# Factors influencing whole grain intake in UK adolescents: A theory-based study

Maya Kamar

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**Chapter 2:**

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## Presentations and publications

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## Abstract

**Background:** Whole grain consumption is associated with reduced risk of chronic disease. One-fifth of UK adults and children do not consume any whole grains, and adolescents have low consumption rates. There is little research on correlates of whole grain consumption in this age group. This study aimed to identify the socio-demographic, environmental, and behavioural factors associated with whole grain intake in UK adolescents, based on the health behavioural Reasoned Action Approach (RAA) model.

**Methodology:** In Study I, five focus groups explored 50 adolescent's attitudes towards, knowledge and consumption of wholegrain foods, as well as barriers to, and facilitators of, consumption. Focus groups were analysed using thematic analysis. Study II conducted SenseCam assisted in-depth interviews with eight adolescents. Participants wore SenseCam for three days, then undertook traditional 24-hour recalls and in-depth interviews for attitudes, knowledge and consumption of wholegrain foods; as well as barriers and facilitators to consumption. SenseCam images prompted conversation during the interviews, which were audio-recorded and analysed using inductive content analysis. In study III, an RAA-based online survey was developed, as informed by Studies I and II. A total of 160 participants completed an online Food Frequency Questionnaire to estimate whole grain intake, and a survey examining their knowledge, attitudes, and consumption of wholegrain foods, as well as barriers and facilitators to consumption. Linear regression models, adjusted for demographic characteristics, were used to identify factors associated with whole grain intake. Participants in this thesis were adolescents of mixed genders and ethnicities, aged 11-16 years; recruited from schools in Leeds city area.

**Results:** Most participants had heard of whole grains but their consumption levels were generally low. The mean whole grain intake was around 10 servings of wholegrain food per week – approximately 1.4 servings per day. Breads and breakfast cereals were the most commonly consumed products. Adolescents were more influenced by parents and online media than by peers. Most adolescents related "whole grains" to wholemeal toast, and were not aware that varieties they already consumed, such as popcorn, quinoa and brown rice, were whole grain as well. Many recognised whole grain health benefits related to digestive health but not those related to heart disease or cancers. Barriers to whole grain consumption included negative sensory properties, poor availability and lack of varieties in stores, a lack of knowledge of the health benefits and difficulties in identifying wholegrain products. Suggested facilitators to consumption included promotion through social media celebrities, increased parental awareness and school-based education, improved sensory appeal, increased availability and variety, and tailoring of products for young people. Key factors significantly associated with increased whole grain intake (survey results, $p<0.01$): home availability of whole grains $(R^2=0.21)$, a supportive friend and family environment to consume more wholegrain foods $(R^2=0.19)$, personal dietary-consciousness $(R^2=0.18)$ and higher physical activity levels $(R^2=0.17)$, followed by positive attitudes to whole grains $(R^2=0.13)$, and intention to consume more wholegrain foods $(R^2=0.11)$. Being male and from a higher family socioeconomic status were also associated with greater whole grain consumption $(R^2=0.10)$. Frequency of eating out and getting lunch from school – non-RAA construct factors – were negatively associated with whole grain consumption *($R^2=0.17$, and $R^2=0.15$*, respectively*)*. The constructs of RAA successfully captured a number of whole grain consumption correlates among adolescents, explaining 19.9% of the variance in whole grain consumption.

**Conclusion:** Findings of this study suggest future interventions should address a broad range of factors, in particular awareness to improve parental and adolescent attitudes and increased home availability of wholegrain foods. Study outcomes may inform future interventions to increase whole grain intake in this age group.

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# Abbreviations

**CVD:** Cardiovascular disease

**NDNS:** National Diet and Nutrition Survey

**RAA:** Reasoned action approach

**SES:** Socioeconomic Status

**SCT:** Social Cognitive Theory

**TPB:** Theory of Planned Behaviour

**WG:** Whole grain OR wholegrain

# Chapter 1 : Background and Literature review

## 1.1 Literature background

Whole grains are defined by the European HEALTHGRAIN Consortium as follows:

> "Whole grains shall consist of the intact, ground, cracked or flaked kernel after the removal of inedible parts such as the hull and husk. The principal anatomical components - the starchy endosperm, germ and bran - are present in the same relative proportions as they exist in the intact kernel."
> "Small losses of components – that is, less than 2% of the grain/10% of the bran – that occur through processing methods consistent with safety and quality are allowed."
> (van der Kamp et al., 2014)

This definition of whole grain (WG) was based on, and is consistent with, the widely-adopted definition of the American Association of Cereal Chemists International (AACCI), with the addition of allowances to small component losses during processing (Seal et al., 2016).

The attempt to reach a standardised universal definition of wholegrain foods has been ongoing and controversial (Korczak et al., 2016; Ferruzzi et al., 2014). Researchers and organisations have adopted and proposed definitions, with varying percentages of required whole grain content to qualify as a wholegrain product (Ross et al., 2015; Ferruzzi et al., 2014; van der Kamp et al., 2014; Bjorck et al., 2012; Richardson, 2003). To qualify for wholegrain food definition and labelling in the UK currently, it has been suggested that foods contain at least 51% wholegrain content (present as the dominant or first ingredient on the list), and provide 16g wholegrain/reference amount customarily consumed (Seal et al., 2016; Seal, 2006; Richardson, 2003). A recently proposed definition at a multidisciplinary expert roundtable discussion in 2014 states that "a food providing at least 8g of whole grains per 30g serving be defined as a wholegrain food (27g/100g)" (Ferruzzi et al., 2014). Establishing a standardised whole grain definition has the potential to strengthen reporting consistency and effective communication between researchers, health professionals, food manufacturers, and consumers regarding the whole grain message. Clarity and consistency is likely to be important to health communication, product availability, and increased consumption (Seal et al., 2016; Ferruzzi et al., 2014; Sjoberg, 2012).

The present thesis will use the current proposal in the United Kingdom (UK) for defining a product as whole grain, i.e. that 51% of the product should comprise whole grain. This is due to it being the established one at the start and design of the research and the educational content to participants.

Examples of wholegrain foods are: wholegrain bread, oats, brown rice, rye, corn, millets, and sorghum (Jonnalagadda et al., 2011). One wholegrain portion size or serving may translate to: one medium slice of wholemeal bread, three tablespoons of wholegrain ready-to-eat cereal, one tablespoon of uncooked oats, half a wholemeal pitta, two heaped tablespoons of cooked brown rice, three tablespoons of cooked pasta, half a wholemeal tortilla, or two to three cups of plain popcorn (BDA, 2016).

### 1.1.1 Benefits and health outcomes associated with increased whole grain intake: A summary

Whole grains form a major source of dietary fibre[1] and are rich in protein, vitamins (Vitamin E and Vitamin B complex), minerals (Fe, Mg, Se, and Zn), and phyto-chemicals (Seal et al., 2016; Slavin, 2003; Slavin et al., 2001). In fact, whole grains contain more than twice the amount of dietary fibre than that found in their refined counterparts (eg: wholemeal bread 7g/100g vs. white bread 2.9g/100g) (Public Health England, 2015). To provide another example, **Table 1-1** compares the nutrient content of white plain flour and wholemeal flour, obtained from McCance & Widdowson's The Composition of Foods (Food Standards Agency, 2002). The exact mechanisms through which whole grains exert their benefits are numerous and have yet to be fully understood; however theories relating to biological pathways including dietary fibre and bioactive components of food have been proposed (Fardet, 2010).

[1] Current fibre recommendation (AOAC): 30g/day for adults and 15-25g/day for children (Scientific Advisory Committee on Nutrition (SACN), 2015)

**Table 1-1 Nutrient content of white plain flour and wholemeal flour (Food Standards Agency, 2002)**

| | White plain flour | Wholemeal flour |
|---|---|---|
| **Water (g/100g)** | 14.0 | 14.0 |
| **Protein (g/100g)** | 9.4 | 12.7 |
| **Fat (g/100g)** | 1.3 | 2.2 |
| **Carbohydrate (g/100g)** | 77.7 | 63.9 |
| **Energy Value (g/100g)** | 341.0 | 310.0 |
| **Total Sugars (g/100g)** | 1.5 | 2.1 |
| **Fibre (non-starch polysaccharides, g/100g)** | 3.1 | 9.0 |
| **Sodium (mg/100g)** | 3.0 (0.003%) | 3.0 (0.003%) |
| **Potassium (mg/100g)** | 150.0 | 340.0 |
| **Calcium (mg/100g)** | 140.0 | 38.0 |
| **Iron (mg/100g)** | 2.0 | 3.9 |
| **Zinc (mg/100g)** | 0.6 | 2.9 |
| **Selenium (mcg/100g)** | 2.0 | 6.0 |
| **Vitamin E (mg/100g)** | 0.3 | 1.4 |
| **Thiamin (mg/100g)** | 0.31 | 0.47 |
| **Riboflavin (mg/100g)** | 0.03 | 0.09 |
| **Niacin (mg/100g)** | 1.7 | 5.7 |

Observational epidemiology studies suggest that habitual whole grain consumption is associated with a reduced risk of non-communicable disease (Seal and Brownlee, 2015). Systematic reviews and meta-analyses reported up to 30% reductions in risk of cardiovascular disease (CVD) and type 2 diabetes (between lowest and highest quintiles of intake) (Ye et al., 2012, Mellen et al., 2008), with dose-respondent associations of 20% CVD risk reduction observed in elevated consumptions of 90g/day of wholegrain foods (Aune et al., 2016), and 0.3% type 2 diabetes absolute risk reduction for each 10g/day whole grain consumed (Chanson-Rolle et al., 2015). Furthermore, increased whole grain consumption was reported to be linked to reductions in cancer risk, whereby the relative risk of colorectal cancer declined by an estimated 10% for increments of 3 servings of whole grain/day (Aune et al., 2011). Reductions in risk of digestive tract cancers, as well as breast, pancreatic and prostate cancers have also been observed between high and low whole grain intakes (Lei et al., 2016; Mourouti et al., 2016; Jacobs et al., 1998). Increased whole grain consumption has also been linked to assisting with weight management (Thielecke and Jonnalagadda, 2014), and a meta-analysis suggested that participants consuming of 3-5 whole grain servings per day, in comparison to rare consumers, showed reductions in weight gain during 8-13 years of follow-up (Ye et al., 2012). Moreover, a study of US data over 12 years reported that increased whole grain consumption may contribute to weight management in adults and children (Albertson et al., 2016).

More recent meta-analyses have examined increased whole grain consumption in relation to mortality from non-communicable diseases, and similar positive results as those related to risks to non-communicable diseases have been found (Huang et al., 2015). In fact, doubling daily whole grain intake, as well as consuming 16g/day and 3 servings per day have been associated with a reduction in risk of all-cause mortality as well as disease-specific mortality (respiratory disease, cancers, diabetes, and CVD or events) (Chen et al., 2016; Wei et al., 2016; Zong et al., 2016; Johnsen et al., 2015).

A recent analysis of the UK National Diet and Nutrition Survey (NDNS) 2008-2011 data has found significant inverse relations between increased whole grain servings and concentrations of C-reactive protein in adults, and white blood cell count in both children, adolescents and adults. Moreover, diets of whole grain consumers were closer in nutrient value to recommendations than those of non-consumers (Mann et al., 2015).

Although evidence from intervention studies suggests an overall beneficial impact of whole grain intake on health outcomes, but the associations have been inconsistent or, in some cases, not significant (Seal and Brownlee, 2015; Vitaglione et al., 2015;

Ferruzzi et al., 2014; Pol et al., 2013; Brownlee et al., 2010). However, this inconsistency in findings may be attributed to issues in study design, such as durations of no longer than four months and relatively small sample sizes, and the types of wholegrain products included in these interventions (Mann et al., 2016). Moreover, there is considerable variation in the methods of measuring, reporting, and calculating whole grain intake within these studies, which increases the difficulty of interpretation and comparison of the results (Ross et al., 2015). However, overall, no negative effects have been reported, and evidence generally points to positive health benefits from whole grain consumption. More trials and intervention studies are needed to substantiate the wealth of epidemiological evidence on the benefits of increased whole grain consumption.

### 1.1.2 Whole grain recommendations and current intake

It has been suggested that daily intake of around one to three servings of wholegrain foods per day can achieve improvements in health outcomes (Seal et al., 2016; Seal and Brownlee, 2015; Bjorck et al., 2012; HEALTHGRAIN EU, 2005-2010). According to the 2005 Dietary Guidelines for Americans and Canadian guidelines (U.S. Department of Health and Human Services and Agriculture, 2015–2020), individuals are recommended to “make half of [their] grains whole grains”, consuming a minimum of 3-5 once-equivalents or servings of wholegrain products per day (48-80g/day). Denmark issued higher dietary guidelines of four portions per day, and Singapore has semi-quantity specific recommendations, where adults are advised to consume sufficient amount of grains, especially whole grain, choosing at least one serving of rice and its alternatives from whole grain (Singapore, 2012). Other countries, such as Australia, China, France, Germany and Ireland have generic advice which, similar to the UK, recommends including or increasing whole grain consumption in general (Seal et al., 2016; Ferruzzi et al., 2014).

At the time of writing, no specific and official UK recommendation for whole grains have been published yet. The current public health recommendation for British adults is to consume a variety of wholegrain foods whenever possible (Seal and Jones, 2007;

HEALTHGRAIN EU, 2005-2010; Food Standards Agency, 2005). The UK government's' Eatwell Guide advices that consumers "choose wholegrain or higher fibre version with less added fat, salt, and sugar"(Mann et al., 2016).

Although, the U.S. Department of Agriculture (USDA) recommends 48-80g of whole grain per day, the National Health and Nutrition Examination Survey (NHANES) 2001-2012 data show that the mean intake among American adults and children was around 27g/day and 21g/day, respectively (Albertson et al., 2016). Similarly low levels of intake are reported in the UK. The UK's National Dietary Survey of British Adults (NDNS) (2008-2011) reported that 18% of adults and 15% of children/adolescents do not consume any wholegrain foods, with the median intake for adults and children/teenagers being around 20g/day and 13g/day respectively (Mann et al., 2015). Individuals from lower socio-economic groups and adolescents (aged 13-17 years) appeared to have the lowest levels of intake (Mann et al., 2015; Nelson et al., 2007). **Table 1-2**, extracted from the mentioned NDNS analysis (Mann et al., 2015), displays the particular low intake levels among adolescents (13-17 years), compared with children and adults. Daily whole grain intake from all sources was a total of 15.0g g/10MJ (14.9g/10MJ in females and 15.1g/10MJ in males). However, when whole grain consumption was examined by percentage whole grain content of food sources, adolescent daily intake from foods with ≥51% whole grain content was lower at 3.3 g/10MJ (2.0g/10MJ in females and 4.4 g/10MJ in males). Females had lower overall consumption levels. Moreover, it was evident that whole grain consumption rates levelled off from childhood and continued to be low into early adulthood.

Therefore studies at a national level reveal the low whole grain intake levels among adolescents, and that they are in specific need of targeting. Increasing whole grain intake in adolescents may prevent the later decline observed in early adulthood. Furthermore, eating patterns and preferences established during adolescence have an impact on health outcomes, making adolescence a particularly important time to promote healthy eating (Shepherd et al., 2006; Story et al., 2002; Croll et al., 2001).

Whole grain intake has been associated with positive diet quality, lower BMI, higher insulin sensitivity, and improved chronic disease risk factors in adolescents (Hur and Reicks, 2011; O'Neil et al., 2011; Steffen et al., 2003). Studies on adults suggest that increasing wholegrain consumption is possible through health programmes, and that long-term habitual preference for wholegrain tends to be established with repeated exposure (Brownlee et al., 2013).

**Table 1-2 Energy-adjusted whole grain intake in the UK by sex, extracted from the latest published NDNS analysis (Mann et al., 2015). Adolescent whole grain intake is indicated within the red frame.**

| | Median energy-adjusted whole grain intake (g/10 MJ per d) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | All whole-grain foods | | | ≥10 % Whole-grain foods | | | ≥51 % Whole-grain foods | | | |
| Age | Male | Female | All | Male | Female | All | Male | Female | All | *n* |
| Children/teenagers (years) | | | | | | | | | | |
| 1·5–5 | 28·1 | 26·8 | 27·3 | 28·1 | 25·8 | 26·8 | 16·3 | 17·0 | 16·8 | 484 |
| 5–12 | 25·0 | 18·6 | 21·7 | 24·3 | 17·4 | 21·3 | 10·7 | 8·0 | 9·3 | 577 |
| 13–17 | 15·1 | 14·9 | 15·0 | 14·7 | 14·1 | 14·7 | 4·4 | 2·0 | 3·3 | 441 |
| Total | 22·2 | 19·1 | 20·3 | 21·7 | 18·5* | 19·6 | 10·4 | 8·0 | 9·3 | 1502 |
| Adults (18+ years) | | | | | | | | | | |
| 18–24 | 10·6 | 17·4 | 16·3 | 10·6 | 17·4 | 15·9 | 5·9 | 12·1 | 7·0 | 194 |
| 25–34 | 18·1 | 14·9 | 16·7 | 18·1 | 14·6 | 16·0 | 8·4 | 4·1 | 4·5 | 228 |
| 35–44 | 29·4 | 27·8 | 28·5 | 28·5 | 17·8 | 28·2 | 13·2 | 18·6 | 14·7 | 311 |
| 45–54 | 21·5 | 34·9 | 31·4 | 21·5 | 34·9 | 31·4 | 12·7 | 19·2 | 15·4 | 275 |
| 55–64 | 36·3 | 33·7 | 33·8 | 36·6 | 33·7 | 33·8 | 19·9 | 19·7 | 19·7 | 258 |
| 65+ | 29·2 | 37·2 | 33·6 | 28 | 37·2 | 33·6 | 16·2 | 22·3 | 21·3 | 305 |
| Total | 23·2 | 29·6* | 26·7 | 23·2 | 29·4* | 26·6 | 12·7 | 16·8* | 14·7 | 1571 |
| Whole population | 22·7 | 22·8 | 22·8 | 22·5 | 22·4 | 22·4 | 11·5 | 12·7 | 12·3 | 3073 |

* Value was significantly different between sex ($P < 0·05$; Mann–Whitney test).

### 1.1.3 Studies exploring whole grain intake correlates

In order to design effective interventions to promote wholegrain consumption, a better understanding of the factors that influence dietary behaviour is needed (Larson et al., 2010). Although prospective studies reported in the literature have examined the associations between whole grain and health outcomes, little has been done in terms of research and public interventions to improve whole grain awareness and consumption in the UK (Brownlee et al., 2013).

To our knowledge, there are no studies that explore whole grain intake correlates in UK adolescents, and only a small number of UK-based studies on whole grain intake correlates, mainly in adults (Hellyer et al., 2014; Brownlee et al., 2013; Kuznesof et al., 2012; McMackin et al., 2012). Only one study focused on British adolescent girls (Rees et al., 2010); this was a computerised-tailored intervention to test the effectiveness of education in improving diets, and included whole grains along with other foods. However, it did not explore whole grain intake correlates.

