship between the encouragement of healthy eating and improvements in child healthy vegetable intake and diet quality, as well as a reduction in the consumption of refined grains.

The practice of child encouragement shows promise for improving the dietary consumption of pre-schoolers in Ghana. However, future studies will need to establish how child encouragement and improvements in dietary intake may serve as protective factors against the development of excessive weight gain among Ghanaian pre-schoolers.

6.5.1.3. Teaching about nutrition

In this study, teaching pre-schoolers about nutrition was not a commonly reported caregiver feeding practice. This observation is similar to findings from the few studies that have explored this feeding practice among caregivers of pre-schoolers (Holley et al., 2020).

As a relatively new construct, only a few cross-sectional and prospective studies have examined the caregiver practice of teaching about nutrition to pre-schoolers and how it may influence child dietary behaviour and weight gain (Vaughn et al., 2016). The novelty of this construct poses a few challenges to its measurement and conceptualisation. Vaughn et al., (2016) have argued that existing measures of caregiver nutrition education are limited, in that, they typically capture only the use of simple messages to encourage children to eat healthy foods, and that they potentially miss out on other perspectives such as education about the nutritional value of foods, the role of foods in health, hunger and fullness cues. In terms of conceptualisation, Vaughn et al., (2016) also point out that other caregiver feeding practices may be used in conjunction with nutrition education. For example, parents may offer nutrition education messages when they are reasoning with their children about what foods to eat, i.e., during negotiation.

Nutrition education intervention studies in other settings, e.g., school and care settings, which have also included caregivers (Hu et al., 2010), highlights the key role that caregivers can play in improving the nutrition of their children through education. In China, for example, Hu et al., (2010) randomised 2,102 4-6-year-olds and their caregivers to either participate in monthly nutrition education activities (1252 children) or not (850 children) for up to 1 year. The authors reported that after nutrition education, there was a significant reduction

in unhealthy diet-related behaviours among children in the intervention group, 6 months and 1 year post-intervention (Hu et al., 2010).

In Ghana, nutrition education is more predominant in the school-age years, but are fraught with challenges including schoolteachers' insufficiency in nutrition knowledge, and lack of resources to adequately deliver nutrition education (Antwi et al., 2020). However, the few that have included caregiver participation e.g., (Quaidoo et al., 2022) have shown promise in improving caregiver nutrition education practices and child dietary attitudes, especially in the preschool years.

6.5.2. Coercive control

6.5.2.1. Pressure to eat

In this study, caregivers were split in opinion, in terms of how often they practiced "pressure to eat".

This finding represents a deviation from observations by Blissett & Bennett, (2013), Gu et al., (2017) and Yilmaz et al., (2019), for example, that show that pressure to eat is commonly practiced among caregivers in Afro-Caribbean households. These findings suggest possible variations in the use of "pressure to eat" among caregivers in the home environment of African pre-schoolers. The findings may also reflect possible differences in the practice of "pressure to eat" between Caribbean and West African caregivers.

In those households where pressure to eat was practiced in this study, participants indicated that pressure to eat was associated with child food fussiness. Cross-sectional and prospective studies have frequently reported associations with child food fussiness (Gregory et al., 2010; Jansen et al., 2017). Prospective studies in particular have shown that food fussiness and pressure to eat are bidirectionally associated, i.e., food fussiness strongly predicts caregiver pressure to eat, and that caregiver pressure to eat also positively predicts future food fussiness among pre-schoolers (J. Wang, Zhu, Wu, et al., 2022). The association between pressure to eat and food fussiness may also be mediated by caregiver concerns for low child body weight (Gregory et al., 2010). It is not immediately clear whether these concerns are related to the child's current body weight or caregiver predictions of the child's future body weight.

Given that caregivers may adjust their feeding practices according to perceptions of their pre-schooler's fussy eating habits or concerns related to their child's body weight, it is important for caregivers to be provided with alternative feeding strategies to support healthier feeding interactions in the home environment of Ghanaian pre-schoolers.

6.5.2.2. Restriction

Caregivers from this study frequently practiced food restriction, and many did so in order to control their child's body weight, or to control their child's eating behaviour. Although caregivers were of the opinion that their children were neither overweight nor obese at the time of the study, caregivers viewed this practice as a preventive approach to child overweight or obesity.

The evidence from some cross-sectional and longitudinal studies suggests that restriction is often a caregiver response to concerns over increasing child body weight or increased food approach behaviours (Beckers et al., 2021; Clark et al., 2007), supporting the findings of this study. However, some other studies have shown that for example, increased food approach behaviours by children may also be in response to food restriction by caregivers, illustrating the bi-directional relationship between caregiver restriction feeding practices and child eating behaviour (Clark et al., 2007). It is believed that the restriction of palatable foods may be counterproductive since children may be more likely to seek out those foods in the absence of the caregiver (Clark et al., 2007).

Given that there is some evidence in the literature implicating food restriction practices with hedonic eating, and hedonic eating with increased child body weight (Fox et al., 2021), Ghanaian caregivers must be informed of the potential impact of food restriction on pre-schooler overweight or obesity.

6.5.2.3. Instrumental feeding

In this study, caregivers frequently provided rewards to their children for attaining some desired outcome, such as attaining good grades in school.

In terms of instrumental feeding, current evidence shows that food-based rewards may predict weight gain among children, because it may promote food consumption outside of the child's hunger cues (Jansen et al., 2020; N. Miller et al., 2020). Specifically, instrumental feeding (reward-feeding) may predict emotional overeating (Berge et al., 2020; N. Miller et al., 2020). Recently, reciprocity of this relationship has been reported (Kininmonth et al., 2023). Kininmonth et al., (2023), in examining the prospective associations of parental feeding practices with child eating behaviour using a bivariate latent change analysis, has shown that greater instrumental feeding predicted an increase in emotional overeating, while greater emotional overeating predicted an increase in caregiver's instrumental feeding.

Controlling, food-based rewards to manage child behaviour may be counterproductive; using non-food-based rewards have rather been suggested (DeCosta et al., 2017). Since instrumental/reward-based feeding may be common among caregivers of Ghanaian pre-schoolers, alternatives to this practice, such as using non-food

based rewards could be encouraged. It may be necessary to incorporate interventions to improve this feeding practice in future child obesity reduction programmes in Ghana.

6.5.2.4. Emotional feeding

Emotional feeding was not commonly practiced by caregivers, as they believed that this amounted to excessive pampering of a child and was not sustainable in the long-term.

Cross-sectional and prospective studies examining emotional feeding habits of caregivers have shown that child emotional eating may be influenced by caregiver emotional feeding (Frankel et al., 2012; Rodgers et al., 2013). Reciprocal effects have also been evidenced (Steinsbekk et al., 2018). Using 801 4-year-old pre-schoolers followed up prospectively for up to 6 years, Steinsbekk et al., (2018) examined potential pathways for the development of emotional overeating, and found that high levels of caregiver emotional feeding predicted high levels of child emotional eating. The authors identified that this relationship was also reciprocal (Steinsbekk et al., 2018). Other authors, for example, An et al., (2022), have shown that in some instances, emotional feeding is linked to an increase in the consumption of ultra-processed foods including sugar-sweetened beverages, packed snacks, and candies.

The finding that emotional feeding was seldomly practiced by Ghanaian caregivers is encouraging, in the light of the available evidence linking emotional feeding to emotional overeating, and which also potentially links to excessive weight gain among pre-schoolers. The non-popularity of this feeding practice must be encouraged.

6.5.3. Structure

6.5.3.1. Availability of food

Food was frequently available in the home environment, as reported by caregivers. These included a variety of foods such as fruits and vegetables and sweets and snacks. Foods were mostly unprocessed, and required some cooking. Food shopping drove food storage options, and food shopping was done periodically to maintain or replenish food stock in the home environment. Cold storage and bulk-buying were commonly used strategies by caregivers.

A recent assessment of food availability in Ghanaian households has shown that storing food is a common practice (Afriyie et al., 2023). However, it appears that fruits and vegetables are generally stored less, as a result of their perishable nature (Afriyie et al., 2023). The frequency of food shopping also determined food storage options (Afriyie et al., 2022). This observation was evidenced in this study. Some caregivers submitted that they preferred to eat fresh foods, and would therefore have to frequently shop for these items, rather than keep them in storage for later consumption. The use of refrigerators and deep freezers is however

common among Ghanaian caregivers (Afriyie et al., 2023), especially for those who do not shop for foods frequently.