As for studies outside the UK, the literature including whole grain intake correlates among adolescents was not abundant (Neo et al., 2016; Norimah et al., 2015; Bruening et al., 2012; Chu et al., 2011; Keast et al., 2011; Larson et al., 2010; Pohjanheimo et al., 2010), whereas a larger number of studies targeted other age groups like younger children and adults (Arts et al., 2016; Magalis et al., 2016; Bakken et al., 2015; Cohen et al., 2014; Tritt et al., 2013; Williams and Mazier, 2013; Chu et al., 2012; Muhihi, 2012; Sjoberg, 2012; Rosen et al., 2011; Sadeghi and Marquart, 2010; Rosen, 2009; Roth-Yousey et al., 2009; Sadeghi, 2009; Toma et al., 2009; Burgess-Champoux et al., 2008b; Rosen et al., 2008; Rosen et al., 2007; Burgess-Champoux et al., 2006; Marquart et al., 2006; Ellis et al., 2005; Burgess-Champoux et al., 2004; Chase et al., 2003a; Chase et al., 2003b; Smith et al., 2001). It should be noted that not all these studies were exploratory nor aimed to explore correlates of whole grain consumption; some were interventions, analysed national intakes, or pilot studies, and included small minor explorations of the correlates to whole grain intake. Details of the key findings of the listed studies on whole grain intake correlates will be examined in detail in the individual chapters of this thesis; thus brief reference and key points have been made here to avoid redundancy.

### 1.1.4 Targeting adolescents to improve whole grain intake

Prior research, including but not exclusive to the studies listed in the previous section, has reported the following as possible barriers to whole grain intake among adults and children: lack of awareness and misconceptions about wholegrain food products; inability to identify them; lack of awareness of the health benefits; perceived or experienced negative sensory properties; high price; low availability; difficulties in integration with current dietary habits, and lack of knowledge of preparation techniques (Martini, 2013; Shepherd et al., 2012; Frølich and Åman, 2010; Jones & Engleson, 2010; Saba et al., 2010; Mancino et al., 2008; Arvola et al., 2007; Seal and Jones et al., 2007; Smith et al., 2003; Jones et al., 2002).

Although many of these barriers are likely to be the same for adolescents, their sensitivity to social norms may render them particularly vulnerable to reduced dietary quality and whole grain intake (Stevenson et al., 2007; Story et al., 2002). One American cross-sectional study conducted in the University of Minnesota on the project EAT cohort (Larson et al., 2010) examined the personal, socio-environmental, and behavioural correlates of wholegrain intake among young adults and adolescents, based on Social Cognitive Theory (Bandura, 1986). This study showed that home availability of wholegrain foods, self-efficacy to consume recommended intakes, and preference of the wholegrain taste were positively related to increased wholegrain intake, whereas fast-food preference was negatively related to wholegrain intake. However, this study relied on data taken from the EAT study examining overall eating habits, thus attitudes and behaviour regarding wholegrain specifically were not assessed in detail, and some major sources of wholegrain were not listed as it included wholegrain foods as one section out of many. Another study was conducted on Finnish adolescents (Pohjanheimo et al., 2010), and used mixed methods to assess whole grain intake correlates (focus groups and a survey); however it was not theory-based. Finnish adolescents viewed whole grain as healthier and more acceptable than their refined counterparts (Rye bread is considered as an integral part of the cultural diet), and consumed whole grains due to preference, feelings of fullness, and for purposes of weight control. A positive attitude towards wholegrain foods was associated with higher consumption. The mentioned studies were based on a American and Finnish adolescent cohort, which may have different awareness, attitudes, barriers and influencing factors than UK adolescents.

Young people aged 10-24 years old form about 20% of the UK population (Office for National Statistics, 2010). Adolescence is among the most challenging periods of life for researchers, and despite the importance of nutrition during adolescence, not enough is known about the eating behaviours of this young age group (Boushey et al., 2009; Neumark-Sztainer et al., 2002).

There is an increased need for a balanced and healthy diet to support the developments and demands of this transitional age which involves substantial biological, cognitive, emotional, and social changes. However, the psychological and social challenges encountered and adolescents' attempts to develop an identity and acceptance by peers often result in a negative impact on dietary habits (Stevenson et al., 2007; Story and Resnick, 1986). They may be an overall sense of lack of urgency/indifference to healthy eating among adolescents (due to peer influence, common eating disorders, fad dieting, or perceived lack of urgency) (Contento et al., 2006; Baker et al., 2003; Croll et al., 2001; Adams, 1997; Story and Resnick, 1986) . Research has shown that eating patterns in adolescence have an impact on future health outcomes, and that developing healthy habits in the those years may promote wiser food choices throughout the lifetime – if implemented properly (Contento et al., 2006; Shepherd et al., 2006; Videon and Manning, 2003; Croll et al., 2001; Neumark-Sztainer et al., 1999; Centers for Disease Control and Prevention, 1996; Bull, 1992). Furthermore, it may be a more motivating approach to improve health among adolescents through encouraging increased consumption of certain foods rather than restriction – an example of the latter being fat reduction (the concept of "do" rather than “don’t”) (Brinberg, 1990). Moreover, wholegrain foods consumption comprises of substitution of food varieties already consumed with the healthier alternative, rather than attempts to introduce a new food item which they may not be able to fit well with existing food habits (Keast et al., 2011).

## 1.2 Developing the methodology in light of the research questions

This doctoral research presented here posed the following questions:

**1. What are UK adolescents’ general awareness, attitudes, and consumption levels of wholegrain foods?**

**2. What are the barriers, possible facilitators, and factors that influence adolescent wholegrain intake?**

This section outlines the steps taken to develop the research theory and methodology chosen to address these questions.

### 1.2.1 Choosing a theoretical framework

A number of theoretical frameworks exist which attempt to map the determinants of health behaviour, and this can be used to inform the design of interventions to improve health behaviour, including diet.

There is strong evidence in the literature to support the use of theory in studying behaviour and designing interventions (Michie et al., 2008; Rasmussen et al., 2006; Michie and Abraham, 2004; Baranowski et al., 1999). “Interventions are likely to be more effective if they target causal determinants of behaviour and behaviour change… [Moreover], theory-based interventions facilitate an understanding of what works and thus are a basis for developing better theory across different contexts, populations, and behaviours.”(Michie et al., 2008). This is especially relevant in informing interventions for new and under-explored topics, such as whole grain intake in adolescents.

Few whole grain studies have used specific behavioural models to explain their proposed intervention, especially for adolescents (Larson et al., 2010; Rees et al., 2010). It is yet unclear if approaches used in adult interventions would also be effective with adolescents, who may have different attitudes, behaviours, environments and ways of accessing whole grain. Therefore, the integration of psychological theory in understanding adolescents may be of particular significance (Baker et al., 2003; Story et al., 2002).

The use of theory in understanding health behaviour has been applied in a variety of adolescent studies – including general health behaviour, dietary patterns, as well as fruit and vegetable intake studies (Rasmussen et al., 2006; Baranowski et al., 2003; Ammerman et al., 2002; Story et al., 2002; Baranowski et al., 1997). However, as studies on wholegrain intake correlates were few, only two theory-based studies were found (Larson et al., 2010; Rees et al., 2010). The first one (Rees et al., 2010) was an intervention to promote a variety of healthier food choices in UK adolescents – including whole grains – but did not explore whole grain intake correlates. The second study was that of the University of Minnesota on the project EAT cohort (Larson et al., 2010). This study used a theoretical base: Social Cognitive Theory (Bandura, 1986; Bandura and McClelland, 1977). It was chosen as it explained the trends revealed in a previous qualitative study conducted on this cohort (Neumark-Sztainer et al., 1999). However, it must be noted that the latter, which comprised of focus group discussions, was an overall healthy eating study and was not specific to wholegrain foods. Wholegrain foods were merely one food type out of many. Therefore, the theoretical framework may or may not be applicable to this study which is specific to wholegrain intake, and perhaps other theories might better explain the behaviour and motivation in this case.

The present thesis therefore opted to draw upon a theoretical framework for understanding health behaviour in order to inform inquiry into the potential factors influencing adolescent whole grain intake. Theories of health behaviour, and specifically those applied in dietary behaviour, were therefore reviewed.

To design this project, it was necessary to build on the literature of other dietary outcomes commonly conducted on adolescents, since the published literature on wholegrain was insufficient. Thus there was a choice between studies on correlates of fat intake, sugar intake, physical activity, or fruit and vegetable intake. Approaches to studies on fat and sugar intake correlates might be slightly different, as they tackle a message of negative or "undesirable" food categories. Such "approach/avoidance" classification of behaviours has been described in a proposed framework to guide behavioural research development (Rothman and Salovey, 1997), and used in several studies (McEachan et al., 2016; McEachan et al., 2010); behaviours are grouped based on a group of similarities for purposes of theory and intervention applications. This further supports the rationale used in the selection of similar behaviour types as a literature guide for this research, since it may be more suitable to focus on behaviours with a similar "approach" or "do more of" message (as that of whole grain consumption). Although physical activity research would have been a diverse and innovative literature base, it may have had different influencing factors and methods than those employed in dietary research. Thus choice of theories and methodologies based on fruits and vegetables research was chosen, and a literature review was carried out on studies exploring fruit and vegetable intake correlates among adolescents.

A reasonable amount of literature was found on fruit and vegetable intake correlates among adolescents (mixed age groups were found in some studies); the focus was on studies with a theoretical basis. The majority of the studies were interventions, or studies that explored correlates qualitatively in preparation for a school-based intervention.

Summaries of the relevant studies identified in the literature and the theories used have been compiled in **Table 1-3** (qualitative studies) and

**Table 1-4** (quantitative studies) below. The tables will be discussed further in the following sections. It is important to note that this literature search was conducted at the beginning of this research study, and served to guide the development of the methodology. It is recognised that new studies may have emerged in the duration of this research.

**Table 1-3: Qualitative studies on fruit and vegetable intake correlates with theoretical frameworks involving adolescents**

| Qualitative studies with theoretical base | | | |
|---|---|---|---|
| **Theory*** | **Paper Title** | **Author(s), Year** | **Notes** |
| Social Cognitive Theory | “5 A day” achievement badge for urban boy scouts: Formative evaluation results | (Cullen et al., 1998) | Adolescents (ten to fourteen years old) |
| | Factors influencing food choices of adolescents: Findings from focus-group discussions with adolescents | (Neumark-Sztainer et al., 1999) | Adolescents (aged 12-14) |
| | Social–environmental influences on children's diets: results from focus groups with African-, Euro-and Mexican-American children and their parents | (Cullen et al., 2000) | Younger and Adolescents (fourth to sixth graders) - reciprocal determinism |
| | Caucasian and Mexican American low-income children's thoughts about vegetables and fruits | (Keim et al., 2001) | Younger age and adolescents (eight to eleven years old) |
| | Outcome expectations, barriers, and strategies for healthful eating: a perspective from adolescents from low-income families | (Evans et al., 2006) | Adolescents (ten to fourteen years old) |

| | | | |
|---|---|---|---|
| | Influences on Fruit and Vegetable Consumption by Low-Income Black American Adolescents | (Molaison et al., 2005) | Adolescents (aged 10-13) |
| | Barriers to and motivators for healthful eating as perceived by rural and urban Costa Rican adolescents | (Monge-Rojas et al., 2005) | Adolescents (aged 12 -18), also ecological perspective (as proposed by Story et al., 2002(Story et al., 2002)) |
| | Outcome expectations, barriers, and strategies for healthful eating: a perspective from adolescents from low-income families | (Evans et al., 2006) | Adolescents (ten to fourteen years old) |
| Theory of Planned Behaviour | Beliefs, knowledge, and values held by inner-city youth about gardening, nutrition, and cooking | (Lautenschlager and Smith, 2007) | Other ages and also adolescents (nine to fifteen years old) |
| Developmental Psychology | Growing youth growing food: How vegetable gardening influences young people's food consciousness and eating habits | (Libman, 2007) | Adolescents (age ten to fourteen) |
| | Dietary choices of urban minority high school | (Campbell, 2009) | Older age (High school |

| | | | |
|---|---|---|---|
| | students | | students) |
| Action Research | Primary prevention of type-2 diabetes and heart disease: action research in secondary schools serving an ethnically diverse UK population | (Khunti et al., 2008) | Adolescents (eleven to fifteen years old) |
| Socio-ecological Approach | Adolescents' views of food and eating: Identifying barriers to healthy eating | (Stevenson et al., 2007) | Adolescents aged 12-15 |
| Studies with Multiple Theories | Fruits, vegetables, and football: findings from focus groups with alternative high school students regarding eating and physical activity | (Kubik et al., 2005) | Ecological Theory + Social Learning Theory (Adolescents and older age, 9 till 12$^{th}$ grade) |
| | Why do kids eat healthful food? Perceived benefits of and barriers to healthful eating and physical activity among children and adolescents | (O'Dea, 2003) | Younger and Adolescents (age range 7-17), Social Learning Theory + Theory of Planned Behaviour |
| | A qualitative exploration of determinants of fruit and vegetable intake among 10-and 11-year-old schoolchildren in the low countries | (Wind et al., 2005) | Health Belief Model + Theory of Planned Behaviour + Social Ecological Models, Younger |

| | | | |
|---|---|---|---|
| | | | and Adolescents (Age ten to eleven years olds) |
| Other Theories | “How can we stay healthy when you’re throwing all of this in front of us?” Findings from focus groups and interviews in middle schools on environmental influences on nutrition and physical activity | (Bauer et al., 2004) | Grounded Theory in analysis, Adolescents (seventh and eight graders) |
| | Development of a school-based nutrition intervention for high school students: Gimme 5 | (Nicklas et al., 1997) | PRECEDE model of health education, Adolescents (ninth graders) |
| | Cognitive development and children's perceptions of fruit and vegetables; a qualitative study | (Zeinstra et al., 2007) | Cognitive Theory. Three age groups: 4-5, 7-8, and 11-12 |

**Table 1-4: Quantitative studies on fruit and vegetable intake correlates with theoretical frameworks involving adolescents**

| Quantitative studies with theoretical base | | | |
|---|---|---|---|
| **Theory*** | **Paper Title** | **Author(s), Year** | **Notes** |
| Social Cognitive Theory | Dietary practices of South Carolina adolescents and their parents | (Rafiroiu et al., 2002) | Adolescents (eighth to eleventh grade) and their parents |
| | Availability, accessibility, and preferences for fruit, 100% fruit juice, and vegetables influence children's dietary behaviour | (Cullen et al., 2003) | Younger children and adolescents (fourth to sixth graders) |
| | Correlates of fruit and vegetable intake among adolescents: Findings from Project EAT | (Neumark-Sztainer et al., 2003) | Adolescents and young adults (average age 14.9)<br>Based on project EAT |
| | Associations between perceived parent behaviours and middle school student fruit and vegetable consumption | (Young et al., 2004) | Adolescents (aged 12-16) |
| | Correlates of fruit and vegetable intake among Norwegian schoolchildren: parental and self-reports | (Bere and Klepp, 2004) | Adolescents (aged 10-12) |

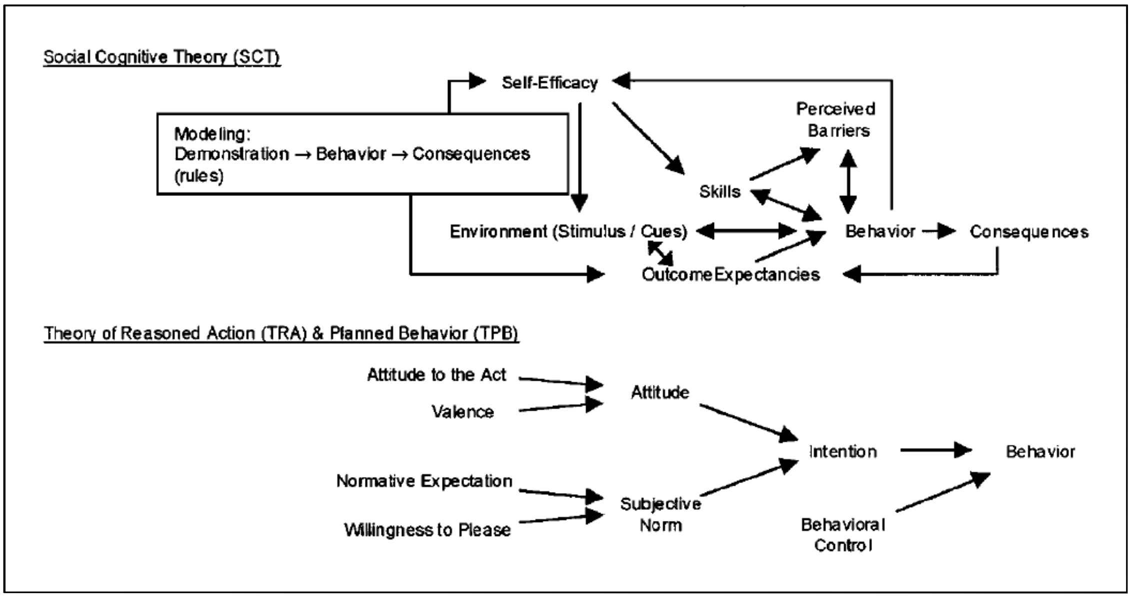
| | | | |
|---|---|---|---|
| | Changes in accessibility and preferences predict children's future fruit and vegetable intake | (Bere and Klepp, 2005) | Adolescents (average age 11.8) |
| Theory of Planned Behaviour | Applying theory of planned behaviour to fruit and vegetable consumption of young adolescents | (Lien et al., 2002b) | Adolescents (seventh graders) |
| | Understanding Adherence to 5 Servings of Fruits and Vegetables per Day: A Theory of Planned Behaviour Perspective | (Blanchard et al., 2009a) | Young Adults (average age 19.8) |
| Transtheoretical Model (Stages of Change) | Stages of change for increasing fruit and vegetable consumption among adults and young adults participating in the National 5-a-Day for Better Health community studies | (Campbell et al., 1999) | Adults, but included adolescents in it too (mean age 14.8) |
| | Application of the transtheoretical model to fruit and vegetable consumption among economically disadvantaged African-American adolescents: preliminary findings | (Di Noia et al., 2006) | Adolescents |
| Studies with Multiple Theories | Personal and family determinants of dietary | (De Bourdeaudhuij and Van | Theory of Planned Behaviour+ |

| | | | |
|---|---|---|---|
| | behaviour in adolescents and their parents | Oost, 2000) | Social Learning Theory (average age 15) |
| | Exploring predictors of eating behaviour among adolescents by gender and socio-economic status | (Lien et al., 2002a) | Social Cognitive Theory+ Problem Behaviour Theory (ages 13-15) Based on The Norwegian Longitudinal Health Behaviour (NLHB) Study |
| | Predicting adolescents' intake of fruits and vegetables | (Lytle et al., 2003) | Social Cognitive Theory+ Theory of Planned Behaviour (seventh graders) Based on project TEENS |
| Other Theories | Factors of Fruit and Vegetable Intake by Race, Gender, and Age among Young Adolescents | (Granner et al., 2004) | Self-Efficacy only (aged 11-15) |

### 1.2.2 The process of theory selection

The majority of studies conducted on adolescent fruits and vegetable intake were primarily based on the Social Cognitive Theory (SCT) (Bandura, 1986; Bandura and McClelland, 1977) and the Theory of Planned Behaviour (TPB) (Montano and Kasprzyk, 2008; Armitage and Conner, 2001; Ajzen, 1991) – a fact that has been mentioned in the literature . **Figure 1-1** below, extracted from Baranowski et al. (1999), illustrates the main components of the two theories.

**Figure 1-1 Schematic representations of the SCT and TPB (Baranowski et al., 1999)**




SCT posits that behaviour is a function of aspects of the environment and the person, and that they are in constant reciprocal interaction. This is the theory's concept of reciprocal determinism (Baranowski et al., 2003).

The personal-level concepts of the theory that include self-efficacy (the belief that one can perform a specific behaviour in a variety of different circumstances), skills (the ability to perform a behaviour when desired), and outcome expectancies (the outcomes expected from performing that behaviour). The main environmental factors include availability (whether the food or the object of interest is present in this certain context), and modelling (watching someone do this behaviour and obtaining reinforcement for it) (Hearn et al., 1998; Bandura, 1986).

The theory suggests that changing behaviour involves enhancing one's ability to control's one's behaviour. "One can achieve self-control by setting specific behavioural change goals, monitoring one's own behaviour through the process of change, rewarding one's self when goals are attained, and engaging in problem solving and decision making when goals are not attained to find more effective ways to attain initial goals or set new more attainable goals (Baranowski et al., 2003)"

Although the SCT considers the issue of availability, which may be a common barrier when it comes to whole grain consumption, the relevance of other variables to the intake of whole grains is questionable: i.e. self-control may be more pertinent in fighting a temptation, as in weight loss attempts; modelling may be more important in younger children than teenagers and adults; and outcome expectancies may be less influential as a rewarding factor for behavioural change, as whole grain consumption may not yield immediate benefits.

The TPB is an extension of the Theory of Reasoned Action (TRA). The TRA hypothesises that intention is the main determinant of behaviour. Intention can be defined as "the motivation required to perform a particular behaviour" (Armitage and Conner, 2000) The greater the intention, the more likely one is to perform a certain behaviour. Intention is based on two factors: one's attitude, which is one's positive or negative assessment or evaluation of the behaviour, and subjective norms, which is the perception of social pressure for this behaviour. Subjective norm is formed through a person's perception as to what extent others would approve or disapprove of this certain behaviour, combined by one's tendency to comply with others' points of view (Fishbein and Ajzen, 2011).

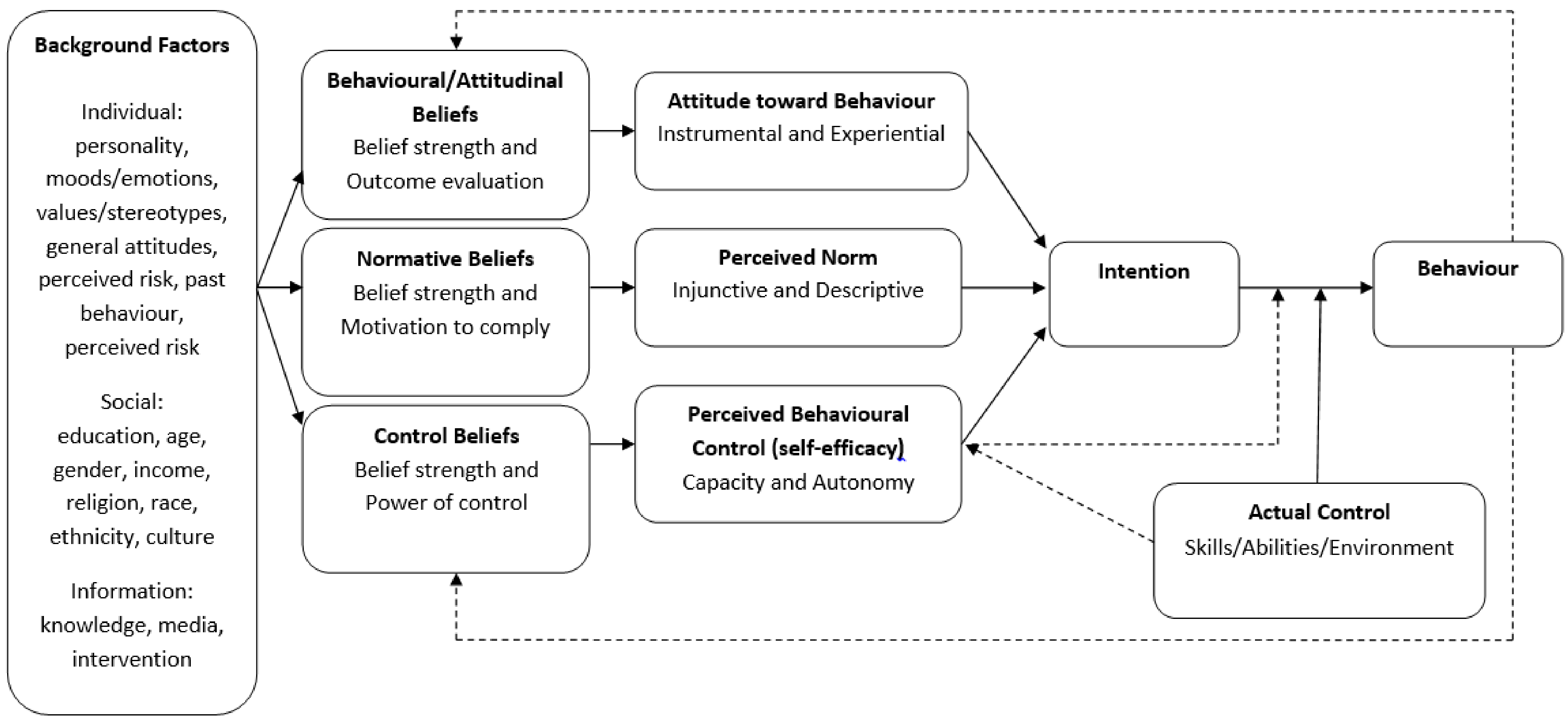
This framework was extended into the TPB, with the inclusion of perceived behavioural control, which is proposed to predict intentions and behaviour (Ajzen, 1988). Therefore, holding intention constant, the greater perceived control, the more likely the behaviour. Further, given that perceived control is proportional to actual control (in real life), then it should directly influence behaviour. "Perceived behavioural control therefore acts as both a proxy measure of actual control and a measure of confidence in one's own ability. Within the theory of planned behaviour, perceived behavioural control is posited as a third determinant of intention: the easier a behaviour is, the more likely one will intend to perform it" (Armitage and Conner, 2000).

The SCT has been mainly applied where there is already a strong intention to change behaviour. "Thus intention may either have reached a threshold value beyond which it has no predictive value, or there may be little variance in intention (Hardeman et al., 2002)." On the other hand, the TPB is helpful where intentions to change behaviour are low or non-existent. Therefore, while the SCT had been applied where people had the intention but needed help to do so (e.g. weight loss studies), the TPB has been more popular in community-based studies targeting preventative behaviours, where the intention to change for the majority of the population sample was assumedly low or not guaranteed (Hardeman et al., 2002). In the case of whole grain consumption, it is likely that people's intention to increase their intake is low.

The TPB has been reported as a superior predictor of intention and behaviour in studies that have compared health behaviour models (including SCT), as it provides an improvement on them (Armitage and Conner, 2000). The TPB appears to be an effective model for predicting food choice among adults (McEachan et al., 2011; Guillaumie et al., 2010; Conner et al., 2002) and adolescents (Conner et al., 2011; Blanchard et al., 2009a).

Although the TPB is popular, a recent meta-analysis (controlling for the impact of past behaviour) indicates that it explains only 19% of the variance in behaviour and 44% of the variation in intentions (McEachan et al., 2011), suggesting that there are factors other than the model's constructs which influence health behaviour.
Rigorous reviewing of health behavioural literature led to a newly proposed extension of the TPB – the Reasoned Action Approach (RAA) (see **Figure 1-2**). The RAA was developed from the TPB (Ajzen, 1991; Young et al., 1991) and TRA (Fisbein and Ajzen, 1975).

**Figure 1-2 The main constructs of the RAA model (Fishbein, 2008)**



The RAA contributes new environmental and knowledge-related variables that were not explicit in the TPB model, and treats them as background variables that distally influence health behaviour. Moreover, the RAA model adds that behaviour is determined by intention and moderated by actual control. The inclusion of the actual control construct, which includes environment, skills, and abilities, as well as the background factors construct, may be very important new additions, and particularly relevant when exploring determinants of dietary behaviour among adolescents (Contento et al., 2006; Bauer et al., 2004). It may also be particularly relevant for exploring whole grain consumption correlates, since knowledge and information are accounted for in the RAA model, and a deficiency in awareness is consistently reported as a main barrier to whole grain consumption (McKeown et al., 2013). Therefore, the theoretical framework adopted for the studies in this thesis was the RAA, and relevant chapters will explain how the theory informed each study.

The intended use of the RAA posed a number of additional avenues of enquiry for this thesis, alongside the main aims detailed at the beginning of this *section 1.2*. There is a lack of qualitative research in relation to the RAA in the domain of nutrition in particular, despite evidence that such approaches could elucidate important personal, situated, and cultural influences on dietary behaviour (Zoellner et al., 2012; Harris et al., 2009; Hardeman et al., 2002). Additionally, the model on its own does not explain how determinants emerge in an individual's life or what form they take; for example, how do adolescents come to understand the norms around a particular dietary behaviour and how does it come to influence them? Researchers rarely conduct exploratory studies to inform the targeting of appropriate theoretical determinants via intervention (Harris et al., 2009); e.g. should dietary interventions for adolescents focus on each health behaviour determinant equally or would it be more effective to change one in particular? Better knowledge of how adolescents contextualise and personally articulate their experiences of determinants of behaviours may help to improve the effectiveness of new RAA-informed interventions for that demographic.

### 1.2.3 Mixed methods and the design process of this research

This section will offer the rationale for the research design that coheres the three studies presented in this thesis.

The literature review revealed patterns of research design and methodologies used in intervention development and design, which were common in theory-based studies targeting fruit and vegetable consumption in adolescents (see *section 1.2.1*), as well as studies focusing on whole grain intake in adults and the few targeting adolescents. These studies were part of larger projects (example: Project TEENS, Project EAT, the WHOLEheart study) (Kuznesof et al., 2012; Brownlee et al., 2010; Larson et al., 2010; Lytle et al., 2003; Neumark-Sztainer et al., 2003), and many relevant publications for the research team were examined to trace their process of research development. It was observed that teams began with exploration of determinants before moving to the development of intervention and, in some cases, their subsequent assessment via trials. There was a preponderance of mixed methods research: starting out with exploratory qualitative studies (focus groups or interviews) which would inform an eventual quantitative exploration of the determinants of intake or the design of an intervention. Some studies further set out to quantitatively examine the utility of the selected theory in predicting the behaviour, by analysing how well the constructs of the theory predict increased consumption (de Bruijn et al., 2012; Blanchard et al., 2009a; Blanchard et al., 2009b; Kellar and Abraham, 2005; Povey et al., 2000).

A key project which has informed the design of the present thesis is project EAT (Neumark-Sztainer et al., 2003; Neumark-Sztainer et al., 1999), as it focused on adolescents/young people; drew upon health behaviour theory in a multitude of qualitative and quantitative explorations of determinants of dietary behaviour; and subsequently a specific interest in whole grain consumption in one of its publications (Larson et al., 2010). Project EAT included a variety of dietary behaviours among adolescents and young adults, and the focus groups conducted in the early stages of the project discussed influences on overall food choices in adolescents (Neumark-Sztainer et al., 1999). Moreover, the research also collected data on overall eating habits and behaviours and whole grain intake correlates were eventually analysed in one of the branching studies. However, this current research will focus on whole grains from the beginning – tailoring aims, data collection and all stages of the research around whole grains as a focal topic of interest. Some details in this research design for the present thesis were also inspired by the WHOLEheart study, which examined whole grain intake correlates as well as its impact on health biomarkers in UK adults (Kuznesof et al., 2012; Ross et al., 2012; Brownlee et al., 2010), in particular, use of focus groups and the Food Frequency Questionnaires (FFQs).

## 1.3 Research aims, objectives and design

This work in this thesis builds on my Masters of Science research, which aimed to (1) explore whole grain awareness, consumption, and barriers and facilitators to consumption among a small sample of UK young adults; and (2) conduct a small pilot study to assess the effectiveness of educational material and tasting of wholegrain food on awareness, perceptions and consumption. This study provided insight into whole grain awareness and barriers to intake in the UK (UK-based published data on whole grain is limited), as well as some useful approaches to promote whole grain intake as suggested by the participants. It also confirmed the assumption that attitudes to wholegrain foods can be improved by education, elimination of misconceptions, and introduction of desirable wholegrain products.

The studies conducted in this doctoral thesis extended this work and aimed to understand the lifestyle and psychological factors that influence adolescents' consumption of whole grains, in answer to the following research questions:

**1. What are UK adolescents' general awareness, attitudes, and consumption levels of wholegrain foods?**

**2. What are the barriers, possible facilitators, and factors that influence adolescent wholegrain intake?**

Three studies were conducted; Studies I and II informed Study III. Each study's aims and methods are outlined in **Appendix 7.1.1**. In brief, Study I (Chapter 2) involved focus groups with adolescents to explore their consumption trends, knowledge, attitudes, and barriers to wholegrain intake among adolescents as well as the approaches that may lead to a willingness to increase and maintain whole grain intake. Study II (Chapter 3) was a SenseCam (Hodges et al., 2006) based interview study, exploring whole grain consumption correlates via in-depth interviews with adolescents. SenseCam technology was used as a novel tool for exploring contexts of dietary intake, real-world behaviour of adolescents, and as a visual prompt for interviews. Outcomes from Study I and II informed the development of Study 3; an online survey of the predictors of UK adolescents' intake of whole grains, based on the RAA model.

The current research focused on adolescents, with recruitment taking place in various schools across the Leeds area. It included a variety of schools to represent the socioeconomic, ethnic, environmental, and geographical diversity of the area. The study's sample included young adolescents (11-16 years of age) comprising both genders, and from diverse ethnicities and income groups (ensuring representation of the diverse Leeds community). The study also explored the usefulness of prominent psychological theoretical models in explaining behaviour, attitudes, motivation, and providing promising ground for change implementation.

In summary, this study attempted to gain insight into effective ways to help public health practitioners to increase wholegrain intake among adolescents. This research considerably added to the limited existing knowledge of promotion of wholegrain food consumption to improve health in this target group.

# Chapter 2 STUDY I - Focus groups with adolescents

## 2.1 Aims

This chapter reports on Study I of this research, which aimed to explore, via focus groups, adolescents' views on whole grain intake. It aims to provide an overview of the main correlates of whole grain consumption to guide an in-depth exploration (Study II), and to inform the final questionnaire stage (Study III). This study also investigates the usefulness of RAA in explaining whole grain consumption correlates in adolescents, by examining whether the main themes obtained from the focus groups were successfully captured by the main RAA constructs.

## 2.2 Methods

### 2.2.1 Ethical approval

The University of Leeds MEEC Faculty Research Ethics Committee approved the study protocol (MEEC 13-003). This study adhered to the guidelines laid down in the Declaration of Helsinki. Head teachers and all adolescent participants provided written informed consent along with parental/legal guardian assent.

Assistant researchers were postgraduate students, with experience in qualitative research, focus groups, and working with adolescents. Both the principal researcher and assistants were female with appropriate clearance for working with young people. The researchers had no prior contact with the participants. The aim of the research was presented on participant information sheets with researchers' academic affiliations. It was stated that the research was not influenced by any funders or third parties. Refer to **Appendices 7.2.1-7.2.3** for full details of all ethical issues addressed, the ethical approval document, information sheets, and consent forms.

### 2.2.2 Recruitment

Participants were recruited using purposive sampling. Twenty schools were contacted by email. The schools were within the City of Leeds geographic area, coeducational, had a minimum of 20% ethnic minorities, and more than 1000 pupils aged above 11 years, to ensure maximum representativeness and diversity. Four out of the twenty

schools responded; however, two out of the four withdrew during the course of the research, and the study was conducted with the remaining two schools.
Schools that indicated an interest in taking part received further information along with participant information sheets, which class teachers then delivered to pupils from years 7 to 11 (approximate age 11 – 16 years). Signed consent forms from the young persons and their parent/guardian were required for study participation. Recruitment of participants continued with transcription and analysis until saturation of data was reached (i.e. no new data emerged).

### 2.2.3 Procedure

The participants were grouped by age and gender into five one-hour focus groups (FGs), consisting of between 9 and 12 participants each. Same-sex groups were each held for 11-13 year old pupils (FG1(boys) n=9;  FG2(girls) n=9) and for the 14-15 years old pupils (FG3(boys) n=9; FG4(girls) n =11). Due to practical constraints, participants aged 16-17 years took part in one mixed-gender group (FG5 n=12). Focus groups took place on school premises and within school hours for the 11-13 year olds, and after school for the remaining 14-17 year olds. Groups were led by the first author with assistance from a co-facilitator.

The focus groups were led with a combination of semi-structured questions and interactive activities (see **Table 2-1**), developed according to: focus group guidelines (Ritchie and Lewis, 2003; Krueger, 2000); focus group work with adolescents (Daley, 2013; Stevenson et al., 2007; O'Dea, 2003; Neumark-Sztainer et al., 1999); previous qualitative studies with other age groups on whole grain intake (Kuznesof et al., 2012; Muhihi, 2012; Larson et al., 2010; Arvola et al., 2007; Burgess-Champoux et al., 2006; Chase et al., 2003b) and with adolescents on other nutritional outcomes (Zoellner et al., 2012; Zeinstra et al., 2007; Wind et al., 2005; Berg et al., 2003) (due to scarcity of studies on whole grain intake with adolescents). The key study material was successfully piloted on a sample of university students (Kamar, 2012). Probes were only used where participants needed further support to generate discussion.

Upon completion of the focus groups, the participants were handed university stamped certificates of scientific research participation to thank them for to their contribution to the research **(Appendix 7.2.4)**. Special certificates of appreciation **(Appendix 7.2.5)** were also posted to the participating school teachers and staff, as a token of appreciation for their time and efforts.