Food availability may be one way by which caregivers are able to influence children's food intake (Vaughn et al., 2016). Depending on the predominant food type made available by the caregiver, children are either exposed to healthy eating options or foods that may influence weight gain. There is ample evidence, for example, that shows that having more fruits and vegetables at home influences an increase in the consumption of fruits and vegetables among children (Pearson et al., 2009; Wyse et al., 2011). There is also some evidence that having lots of processed or non-core foods at home leads to an increase in their consumption among pre-schoolers (McGowan et al., 2012). Food availability may also influence other food feeding practices such as food restriction (Vaughn et al., 2016), when caregivers attempt to, for example, limit the access of children to previously available foods.

Since it appears that food availability is not an issue among Ghanaian households with toddlers, caregivers must be encouraged to continue to make healthy fruits and vegetables available to their children, and to minimise the amount of ultra-processed foods that they bring into the home environment. Caregivers must also be made aware that the foods they bring into the home may also affect their child feeding behaviour, and so care must be taken when introducing foods into the home environment.

6.5.3.2. Modelling of healthy eating

Modelling was a common practice among caregivers. Caregivers frequently reported an increase in the child's uptake of new foods as a result of eating foods in the presence of their children, or sharing platters with their children.

Parental modelling of healthy eating may be effective at encouraging healthy eating among children. For example, Pearson et al., (2009) in their review of caregiver modelling of fruit and vegetable consumption, demonstrated significant correlations with child eating behaviour, i.e., the parental modelling of healthy eating predicted an increase in the intake of fruits and vegetable by children. A recent review of the influence of parental dietary behaviour on child food promotive and preventive behaviours has also provided additional support for this relationship (Yee et al., 2017). Two recent systematic reviews examining the effect of parental modelling on child eating behaviour or dietary intake have however reported that the evidence in support of the relationship is weak or modest (Pervin et al., 2023; Y. Wang et al., 2011).

Modelling of healthy eating among caregivers of Ghanaian toddlers however remains a positive feeding practice and must be encouraged. In terms of childhood obesity, this feeding practice could serve as an important component of behavioural change interventions in Ghana.

6.5.3.3. Monitoring of the consumption of unhealthy food

Monitoring was a common practice among caregivers, and this ensured that children were not regularly eating sweets and snacks. This was usually done by limiting the portion sizes or the frequency of consumption of unhealthy foods.

The evidence linking monitoring and child dietary behaviour is inconsistent (Vaughn et al., 2016), i.e., while some studies have suggested that parental monitoring may be protective of unhealthy eating behaviour among toddlers/pre-schoolers (Clark et al., 2007; McGowan et al., 2012), others e.g., have not found any significant relationships (Jansen et al., 2012).

Vaughn et al., (2016) have argued that a possible reason behind this discrepancy may be that the relationship between monitoring and child eating behaviour is curvilinear, i.e., monitoring is only beneficial when it is not done in excess, and that when overdone, it may rather be counterproductive.

However, since monitoring may be helpful in preventing unhealthy eating among children, this practice should be encouraged among caregivers. Further research is required to understand the extent to which monitoring may be beneficial to Ghanaian pre-schoolers in preventing excessive weight gain.

6.6. Strengths, Limitations, and Recommendations

This study presents insights into the feeding practices of Ghanaian caregivers juxtaposing them with established constructs of food feeding in the home environment. Since the sample size for FGDs are typically small, inference and the transferability of findings to the wider population have to be made with caution. Since themes were obtained from already established constructs in the literature, it is possible that some very contextual food feeding practices may have not been captured in the analysis. However, since this is one of the few studies to qualitatively study these food feeding constructs, this study serves as a good start into examining how caregiver feeding is practiced in the Ghanaian context. Parental perceptions of their child's weight status and concerns for the weight of their children need to be studied in relation with caregiver food feeding practices in future studies. Another potential limitation of this study is the absence of data that could reflect the context of responses from qualitative participants, e.g., more detailed SES data for each caregiver. The choice of Sunday schools may also be a limitation, as children from other religious sections of Ghana were not represented in this study.

6.7. Conclusion

Caregivers of Ghanaian toddlers employ a variety of food feeding practices, some of which may impact on child eating behaviour and may be counterproductive in the long-term. In particular, restriction of food should be re-examined to find out how it may be linked with child weight gain among Ghanaian toddlers.

Chapter 7– General Discussion

This chapter summarises and integrates the findings from studies 1 – 4 (the systematic review, secondary data analysis, the survey, and the qualitative study).

7.1. Summary of Findings

The overall objective for this project was to evaluate the home environment of Ghanaian pre-schoolers, and report on how it could be contributing to increases in overweight and obesity. The project was completed using an explanatory sequential mixed methods approach comprising of 4 studies: one systematic review, 2 quantitative studies, and one qualitative study.

7.1.1. Summary of Study 1 findings

The systematic review was designed to summarise the evidence on the home environment and overweight/obesity among SSA preschoolers. The findings demonstrated that the home food environment (through dietary diversity) and some socio-demographic factors, e.g., mother's BMI, were consistent predictors of overweight and obesity among pre-schoolers in sub-Saharan Africa. No associations were observed for the home physical activity environment and the home media environment.

7.1.2. Summary of Study 2 findings

Study 2 (secondary data analysis) was designed to investigate the sociodemographic determinants of overweight/obesity in the home environment of 2–4-year-old Ghanaian toddlers. No association was observed between the home physical activity environment, the home media environment, and overweight/obesity, just as demonstrated by the systematic review of sub-Saharan Africa. Contrary to the findings in SSA, the home food environment (through dietary diversity) was not a predictor of overweight/obesity among Ghanaian toddlers. Education and household wealth consistently predicted the home food, home physical activity, and home media environments; however, they demonstrated no association with overweight/obesity, just as observed in SSA.

7.1.3. Summary of Study 3 Findings

Study 3 (the survey) was conducted to investigate the home food environment determinants of overweight/obesity among Ghanaian toddlers. In that study, food restriction was shown to be a strong home food environment predictor of overweight/obesity. The household availability of food (household dietary diversity) was not a predictor of overweight/obesity, an observation that was consistent with the findings from the secondary data analysis study. Child eating behaviours that were found to be associated with overweight/obesity included a reduction in satiety responsiveness and an increase in the enjoyment of food.

Bidirectional relationships were also observed between caregiver food feeding practices and child eating behaviour.

7.1.4. Summary of Study 4 Findings

Study 4 (the qualitative study) was a qualitative exploration of the food feeding practices commonly used by caregivers of Ghanaian toddlers. Caregiver food feeding practices were the focus of the final qualitative study, as the only home food environment predictor of overweight/obesity from the survey (study 3). These were further explored to reveal a mix of feeding practices that varied in the way they were expressed by caregivers in their home environments. Common caregiver food feeding practices (in confirmation of those found in study 3) included encouragement, food restriction, modelling, and monitoring. Involvement and instrumental feeding were also found in this study; however, they were not observed in the survey study (study 3) of the home food environment. Teaching about nutrition, emotional feeding, and pressure to eat, were not popular food feeding practices among the caregivers of Ghanaian toddlers.

7.2. Triangulation of Findings

Overall, this project has shown that the availability of items in the home food, the home PA, and the home media environments, are by themselves inadequate to explain increases in the prevalence of child overweight/obesity, especially among the toddler age group. Social interactions between caregivers and children appear to be the most likely contributor, shaping child behaviour towards more obesogenic lifestyles. In particular, this project has identified caregiver food feeding practices as important home environment contributors to pre-schooler weight gain. Caregivers must be made more aware of their potential in shaping child eating behaviour, whether in response to, or to influence child behaviour. Caregivers should be made aware that child eating behaviour is proximally linked to overweight/obesity, and that eating behaviour that is established in toddlerhood may be difficult to change in adolescence and adulthood.