**Table 2-1 Sample focus group questions. (Illustrated questions are meant to be representative of the focus script and do not represent all of the sections or questions within each section)**

| |
|---|
| “Choose your meal” Game: From pictures of meals containing wholemeal bread and processed bread, which one would you choose and why? |
| What do you know about whole grains? What do you think wholegrain foods are? |
| Education about whole grains: participants given brief overview of wholegrain foods with a few examples to allow for a discussion based on some knowledge. Health benefits of whole grains were not cited here though. Further comments/discussion invited. |
| Can you think of other examples of wholegrain foods? From your culture? |
| How do you feel about/what do you think of wholegrain foods? (good/bad/why?) |
| Are there good things/health benefits in wholegrain foods? (Health benefits listed to participants after hearing their suggestions) |
| Have you ever tried wholegrain foods? How often do you consume them?<br>What do you think are the factors that affect/influence your whole grain consumption? Probing questions:<br>- Physical environment: availability at home, school, takeaways, eating-out, cost?<br>- Social environment: school environment? Adults you live with?<br>- Personal: lifestyle, your own preferences, image among peers?<br>- Varieties available (wholemeal bread vs. wholewheat cookies)?<br>- Appeal of the food?<br>- Do you feel wholegrain foods are more or less expensive than refined grain foods?<br>- Any physical annoyance like bloating etc? |
| What kinds of situations can you think of where the barriers to whole grain intake were different, or you felt different? |
| What does it mean for a grain-based food to taste (flavour), look (visual appeal), or feel good to you (texture)? What are the various qualities/things that make it good or bad? Do you think there are any wholegrain foods out there that suit your taste? |
| Do you think media is important and does it affect what you eat? If wholegrain foods were made “cool” for teenagers by media would that affect how much you eat whole grains? How could they make whole grains cool? |
| Identification Game: how do we identify a wholegrain food product? Participants assigned to teams and competed to correctly identify wholegrain food products Examples of wholegrain products used: Quakers Oat So Simple Fruit Muesli Morning Bars, McVitie’s Hobnobs, Uncle Ben’s Brown Basmati Rice, Hovis Wholemeal Medium |

| |
|---|
| Bread, Kellogg's Fruit n Fibre Breakfast Cereals, Butterkist Salted Microwave Popcorns, Belvita Crunchy Oats Breakfast Biscuits<br><br>Examples of non-wholegrain products used: Warburtons Seeded Batch Bread, Kellogg's Special K Cereal bars (old formulation), McVitie's The Original Digestives |
| Do you think you will start eating or increase your whole grain intake in the future? Why or why not?<br>Would you eat differently if you had more time or the wholegrain option was conveniently available?<br>If a wholegrain food was set out on the table in the morning, would you eat it? Why or why not?<br>If a wholegrain option was available at an eat-out (example Subway, Mc Donald's, pizza places), would you choose it? Why or why not?<br>If you ate more meals with your family, do you think you would eat more wholegrain foods?<br>Would you choose wholegrain foods for their health benefits even if they are not that tasty? |
| Have you changed any specific type of food you ate over the past year or two (habitually)? Why has that happened? What caused the change? |
| Design an Intervention Game: participants asked to imagine their future job was to increase young people's health and whole grain intake. Asked to work in groups and post ideas on sticky notes on boards. |

### 2.2.4 Data preparation and analysis

This study addressed the need to understand the usefulness of the RAA in explaining and exploring adolescent whole grain intake. We elicited UK adolescents' accounts of whole grain awareness and intake and adopted both a deductive and inductive analytic strategy by (a) exploring the extent to which RAA constructs were represented in young people's accounts of whole grain intake and (b) attempting to identify additional determinants of behaviour, as reported by adolescents, but which were not captured or adequately represented in the RAA.

All focus groups (discussion and activities) were audio-recorded and transcribed by the main researcher to playscript standard, with all identifying information removed. Data were analysed using thematic analysis as described by Braun & Clarke (Braun and Clarke, 2006); NVivo software was used (NVivo qualitative data analysis Software, 2012). First, the data were read carefully to identify and descriptively label meaningful units of text relevant to the research topic. Second, units of text relating to the same issue were assigned to provisional themes and the same unit of text could be included in more than one theme. These included themes relating directly to the constructs in the RAA model, as well as themes capturing data which did not appear to be represented in the RAA model. Analysis was led by the main researcher. Emergent themes were discussed with the research supervisors and credibility checks conducted (i.e. that the interpretation of the data were credible for their assignment to a theme and that there was sufficient evidence to support the generation of a theme). The third and final stage of analysis involved review and refinement of the themes. The analytic outcomes are reported as RAA constructs and non-RAA constructs, if any, to distinguish between data represented by constructs in the model and those which appear additional to the framework.

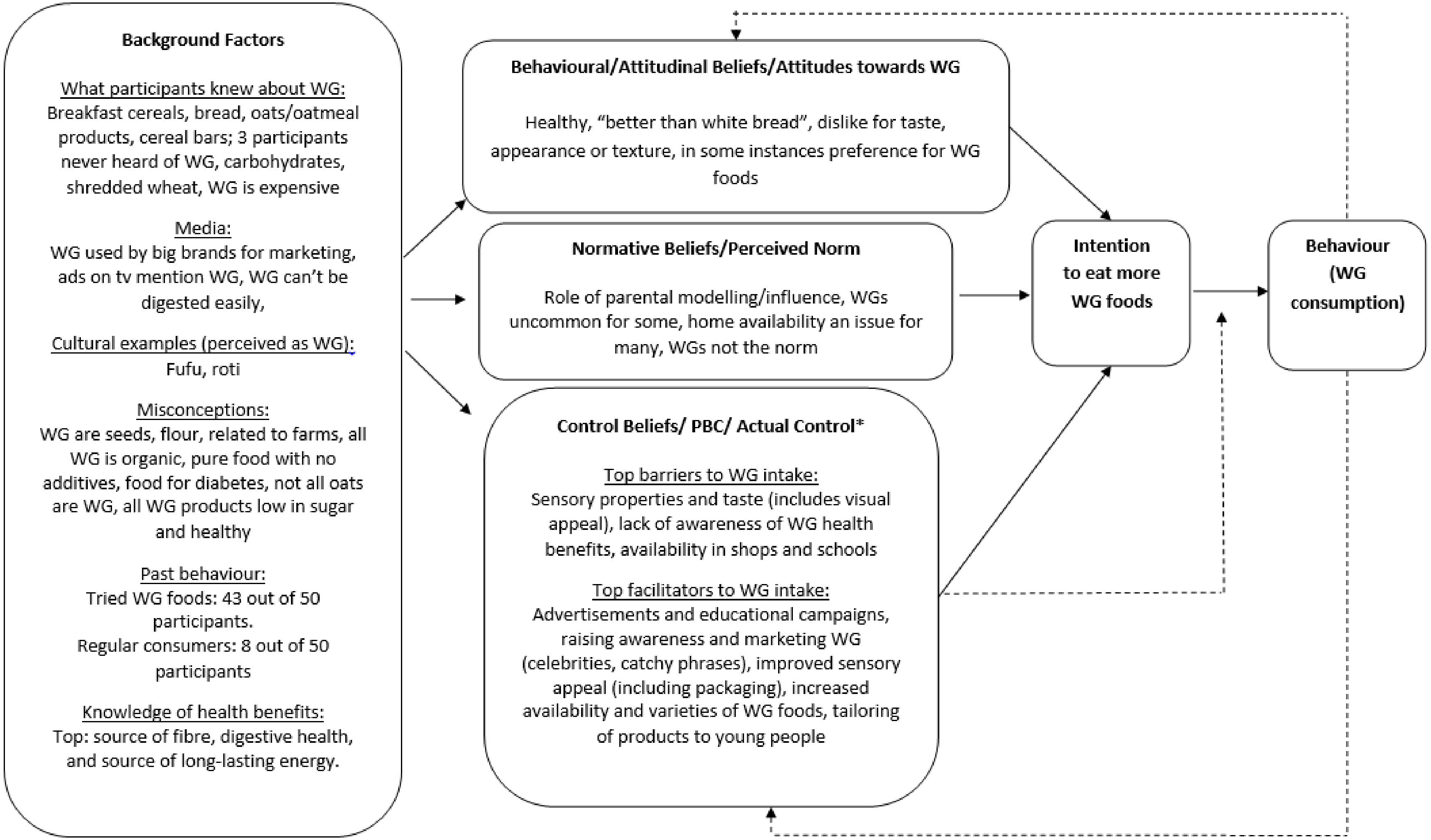
## 2.3 Results

### 2.3.1 Participants

Fifty-two participants were recruited (n= 25 boys and 27 girls). Two male participants did not complete the study (one was absent for data collection and the other unavailable). The final sample included 50 adolescents (n= 23 boys and 27 girls) aged 11 to 17 years, of mixed ethnicities and socioeconomic backgrounds. No pupils were excluded from recruitment or participation. Saturation of data was reached after sequential recruitment of five focus groups.

The results of the focus groups are presented under RAA constructs (i.e. themes falling under background factors, behavioural/attitudinal beliefs, normative beliefs, and/or control beliefs). **Figure 2-1** provides a summary of the main focus group themes under RAA theory constructs. All of the data were captured by the RAA model.

**Figure 2-1 Summary of the main focus group themes under RAA theory constructs**




*Themes overlapped across both constructs, therefore constructs were combined

### 2.3.2 RAA constructs

#### 2.3.2.1 Background factors: knowledge/awareness of wholegrain products

When asked what they knew about whole grains, most participants cited breakfast cereal followed by brown bread and oats/oatmeal products. Oatmeal products included porridge, which was mentioned by two participants. Certain brands of breakfast cereals stood out markedly, such as *Weetabix* and *Cheerios*, whereas cereal bars were mentioned less often. With regards to breakfast cereals, participants could list wholegrain varieties as well as their favourite brands, whereas in the case of bread, responses were a mixture of: bread, brown bread, 50-50 bread, and other guesses like croissants and white bread with added fibre. Three of the fifty participants had never heard the word "whole grains" before. Some participants also thought of "healthy/healthiness" or simply "carbohydrates" as an initial answer and some mentioned "flour" or "wheat/shredded wheat". One participant asked if whole grains meant "seeds". Other responses included "farm" and "breakfast". One of the participants said that "big brands try to use this [label] to market their products", and another said "I've heard it in some ads on the T.V." Then a participant added: "but I heard we can't digest brown bread easily". Other individual comments were made such as assumptions that whole grain must mean it is organic, or that it is food that is "pure with no artificial additives", as well as questioning whether it was actually "food for diabetes".

After explaining what whole grain meant, some participants were then able to give some examples of what they perceived to be wholegrain foods. When asked to list those examples, and encouraged to add some cultural varieties, some previously mentioned as well as new varieties emerged in the discussion. Previously suggested varieties included brown bread, wholemeal bread, 50-50 bread, porridge, brown rice, and brown pasta. Cited cultural varieties were fufu, an Afro-Caribbean dough-like "bread" made of various grain and starchy crops, and roti, an Indian Subcontinent flat bread, made from unleavened stone-ground wholemeal flour.

Some participants thought that wholegrain foods were more expensive, as “the most [healthy] food would be more expensive, just like organic food.” However, participants in two separate sessions started discussions on how it should be cheaper, according to the assumed logic of: “isn’t it cheaper to make?” This exchange was interesting, as it depicted varying attitudes towards product pricing; some adolescents linked higher prices with healthiness, while others associated it with levels of product processing and its costs.

In the identification game (see **Table 2-1**), and after being taught what whole grain broadly meant, participants were able to correctly identify slightly less than half of the game products as either whole grain or non whole grain. They named the following (in order of frequency): pasta, rice, bread, porridge, popcorn, breakfast cereals, cereal bars, biscuits.

Misconceptions that arose within the identification game were that: wholegrain food products had no or minimum additives or preservatives; “oat” may not mean whole grain as “it does not say wholeoats”; multigrain equals whole grain; “made with whole grains” means whole grain; product is not whole grain as “product does not seem heathy and has lots of sugar”; popcorn does not have health claims so must be non whole grain; bread is brown and has seeds thus must mean it is whole grain; or that a product is overly-advertised and that must mean the company is making up for the fact that it is not whole grain.

Knowledge of wholegrain products varied considerably between participants with many of the participants not able to correctly identify wholegrain foods and products. As well as large differences in knowledge, many of the adolescents had misconceptions about wholegrain foods identifying a need for more education on wholegrain foods.

#### 2.3.2.2 Background factors: past behaviour

When asked whether they have previously tried wholegrain foods (after being taught what whole grain broadly meant), 43 (86%) out of 50 responded positively. However, when asked about regular whole grain consumption (measured as daily or at least three times a week), only 8 out of 50 (16%) responded positively. A few indicated they were occasional whole grain consumers, mainly due to enjoying wholegrain breakfast cereals now and again such as *Weetabix*, *Cheerios* and *Belvita* brands consumed as snacks or a quick breakfast.

#### 2.3.2.3 Background factors: knowledge of whole grain health benefits

When asked what they thought the benefits of wholegrain food consumption were, the top responses were that wholegrain foods contained fibre and that they were good for the digestive system, followed by the fact that they gave energy or long-lasting energy. The least identified were the cancer-preventative properties of wholegrain foods. There was a range of random guesses of whole grain health benefits across the sessions. Some examples of these were: "[Does eating whole grain] help in old-people sickness like keeps people living longer – antioxidant?"; "does it like calm the nervous system?";"feeds the immune system?"; and "in the advert it says [whole grain is] fuel for the brain." Although most adolescents were aware that whole grains are healthy they were not knowledgeable about the specific reasons why whole grains improve health.

#### 2.3.2.4 Behavioural/attitudinal beliefs: feelings about wholegrain foods

The participants were asked about their perceptions of, and feelings towards, wholegrain foods. They talked about this in answer to this question and also in response to questions about the health benefits of whole grain. Thus, responses to both questions are listed separately here.

The most prevalent perception among adolescents is that wholegrain foods are healthy or related to healthiness "somehow", or that they are at least "better than white bread". Expressions of dislike for whole grain taste, appearance and texture were prominent, with slightly more emphasis on the latter: "I like some of it, like porridge, but not brown bread – sometimes it's like really dry you have to have something to drink with it."; "It does not look inviting to eat" and "white bread is [softer]."; "I would prefer to buy a *nutri-grain* rather than [a wholegrain cereal bar], because I wouldn't want to walk around the school with things sticking out from my teeth." The prevalence of such comments raise questions about whether food appearance and texture may be of even higher importance to adolescents compared with adults.

On the other hand, the third most prevalent attitude was liking the taste of wholegrain food: "for me I think brown bread tastes richer" and "*Belvita* biscuits are the best thing I've ever tasted!"

In summary, a variety of beliefs about whole grains were expressed by participants, and these included health outcomes. However, taste and acceptability were reported as possibly more influential in determining behaviour.

#### 2.3.2.5 Normative beliefs

Some aspects of normative beliefs emerged in the discussions – mainly the concept of the "norm" and parental modelling as barriers to whole grain intake (*barriers* are discussed below). Some participants reported that wholegrain foods were uncommon or unfamiliar in their everyday lives. For example, one participant stated that "I will not just go for whole grain because I am not used to it. It never comes to my mind even" – suggesting that dietary choices are habit driven and that whole grain had never been part of their repertoire of choices. Another participant stated that "It is not like something you find at home or anywhere, why should I go and eat it myself? I only shop for my snacks.", indicating the importance of access and availability in shaping intake alongside the perception of what others are consuming.

Parental influence was remarked upon in discussions of availability and habit as barriers to whole grain intake, and was present in nearly half of total discussions of barriers. For example, here the participant suggests that parents' introduction of foods from an early stage is fundamental to later acceptance by children: "When kids are introduced to bread and stuff the parents normally give them white bread, but if kids at first get introduced to brown bread then they'll probably get more used to it and like it." On the other hand, one participant said "My mum said if I eat whole grain I'd grow up but I know she's lying to me." Thus, many parents may make efforts to encourage their children's whole grain intake, even though they are not clear about the exact health benefits and have to deal with resistance from their adolescent child.

#### 2.3.2.6 Control beliefs/actual control: barriers and facilitators to wholegrain food consumption

The predominant barriers to whole grain consumption in general were reported to be sensory properties and taste, followed by lack of awareness of health benefits, and availability in shops and schools. Sensory property barriers were just as much due to appearance and packaging, as due to taste, with one participant citing wholegrain food products were "serious and boring". This indicated that improving whole grain consumption is not just about changing the flavour of the product but the way it is marketed and packaged.

When probed further about the issue of availability, one of the participants mentioned that "it's not accessible as well because you can't just get it, say, when you go to the corner shop; it won't be there". A question about whole grain availability in school started a discussion in one of the groups, where one of the participants argued that "the school did [provide] wholegrain toast." However, another participant disagreed, saying "yeah but that's just for breakfast, and just the dry ones with boiled egg which no one eats! The better cheese toasties and the good ones are all white bread." This raises the issue of quantity as well as appealing foods that should accompany the wholegrain food options for adolescents. In another group, one girl stated that in her school "they just sell *Nutrigrains*, but bread and everything, it's all just white. And *Nutrigrains* are more expensive than the other snacks." Thus, accessibility was affected by price and what other apparently comparable products are available in that space. The cost of wholegrain foods was mentioned by some participants although this age group were generally buying snacks rather than being in charge of shopping for the household.

Habit was also mentioned as a barrier of whole grain consumption, which appeared to be driven by many different factors. Parental modelling and provision (see *normative beliefs above*) were mentioned and participants also cited time and convenience as barriers. Only a few participants reported that they liked wholegrain foods and did not find themselves facing any barriers other than availability, especially when “eating out”. Two participants spoke of brand loyalty as a barrier, as they were used to consuming a certain brand and type of cereal or bread from their childhood.

Facilitators to eating wholegrain foods were not naturally mentioned by the participants as part of the discussions, and the moderator had to specifically ask questions to prompt this topic. However, when asked to imagine that they were in some position of authority and could do anything to facilitate or increase adolescent whole grain intake in the UK, they had many ideas. The main suggestions included; advertisements and educational campaigns to both raise awareness of wholegrain products and market them as a contemporary food; (e.g. “Get children’s role models to eat it and tweet it – get it? That’s like a campaign, eat and tweet! I think that’s the best thing to do.” and “Use a catch-phrase to make people remember whole grain. Make it rhyme and stick in their head”); improved sensory appeal; (e.g .“Why can’t wholegrain products be colourful and fun like chocolate? Why does it have to look so boring?”); and increased availability and varieties of wholegrain food products and tailoring products for young people (e.g. “It’s like all wholegrain food is bread and stuff, why don’t they make more snacks like chocolates with wholegrain bits in them or, say, ice cream made with a wholegrain cone?”).

Reduced cost was also raised as a potential facilitator for increased adolescent whole grain intake, although it was mentioned along with availability in schools: “Put whole grain in schools, and make them cheap. They are not the cheaper thing to buy in school here”. Other suggestions included those of making wholegrain products easier to identify, along with other points related to shelving strategies: “On the front of the product, it should say WHOLE GRAIN.” “I would put white bread at the back of the shelf.”

Thus, these young people targeted education, marketing, cost and availability as key strategies to promote intake for the age group alongside more creative and attractive ways of incorporating whole grains in habitually consumed foods and snacks.

## 2.4 Discussion

This study found that many adolescents are aware of health benefits of consuming wholegrain foods even if they did not know which specific diseases were associated with low whole grain consumption. However, the adolescents found it difficult to identify wholegrain products and often perceived wholegrain foods as boring and lacking in taste. They identified a wide range of barriers to eating wholegrain foods including habits, availability, parental controls and cost. Adolescents made suggestions to increase whole grain consumption in their age group including education, marketing and increased availability in schools and shops as well as formulation of new foods and snacks higher in fibre aimed at this age group.

This study also reported that the Reasoned Action Approach was largely effective in representing adolescents' subjective accounts of determinants of whole grain intake. Most participants reported having tried wholegrain products in the past; however few reported regularly eating wholegrain foods and therefore habitual consumption. This could be due to many reasons and a wide range of beliefs and barriers were identified. Expressions of like and dislike for whole grain taste were reported by different participants in the focus groups and were likely to be related to habitual consumption and whether they were familiar with the foods. Although many participants mentioned healthiness in relation to consumption of wholegrain foods, few were able to provide details.

These findings were in line with those of other studies in different populations. Bread and breakfast cereals were reported as the most popular wholegrain food sources in various studies (Thane et al., 2007; Marquart et al., 2006; Smith et al., 2003; Smith et al., 2001). Previous research has also shown that whole grain intake is increased as people are educated about health benefits (Jones & Engleson, 2010; Ellis et al., 2005; Smith et al., 2001). However, with child and adolescent populations, where they were not the purchasers of food for the household, it could potentially be that the education of parents and carers was more important.

Many participants were not able to correctly identify wholegrain products, which has also been identified as a problem with adult populations. The word "brown bread" was used by participants to refer to wholemeal bread, and this incorrect use of terms points to the need for education regarding wholegrain products. Despite the fact that the mentioned difference was explained to them during the focus groups, it was likely that correct use of the terms might take some time. The problems with identifying wholegrain foods may be partially due to the terms used to advertise products, which may confuse consumers. Some descriptions such as “brown”, “seeded”, “wheat”, “whole”, “enriched” may mislead consumers into believing the product is whole grain (Jones  & Engleson, 2010). Most of the participants in the present study were not aware that products must have at least 51% whole grain content to qualify for classification as whole grain (Seal et al., 2016). Perhaps these findings wre to be expected, as an official whole grain definition, guidelines and recommendations have yet to be established in the UK.

### 2.4.1 Barriers and facilitating factors to whole grain consumption

A number of important barriers for whole grain consumption were identified in this study. These findings generally agreed with, and added to existing studies of whole grain in different age groups. Factors included: sensory properties and taste of wholegrain products (McMackin et al., 2012; Arvola et al., 2007; Chase et al., 2003b) followed by lack of awareness of health benefits,(McMackin et al., 2012; Arvola et al., 2007; Chase et al., 2003b) and lack of varieties and convenient availability (Kuznesof et al., 2012; McMackin et al., 2012; Muhihi, 2012; Larson et al., 2010; Smith et al., 2001).

In this study, habit was mentioned as an important barrier to wholegrain food consumption. Generally, as people are exposed to certain foods, they get used to the taste over time and a habitual taste preference occurs (Cooke, 2007). Such acceptability trends have also been observed for wholegrain foods in a recent study (Brownlee et al., 2013; Kuznesof et al., 2012) and participants of this study made such comments in the focus groups before and after trying some wholegrain product samples.

This study's results were also in agreement with some of the barriers reported by Adams and Engstrom (2000), such as awareness, identification, taste, texture, cost, ease of preparation/skills required, and availability in stores. However, identification and preparation skills (also mentioned in some of the above studies) (Kuznesof et al., 2012; McMackin et al., 2012; Chase et al., 2003b) were not verbally highlighted in the current study.

A small intervention study by Smith et al. ( 2001) found similar barriers but also included intestinal discomfort. However, the latter may have arisen since the participants consumed a large amount of wholegrain foods (5 portions) per day. Taking household members' taste into consideration was also mentioned, which was also one of the barriers of The WHOLEheart study participants (Kuznesof et al., 2012) and with McMackin et al. (2012). Those two studies also included a lack of cooking/preparation skills, a barrier mentioned in a Tanzanian study by Muhihi et al. (2012) as well. The lack of such factors in our study may be expected, given the sample age group and the corresponding lifestyles.

A number of potential key facilitators to whole grain consumption were cited in this study. The facilitators generally agreed with existing studies in different populations and included: (1) increased awareness through advertisements and educational campaigns (Kuznesof et al., 2012); (2) improved sensory appeal (McMackin et al., 2012; Muhihi, 2012) and (3) increased availability and varieties (Kuznesof et al., 2012; Muhihi, 2012; Larson et al., 2010). In this study, participants also highlighted a need for tailoring of products for young people.

Studies in the literature such as McMackin et al. (2012) and Muhihi et al. (2012) listed similar facilitating factors. The WHOLEheart study (Kuznesof et al., 2012) participants also considered preparation techniques to be important, perceived health benefits, and "substitutability of whole grains with existing ingredients and meal patterns"

(Kuznesof et al., 2012). An American study on young adults and adolescents (project EAT) found sensory appeal, self-efficacy, and home availability to be related to increased whole grain consumption (Larson et al., 2010).

### 2.4.2 Findings in relation to the RAA

Most of the data produced in discussions could be mapped to constructs in the RAA, although the data did not permit any kind of test of the causal pathways proposed by the model. A recent intervention study with South African adolescents targeting HIV reduction strategies, similarly showed the usefulness of the RAA in informing the intervention targets (Jemmott, 2012).

Some themes identified in the present study seemed to cross two different RAA constructs and were difficult to separate, such as general knowledge of whole grain, identification abilities, and knowledge of health benefits (a combination of background factors as well as attitudinal ones). In addition, parental provision and influence could arguably fall between background factors and normative beliefs. Habit features independently as a factor in the RAA model, whereas it was mentioned in the focused groups mainly in conjunction with parental influence.

Some RAA constructs were not particularly dominant in the data, For example, intention to perform the behaviour of whole grain intake was not easy to capture completely.  This could be due to the exploratory rather than hypothesis-testing nature of the study. Some elements within *Background factors* were also not present; namely the influence of mood/emotions, stereotypes, stigma, and possible health-promoting interventions. It may be that were these directly asked about, that adolescents may have indicated how they influenced their whole grain intake. *Normative beliefs* also had minimal presence in the discussions, despite the common assumption that social norms and influences play a key role in shaping adolescence behaviour (Contento et al., 2006). Participants avoided responding to direct questions as well as probes around such themes, and merely hinted at the various social/normative influences within discussions of other whole grain intake correlates.

### 2.4.3 Limitations

The use of focus groups with young people - with the overall intention of using data to inform questionnaire design - posed some challenges. Much probing was required as the groups were sometimes reluctant to engage in discussion. This was especially evident when it came to talking about normative influencing factors, where it is likely to have been unconformable to suggest that one is influenced by peer behaviour or other norms. It may be that one-to-one work would be an important source of complementary data to for this demographic. In addition, the reported ability of the participants to correctly identify wholegrain food products may have been overestimated by them, as the comments they wrote to justify their guesses contradicted strongly in some instances with their choices of answer (wholegrain vs. non-wholegrain food product). Moreover, the representativeness of the focus group population studied may have been reduced due to the limited sample size as well as the fact that the participants were only recruited from two schools in one city. This is a practical limitation that arises when working with schools within a time and budget limit, and the results of this research would not be considered representative, but rather exploratory and descriptive. A similar note should be made about whole grain consumption levels in this study, which were self-reported and discussed in a general way. The research does not attempt to quantify whole grain intake in this age group. Finally, the mixed gender session, in the case of the older participants, may have influenced the resulting discussions if the adolescents felt awkward.

## 2.5 Conclusion

This study identified whole grain awareness, consumption, barriers and facilitators of intake in a sample of UK adolescents, employing a theoretical framework. The RAA was useful in representing factors influencing self-reported adolescent whole grain intake, and has demonstrated similar utility in recent non-dietary studies in the literature on this age group. The results of this study highlight the need for raising awareness of the specific health benefits of whole grain consumption among adolescents to motivate consumption. Moreover, they revealed a unique need to address issues of product appeal and the targeted tailoring of products for young people. This study has the potential to inform further research on whole grain consumption, and acts as a basis to guide public health nutritionists involved in development of programmes and strategies to improve whole grain intake in this age group.

# Chapter 3 : STUDY II - In-depth interviews with adolescents using SenseCam technology

## 3.1 Aims

This chapter reports on Study II of this research, which was an exploratory interview study with a small sample of adolescents, with the assistance of SenseCam technology. This study aimed to explore self-reported consumption, knowledge, attitudes, and barriers to wholegrain intake among adolescents (socio-demographic, environmental, personal), while investigating the factors that may lead to a willingness to increase wholegrain intake. It also evaluated the usefulness of SenseCam technology as a novel tool for exploring contexts of dietary intake, real-world behaviour of adolescents, and as a visual prompt for interviews. This study also informed Study III, a large-scale quantitative study with a representative UK adolescent sample.

## 3.2 Background to SenseCam technology

SenseCam is an automated camera, developed by Microsoft Research, Cambridge, UK, which was initially used in research with a memory impaired patient to capture and aid in recalling the details of daily life (Berry et al., 2007). SenseCam (see **Figure 3-1**) has been used since then in a variety of health research interests, including physical activity and nutrition mainly with adults (Gemming et al., 2015b; Chen et al., 2013; Gemming et al., 2013; Kelly et al., 2011a). Few studies have addressed adolescents, some of which included documenting and measuring active and sedentary behavior(Kelly et al., 2012), food consumption and purchasing habits of adolescents

**Figure 3-1. The Microsoft SenseCam digital camera. "This wearable device weighs 175 g and passively captures approximately 3,600 first-person point-of-view digital images per typical day" (Kelly et al., 2011b).**

on their commute to and from school (Matthews et al., 2011), as well as measuring built environmental features that impact physical activity (Sheats et al., 2013). The aforementioned studies (on all age groups) offered quantitative analysis of the SenseCam images and feasibility testing of the novel technology. One recent study used focus groups to qualitatively assess the SenseCam use experience among adolescents, while quantitatively measuring daily exposure to food marketing across media to explore determinants of health (Barr et al., 2015).

The use of photos as prompts for interviews is on the rise in the health and nutritional science fields (Johnson et al., 2010), and SenseCam has been tested as a potential useful tool for dietary assessment (Gemming et al., 2015c; Chen et al., 2013; O'Loughlin et al., 2013). The feasibility of SenseCam use has been established with adolescents (Sheats et al., 2013), as well as its usefulness as a dietary assessment tool to eliminate some of the drawbacks of self-reporting and reliance on memory in traditional 24 hour recalls. Images generated by SenseCam during a dietary assessment session have the potential to aid in recall of food items consumed which would otherwise be forgotten or missed out in the case of traditional 24-hour recalls (Gemming et al., 2015b; Gemming et al., 2013).

This study aimed to explore the environmental, situational and personal factors that influence wholegrain intake in adolescents, employing SenseCam technology. In this study, the participants were required to wear the SenseCam device for a period of three days, followed by a 75-minute in-depth interview on day four. SenseCam allowed for generating images that would aid as photo prompts during interviews with adolescents, capturing otherwise unattainable real-life environmental, situational and personal moments, and facilitating in-depth discussions **(Figure 3-2)**. According to our knowledge, this is the first study to use SenseCam images as a conversation-prompting tool in interviews on dietary intake. However, it is to be noted that the photos in this study have been only used as a tool to mediate the interview and facilitate expression and experience exchange, and the photos thus were not quantitatively analysed for content or for dietary assessment on their own. They did help pinpoint some issues with whole grain identification and highlight dietary intake

**Figure 3-2 Image generated by SenseCam for one of the participants while having dinner**


and the factors that influence it in this age group. The dietary analysis of the content of the images (usefulness of SenseCam as a dietary assessment tool) may be addressed in subsequent analysis of the data and would be the outcome of a further research study.

The use of such in-depth approaches to exploring determinants of dietary behaviour was first inspired by a study on African American women which used the think-aloud method to follow the decision-making process and thoughts of the participants as they shopped for bread and cereals (Chase et al., 2003b). The search for an innovative, interactive method to engage adolescents and prompt conversations during interviews led to studies on techniques of recent use, such as photo elicitation; in that process, the literature search eventually revealed the novel use of SenseCam technology. Photo elicitation is an interview technique that uses visual images to elicit conversation or discussion. Images may be provided by the researcher or the participant (Harper, 2002) in response to a research question, which are then used to facilitate the interview. The use of photo elicitation methods, generally, has proved to be an effective tool when interviewing adolescents for its ability to help prompt conversations and facilitate recollection of details of daily activities, otherwise uncovered or deemed unworthy of discussion (Harper, 2002). Moreover, it can help in verbalization of difficult or complex concepts, and alleviates the hierarchical nature of the relation between the adult researcher and the younger participant (Lachal et al., 2012; Epstein et al., 2006). However, the use of SenseCam auto-captured images in a similar style to photo elicitation may have an advantage, as the outcomes are more natural, and the focus on personally selected details of the day is eliminated to obtain a less biased insight and range of topics. This is particularly important in the case of under-studied topics such as factors influencing whole grain intake, due to the novelty of the interest and need for open-ended exploration in the early stages of understanding this research field.

## 3.3 Methods

### 3.3.1 Design

This research was an exploratory interview study with a small sample of adolescents, with the interviews taking place at a single time point. Visual methods, in the form of photos capturing the participants' daily activities, were used to structure the interviews, using SenseCam technology. Participants wore the SenseCam device for three days; on day four, the SenseCam-assisted interviews were conducted following a traditional 24-hour food recall.

### 3.3.2 Participant Recruitment and Ethics

A convenience sample of 8 adolescents was recruited for this study, aged 11-16 years old (mean age: 13.7 years). Participants were British adolescents with a mixture of ethnic backgrounds, and there was an equal number of males and females. **Table 3-1** outlines the details of this study's participants.

**Table 3-1 Characteristics of the adolescents participating in this study**

| Participant | Gender | Age | Ethnicity |
|---|---|---|---|
| **Participant 1** | Male | 13 | British Asian – Indian |
| **Participant 2** | Male | 11 | British White |
| **Participant 3** | Female | 15 | British Black/African |
| **Participant 4** | Female | 14 | British White |
| **Participant 5** | Male | 13 | British Asian – Chinese |
| **Participant 6** | Female | 12 | British White |
| **Participant 7** | Male | 16 | British White – half Turkish |
| **Participant 8** | Female | 14 | British White |

Participants were reached by contacting a school about the research as well as through word of mouth. Due to the qualitative and in-depth nature of the study, sample representativeness was not required. Participants interested in taking part in the research were given a brief overview of the research and information sheets and were asked to contact the researcher if they were interested in participating. They were also required to sign consent forms, and obtain signed parental consent (**Appendix: 7.3.1 and 7.3.3)**. Ten participants expressed interest in taking part in the study initially, but two of them dropped out due to family expressing concern over SenseCam use with regards to privacy issues and the possibility of negative attention.

The University of Leeds MEEC Faculty Research Ethics Committee approved the study protocol (MEEC 13-015, date of approval 09/04/2014). This study adhered to the guidelines laid down in the Declaration of Helsinki. Head teachers and all adolescent participants provided written informed consent along with parental/legal guardian assent. Obtaining ethical approval was a tedious and challenging process, particularly in light of SenseCam use and the multitude of privacy concerns which had to be addressed rigorously. Guidelines and recommendations on such ethical concerns were available from previous research on SenseCam use with participants (Kelly et al., 2013). The ways which many of these concerns were addressed in the design of the study will be revealed in the following sections within context. Refer to **Appendix**

**7.2.5** for full details of all ethical issues addressed, the ethical approval document, information sheets, and consent forms.

### 3.3.3 Using SenseCam

The study was single-blinded, in that participants were told that the researcher was interested in general adolescent lifestyle, choices, and the factors that influence these choices. Interest in dietary intake and the focus on whole grain was not revealed to the participants in order to, limit bias in results and prevent any form of consciousness and altered choices as a result.

Vicon Revue 3MP was the device used in this study, which auto-captured images every 20-30 seconds. One device was available throughout the study, and participants used it in turn. One after the other, after signing the consent forms, the participants had a briefing on the research, borrowed the SenseCam, used it for three days, then met the researcher and went through the interview on day four. Recruitment, interviews, and simultaneous coding continued until saturation of data was reached.

At meeting one, a briefing on SenseCam use was given to the participants. In line with ethical conduct of the study and as part of ensuring privacy and discretion, participants were told that they could use the pause button on the SenseCam device while wearing it, which freezes image auto-capture for five minutes. Moreover, they were allowed to remove it in situations of discomfort or locations where objection or unwanted attention would occur as a result of wearing it, such as in private gatherings or places of worship. Participants were encouraged to try explaining to people about the camera if asked, and were provided with details of what they could say if asked. They were given the contact details of the researcher in case of any arising issues or in case any further details needed to be provided to concerned individuals.

Participants were also informed that after wearing the SenseCam for three days, and on day four, before the interviews were conducted, they had the right to eliminate any private/unwanted images generated by SenseCam. In the process of eliminating unwanted images, the participants were encouraged to keep as many acceptable images as possible, and that the aesthetic nature of the image would not be relevant, as they would never be revealed to anyone outside the research team. Participants agreed that any images which did not comprise anonymity could be published. Otherwise, in unidentifiable settings, people's faces would be blurred. The photos were treated with high confidentiality and stored in a secure, password-protected computer within the research office premises, in an encrypted file which was strictly only accessible to the members of the research team. The same confidentiality and security was applied to handling and storing of interview audio-recordings and transcripts of the interviews.

Upon completion of the interviews, the participants were provided with vouchers to thank them for to their contribution to the research, as well as handed university stamped certificates of scientific research participation **(Appendix 7.2.4)**.

### 3.3.4 The 24-hour dietary recall

After wearing SenseCam for three days, and upon meeting with the researcher on day four, traditional 24-hour recalls of day three were conducted, with the aid of the FSA's Photographic Atlas of Food Portion Sizes (Nelson et al., 1997b, a).

Directly after the 24-hour recalls, the SenseCam-generated images were uploaded onto the research computer and saved into a secure, password-protected file. In line with the ethical requirements of the research, the participants were allowed some time to privately check the images generated by the SenseCam device and delete any private/unwanted images (as mentioned in the previous recruitment section).

The choice of conducting 24-hour recalls followed by checking the images, in that order, was made in order to eliminate the bias resulting from the participants viewing the images of the day and their dietary intake, and relying on that to remember their intake. The 24-hour recall was conducted in the traditional way, relying on participant memory before checking their images, and then the resulting outcome was compared with the information from the images generated by the SenseCam device during the interviews, with differences or missed items noted.