The findings from this study are early indications that caregiver food restriction may be contributing to population increases in paediatric overweight/obesity, through increases in child food approach behaviours. In our study, there is ample evidence to support the claim that food restriction is a common practice among Ghanaian caregivers. In addition, caregivers commonly described using restriction because of concerns or perceptions about their child's body weight or health. Restriction has been linked to caregiver concerns about the child's weight/health (Blanchet et al., 2019; Cachelin & Thompson, 2013; Crouch et al., 2007; May et al., 2007; Styles et al., 2007); although it is yet to be evidenced in the Ghanaian population, caregiver misperceptions about the child's body weight is not uncommon (Blanchet et al., 2019; Crouch et al., 2007). Specifically, it appears that caregivers may be less likely to correctly identify a child as overweight compared to

identifying obesity in children (Blanchet et al., 2019; Crouch et al., 2007). Child nutrition healthcare providers should be cognisant of this and encourage or support caregivers in accurately describing their child's body weight when accessing nutrition healthcare services.

Although food restriction has generally been shown to be counterproductive, some evidence suggests that not all restriction may be associated with negative health outcomes (J. Ogden et al., 2006; Say et al., 2023). Some early evidence suggests that restriction may be operationalised in 2 ways – overtly or covertly (J. Ogden et al., 2006). The evidence further suggests that overt restriction, rather than covert restriction, is the form of restriction which is commonly associated with increased child food approach behaviours and increased body weight among pre-schoolers (J. Ogden et al., 2006; Say et al., 2023). Covert restriction, on the other hand, is thought to be associated with improvements in healthy eating, and a reduction in food approach behaviours (J. Ogden et al., 2006; Say et al., 2023). This suggests that covert restriction may be protective of excessive weight gain.

Although this study suggests that overt restriction is the most commonly practiced form of restriction among Ghanaian caregivers, further studies are needed to confirm this. The possibility of incorporating techniques to encourage covert restrictive food feeding practices in childhood overweight/obesity intervention studies in Ghana must be explored.

Caregivers also need to be encouraged to utilise feeding practices that encourage structure and autonomy, and to try to limit controlling feeding practices. Further research is required to identify ways in which structure and autonomy may be promoted and incorporated into overweight/obesity intervention designs for pre-schoolers. Interventions that aim to modify food feeding practices should aim to achieve a balance between child food approach and child food avoidance behaviours.

The identification of maternal BMI as a strong predictor of child body weight is indicative of either genetic or environmental influences of mothers on the body weights of children. However, since the focus of this study is the home environment, it is possible that the eating habits of overweight/obese mothers may be shared or transferred to toddlers through their daily social interactions, for example, through the caregiver modelling of feeding. The exact mechanism by which maternal BMI predicts pre-schooler body weight needs to be explored further in the Ghanaian context.

This study found no evidence for the association between the home physical activity, the home media environment, and overweight/obesity among Ghanaian toddlers. However, data for these aspects of the home environment were limited to the availability of items, and social aspects such as rules governing the use of

electronic media devices at home, or the parental modelling of physical activity, were lacking. These could be explored in future studies. Future studies into the sociodemographic predictors of the home environment are also recommended.

Another potential aspect of the home environment that could influence child body weight, but which was not explored in this study, is the home sleep environment. Sleep behaviour (sleep quality and the duration of sleep) has been associated with overweight/obesity (Appelhans et al., 2014); however, the current conceptual framework for the home environment in relation to child body weight does not include sleep. The current conceptual framework for the home environment may need to be expanded to include the home sleep environment. For example, physical and social aspects of the home sleep environment, such as the availability of rooms for sleeping, the number of rooms for sleeping, or caregiver rules and routines around sleep, could be added to the conceptual framework.

The study recommends the use of/or validation of its modified versions of the comprehensive feeding practices questionnaire (CFPQ) and child eating behaviour questionnaire (CEBQ) for studies of food feeding practices and child eating behaviour among pre-schoolers in Ghana.

Finally, future work on childhood obesity in Ghana should incorporate longitudinal designs, as these designs are more likely to identify stronger links to establish causation.

7.3. Strengths of the study

General attributes of this study that have helped to strengthen the reliability and validity of its findings include:

- The use of standard validated tools (e.g., PRISMA guidelines for the reporting and conduct of systematic reviews, the CEBQ, and the CFPQ) and measures (e.g., BMI z-scores, household dietary diversity scores) for the collection and analysis of data.
- Further validation of the CEBQ and CFPQ after confirmatory factor analysis (CFA) and exploratory factor analysis (EFA), which enabled context-specific analysis of the associations between child eating behaviours, caregiver food feeding practices, and child overweight/obesity.
- The use of the very large MICS datasets over 3 different time periods for the secondary data analysis, strengthens the generalisability of the findings.
- The study design – explanatory sequential mixed methods design – enabled the validation and expansion of findings for an improved comprehension of how the home environment could be influencing overweight and obesity among Ghanaian toddlers.

- The additional measurement of child eating behaviour in the survey, helped to strengthen the quality of the evidence between the home environment and child overweight/obesity, as child eating behaviour has consistently been shown to be strongly associated with pre-schooler weight gain.
- The qualitative expansion of findings with the FGDs, helped to gain insights into food feeding practices among Ghanaian caregivers.

7.4. Limitations of the study

The study was however not without its limitations. Although the limitations of each study have been separately reported as part of each study's report, the most notable ones include:

- Limitations in the use of the secondary MICS datasets, as they were originally designed to fulfil other objectives. As such, variables such as caregiver food feeding practices and other social aspects of the home environment were unavailable for analysis.
- The review of the literature from SSA did not include a meta-analysis of the association between the home environment and child overweight/obesity. Future work could include an update of the review with a meta-analysis component.
- The small sample sizes for each FGD means that the findings from the qualitative component had to be interpreted with caution.
- The survey study relied on convenience sampling (a non-probability sampling technique. As such any attempt to generalise its findings had to be approached with caution.

7.5. Implications for Policy and Practice

A recent rapid review of nutrition-related policies in Ghana has shown although overweight and obesity is or is becoming an urgent public health issue among the adult and child populations, it has not been prioritised for remediative action (Aryeetey, 2022). Any future interventions against childhood overweight/obesity that will be incorporated into Ghana's national nutrition policy should consider including social aspects of home food environment. Caregiver food feeding practices in particular should be considered. Healthcare providers working to improve the nutritional status of children in Ghana must be informed of the potential impact of caregiver feeding practices on weight gain in toddlerhood, and to encourage caregiver feeding practices that are less coercive, promote structure and autonomy.

Implications for future research

The findings of this project serve the foundations for future research. Although recommendations for future research have previously been mentioned in the previous study chapters, some key recommendations include:

- Evidence of the bidirectional associations between child eating behaviour and caregiver food feeding practices, i.e., child eating behaviour can influence caregiver food feeding practices, while caregiver food feeding practices can also influence child eating behaviour. More research is required to expand on this finding, especially among preschoolers in the Ghanaian setting.
- Further studies are needed on the socioeconomic/sociodemographic determinants of the home environment, as these may highlight underlying socioeconomic/sociodemographic differences in the structure and function of the home environment of Ghanaian preschoolers.
- Although the secondary data analysis and survey failed to replicate the findings of the systematic review with respect to household dietary diversity, the findings from this project are only suggestive (based on this sample) and not conclusive. As such, further studies on household dietary diversity and overweight/obesity among preschoolers are needed.
- Further research on food restriction and overweight/obesity is needed. In particular, it is necessary to establish whether differences in overt and covert restriction can account for population increases in excess preschooler body weight.
- Since this study's findings suggest that caregiver food feeding practices which promote structure in the home food environment and child autonomy may be protective of excess child body weight, further work is needed to understand how they may be incorporated into future interventions.
- Finally, further work in this area of research may serve as a basis for conducting a more detailed meta-analysis of findings about the home environment and child overweight/obesity, in Ghana and in SSA.

General Conclusion

The results of the systematic review highlight the paucity of studies exploring factors in the home environment associated with overweight and obesity in preschool children in SSA. It is important that further work is conducted in this under-researched area.

The study also provides a confirmation of the relationship between child eating behaviour and child body weight. As shown in many other studies, childhood obesity among toddlers may be predicted by an increase in food approach behaviours and/or a reduction in satiety responsiveness. Social aspects of the home food environment (rather than its physical aspects), which includes caregiver food feeding practices, appear to be more influential in increasing the body weights of Ghanaian toddlers. Restrictive caregiver food feeding practices in particular may have the potential to shape the eating behaviour and body weight of Ghanaian pre-schoolers.

This study concludes that the home environment is an important determinant of pre-schooler overweight/obesity in Ghana. Social aspects of the home food environment in particular may be more influential in population increases of paediatric obesity, through alterations in child eating behaviour. More research in understanding the home environment and its associations with child obesity in Ghana is needed.