Day three is the day which the researcher was primarily concerned with when it came to dietary recalls as well as for the SenseCam images. For the 24-hour-recall, it was the most feasible day, as the participants would easily remember their dietary intake which took place just the day before. As for the SenseCam images, and since the participants wore the camera for three consecutive days, choosing day three for consideration in the research allowed for images that capture the participants' most natural behaviour, as they would be conscious and aware of wearing the camera on the first two days. By day three, the participants and the people in their surroundings would have been used to wearing the camera, might have forgotten that they were wearing it, and would behave according to their most natural self, being possibly less conscious of the camera auto-snapping all day. Previous studies on adults and young people in the literature using SenseCam have revealed that, after an initial period of adjustment, participants became familiar with SenseCam use and eventually felt unaware of their wearing the device (Gemming et al., 2013; Sheats et al., 2013). Therefore, the use of SenseCam images to support the interviews (taking images from the third day), along with single-blinding the study, aimed to capture the environmental and personal factors influencing whole grain intake as naturally and objectively as possible. Choosing that same day for the 24 hour recalls, as well as conducting the traditional 24-hour recalls prior to image viewing (as mentioned above), allows for the comparison between the dietary information obtained via the 24-hour recall and the SenseCam technology. This would allow the researchers to evaluate the usefulness of the tool as a novel dietary assessment method, in comparison to the traditional 24-hour recall. Although this study focused on exploring the participants' viewpoints on wholegrain, healthy foods and the factors that influence their choices through the SenseCam-assisted interviews, but the mentioned intention to assess the usefulness of SenseCam as a dietary assessment tool could be explored in detail at a further stage of the research. Such an assessment has been carried out with adult participants (Gemming et al., 2015b; Gemming et al., 2013). This detailed assessment was not possible in the current study due to time restrictions, in addition to it falling outside the scope of the PhD project aims. However, the data generated opens possibilities for future research into SenseCam as a tool for dietary assessment in the adolescent population, which had not yet been explored. In the current research, comparing the 24 hour recalls to the SenseCam images allowed a revelation of a major gap in wholegrain identification among the participants, an issue which will be detailed in the following discussion section.

### 3.3.5 In-depth interviews

After the participants went through the images and deleted any unwanted personal photos, the one-to-one in-depth interviews were conducted. Interviews were audio-recorded and lasted approximately 75 minutes each. They were participant-led, with a loose framework of ideas by the researcher to guide the discussions (see **Appendix 7.3.6**), along with the displayed SenseCam images of day three as prompts.

At the start of the interviews, conversations revolved around overall adolescent lifestyle and choices, then moved on to discussing diet specifically. Shortly after, the focus of the research (whole grains) was revealed, and participants were given a chance to express initial opinions and attitudes. This was followed by an educational briefing about wholegrains to allow the participants to carry out informed discussions.

The interviewer encouraged participants to express their opinions freely and used open-ended, non-leading questions, letting the participants do the majority of the talking and freely discuss the general topics around which the research revolves. The SenseCam images were displayed on a computer screen throughout the duration of the interviews. The participants would go through the images on their own, pause at an image, or once asked a question by the researcher about the image settings. Conversations oscillated between topics prompted by the researcher for guidance on the themes, as well ideas that were inspired by the participants as they observed their daily activities and expressed their opinions on their choices and behaviour. The images generated from the SenseCam device were very helpful in reminding the participants of the details of their daily habits, environmental settings and the motives for the various choices they made. This is in line with previous research in adult populations using SenseCam technology, which has established the usefulness of this method in identifying environmental surroundings, influences and settings of eating episodes (Gemming et al., 2015a).

### 3.3.6 Data analysis

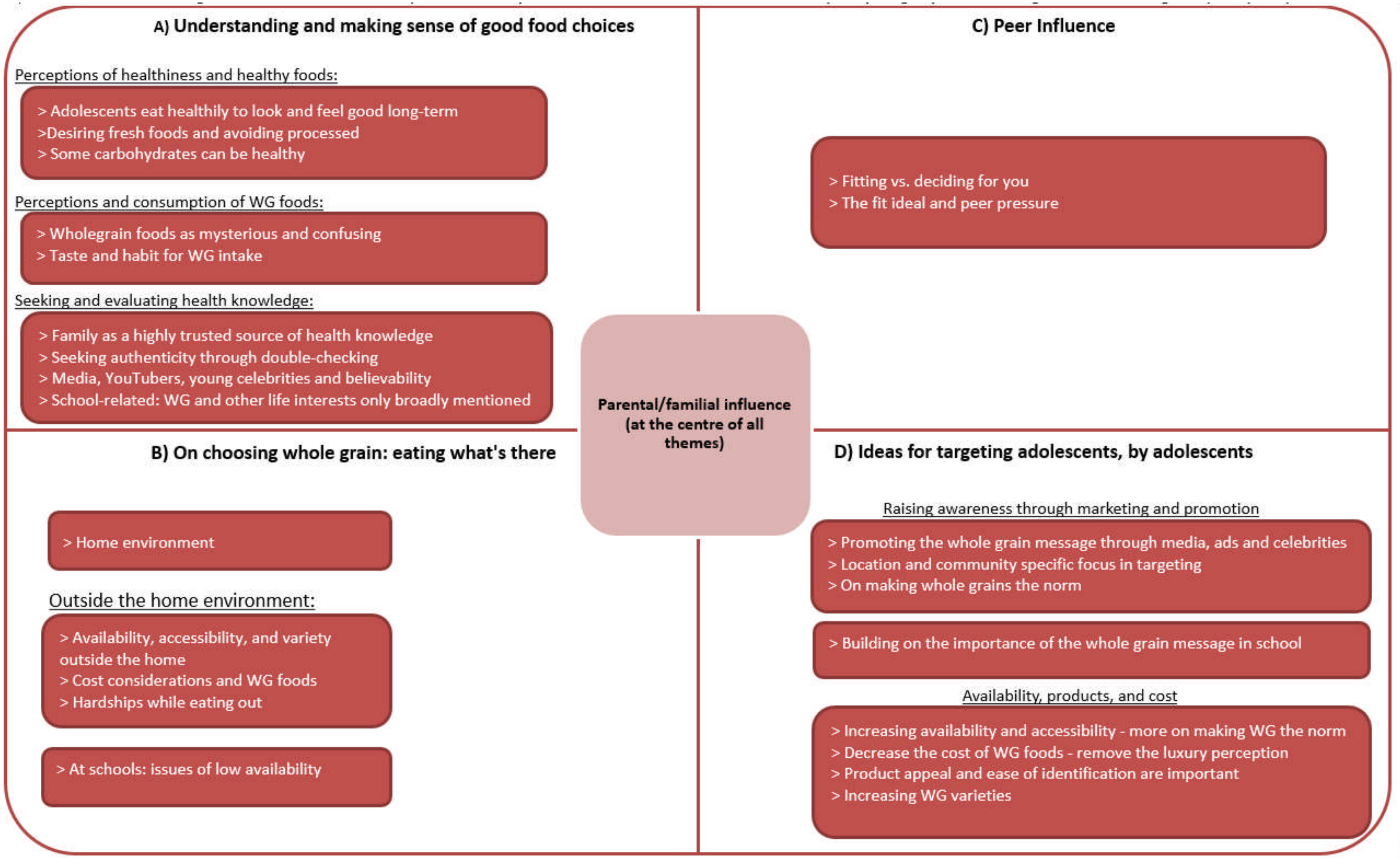
All interview data were audio-recorded and transcribed by the first author to play script standard, with all identifying information removed. Pseudonyms were used to eliminate possibility of participant identification in the use of data throughout the research process. Data were analysed using inductive thematic analysis as described by Braun & Clarke (Braun and Clarke, 2006). NVivo software was used to aid in the data analysis (NVivo qualitative data analysis Software, 2012), which was led by the interviewing researcher of the study. First, the data were read carefully line by line and assigned descriptive labels. As many labels as possible were generated from every line of conversation exchange. Second, units of text containing common labels were assigned to provisional codes. Interviews and coding continued until no more new codes were generated (data saturation). At this point, codes (linked to the original text) were screened and those relevant to the research topic were grouped into common themes. The same code/unit of text attached could be included in more than one theme, depending on codes generated in that text unit. The third and final stage of analysis involved review and refinement of the themes and putting them under categories and sub-categories (as required) for ease of data presentation.

In the analysis of the SenseCam data, those images which were paused on and discussed in detail during the interviews were highlighted and marked for support during the analysis process. Moreover, images were screened at a later stage for differences between the traditional 24-hour recalls (altered/missed out food items) as well as for any relation to wholegrain consumption, identification, or major points brought up in the discussions where the image was not stopped on during the interview. The researcher looked out for supportive or conflicting data, generated by the images, in comparison to the discussions and accounts described by the participants. Participants would use some images in the discussions, and dismiss others; the latter sometimes were helpful in connecting the data to draw a more complete picture for analysis and theme generation. However, as mentioned previously and due to time limitations, as well as to avoid derailing from the main objectives of this particular study, further analysis for the difference between 24-hour recalls and SenseCam-generated data was not conducted. This could be addressed in further research using the data generated in this study.

## 3.4 Results

The results of the interviews were summarised and grouped into four major categories and a few sub-categories (as needed), which contain the 24 themes obtained from the final round of analysis and grouping of the data. The themes obtained represent the most frequently mentioned ideas by the participants, as well as the most relevant ones to answering the main questions of the research. The themes, as organised by topic of discussion for ease of data presentation (under major categories A-D), are presented within boxes in **Figure 3-3**, and detailed out as the main numbered headings. A final heading with participants' feedback on the SenseCam experience is listed at the end of the section.

**Figure 3-3 Outline of themes generated from the discussions (the themes are preceded with a > and contained inside boxes).**



## A) Understanding and making sense of good food choices

This section captures the thoughts and perceptions of the participants on healthy eating and wholegrain foods as mentioned at various points across the interviews. The challenges and struggles of achieving this goal emerge in the conversations, as well as the idea that adolescents may have their own personalised, working framework for health that informs their attitudes and choices. Some of these accounts were mentioned spontaneously by the participants during the conversations, while others were prompted by SenseCam images viewed during the interviews as well as questions encouraging them to elaborate on the topic in the course of the discussions.

**Perceptions of healthiness and healthy foods**

### 3.4.1 Adolescents eat healthily to look good and feel good long-term

When asked how important being healthy and healthy eating was to them, the majority of the participants felt that they were average when it came to healthiness. There was a natural recognition for the need to be healthy which was spontaneously expressed. However, they felt they were not close to achieving such goals as they did not exercise as much as they should, nor eat as healthily on most days. Few reported that they exercised often but were not diet-conscious at all. Most of them also stated that they tried to eat healthily, but it was a very hard thing to do in practice. The tensions between enjoyment and health were often expressed – a theme that was present at various points during the interviews. "*If I like it, I eat it. I might feel a little bad if it were really high in sugar, but I'd still probably have it anyways*" (Participant 1, male, aged 13 years).

Regarding motivations for eating healthily, or why adolescents felt they wanted to be healthy, five of the eight participants raised this topic themselves. Most of the discussions revolved around ideas of "*doing good to your body*"(Participant 4, female, aged 14 years), "*looking your best and feeling your best*"(Participant 8, female, aged 14 years) and aging in a good way. One participant stated: "*I want to be healthy; I* *want to live a long time I guess… I don't want to get diseases [in the future because] of the way I do things because [that would be] like bringing it up on myself*" (Participant 4, female, aged 14 years). Therefore long-term thinking, physical and emotional well-being, as well as notions of "doing the right thing" motivated most participants to attempt eating healthily –or at least have it in mind as an ideal goal. However, one of the participants stated that her main motive would be weight loss. "*I feel when I gain weight I start hating myself for eating anything at all, and I feel like I don't want to get a larger size when I shop. I never want to be a fat person, and it scares me so much when I start gaining weight*" (Participant 3, female, aged 15 years). This same participant mentioned that exercise and healthy eating is a global trend these days, a culture where "*everyone is working out and eating healthy foods*". She attributed this trend to social media and online celebrities, and felt that media is "*making people more [diet and health] conscious, but maybe not for the right reasons*". More around the media discussions is covered in subsequent sections. In summary, healthy eating certainly had moral as well as social connotations for adolescents.

### 3.4.2 Desiring fresh foods and avoiding processed

Discussions of what the adolescents' definition of a healthy diet entailed, and which were the foods they considered to be healthy, emerged through prompts and as a result of SenseCam image viewing of daily events and choices (**Figure 3-4**). The first

**Figure 3-4 Example of a SenseCam image that prompted conversations around processed food**

foods that always came to mind for all participants were fruits and vegetables, as well as proteins and vitamins. They often gave examples of foods such as eggs, grilled chicken breast, broccoli, apples and bananas. Some participants also followed up with comments like "not a big amount of each food type" and "a bit of all food types", which indicated an understanding of the importance of variety in a healthy diet. One of the participants also commented on the fact that there is a misconception among young people that eating less is the healthy thing to do (especially for weight loss purposes), whereas she felt that this was "*being unhealthy while trying to be healthy*" and thinks they should actually eat "*a bit of everything, in the right amounts*" (Participant 4, female, aged 14 years). Moreover, there was mention of healthy carbohydrates (where examples like potatoes and rice were given), as well as "all fresh foods", and "food with less preservatives". Whole grains as an example of such healthy carbohydrates were spontaneously mentioned by three of the participants. Foods that were frowned upon by the adolescents were "junk food", sugar, processed foods, takeaway foods which were cited as "full of oil", and, in every single interview, McDonalds was mentioned as an example of foods to steer away from.

"*At a younger age fast foods, which we see as unhealthy now, were seen as sort of having a treat. I guess because they were a rarity. It was always like, I would hear people say that this place – this is the way they make their food (negative tone). It was that sort of thing that was going in my head. Then I made my own research into different types of food. Then it was like, going to a place like McDonald's, doesn't sound like a healthy thing anymore. And then I started not eating the kind of meaty things that are there generally. So whenever I feel like eating in a place like McDonald's, something in my head tells me you shouldn't be eating it, it's all processed. Even if I don't know for certain that all they say is true, just because of hearing it once -- it is running in my head, all those negative thoughts*." (Participant 2, male, aged 11 years)

What was a novel concept worth noting was the participants' focus in their talk on the freshness of food and lack of processing, and it being free of preservatives. This concept seemed to comprise an important part of their definition of healthiness, and sometimes the food production and level of “freshness” was more important to them than the individual nutrient content of the foods. For example, fast food takeaways and ready meals were seen as very unhealthy, whereas fish and chips fried at home was more acceptable – seen as more “fresh” and less of “processed” foods.

Some participants went deeper into portraying how they were convinced with this “processing” viewpoint of food healthiness. From their point of view, it made sense, as our “healthier” grandparents “never counted calories” and probably fried food at home and ate lots of fat and high-sugar jams. Therefore the problem must not be in the natural fat or sugar content of the food, but rather with the modern day processing, chemical, preservatives, and fast-food concept.

### 3.4.3 Some carbohydrates can be healthy

Participants discussed how they felt about carbohydrates being healthy, whether all carbohydrates were the same. In most discussions, there were mixed opinions and feelings on carbohydrates, therefore prompts were needed in order to clarify and understand these thoughts. Once more, the “fresh vs. processed” conversation came up, as most participants frowned upon “sweets you get from supermarkets” and did not find natural fruit jams and cakes baked at home to be unhealthy. However, a few did recognise the difference between simple and complex carbohydrates, stating that potatoes, as an example, were healthier than sweets and “such sugary foods”. Some participants even related high sugar intake to future risks of diabetes. Moreover, there were comments on the way the food itself was prepared, as, according to the one of the participants, “*it really depends on the way you cook them. I guess you can even make sweets vaguely healthy*” (Participant 4, female, aged 14 years). This was stated in reference to home baking and including fruits in sweet-preparation. Therefore the conversations indicated some knowledge of carbohydrates, but that was more profound among the older participants, who were likely to have studied about the different types of carbohydrates at school.

**Perceptions and consumption of wholegrain foods**

### 3.4.4 Wholegrain foods as mysterious and confusing

Upon being asked about wholegrains, most of the participants knew whole grains were supposed to be a "*healthier version of something [they] already ate*"(Participant 6, female, aged 12 years), or, for those who recognised it immediately, it was "*healthier than white bread but [they did] not know why it was healthier and what was healthy about it.*" (Participant 7, male, aged 16 years)

One participant asked if "whole grain" was bread which had organic wheat in it, and if it was that which made it healthy. Another guessed that it must have less sugar in it, which was why it was healthier and recommended for people with diabetes, unlike "white bread". On the other hand, one participant said: "*I've always thought it was just the colour. But then I guess for some reason it was supposed to be healthy, so yeah I would like to know more*" (Participant 6, female, aged 12 years). There was also an assumption that "whole grain" was bread with added seeds to it, which increased its fibre content. Another participant mentioned that his father ate "those healthy breads with fibre which filled you up right away". Those participants who mentioned fibre knew that fibre must be better for your digestion and "helped food travel in the intestines", but were also a little hesitant and unsure of their responses.

Four of the participants mentioned that wholegrain foods were not something they would usually discuss or learn about in school, despite the fact that they had nutrition sections in various classes such as chemistry and biology. However, when probed on how they heard about whole grains or that they were healthier foods, answers ranged from family to school to online, but most of them had only vaguely heard it was the healthier choice. Most of the participants had no idea why it was healthier nor of its specific health benefits. One participant added that he heard about it being good to eat before sports or running, so that you don't get a "sugar crush". However, he did not know any further details about this, and that was all he had heard or could remember.

When discussing wholegrain foods, it was noted that most participants thought mainly of wholemeal bread varieties (mainly toast loaves), thus probes were often needed to remind them of other varieties of wholegrain foods.

Identification issues were massively highlighted as a result of the SenseCam images viewed during the discussions, where participants would point to a refined grain product they were consuming or purchasing, and refer to it as whole grain **(Figure 3-5)**. When it came to identification, most participants thought that the colour was the main method of identifying wholegrain varieties. This was a little concerning, especially when it came to bread, where colour may be indicative of other treatment processes and not necessarily of wholegrain status. However there was one remark about looking around the product to see if it says wholegrain or oats somewhere, including in ingredients.  According to this participant: "*You see like here I was reading the labels. It would usually say wholegrain somewhere on the front. Because if it was wholegrain then the company is like proud and literally want everyone to know*" (Participant 5, male, aged 13 years). At this point the participants were taught how to identify a wholegrain product, and expressed frustration at the complexity of the process.

**Figure 3-5 Examples of SenseCam images highlighting whole grain identification issues**


On the other hand, other participants expressed preference for wholegrain foods (mainly discussing wholemeal toast, as mentioned previously). This preference seemed to come from habit and parental influence, as it was often what they were used to eating at home. For those participants, they cited their preference of wholegrain to it being tastier, more "special", more filling, and healthier. One of the participants did admit though that it might be the fact that he knew it was healthier and was used to it, that might made him prefer it over white bread. One participant cites that it was a "*habit that became personal preference really*" (Participant 4, female, aged 14 years). Another participant said that she only ate it if it was toasted, as it seemed to "solve the texture issue". One of the participants cited that she preferred wholemeal bread due to the fact that white bread was so plain and not a long time ago she discovered that it could "*make [her] fat*" (Participant 3, female, aged 15 years). Some participants also liked the seeds that topped some wholemeal bread varieties and that it had a nice "nutty" taste to it.

### 3.4.5 Taste and habit for whole grain intake

The participants expressed various opinions and feelings towards wholegrain foods, their personal preferences, and reasons why they preferred wholegrain varieties or the refined ones. Although opinions varied on enjoying the taste of wholegrain foods, but all participants professed that the texture was dry (mainly due to relating whole grains to wholemeal bread, as previously mentioned). There was often a focus on this dry texture as a negative sensory trait during the discussions.