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Appendix 1 - Supplementary Materials: Literature Search strategy and records retrieved from each database.

MEDLINE: [*n* = 765]

#	Searches	Results
1	Risk Factors/	914213
2	Association/	4155
3	Child, Preschool/	971519
4	Schools, Nursery/	1497
5	exp "Africa South of the Sahara"/	236892
6	Pediatric Obesity/	11842
7	Nutritional Status/	50583
8	Overnutrition/ or Hyperphagia/	3983
9	Obesity/	200098
10	Overweight/	29330
11	Adiposity/	14523
12	body mass index/	141707
13	Body Weight/	196020
14	(risk factor* or predispo* factor* or determin* or predict* or relat* or associat* or correlat*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	13987945
15	(preschool* or pre school* or pre-school* or toddler* or kindergarten* or nursery school* or day care center* or day care centre* or daycare center* or daycare centre* or day-care center* or day-care centre* or pre-primary school* or pre primary school* or creche*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	989973
16	(Sub-sahara* Africa or SSA or east Africa or west Africa or central Africa or southern Africa or Angola or Benin or Botswana or Burkina Faso or Burundi or Cameroon or Cape Verde or Central African Republic or Chad or Comoros or Congo or Democratic Republic Congo or Cote d'Ivoire or Ivory Coast or Djibouti or Equatorial Guinea or Eritrea or Ethiopia or Gabon or Gambia or Ghana or Guinea or Guinea-Bissau or Kenya or Lesotho or Liberia or Madagascar or Malawi or Mali or Mauritania or Mauritius or Mozambique or Namibia or Niger or Nigeria or Rwanda or Sao Tome or Senegal or Seychelles or Sierra Leone or Somalia or South Africa or Sudan or Swaziland or Eswatini or Tanzania	502052

	or Togo or Uganda or Zambia or Zimbabwe).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	
17	(nutritional status or obes* or overweight or overnutrition or over nutrition or overeat* or overfeed* or adipos* or fatness or bmi z score* or body weight*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	892551
18	(home* or house* or household* or household-level or mother* or maternal or father* or paternal or parent* or family$ or caregiver*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	2690966
19	(home* or house* or household-level or mother* or maternal or father* or paternal or parent* or family$ or caregiver*).af.	2970051
20	1 or 2 or 14	13987945
21	3 or 4 or 15	990107
22	5 or 16	507859
23	6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 17	943609
24	18 and 20 and 21 and 22 and 23	906
25	19 and 20 and 21 and 22 and 23	954
26	limit 25 to (english language and yr="2000 -2021")	765

EMBASE: [*n* = 733]

#	Searches	Results
1	risk factor/	1193752
2	association/	40255
3	predictor variable/	29034
4	disease predisposition/	97663
5	preschool child/	586251
6	nursery school/	1031
7	toddler/	5718

8	kindergarten/	3262
9	day care/	12522
10	exp "Africa south of the Sahara"/	278128
11	childhood obesity/	18127
12	nutritional status/	73428
13	overnutrition/	6047
14	hyperphagia/	6510
15	obesity/	476454
16	body mass/	529973
17	body weight/	333931
18	(risk factor* or susceptib* or prone* or predispo* factor* or determin* or predict* or relat* or associat* or correlat*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	17728342
19	(preschool* or pre school* or pre-school* or toddler* or kindergarten* or nursery school* or day care center* or day care centre* or daycare center* or daycare centre* or day-care center* or day-care centre* or pre-primary school* or pre primary school* or creche*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	617208
20	(Sub-sahara* Africa or SSA or east Africa or west Africa or central Africa or southern Africa or Angola or Benin or Botswana or Burkina Faso or Burundi or Cameroon or Cape Verde or Central African Republic or Chad or Comoros or Congo or Democratic Republic Congo or Cote d'Ivoire or Ivory Coast or Djibouti or Equatorial Guinea or Eritrea or Ethiopia or Gabon or Gambia or Ghana or Guinea or Guinea-Bissau or Kenya or Lesotho or Liberia or Madagascar or Malawi or Mali or Mauritania or Mauritius or Mozambique or Namibia or Niger or Nigeria or Rwanda or Sao Tome or Senegal or Seychelles or Sierra Leone or Somalia or South Africa or Sudan or Swaziland or Eswatini or Tanzania or Togo or Uganda or Zambia or Zimbabwe).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	520713
21	(nutritional status or obes* or overweight or overnutrition or over nutrition or overeat* or overfeed* or adipos* or fatness or bmi z score* or body weight*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism	1293712

	supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	
22	(home* or house* or household* or household-level or mother* or maternal or father* or paternal or parent* or family$ or caregiver*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	3383483
23	(home* or house* or household* or household-level or mother* or maternal or father* or paternal or parent* or family$ or caregiver*).af.	3962634
24	1 or 2 or 3 or 4 or 18	17744942
25	5 or 6 or 7 or 8 or 9 or 19	624365
26	10 or 20	523175
27	11 or 12 or 13 or 14 or 15 or 16 or 17 or 21	1572761
28	23 and 24 and 25 and 26 and 27	849
29	limit 28 to (english language and yr="2000 - 2021")	733

CINAHL: [*n* = 212]

#	QUERY	RESULTS
S1	(MH "Risk Factors+")	223,487
S2	risk factors or contributing factors or predisposing factors or predictor or cause or influencing factors or determinants or relationship or correlation	1,458,698
S3	S1 OR S2	1,471,329
S4	(MH "Child, Preschool") OR (MH "Schools, Nursery")	222,756
S5	(MH "Child Day Care")	2,793
S6	preschool or kindergarten or early childhood education or nursery school or toddlers or day care center or day care centre or pre-primary school or creche	233,726
S7	S4 OR S5 OR S6	234,188
S8	(MH "Africa South of the Sahara+") OR (MH "Africa, Western") OR (MH "Africa, Southern") OR (MH "Africa, Northern") OR (MH "Africa, Eastern") OR (MH "Africa, Central")	78,033
S9	Sub-Saharan Africa or SSA or east Africa or west Africa or central Africa or southern Africa or Angola or Benin or Botswana or Burkina Faso or Burundi or Cameroon or Cape Verde or Central African Republic or Chad or Comoros or Congo or Democratic Republic Congo or Cote d'Ivoire or Ivory Coast or Djibouti or Equatorial Guinea or Eritrea or Ethiopia or Gabon or Gambia or Ghana or Guinea or Guinea-Bissau or Kenya or Lesotho or Liberia or Madagascar or Malawi or Mali or Mauritania or Mauritius or Mozambique or Namibia or Niger or Nigeria or Rwanda or Sao Tome or Senegal or Seychelles or Sierra Leone or Somalia or South Africa or Sudan or Swaziland or Eswatini or Tanzania or Togo or Uganda or Zambia or Zimbabwe	106,956
S10	S8 OR S9	107,818

S11	(MH "Pediatric Obesity")	16,178
S12	(MH "Nutritional Status")	17,085
S13	(MH "Hyperphagia")	1,003
S14	(MH "Obesity+")	109,272
S15	(MH "Body Mass Index")	90,757
S16	(MH "Body Weight+")	166,183
S17	childhood obesity or obese children or overweight children or nutritional status or fatness or adiposity or overnutrition or overeat or overfeed or bmi z score or bmi or body weight or	219,507
S18	S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17	301,563
S19	(MH "Home Environment")	11,784
S20	home environment or family influence or family environment or household or caregiver or mother or father or paternal or maternal or parent	424,177
S21	S19 OR S20	424,177
S22	S3 AND S7 AND S10 AND S18 AND S21	258
S23	S3 AND S7 AND S10 AND S18 AND S21 (Limiters - Published Date: 20000101-20211231; English Language; Research Article Expanders - Apply equivalent subjects Search modes - Boolean/Phrase)	212

SCOPUS: [*n* = 318]

SEARCH TERMS	RESULTS
TITLE-ABS (preschool* OR "pre school*" OR pre-school* OR kindergarten* OR "nursery school*" OR "day care center*" OR "day care centre*" OR "daycare center*" OR "daycare centre*" OR "day-care center*" OR "day-care centre*" OR "pre-primary school*" OR "pre primary school*" OR creche*) AND ("nutritional status" OR obes* OR overweight OR overnutrition OR "over nutrition" OR overeat* OR overfeed* OR adipos* OR fatness OR "bmi z-score*" OR "body weight*") AND ("Sub-sahara* Africa" OR ssa OR "east Africa" OR "West Africa" OR "Central Africa" OR "southern Africa" OR angola OR benin OR botswana OR burkina AND faso OR burundi OR cameroon OR "Cape Verde" OR "Central African Republic" OR chad OR comoros OR congo OR "Democratic Republic Congo" OR "Cote d'Ivoire" OR "Ivory Coast" OR djibouti OR "Equatorial Guinea" OR eritrea OR ethiopia OR gabon OR gambia OR ghana OR guinea OR guinea-bissau OR kenya OR lesotho OR liberia OR madagascar OR malawi OR mali OR mauritania OR mauritius OR mozambique OR namibia OR niger OR nigeria OR rwanda OR "Sao Tome" OR senegal OR seychelles OR "Sierra Leone" OR somalia OR "South Africa" OR sudan OR swaziland OR eswatini OR tanzania OR togo OR uganda OR zambia OR zimbabwe)	433 document results
TITLE-ABS (preschool* OR "pre school*" OR pre-school* OR kindergarten* OR "nursery school*" OR "day care center*" OR "day care centre*" OR "daycare center*" OR "daycare centre*" OR "day-care center*" OR "day-care centre*" OR "pre-primary school*" OR "pre primary school*" OR creche*) AND ("nutritional status" OR obes* OR overweight OR overnutrition OR "over nutrition" OR overeat* OR overfeed* OR adipos* OR fatness OR "bmi z-score*" OR "body weight*") AND ("Sub-sahara* Africa" OR ssa OR "east Africa" OR "West Africa" OR "Central Africa" OR "southern Africa" OR angola OR benin OR botswana OR burkina AND faso OR burundi OR cameroon OR "Cape Verde" OR "Central African Republic" OR chad OR comoros OR congo OR "Democratic Republic Congo" OR "Cote	318 document results

d'Ivoire" OR "Ivory Coast" OR djibouti OR "Equatorial Guinea" OR eritrea OR ethiopia OR gabon OR gambia OR ghana OR guinea OR guinea-bissau OR kenya OR lesotho OR liberia OR madagascar OR malawi OR mali OR mauritania OR mauritius OR mozambique OR namibia OR niger OR nigeria OR rwanda OR "Sao Tome" OR senegal OR seychelles OR "Sierra Leone" OR somalia OR "South Africa" OR sudan OR swaziland OR eswatini OR tanzania OR togo OR uganda OR zambia OR zimbabwe) AND PUBYEAR > 2000 AND PUBYEAR < 2021 AND (LIMIT-TO (LANGUAGE , "English"))	

WEB OF SCIENCE:[*n* = 117]

#	SEARCH RESULTS	SEARCH QUERY
# 1	41,928	(TI=(preschool* or "pre school*" or pre-school* or kindergarten* or "nursery school*" or "day care center*" or "day care centre*" or "daycare center*" or "daycare centre*" or "day-care center*" or "day-care centre*" or "pre-primary school*" or "pre primary school*" or creche*))
# 2	55,496	(AB=(preschool* or "pre school*" or pre-school* or kindergarten* or "nursery school*" or "day care center*" or "day care centre*" or "daycare center*" or "daycare centre*" or "day-care center*" or "day-care centre*" or "pre-primary school*" or "pre primary school*" or creche*))
# 3	74,706	#2 OR #1
# 4	283,009	(TI=("nutritional status" or obes* or overweight or overnutrition or "over nutrition" or overeat* or overfeed* or adipos* or fatness or "bmi z-score*" or "body weight*"))
# 5	575,025	(AB=("nutritional status" or obes* or overweight or overnutrition or "over nutrition" or overeat* or overfeed* or adipos* or fatness or "bmi z-score*" or "body weight*"))
# 6	705,972	#5 OR #4
# 7	480,653	(TI=("Sub-sahara* Africa" or SSA or "east Africa" or "West Africa" or "Central Africa" or "southern Africa" or Angola or Benin or Botswana or Burkina Faso or Burundi or Cameroon or "Cape Verde" or "Central African Republic" or Chad or Comoros or Congo or "Democratic Republic Congo" or "Cote d'Ivoire" or "Ivory Coast" or Djibouti or "Equatorial Guinea" or Eritrea or Ethiopia or Gabon or Gambia or Ghana or Guinea or Guinea-Bissau or Kenya or Lesotho or Liberia or Madagascar or Malawi or Mali or Mauritania or Mauritius or Mozambique or Namibia or Niger or Nigeria or Rwanda or "Sao Tome" or Senegal or Seychelles or "Sierra Leone" or Somalia or "South Africa" or Sudan or Swaziland or Eswatini or Tanzania or Togo or Uganda or Zambia or Zimbabwe))
# 8	467,119	(AB=("Sub-sahara* Africa" or SSA or "east Africa" or "West Africa" or "Central Africa" or "southern Africa" or Angola or Benin or Botswana or Burkina Faso or Burundi or Cameroon or "Cape Verde" or "Central African Republic" or Chad or Comoros or Congo or "Democratic Republic Congo" or "Cote d'Ivoire" or "Ivory Coast" or Djibouti or "Equatorial Guinea" or Eritrea or Ethiopia or Gabon or Gambia or Ghana or Guinea or Guinea-Bissau or Kenya or Lesotho or Liberia or Madagascar or Malawi or Mali or Mauritania or Mauritius or Mozambique or Namibia or Niger or Nigeria or Rwanda or "Sao Tome" or Senegal or Seychelles or "Sierra Leone" or Somalia or "South Africa" or Sudan or Swaziland or Eswatini or Tanzania or Togo or Uganda or Zambia or Zimbabwe))
# 9	711,668	#8 OR #7
# 10	117	#9 AND #6 AND #3 AND LANGUAGE: (English) AND DOCUMENT TYPES: (Article) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=2000-2021

OTHER SEARCHES

Databases and the search terms/phrases used to perform searches	Research Results
AFRICAN INDEX MEDICUS: Childhood obesity and overweight among preschoolers in Titles Keywords for all material types	No eligible studies
African Journals Online: ("risk factor*" OR "determinant*" OR "predict*" OR "associate$" OR "predispose$" OR "relate$" OR "correlate$") AND ("nutritional status" OR "obesity$" OR "overweight" OR "overnutrition" OR "overnutrition" OR "overeat$" OR "overfeed$" OR "fatness" OR "bmi z score*" OR "body weight*") AND ("preschool*" OR "pre school*" OR "pre-school*" OR "kindergarten*" OR "nursery school*" OR "day care center*" OR "day care centre*" OR "daycare center*" OR "daycare centre*" OR "day-care center*" OR "day-care centre*" OR "pre-primary school*" OR "pre primary school*" OR "creche*") AND ("home*" OR "home environment*" OR "house*" OR "household*" OR "household-level" OR "mother*" OR "maternal" OR "father*" OR "paternal" OR "parent*" OR "family$" OR "caregiver*")	28 Eligible Studies

Appendix 2 – Ethical Approval Letter for Primary Survey and Qualitative Study

Kwame Nkrumah
University of Science
and Technology, Kumasi

College of Health Sciences
SCHOOL OF MEDICINE AND DENTISTRY

COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS

Our Ref: CHRPE/AP/270/22

14th June 2022

Mr. Albert Lawrence Kwansa
School of Health and Related Research
University of Sheffield
ENGLAND.

Dear Sir,

LETTER OF APPROVAL

Protocol Title: *"Home Food Environment Factors Influencing Overweight and Obesity among Preschoolers Aged 2-5 years in Urban Ghana"*

Proposed Site: *Sunday Schools in Kumasi.*

Sponsor: *Principal Investigator.*

Your submission to the Committee on Human Research, Publications, and Ethics on the above-named protocol refer.

The Committee reviewed the following documents:

- A notification letter of 19th April 2022 from the office of the Archbishop Thomas Cranmer Anglican Church (study site) indicating the approval for the conduct of the study at the churches.
- A Completed CHRPE Application Form.
- CHRPE_Participant_Information_Leaflet_ALK_v2_25052022.
- Study Protocol for Ghana Study - CHRPE_v3_27042022.
- Ghana Study Questionnaire 3.
- Data Sharing Agreement_ALK_MN

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for a fixed period of one year, beginning **14th June 2022** to **13th June 2023** renewable thereafter. The Committee may, however, suspend or withdraw ethical approval at any time if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

Thank you for your application.