One of the participants said he disliked wholemeal bread as he didn’t like its taste, texture, and felt it was dry and hard. “*I would only think of eating whole grain one day in the future if I wanted to be healthy. But I don’t see myself liking it any time soon*” (Participant 1, male, aged 13 years).

Another participant expressed her dislike for both “extremes” (meaning whole grain and white bread), pointing to a SenseCam image which showed the home-made bread they consumed at home. She said that she sometimes found wholemeal bread a little too dry, and that “*there was something about the crust and all those seeds*”(Participant 4, female, aged 14 years). However, she also thought white bread was “*like cotton wool, barely even a centimetre thick when made into a sandwich, and* *not filling enough*". She said that she only liked the bread her parents made at home, which was more of a 60-40 white and whole-grain, and disliked most varieties which were sold on the market.

As mentioned, since most participants linked whole grains to wholemeal toast, probes were needed to remind them of other categories. When such clarification was made, their opinions seemed more favourable, as most of the participants who minded the wholemeal toast texture and taste expressed acceptance towards other varieties. Examples of these would be wholemeal buns, wraps, cultural varieties like chapattis and rotis, as well as whole grain breakfast cereals. One of the participants even mentioned that he preferred many other bread types such as hotdog buns and wished that they were available in a wholegrain option, as he might be inclined to start liking wholemeal bread. In fact, most of the participants were pleasantly surprised to learn that other varieties such as bulghur, wheat, brown rice, brown pasta, quinoa, and even popcorn were whole-grain foods. Participants started skipping and forwarding through their SenseCam images, showing examples of wholegrain varieties they consumed, and seeking clarification as to why it was or wasn't whole grain **(Figure 3-6)**.

**Figure 3-6 Example of product which on of the participants inquired on, leading to researching of the product online and further discussions**

Participant attitudes were more positive as the conversation steered away from the classical wholemeal toast as the main example in their minds of wholegrain foods. Following are some examples of those opinions:

"*Oh I love bulgur wheat, it's so good! It has a really nice consistency because it's slightly chewy but crunchy and nutty. It's nice!*" (Participant 4, female, aged 14 years)

"*I've actually never tried whole grain rice and I really want to, because you hear about it and it sounds quite nice actually.*" (Participant 6, female, aged 12 years)

"*Ummm I've actually had some of it (whole grain pasta). I really like it because now I know it's healthy and it still tastes nice at the same time!*" (Participant 5, male, aged 13 years)

"*I've never tried quinoa, but it sounds different. People talk about it on YouTube and I kind of want to try it just because it's different (laughs).*" (Participant 4, female, aged 14 years)

After the "varieties" misconception was cleared, one of the participants cited that he believed that he got enough whole grains, due to the fact that, as was explained to him in the conversation, the definition entailed that products contain 51% whole grain per serving. He said the products he ate were usually 100% whole grain content, such as brown rice or wholemeal bread. "*If brown rice is whole grain then I think I personally eat enough whole grain. Well at least two servings per day, but then some days I eat this brown rice packet which is microwavable so that's at least two servings, right?*" (Participant 2, male, aged 11 years)

**Seeking and evaluating health knowledge**

### 3.4.6 Family as a highly trusted source of health information

As a result of the healthy eating topics discussed, the conversations naturally led to sources of health information, and prompts to explore this further were needed. Most of the participants rated their family as the number one trusted source of health and dietary advice, followed by school teachers in most cases. Peers were often a third most trusted source. Parents of three of the participants worked in the public health fields, such as nurses or researchers, and that further increased their credibility for the participants as their most trusted source. Out of both parents, the mother was usually responsible for fulfilling this kind of educational and motivational role - although in case of one of the participants, it was the father. Educational levels of parents might play a role, as in the case of this particular participant, the mother was of a lower educational level and the father had a postgraduate degree in health sciences. All the rest of the parents were degree holders

However, two of the participants cited that they preferred listening to friends. "*I would listen to my friend more than my mum because if she is telling me that then she probably tried it herself or knows someone who did. Whereas I feel my mum would tell me something because theoretically it is the "right" thing to do or heard it from culture etc. And also she is always saying these kind of lecture things. But if my friends say it then it must really be important to us, not just routine lectures you should tell your kids*" (Participant 3, female, aged 15 years)

While parents were a more trusted source of health information than friends to most, but it is worth noting that, regardless of the source, there seemed to be a valuing of first-hand experience (or opinions that sounded like it). This will be more prominent in the following section highlighting the importance of modern-day YouTube and online celebrities to young people.

### 3.4.7 Seeking authenticity through double checking - between word of mouth and online

There was a trend of questioning and researching everything the adolescents heard in the media, from peers, and even from teachers and parents. This was particularly the case when the information contradicted with other sources. They frequently mentioned the need to get a second and third opinion on new facts and double-check facts. Schools seemed to have positively contributed to this sceptical and curious attitude, and most adolescents did seem to be well-equipped and knew how to judge their online sources (that is, in case they decided to do the double checking, further discussed below). The adolescents would research or "Google" the facts they've heard, but then most of them only believe the trustworthy websites. Most of them confirmed that they have been taught in school how to differentiate between websites and to look out for “logos of approval” and signs of authenticity of the used sources.

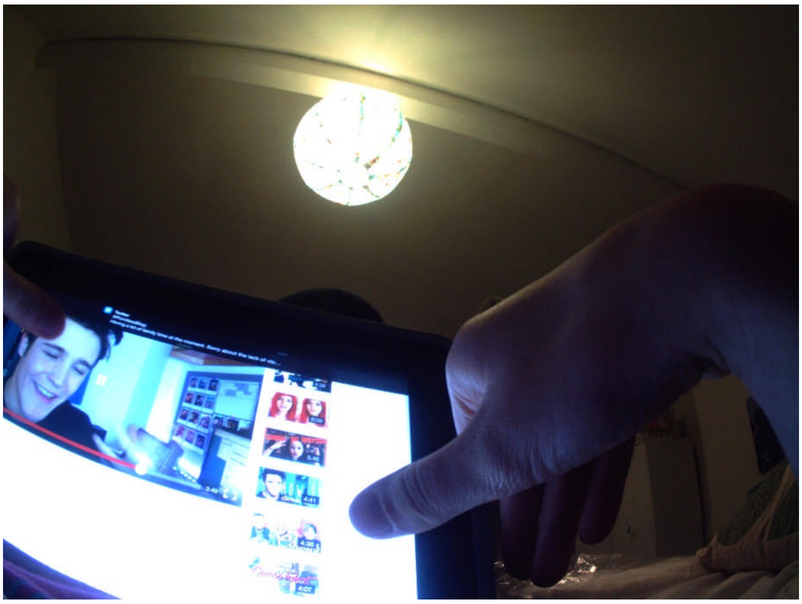
### 3.4.8 Media, YouTubers, young celebrities, and believability

Adolescents spent a large amount of their time on social media. When specifically asked to provide an estimate, they cited an approximate 30-50% of their day (depending on whether it is a school night or weekend). For the male participants generally, there was approximately another 30% on games. They would play the games alone or with friends on weekends, depending on the availability of transport.

"*When I am at home in summer, I am always on the computer. At school times – only a few hours. We are not allowed to use it in school.*" (Participant 3, female, aged 15 years)

The participants' statements were confirmed with the SenseCam images as seen during the interviews, whereby a large portion of the photos would be of hours spent on smart phones, tablets (watching videos and reading articles), and playing games at home. The huge amount of images comprising of social media use prompted a lot of the discussions on the importance of online media as a source of health information and an influence on behaviour and choices. **(Figure 3-7)**

**Figure 3-7 One of a large number of images featuring time spent by adolescents on social media**



As mentioned previously, it was not always the case that the participants double checked and doubted their sources. Since sometimes online celebrities or "YouTubers" can establish a good reputation and promote ideas, and due to the trust formed over time with their young fans, the adolescents admit they might find themselves automatically believing the celebrity. It was noted that only those type of celebrities were trusted - the "normal" young person who becomes gradually famous due to their popular online work and credibility. The classical celebrity (outside social media) such as the footballer, singer, or actor was not trusted as much by the participants, due to the fact that they felt those were not "real" people and would only ever say anything because they were paid. One of the participants stated that "in fact, if I knew something was true and one of those celebrities speaks positively of it or tries to promote it, then I would start doubting it and research it all over again!"

This raised very interesting probing points on what adolescents view as credible or trustworthy. Although these online celebrities (the YouTubers) might (or might not) be getting paid to share a certain thought or opinion, but the adolescents tend to prefer and relate to them in ways that they don't with the "offline" or real-life celebrities. They feel they are more real as they are young just like them. They also share their accounts of the promoted concept as a friendly first-hand experience – a point noted in the previous section when participants cited trusting their friends. Moreover, these celebrities gained their popularity through being credible -- knowing that the young people of these days will doubt and research every word they might say. They "passed that test on and on", thus their "followers" eventually start trusting them and knowing they will not say anything false.

"*Besides, they know that if they said one wrong word, everybody will be bombarding them in the comments below their video and then they start losing their credibility. That is definitely not the case with your offline celebrity -- they get away with so much more. I wouldn't trust them much*" (Participant 6, female, aged 12 years)

When asked specifically about wholegrain in the media, a few of the participants said that social media is definitely promoting the "exotic" wholegrain varieties.

"*YouTube -- I watch a lot of YouTubers. Like they're all eating more healthily and it's like -- quinoa! Wait, what is quinoa? Is that actually a healthy thing? Then I go ask my mum and look it up online and find out all about it.*" (Participant 4, female, aged 14 years)

With regards to online blogs and TV content, it depended on who was providing the content. Again, celebrities were not very trusted, and blogs had to be written by a specialist in the field - with proof that they were. All proof had to be made available online; if it were not online, it did not exist.

As for ads and TV, most of the participants were not heavy TV users. Still, for them, it depended on who was providing the content:

"*Umm I'd say for videos it depends on who's doing it. Say for example a scandalous documentary about McDonald's done by food researchers? Then I'd be bothered about it. But say it was a McDonald's documentary done by McDonald's, then I wouldn't bother to see it, because it would be like a long advertisement.*" (Participant 2, male, aged 11 years)

### 3.4.9 School-related: Whole grains and other life interests only broadly mentioned in class and educational sessions

Although none of the participants had first heard about whole grains from school, but most confirmed that it was mentioned "at some point in some class". "*Brown bread was better than any other bread – that's what they said in school*"(Participant 6, female, aged 12 years). After family as the most trusted source of health information, school and teachers seemed to come in the second place, according to the participants. To be precise, the participants believed academic books were the most reliable of all sources, and were the only source that one does not need to double check after. After that came parents, then teachers in most participants' discussions.

Participants cited that they learned about the benefits of grain-based foods through a "lifestyle and physical education" class. However, when the participants were asked whether such classes, nutrition classes, or nurse visits ever discussed whole grain, the answers ranged from never to general mention, such as simply stating that wholegrain was a better choice. Wholegrain was only referred to when bread was discussed, no health benefits were discussed, and other varieties were not mentioned either. Participants also complained that such sessions were too general, lecture-like, repetitive sometimes, and did not involve enough activities to provoke their interest, or get them to remember the content. One participant even said that she "*would* *easily find any of this information online*" (Participant 6, female, aged 12 years). Participants confessed they would get bored and sometimes start talking to their friends in those sessions, and that the sessions needed more "sophistication" and details. Therefore, promoting an idea to adolescents may not only be a matter of providing credibility, but also triggering enough interest to get the message across.

Another issue that the participants criticised after some discussions on wholegrain, was that even biology and science classes provided a limited amount of guidance on such "more recent scientific interests" and useful general knowledge. Most of the participants felt that schools, generally, did not provide them with enough facts and information that were useful or relevant to their everyday life, and that curriculums were very classic and tailored with focus on passing the GCSE and A-level exams. They felt they were hearing a lot about the latest scientific research online (where they doubted the sources), and wished there was more focus on interesting new studies and research updates in the school.

"*We get some health information from biology class and from parents in conversation and dialogue. I think in biology there is this whole unit on health and fitness so it might go into deeper details like healthy diet and that might include whole grain. Maybe. But then I am not doing biology in my A Levels so I don't benefit in that way*" (Participant 7, male, aged 16 years)

"*The problem is that they only teach you what's needed in the curriculum, only what you need to know. I think I wouldn't be surprised to know that teachers don't know half this stuff. They only know what they need to teach you, you would ask them certain questions and you can tell they don't know about it or bother to look it up later.*" (Participant2)

In summary, this data shows that young people are attentive to who is saying what, and are alert and interested in health talk as a way to inform their own behaviour. This is an interesting finding of these interviews, as it counters a cultural perception of youth as a disinterested age group.

## B) On choosing whole grains: Eating what's there

### 3.4.10 Home environment

A large number of images capturing family meals led to discussions on the influence of home environment and availability of whole grain consumption **(Figure 3-8)**. When it came to home availability of wholegrain varieties, there were varying home environments ranging from the participants whose parents made sure that there was a constant supply of whole grain by baking the bread at home, to those whose parents did not like it thus never bought it. In case of the former, only the bagels and novelty bread types were refined and were consumed by the family less often. "*It's always been available, there is always a brown loaf in the house. There's more often brown bread than white bread*" (Participant 4, female, aged 14 years).

As for some of the other participants, health-conscious parents made sure there were wholegrain varieties in the house often enough, which was cited by the participants, as mentioned above, as being mainly present in the breakfast and some family meals. However, in the case of a few participants, one or both parents did not prefer whole-grain foods, thus consuming whole-grains foods was not the norm in the house. Sometimes, the parents would prefer buying refined varieties as not everyone in the house consumes whole grain, and there was concern of food going to waste in case of buying duplicates of the same type (example: one whole grain and another white bread loaf). One positive observation would be, that in the case of all most participants, there was a general recognition of the healthiness of whole-grain foods by both the adolescents and their parents, and some sort of attempt to consume them, even if minimal and occasional, was always present.

Some of the participants would not go for whole grain for the sake of eating whole grain, but only if it's eaten along with a home cooked meal, "*like I'd have a chapatti or a roti with my dinner - I like those. But I wouldn't go for the whole grain option otherwise like, say, in a sandwich or to school. I prefer white bread*" (Participant 1, male, aged 13 years). He said that although wholemeal bread is available at home, but only his mum and grandma eat that.

**Figure 3-8 Examples of images featuring family meals or meals consumed at home**

One of the participants said they usually have wholemeal at family breakfast, and that would usually be on Sundays. He indicated there is rarely a chance for him to have wholemeal when he eats out or visits a friend’s place during the week, as “*you tend to eat what’s out there, and there would usually be no wholegrain [option]*” (Participant 2, male, aged 11 years). More details on whole grain availability outside the home is covered in the following section.

Cultural factors played a positive role in the participants' whole grain consumption, as it seemed like the ethnic whole grain options were accepted and enjoyed by the participants. Examples would be rotis and chapattis, consumed by participants coming from South Asian backgrounds, bulgur wheat by those coming from Turkish origins, and teff by those from African origins. Those varieties, which were a basic part of family meals, were a readily consumed source of wholegrain for the participants which they enjoyed, which in many cases were the sole sources. One of the participants confirmed this by stating that he does not enjoy brown bread or brown rice except for the cultural varieties which he is used to since childhood.

The majority of the participants did not participate or help in home-cooking, or did so minimally for those who did. They might help their parents by buying any missing ingredients (participants with nearby shops) or by helping set the table. Therefore they are unlikely to influence the details of ingredients in the main family meal, unless they disliked something specific, in which the parents would avoid including. They may occasionally suggest an overall meal based on personal preference, but did not influence the details of the ingredients in the making of the meal (example whole grain vs refined grain).

There was a difference in food habits in the stage of growing from childhood to adolescence for most of the participants, where most of their food used to be home-cooked or packed from home (in case of school lunch). As for the current age, most of the participants did tend to buy some meals or snacks from school, as well as go out occasionally for a "treat" with family and sometimes friends. However, their main meals and the majority of their food still came from home (see *section 3.4.11*). This was also evident in the SenseCam images generated, which revealed the home as a main source of their food intake. Most of them did talk of other peer groups who habitually eat from takeaways, around school lunchtime as well as on a daily basis as a lifestyle. However, most of the participants in this research seemed to view those groups as the "other" groups and generally disapprove of their lifestyle. Only two participants seem to have this type of lifestyle, and that did reflect negatively on their food habits and diet-consciousness, as indicated by the SenseCam images as well as the corresponding interviews.

“*I used to eat a lot [of breakfast cereals] before, I sort of eat less now. Uhh like Fruit and Fibre, or Weetabix. I think that those are also things that are like, fallen off... You’ll see that for some friend groups breakfast is like grabbing something from McDonalds or something -- which isn’t very nice but we do it sometimes.*”(Participant 2, male, aged 11 years)

Therefore, although the general knowledge on healthy eating was there, peer groups and trends within the groups still tend to develop. Parental pressure to healthy eating does seem to be the key though, even in these stages of increased autonomy. It was noted that parents who actively guided or even pressured their children into healthy eating were the ones whose children grew up into more diet conscious adolescents. As one of the participants puts it

"*Like I used to never eat vegetables or anything even if my mum used to force me to but recently I am just like I do.. I eat the vegetables I like. I guess it all eventually sinks in and becomes your own priority too, and it's probably been two years now.*" (Participant 4, female, aged 14 years)

**Outside the home environment**

### 3.4.11 Availability, accessibility, and variety outside the home

Upon coming across the food shopping SenseCam images during the interviews, discussions of availability and accessibility to wholegrain foods in retail shops were inspired **(Figure 3-9)**. Adolescents felt it was "*cheaper and easier to get white bread*" (Participant 2, male, aged 11 years), and that's one of the reasons most people were not able to achieve the recommended 3 portions per day. The majority of the participants agreed that wholegrain foods were mostly stocked in the larger chain supermarkets, which had at least ten varieties of any given food type. However, they felt that they were still not as visible or "*out there*", and that "*whole grain [varieties] would be somewhere at the top of the shelf or something, where you don't notice them as much*" (Participant 7, male, aged 16 years).

**Figure 3-9 Participants shopping for personal meals**

Four of the participants lived in areas where there is an Asda, Morrison's or Sainsbury's nearby. Others only had a small off-licence nearby, or a smaller branch of these franchises, which did not allow whole grain availability in the close neighbourhood proximity.

On the issue of availability of other wholegrain varieties such as wraps, quesadillas, rolls, rice, or pasta, one participant commented: "*If u go to the big supermarkets like Asda and all, you won't see anything of that sort of stuff. You'd see the small stuff that* *are cultural, like a few pittas, maybe some roti... If you look at [foods for] eastern countries, they generally eat more brown breads, brown rice maybe. I think that's what you see in supermarkets - a few whole grain [varieties] in the cultural section. Instead Asda's proper bread section is just like being one whole shelf of white bread and behind it maybe one loaf of brown bread*" (Participant 2, male, aged 11 years). This also implies an issue of accessibility since the products might be available but less accessible than their refined counterparts.