[redacted]

Rev. Prof. John Appiah-Poku.
Honorary Secretary
FOR: CHAIRMAN

Room 7, Block L, School of Medicine and Dentistry, KNUST, University Post Office, Kumasi, Ghana
Tel: +233 (0) 3220 63248 **Mobile:** +233 (0) 20 5453785 **Email:** chrpe.knust.kath@gmail.com/chrpe@knust.edu.gh

Appendix 3 - Participant Information Leaflet and Consent Form

This leaflet must be given to all prospective participants to enable them to know enough about the research before deciding to or not to participate.

Title of Research:
Home Food Environment Factors Influencing Obesity and Overweight among Pre-schooler's aged 2-5 years in Urban Ghana

Name(s) and affiliation(s) of researcher(s):
This study is being carried out by Albert Lawrence Kwansa (PhD candidate from the School of Health and Related Research, University of Sheffield), and Dr Michael Ntim from the Department of Physiology, School of Medical Sciences, University of Science and Technology.

Background (Please explain simply and briefly what the study is about):
There is currently an increase in the number of Ghanaian children who are obese or overweight. These children are more likely to carry this condition into adolescence and adulthood, and children and adults who are overweight or obese are more likely to suffer from illnesses and the stigma associated with excessive weight gain. Some of these illnesses include strokes, cancers, kidney diseases, and heart diseases which are very expensive or costly to treat or manage. Knowing the causes of excessive weight gain in the early stages of the life course, i.e., in childhood, is therefore necessary. However, in Ghana, we still do not know much about how or why children become overweight or obese.

Some people will become obese because they are born with obesity genes. However, we now know that this occurs in a very small number of people, and that in much of the population the environment contributes more to obesity than genes. We also know that the environment influences obesity through changes in behaviour. These behaviours are primarily linked to food consumption and physical activity. Thus, excess weight gain is more likely to occur in an individual when there is a change in feeding behaviour towards an increase in the consumption of processed foods and a change in physical activity towards more sedentary behaviour.

The home environment is the first point of social interaction for most children. It can be viewed in terms of the home food environment that influences feeding behaviour, and the home physical activity and home media environment that influence physical activity and sedentary behaviour. We currently do not know how the home environment contributes to weight gain among Ghanaian children. For this study we will first start by looking at the home food environment. This is where children learn everything about feeding, including how to eat, why to eat, what to eat, and when to eat. Children will also learn these from their parents or caregivers. We hope to examine the home physical activity environment and the home media environment in the future.

In terms of obesity and overweight, children who are 2-5 years have not really been studied in Ghana. It is important to study this age-group for two reasons. Firstly, we know that obesity or overweight that is established among children in this age group continues into their adolescence and adulthood. Secondly, we know that it is during this period of childhood that they tend to develop other unique feeding behaviours such as being fussy or responding differently to new foods.

To help to fill these research gaps, this study wants to specifically examine how the different kinds of foods that caregivers provide to their children as well as how they feed their children at home influence the way Ghanaian toddlers/preschool children eat and how this subsequently leads to weight gain.

Purpose(s) of research:
The purpose of this research is to examine how the Ghanaian home food environment influences the eating behaviour of toddlers/preschool children, and how this subsequently leads to weight gain.

Procedure of the research, what shall be required of each participant and approximate total number of participants that would be involved in the research:
The study will be conducted in Kumasi in the Ashanti region of Ghana. Kumasi is an ideal choice for this study because although it is a major city, many children from urban, peri-urban, and rural communities stay here with their families.

The primary point where children and their caregivers will be recruited will be "Sunday schools". "Sunday Schools" are the preferred choice for this study because they provide ready access to the study population and have a similar composition to regular nurseries or kindergartens for 2-5-year-old children. We will contact eligible caregivers and their children with the help of "Sunday school" teachers. Trained field/research assistants from the Department of Physiology, Kwame Nkrumah University of Science and Technology (KNUST) will be directly involved in contacting "Sunday school" teachers and collecting the study data. Children will be considered for the study if they have lived in their current home and have been under the care of the selected or contacted caregiver for at least one year. Children will generally not be considered for the study if they have any chronic health conditions that is affecting their body weight. If more than one child represents a household, only one will be allowed to participate in the study. Eligible children and their caregivers will be scheduled and invited by the study team to obtain consent and partake in the study.

The study is a mixed-methods study, i.e., it will be conducted in two parts or use two approaches. In the first part standard questionnaires about household foods, parent feeding practices, and child eating behaviour will be administered to 207 caregivers and their children. The questionnaires will primarily be administered in English. For participants who do not understand English, the questionnaires will be read out in the local dialect. The weights and heights of participating children will also be measured. The second part will involve focus group discussions with a smaller number of caregivers during which parental attitudes and beliefs related to food choices and child feeding will be further explored. Each focus group will have 8-10 caregivers. We do not know how many caregivers in all we will need for the second part, but we will continue the focus group discussions until no new information is obtainable from additional focus groups.

Risk(s):
There is minimal risk involved in this study. However, you may experience slight delays between interviews.

Benefit(s):
The goal of this research is to examine household food environment factors that contribute to overweight and obesity among 2-5-year-old children. There will be no direct benefits of the study to you or your child. However, you will be compensated for the time spent in the study.

Confidentiality:
All information collected in this study will be given special codes. Apart from your contact details that will be collected at the beginning of each interview, you will be assigned unique computer-generated alpha-numeric codes and participant IDs that will not be directly traceable or identifiable to you. Interviews will also be conducted in private. No name or identifier will be used in any publication or reports from this study. However, as part of our responsibility to conduct this research properly, we may allow officials from the ethics committees in Ghana and Sheffield to have access to your records.

Voluntariness:
Taking part in this study should be out of your own free will. You are not under obligation to. Research is entirely voluntary.

Alternatives to participation:
If you choose not to participate, this will not affect your you or your child's participation in other Sunday school or church activities.

Withdrawal from the research:
You may choose to withdraw from the research at any time without having to explain yourself. You may also choose not to answer any question you find uncomfortable or private.

Consequence of Withdrawal:
There will be no consequences or loss of benefits to you if you choose to withdraw from the study. Please note however, that some of the information that may have been obtained from you before you chose to withdraw may have been modified or used in analysis reports and publications. These cannot be removed anymore. We do promise to make all efforts to comply with your wishes as much as practicable.

Costs/Compensation:
To show our appreciation for your participation and your time in the study, we will compensate you with a gift or token.

Contacts:
If you have any question concerning this study, please do not hesitate to contact Dr Michael Ntim on 020 9418603 or 024 3372089.

Further, if you have any concern about the conduct of this study, your welfare, or your rights as a research participant, you may contact:

The Office of the Chairman
Committee on Human Research and Publication Ethics
Kumasi
Tel: 03220 63248 or 020 5453785

CONSENT FORM

Statement of person obtaining informed consent:

I have fully explained this research to _____ and have given sufficient information about the study, including that on procedures, risks, and benefits, to enable the prospective participant to make an informed decision to or not to participate.

DATE: _____ NAME: _____

Statement of person giving consent:

I have read the information on this study/research or have had it translated into a language I understand. I have also talked it over with the interviewer to my satisfaction.

I understand that my participation is voluntary (not compulsory).

I know enough about the purpose, methods, risks, and benefits of the research study to decide that I want to take part in it.

I understand that I may freely stop being part of this study at any time without having to explain myself.

I have received a copy of this information leaflet and consent form to keep for myself.

NAME: _____

DATE: _____ SIGNATURE/THUMB PRINT: _____

Statement of person witnessing consent (Process for Non-Literate Participants):

I _____ (Name of Witness) certify that information given to

_____ (Name of Participant), in the local language, is a true reflection of what l have read from the study Participant Information Leaflet, attached.

WITNESS' SIGNATURE (maintain if participant is non-literate): _____

MOTHER'S SIGNATURE (maintain if participant is under 18 years): _____

MOTHER'S NAME: _____

FATHER'S SIGNATURE (maintain if participant is under 18 years): _____

FATHER'S NAME: _____

Time Started: ___ ___:___ ___ Time Completed: ___ ___:___ ___

CHILD CONTACT INFORMATION

Surname _____ First Name _____

Other Names _____

House Address _____

Postal Address _____

City/Town of Residence _____

Region of Residence _____

Phone Contact Number _____

Email Address _____

BASIC DEMOGRAPHICS

Caregiver	Child
DOB: ___ ___/ ___ ___/ ___ ___ ___ ___	DOB: ___ ___/ ___ ___/ ___ ___ ___ ___
Age: ___ ___ ___ (years)	Age: ___ (years)
Sex: Male ___ / Female ___	Sex: Male ___ / Female ___
Caregiver's Weight ___ ___ ___ kg	Child Weight ___ ___ ___ kg
Caregiver's Height ___ ___ ___cm	Child Height ___ ___ ___cm

1. Are you the primary caregiver of *"insert child's name"*?
   - ☐ Yes
   - ☐ No
   - ☐ Refused to answer

2. What is your relationship with *"insert child's name"*?
   - ☐ Parent
   - ☐ Extended Family
   - ☐ Non-family guardian

3. Do you reside in the same house with *"insert child's name"*?
   - ☐ Yes
   - ☐ No
   - ☐ Refused to answer

4. How long have you resided in the same house with *"insert child's name"*?
   - ☐ Less than 1 year
   - ☐ 1 year or More

5. What is the marital status of *"insert child's name"'* primary caregiver?
   - ☐ Married/living as married
   - ☐ Divorced/separated
   - ☐ Single
   - ☐ Widowed
   - ☐ Refused to answer

6. What is the rough average/estimated total monthly household income (in GHS) of all household members including yourself (if income is earned daily or weekly, probe for rough monthly estimate)?
   - ☐ ≤ 500
   - ☐ 500 ≤ 1000
   - ☐ 1000 ≤ 1500
   - ☐ 1500 ≤ 2000
   - ☐ More than 2000

- ☐ Don't know
- ☐ Refused

7. What is the highest or most recent level of education attained by *"insert child's name"* primary caregiver?
   - ☐ No formal education or less than primary school
   - ☐ Middle School Leaving Certificate
   - ☐ Junior High School
   - ☐ Senior High School
   - ☐ O levels—Commonwealth system
   - ☐ A levels—Commonwealth system
   - ☐ Vocational degree or certification
   - ☐ Bachelor's (college or university undergraduate) degree
   - ☐ Graduate or advanced professional degree (MBA, PhD, JD, MD, etc.)

8. What is the employment status of *"insert child's name"* primary caregiver?
   - ☐ Unemployed
   - ☐ Self-employed
   - ☐ Employed
   - ☐ Refused to answer

9. How many people (including you) make up the household where you reside with *"insert child's name"*? _____

10. What is the location of the household?
    - ☐ Rural
    - ☐ Urban
    - ☐ Peri-urban

HOUSEHOLD DIETARY DIVERSITY QUESTIONNAIRE

Please describe the foods (meals and snacks) that *"insert child's name"* **ate yesterday during the day and night, whether at home or outside the home. Start with the first food eaten in the morning.**

Write down all food and drinks mentioned by the respondent. When the respondent has finished, probe for meals and snacks not mentioned.

Breakfast	Snack	Lunch	Snack	Dinner	Snack

[Household level: exclude foods purchased and eaten outside of the home]

When the respondent recall is complete, fill in the food groups based on the information recorded above. For any food groups not mentioned, ask the respondent if a food item from this group was consumed.

Question number	Food group	Examples	YES=1 NO=0
1	CEREALS	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + *insert local foods e.g. porridge or pastes or other locally available grains*	
2	VITAMIN A RICH VEGETABLES AND TUBERS	pumpkin, carrots, squash, or sweet potatoes that are orange inside + *other locally available vitamin-A rich vegetables (e.g. red sweet pepper)*	
3	WHITE TUBERS AND ROOTS	white potatoes, white yams, white cassava, or other foods made from roots	
4	DARK GREEN LEAFY VEGETABLES	dark green/leafy vegetables, including wild ones + *locally available vitamin-A rich leaves such as cassava leaves, kale, spinach etc.*	
5	OTHER VEGETABLES	other vegetables (e.g. tomato, onion, eggplant) , including wild vegetables	

6	VITAMIN A RICH FRUITS	ripe mangoes, cantaloupe, apricots (fresh or dried), ripe pawpaw + *other locally available vitamin A-rich fruits*	
7	OTHER FRUITS	other fruits, including wild fruits	
8	ORGAN MEAT (IRON- RICH)	liver, kidney, heart or other organ meats or blood-based foods	
9	FLESH MEATS	e.g. beef, pork, lamb, mutton, goat, rabbit, wild game, chicken, duck	
10	EGGS	chicken, duck, guinea fowl or any other eggs	
11	FISH	fresh or cooked fish or shellfish or seafood	
12	LEGUMES, NUTS AND SEEDS	beans, peas, lentils, nuts, seeds or foods made from these	
13	MILK AND MILK PRODUCT	milk, cheese, yogurt or other milk products	
14	OILS AND FATS	oil, fats or butter added to food or used for cooking	
15	RED PALM PRODUCTS	Red palm oil, palm nut or palm nut pulp sauce	
16	SWEETS	sugar, honey, sweetened soda or sugary foods such as chocolates, candies, cookies and cakes	
17	SPICES, CONDIMENTS, BEVERAGES	spices(black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages OR *local examples*	
			YES=1 NO=0
Household level only	Did *"insert child's name"* or anyone in your household eat anything (meal or snack) OUTSIDE of the home yesterday?		

Child Eating Behaviour Questionnaire (CEBQ)

Please read the following statements and tick the boxes most appropriate to *"insert child's name"* eating behaviour

Eating Behaviour	Never	Rarely	Sometimes	Often	Always	
My child loves food	☐	☐	☐	☐	☐	EF
My child eats more when worried	☐	☐	☐	☐	☐	EOE
My child has a big appetite	☐	☐	☐	☐	☐	SR
My child finishes his/her meal quickly	☐	☐	☐	☐	☐	SE
My child is interested in food	☐	☐	☐	☐	☐	EF
My child is always asking for a drink	☐	☐	☐	☐	☐	DD
My child refuses new foods at first	☐	☐	☐	☐	☐	FF
My child eats slowly	☐	☐	☐	☐	☐	SE
My child eats less when angry	☐	☐	☐	☐	☐	EUE

My child enjoys tasting new foods	☐	☐	☐	☐	☐	FF
My child eats less when s/he is tired	☐	☐	☐	☐	☐	EUE
My child is always asking for food	☐	☐	☐	☐	☐	FR
My child eats more when annoyed	☐	☐	☐	☐	☐	EOE
If allowed to, my child would eat too much	☐	☐	☐	☐	☐	FR
My child eats more when anxious	☐	☐	☐	☐	☐	EOE
My child enjoys a wide variety of foods	☐	☐	☐	☐	☐	FF
My child leaves food on his/her plate at the end of a meal	☐	☐	☐	☐	☐	SR
My child takes more than 30 minutes to finish a meal	☐	☐	☐	☐	☐	SE
Given the choice, my child would eat most of the time	☐	☐	☐	☐	☐	FR
	☐	☐	☐	☐	☐	EF

My child looks forward to mealtimes						
My child gets full before his/her meal is finished	□	□	□	□	□	SR
My child enjoys eating	□	□	□	□	□	EF
My child eats more when she is happy	□	□	□	□	□	EUE
My child is difficult to please with meals	□	□	□	□	□	FF
My child eats less when upset	□	□	□	□	□	EUE
My child gets full up easily	□	□	□	□	□	SR
My child eats more when s/he has nothing else to do	□	□	□	□	□	EOE
Even if my child is full up s/he finds room to eat his/her favourite food	□	□	□	□	□	FR
If given the chance, my child would drink continuously throughout the day	□	□	□	□	□	DD
	□	□	□	□	□	SR

My child cannot eat a meal if s/he has had a snack just before						
If given the chance, my child would always be having a drink	□	□	□	□	□	DD
My child is interested in tasting food s/he hasn't tasted before	□	□	□	□	□	FF
My child decides that s/he doesn't like a food, even without tasting it	□	□	□	□	□	FF
If given the chance, my child would always have food in his/her mouth	□	□	□	□	□	FR
My child eats more and more slowly during the course of a meal	□	□	□	□	□	SE

SCORING OF THE CEBQ

(Never=1, Rarely=2, Sometimes=3, Often=4, Always=5)

Food responsiveness =item mean FR

Emotional over-eating=item mean EOE

Enjoyment of food=item mean EF

Desire to drink=item mean DD

Satiety responsiveness=item mean SR

Slowness in eating=item mean SE

Emotional under-eating=item mean EUE

Food fussiness=item mean FF

Comprehensive Feeding Practices Questionnaire (CFPQ)

Parents take many different approaches to feeding their children and may have different concerns about feeding depending on their child. *Please answer the following questions as honestly as possible with "insert child's name" in mind.*	Never	Rarely	Sometim	Mostly	Always
1. How much do you keep track of the sweets (e.g. candy, ice cream, cake, pies, and pastries) that your child eats?	1	2	3	4	5
2. How much do you keep track of the snack food (potato chips, Doritos, cheese puffs) that your child eats?	1	2	3	4	5
3. How much do you keep track of the high-fat foods that your child eats?	1	2	3	4	5
4. How much do you keep track of the sugary drinks (soda/pop, Kool-Aid) this child drinks?	1	2	3	4	5
5. Do you let your child eat whatever s/he wants?	1	2	3	4	5
6. At dinner, do you let this child choose the foods s/he wants from what is served?	1	2	3	4	5
7. When this child gets fussy, is giving him/her something to eat or drink the *first* thing you do?	1	2	3	4	5
8. Do you give this child something to eat or drink if s/he is bored even if you think s/he is not hungry?	1	2	3	4	5
9. Do you give this child something to eat or drink if s/he is upset even if you think s/he is not hungry?	1	2	3	4	5
10. If this child does not like what is being served, do you make something else?	1	2	3	4	5
11. Do you allow this child to eat snacks whenever s/he wants?	1	2	3	4	5
12. Do you allow this child to leave the table when s/he is full, even if your family is not done eating?	1	2	3	4	5
13. Do you encourage this child to eat healthy foods before unhealthy ones?	1	2	3	4	5
14. Most of the food I keep in the house is healthy.	1	2	3	4	5
15. I involve my child in planning family meals.	1	2	3	4	5

16. I keep a lot of snack food (potato chips, Doritos, cheese puffs) in my house.	1	2	3	4	5
17. My child should always eat all of the food on his/her plate.	1	2	3	4	5
18. I have to be sure that my child does not eat too many high-fat foods.	1	2	3	4	5
19. I offer my child his/her favorite foods in exchange for good behavior.	1	2	3	4	5
20. I allow my child to help prepare family meals.	1	2	3	4	5
21. If I did not guide or regulate my child's eating, s/he would eat too much of his/her favorite foods.	1	2	3	4	5
22. A variety of healthy foods are available to my child at each meal served at home.	1	2	3	4	5
23. I offer sweets (candy, ice cream, cake, pastries) to my child as a reward for good behavior.	1	2	3	4	5
24. I encourage my child to try new foods.	1	2	3	4	5
25. I discuss with my child why it's important to eat healthy foods.	1	2	3	4	5
26. I tell my child that healthy food tastes good.	1	2	3	4	5
27. I encourage my child to eat less so he/she won't get fat.	1	2	3	4	5
28. If I did not guide or regulate my child's eating, s/he would eat too many junk foods.	1	2	3	4	5
29. I give my child small helpings at meals to control his/her weight.	1	2	3	4	5
30. If my child says, "I'm not hungry," I try to get him/her to eat anyway.	1	2	3	4	5
31. I discuss with my child the nutritional value of foods.	1	2	3	4	5
32. I encourage my child to participate in grocery shopping.	1	2	3	4	5
33. If my child eats more than usual at one meal, I try to restrict his/her eating at the next meal.	1	2	3	4	5
34. I restrict the food my child eats that might make him/her fat.	1	2	3	4	5
35. There are certain foods my child shouldn't eat because they will make him/her fat.	1	2	3	4	5
36. I withhold sweets/dessert from my child in response to bad behavior.	1	2	3	4	5
37. I keep a lot of sweets (e.g. candy, ice cream, cake, pies, and pastries) in my house.	1	2	3	4	5
38. I encourage my child to eat a variety of foods.	1	2	3	4	5
39. If my child eats only a small helping, I try to get him/her to eat more.	1	2	3	4	5

40. I have to be sure that my child does not eat too much of his/her favorite foods.	1	2	3	4	5
41. I don't allow my child to eat between meals because I don't want him/her to get fat.	1	2	3	4	5
42. I tell my child what to eat and what not to eat without explanation.	1	2	3	4	5
43. I have to be sure that my child does not eat too many sweets (candy, ice cream, cake, or pastries).	1	2	3	4	5
44. I model healthy eating for my child by eating healthy foods myself.	1	2	3	4	5
45. I often put my child on a diet to control his/her weight.	1	2	3	4	5
46. I try to eat healthy foods in front of my child, even if they are not my favorite.	1	2	3	4	5
47. I try to show enthusiasm about eating healthy foods.	1	2	3	4	5
48. I show my child how much I enjoy eating healthy foods.	1	2	3	4	5
49. When he/she says he/she is finished eating, I try to get my child to eat one more (two more, etc.) bites of food.	1	2	3	4	5

Appendix 5 - Focus Group Interview Guide

Introduction

Welcome to you all, and thanks for agreeing to be a part of this focus group discussion. We appreciate your willingness to participate.

We have been asked by Albert Lawrence Kwansa, a PhD student at the University of Sheffield, to conduct the focus groups.

The reason we are having these focus groups is to understand more about your food choices and feeding practices and try to see how they may relate to a child's body weight.

We need your input and want you to share your honest and open thoughts with us.

Ground rules:

1. We want you to do the talking. We would like everyone to equally participate, and we may call on you if we have not heard from you in a while.
2. There are no right or wrong answers. Every person's experience and opinions are important. Speak up when or whether you agree or disagree. We are interested in a wide range of opinions.
3. What is said in this room stays here. We want you to feel comfortable when sensitive issues come up.
4. We will be recording the discussions. We want to capture everything you have to say. We do not identify anyone by name in the report, and you will remain anonymous.
5. There will be 8-10 people in each group.
6. A focus group discussion is not:
    a. A debate
    b. Group therapy
    c. A conflict resolution session
    d. A problem-solving session
    e. An opportunity to collaborate.
    f. A promotional opportunity, or
    g. An educational session
7. The focus group discussion is conducted by a team consisting of a moderator and an interpreter. The moderator facilitates and records the discussion..

Thank you!

Focus group questions.

1. Tell me about the food you give to your children.

2. What influences your choice of food?

3. Do you ever deviate from your food choices?

4. Does your child like the food you prepare?

5. Are there any foods you would not feed your child? Why?
6. Will your child be given special foods on special occasions?
7. How do you decide the quantity of food to give to your child at a time?
8. Does your child eat between meals?
9. Can you tell me how you prepare the child's food, and what influences your decisions?
10. What makes you feed your child at a particular time?
11. How do you know when your child is hungry?
12. Are there any differences between how the child is fed now and how they were fed when they were younger?
13. How do you know if your child is satisfied?
14. Tell me how your child learns to eat independently.
15. How do you know if your child has had enough of your food?
16. How do mealtimes usually start and end?
17. Are they involved in adult mealtimes in any way?
18. Which of the foods that you give to your child will you consider indigenous, and which will you consider non-traditional?
19. Do you have any preference for the food that should be given to children?
20. Why do you prefer this food over the other?
21. Does it really matter, which food should be given to children?
22. How do you feel if your child chooses to stay without eating food a whole day?
23. What are your responsibilities as a parent in feeding your children?
24. What are some of the rewarding things about feeding your children?
25. What are the challenges or frustrations of feeding your children?
26. How important are childhood eating habits and nutrition in terms of lifelong health?

27. If you were to compare the eating habits of your children with the dietary guidelines, how do you think they would rate?
28. If you were to compare your children's diet (eating) with the eating habits of their friends and the children of your friends, how would they be similar and how would they be different?
29. To what extent do you keep check of or limit the foods your children have?
30. How much influence do your children have in choosing what they eat?
31. What do you think are the main influences on what children eat?
32. Talk to me about parts of your children's food intake or eating habits that you would like to change.
33. Can you think of any reasons why you would want to change the way you feed your children?
34. Is there anything else about child feeding that you usually deal with that we have not discussed?