When asked about the sweeter varieties such as biscuits, cookies, some participants felt that supermarkets might not stock enough of them, since people tend to go for familiar refined options. Therefore they tend to believe there was not enough demand. One of the participants stated that, when one is shopping for sweet varieties, one does not think of healthier options as they already know they are just fulfilling an unhealthy craving. This was an interesting and thought provoking point on shopping mind-set and its influence on the food choices made. Cost factored here as she cited that when it came to sweeter varieties "*people want the tastiest and the cheapest*" (Participant 3, female, aged 15 years). But then again, another participant said that if healthier and affordable options were found and were more abundant, "*rather than having just one in ten healthy [varieties]*"(Participant 4, female, aged 14 years), then people would get used to them and enjoy them.

Perhaps the influences of the local retails environment on whole grain intake might be thought of as similar to the home environment. In both cases, it was about eating what was available – what was “there”. However, in the case of food shopping, the common perception was that wholegrain foods were “not there” due to limitations in retail availability, accessibility, and in many cases, shopping mind-set as a result.

### 3.4.12 Cost considerations and wholegrain foods

Most of the participants thought that white bread was cheaper, and they attributed that to the fact that it is more desirable and has higher demand, thus competition helps keep it cheaper. Moreover, some participants had the general impression that wholegrain foods were more expensive, but were wondering why would they be more expensive, as it made sense that they were cheaper, as it should be easier to process them without pealing the grain.

Some of the participants cited that they don't look at the price when selecting their food choices in shops, and when probed about bread and grain choices, that was no exception. "*Usually it has to do with what you feel like having. Then also I might check for sugar and additives, if I was feeling like going healthy*" (Participant 3, female, aged 15 years). This indicated that flavour and preference plays a larger role in food choices for some adolescents, and on certain days, healthiness might also feature as part of that process. This idea was mentioned by participants at various points during the conversations, where the conflict between choice based of enjoyment of or health manifested itself – and the former often dominates.

However, for a few, price was the first thing they would look at. According to one of the participants it was price, then brand, then sugar content and additives. Sometimes it was protein content as well, and that was justified by the participant explaining how higher protein and lower sugar foods were the healthier options to go for. Unfortunately, when probed for things like fibre or wholegrain content, the participant said that he did not look out for those in most grain products. He said that, however, only if it's bread, he would "*try to go for the brown-looking varieties, as [he] heard that brown bread is healthier, but that's it*." (Participant 7, male, aged 16 years) He would not go into fibre and wholegrain-identification details further, as he did not know that it was that complex to find wholegrain foods.

One of the participants indicated that they helped their mother in food shopping by comparing the prices of the different items and helping her go for the more economic choices. He would also take into consideration expiry date and overall value (like differences in size). However, health value did not justify larger price differences in this participant's point of view (Participant 1, male, aged 13 years)

### 3.4.13 Hardships while eating out

When eating out was discussed, most of the participants stated that it was hard to get any whole grain, whether it was when visiting friends or eating out over the weekend.
"*When you're eating out I don't think it's available enough at all! Because when you see things like fast food or just general restaurants, if they do any kind of bread it's always white bread. Because people like the appearance of white bread, they think it looks better and they think it tastes better*" (Participant 8, female, aged 14 years).

This points out to the fact that adolescents are aware that restaurants and takeaways offer only what is appealing, rather than what is healthy. Another participant added, on eating out, that "*You have to ask them to bring wholegrain bread. And only few places might have it*" (Participant 3, female, aged 15 years). Whole grain snacks were cited to be very hard to get while outside the house, as most vending machines in schools, hospitals, and public places "*never have wholegrain cereal bars or the like*"(Participant 1, male, aged 13 years).

### 3.4.14 At school: issues of low availability

When asked about the availability of wholegrain varieties in school, all participants agreed that it was very hard or impossible to find them.
"*The school food is always pre-packed stuff, then they're just ovened or microwaved. You would find croissants and, say, toast with butter. So it's not usually proper food or even freshly cooked.*" (Participant 5, male, aged 13 years)
There was agreement that the food options in schools were mostly based on convenience and popularity, rather than on nutritional value. However, one of the participants particularly liked the "*perfectly portioned*" meals that the school dinner scheme offered (Participant 4, female, aged 14 years), which included varieties of wholesome meals on a daily basis. However, she did feel that they still lacked in nutritional value, containing minimal amounts of vegetables and never included wholegrain varieties. Moreover, any whole grain snack options (including cereal bars) were usually limited in number and overpriced.

## C) Peer influence

### 3.4.15 Fitting in vs. deciding for you

Although the participants claimed that peers rarely directly influenced their food choices and their wholegrain consumption, some did indicate indirectly that there was some sort of influence once probed further about the topic. One of the participants stated that peers were not a major factor influencing what she chose to take to school or buy during lunchtime, and the reasons she might choose to eat or not eat something was based mainly on taste and appearance. However, in the back of one's mind, there might be a little fear of "looking different" if she chose to eat a new bread type or something which might be considered "new" to others. She believed that this kind of fear is one that is carried on from the childhood years. "*They might start asking what is this stuff you're eating there? And just the fact that you might be questioned or the slightest possibility of teased or mocked, especially by the boys, makes you think twice before doing anything that is remotely different than others*"(Participant 4, female, aged 14 years). However, she also said that it really depends on what group you are "hanging out with". This concern did not bother her too much because her friends are relatively "okay", but might be more of an issue for people who are in certain "cool" groups or care a lot about other's opinions. It seems that food choices based on culture were mocked at previous stages in the childhood, but that situation did not continue into adolescence, where peers seem to start understanding and interacting more with the various cultures around them. As one participant put it:

"*So at first when we were younger I used to be self-conscious that I am bringing different food and when I was questioned about it. It took time but I came to terms with it and I'm like: just be honest, this is Turkish food, this is what I eat. Then they try* *it, it tastes good, and then they have a choice either to mock you for it, or they can just accept the fact that yeah, it's different food, that's interesting food.*" (Participant 7, male, aged 16 years)

Therefore, although the adolescents were reluctant to admit that peers do influence their food choices and behaviour directly, but most of them did seem to try to keep as low profile as possible in terms of blending in and not standing out, as "*you need to be the same as everyone else. Everything and anything that is different might be mocked.*"(Participant 1, male, aged 13 years)

Participants claimed that things did change in the later adolescence years and as they entered sixth form. One of the participants (16 years old) said that this overall ambience of everybody trying to act the same and keep a standardised profile changed as they enter their late adolescent years. He believed that peer groups started emerging and the differences became sharper as everybody "matured" and started acting more on their real selves and beliefs. When younger, the "cool" groups were more popular and seemed to overshadow other groups and make them feel less important. As opposed to the fear of being mocked previously, "*you start embracing the things you were taught and your own beliefs, and hang around people who think similarly*" (Participant 2, male, aged 11 years). His friendship group now helps him to carry out his healthy eating habits, as the girls in the group have always chosen healthier foods and are quite diet conscious, and the boys are into football and other sports. Thus he said that he did not feel shy ordering a salad when he ate out or asking for the wholegrain option in *Subway,* since his friends were all either eating healthy options anyway, or constantly talking about their intention to start doing so. "*When you are closer to getting into sixth form, people start trying to act more adult-like. The stereotypes become more extreme as well, but then you find your group and stick to them. I don't mean to be harsh, but you can tell the difference – the same people who are into doing well on the studies and their A-levels seem to be disciplined and bring their healthy food from home. Then there is the other group who would go to McDonald's over lunch and stay late, maybe miss their class as well.*"

Therefore, according to the participants, there seemed to be a shift in trends from the younger adolescence into their later years: from everybody trying to act similar, fit-in-or-keep-a-low-profile, and the constant fear of mocking, into an eventual emergence of separate groups who embraced their interests and lifestyles and were very distinct in every aspect of their behaviour.

### 3.4.16 The fit ideal and peer pressure

When asked about the pressure to be skinny for females, or muscular in case of males, the adolescents admitted there was that kind of pressure, but it greatly affected those same groups who were most interested in being “cool”. Social media and fitness celebrities promoted an increasing trend of awareness, combined with consciousness and pressure for young people. For males, that kind of pressure did not start before the age of 15. But in case of females, it seemed to be earlier. This might have implications on whole grain intake in this age group, as carbohydrates did seem to be the "enemy" for both genders, as promoted heavily by their social media role models. Previous discussions during the interviews showed that the adolescents were unclear regarding the specific health benefits of wholegrain foods, especially those related to their benefits in satiety, and slow energy release. Their tone implied they sometimes tend to lump them along with the other "carbohydrates" they are meant to avoid. SenseCam images of social media (Instagram photos) as well as shopping time and fashion retail ideals prompted these discussions for many participants **(Figure 3-10)**.

One of the female participants (15 years old) stated that there is a huge pressure on being skinny. She felt that in order to belong to be more popular, a girl should be skinny and that would bring her more attention and some sort of “respect” in every way from both genders.

“*There is pressure to keep our weight down. Like if you are fat, friends will look at you like you are a monster. Like if you are eating salad with them, they would say “Oh come on, we know you did not get this fat by eating salad all the time!” It’s like she’s*

**Figure 3-10 One of the images captured while shopping which triggered discussions of body image and the "skinny" standard**

*being fake. And if you eat junk food, they would say something like "Oh my God, all this weight, and you're still eating junk food?""*(Participant 3, female, aged 15 years)

The female participants in this study did not seem to be the type who conformed to this kind of pressure and claimed to belong to the "less popular groups", as they put it, who did not prioritise physical appearance. Although they in part resented the fact that they were not among the popular girls, but they also criticised the latter's behaviour and choices. The participants believed that those girls were not being healthy and that their choice of popularity leads them to go for extremes in food and lifestyle choices. One of the participants elaborated: "*They would go out and eat McDonald's to appear relaxed and "chill" and then starve themselves for the rest of the day so they would stay skinny. Not very healthy and they're not thinking of the long-term consequences – they just want to look cool*" (Participant 8, female, aged 14 years)

The female participants believed that this pressure from peers and the media to be skinny was a negative one and that those affected by it were constantly on fad diets and avoided healthy foods such as fruits or grains completely. Two of the participants claimed to being tempted to go with that kind of pressure at some point, but soon found themselves researching and reading about the long-term health risks (as well as getting advice from family) and decided that "this was not for [them]".

While most of the female participants were of healthy body weight, one of the participants said she struggled with her weight at some point. But she said that, after a long struggle with fad dieting, she resorted to losing weight in a healthy way rather than by completely eliminating carbohydrates.

"*When it's friends that you listen to, then you might end up going for the wrong choices or get obsessed for the wrong reasons. But in my case my mum is the one who sometimes reminded me to watch my diet when I gained weight, but then she also started helping me by cooking healthier food and giving me more salad. This made me start losing weight in a healthy way – with my mum's support. She wants me to be healthy not skinny. I eat wholegrain when I am in diet-mode. It keeps me full and helps me lose weight. I read it online.*" (Participant 6, female, aged 12 years).

This indicated that wholegrain is related to diet, weight loss, and satiety for those who did know about it. However, none of the participants learnt about the specific wholegrain benefits through school, and only knew from school that wholegrain was vaguely healthier. Moreover, this showed that parents approached weight issues in a more positive and encouraging way than peers.

What was concerning though is the "yoyo dieting" behaviour, whereby the participants seemed to be in contrasting modes at a specific point in time. Other participants spoke of a similar "diet mode" or "days of feeling healthy", where wholegrain featured exclusively. In the case of lowered sugar intake and fruits and vegetables, participants were always concerned or attempting somehow to watch out for recommended intakes. However, in the case of wholegrain intake, it seemed to be optional and only taken into consideration when dieting or on those extra-healthy days.

As for the male participants, they did indicate that “working out” and building a “buffed and muscular” figure was becoming an increasing trend among adolescents **(Figure 3-11)**. However, similar to the female participants in this research, the boys did not seem to consider themselves among those “cooler groups”, did not take part in those sports, and criticised those who did. The boys also revealed that those interested in going with this trend avoided all sugars, grains, and fruits, or “*stuffed themselves with unhealthy loads of protein and sugars from food and protein shakes in case they wanted to gain weight*” (Participant 7, male, aged 16 years).

One of the participants mentioned that he felt those boys who were interested in building muscles trusted their gym coaches a lot, and that the latter were not usually the most reliable sources in his opinion, as they led those boys to go for extreme and unhealthy diets.

Two of the male participants in this research were interested in sport such as football and cricket. The other two were not into sports and preferred reading or video games for leisure. In case of the former (participants who were into sports), they felt that their sports coach did not give dietary advise and only gave exclusively game-related guidance and advice.

**Figure 3-11 Sports interest images prompting  discussions around gyms and body image**

## D) Ideas for targeting adolescents, by adolescents...

Participants were asked towards the final parts of the interviews to imagine that they were “whole grain teenage ambassadors”, and that they had the power and budget to intervene at any level and promote whole grain consumption among adolescents their age any way they wished. The responses fell into the following general categories. Ultimately, most ideas were linked to the direction of making wholegrain foods more of a social norm rather than "*special foods for extra health conscious individuals*"(Participant 7, male, aged 16 years).

**Raising Awareness through Marketing and Promotion**

### 3.4.17 Promoting the whole grain message through media, advertisements and celebrities

Participants believed that increased efforts in raising whole grain awareness would help promote an increase in whole grain consumption. There were a few remarks on limitations of the impact of increased awareness on its own, but generally, many agreed that increased awareness was crucial.

"*Ummmm I think actually it's awareness. So that they actually know that whole grain is much better for you even though it may be more expensive or less 'out there'. So you could tell them that. I mean, they might know about it, and they know it's healthier, but I don't think most of them know about HOW much healthier it may be. And I think that would make them try to eat more whole grain*"(Participant 5, male, aged 13 years). These words may have an interesting underlying message, in that adolescents feel that 'the world' may not necessarily have the healthiest foods in your face, but that you have to educate yourself and root them out.

Most participants agreed that using radio, television, and online platforms would work. There were suggestions about flashing it strongly as a message by using catchy advertisements which would grab attention and generate popularity, or alternatively about "sneaking the message through media" in a subtle way through celebrities. They believed this method might raise controversy (due to people doubting the words of celebrities sometime), but then they still thought that was the smart way media "generates discussions these days", sparks interest in a topic, and encourages people to look it up.

"*I think media has a very big impact on people these days because like almost everyone I know owns an iPad or a computer to get online. Add TV and radio to that and you would literally be reaching everybody*". (Participant 5, male, aged 13 years)

"*Maybe advertise it online, but only people who are interested in will click it. So I guess you can start by using TV and radio, then make it available online after people have heard of it. But then you have to do something really catchy to get people to see it or care. It has to be catchy enough or funny to be talked about or shared with friends so people would remember it.*" (Participant 1, male, aged 13 years)

While many participants agreed that it was best to use music and humour in advertisements to promote the whole grain message (directly or indirectly), but then others suggested that the strongest messages do not always work that way on their own. Instead, they believed in combining such efforts with an anonymous spreading of "shocking" content that would go "viral", which would serve as an amplifier to the main message by attacking "white bread". As one of the participants suggested:

"*It sounds bad, but I might sort of "lie" in a sense. Like that video that says if you eat this certain kind of processed meat, then this will happen to you, with some scary image. But then in the end turns out it was just a zoomed-in nail. They said that will be the inside of your stomach, but then we found out later what it was! False marketing -- it does scare people so no problem using that sometimes. Although people will know it was fake, but at least it would bring attention to the topic and people might search it up at the good websites!*" (Participant 8, female, aged 14 years)

Other creative thoughts led to suggestions such as paying famous YouTubers with thousands of teenage followers to talk about whole grain and report eating it as part of their "healthy food blogging". The celebrities would need to say something about the health benefits of whole grain and that they recently found out about it, and were surprised at how much healthier it was. This would spark interest in the topic and create discussions, according to the participants. One of the participants even suggested that more whole grain companies should sponsor sports events, with the comment: "*If McDonald's does it, then Kellogg's certainly can!*" (Participant 7, male, aged 16 years)

### 3.4.18 Location and community specific focus in targeting

Moreover, there were suggestions on promoting the whole grain message in places where people were "*in the mood for being healthy*", such as gyms and hospitals. However, promoting it in schools was not encouraged (at least not in form of posters or leaflets), as the pupils will "*look at it and just scoff or make fun of it -- you know just* *to seem cool*" (Participant 3, female, aged 15 years). Therefore, the same adolescents would react differently to a message if presented in another setting. This was another instance where the participants implied that the desire for health is not consistently felt, or is at least in tension with other factors that influenced intake, such as social norms, wants, etc.

On a similar note, participants brought up ideas of focusing on specific communities in advertising the whole grain message. They felt that people living outside of town areas needed to be targeted, as they tend to have fewer choices due to shopping from corner shops which don't stock enough whole grains and healthy foods. They believed that efforts to increase consumption through increased availability might still be challenging in those areas due to limited control over such small shops. Therefore more awareness should be spread to increase demand so that such shops would consider stocking such varieties. Moreover, participants thought there was also less access to restaurants that offer healthy foods in areas outside of town, as the "more sophisticated and developed" places were usually open in town.

While there was focus on advertising the whole grain message through TV, radio and online, but the participants did not fail to recognise the importance of point-of-purchase promotion. Supermarket and shop advertisements were suggested since they would reach everybody, as" no one does not go to the supermarket". The main idea behind that was to make wholegrain varieties "the norm" through advertisements that feature them as standard in dishes and sandwiches. However, they also felt availability should be increased to achieve that "normalising whole grain" purpose (more on that in the following 'availability' section). As one of the participants put it regarding supermarket advertising:

"*You will also see in the shops , the way they sort of advertise food -- like if you see an advertisement for bread or a sandwich, there is no brown bread in the advertisement. It's all white bread. Same for pasta and rice, or all those other interesting varieties we discussed. You need to make them the norm.*" (Participant 2, male, aged 11 years)

### 3.4.19 On making whole grains the norm

Although the role of increased awareness by providing information was encouraged by the participants, the majority of them were stressing on the fact that whole-grain foods were not the norm but rather that special variety which certain people would seek out and eat. It was associated with being "extra" or a special requirement which would make them "stand out" if they chose and fear getting questioned. Moreover, they felt that perhaps giving out information might be counterproductive, as people get "bombarded" with health and positive moral messages all the time that they eventually get tired and discard them as another trend or "fad". That is where they felt increased availability and indirect promotion (such as making it feature in general food advertisements) would help normalise it and promote it more than direct awareness. One of the participants felt there should not be a special "whole grain" label on products, as that would reinforce the idea that this specific product is different from the norm. This is an excerpt from her thoughts on it:

"*Make it seem like a normal thing, rather than a special thing like only for healthy people. Make it more like brown bread is the normal thing rather than the white bread. Make it dominate the market. Create varieties too. Because there's probably a lot of people that only eat white bread because their parents only eat white bread. And like they've never tried it, so make it more of a social norm I guess to have brown bread, if that's possible. Get parents to give it to children when they're little. White bread should get the special 'white bread label' and not whole grain, because whole grain is the norm of bread. Just like that.*"(Participant 4, female, aged 14 years)

### 3.4.20 Building on the importance of the whole grain message in school

Participants felt that before whole grain would be promoted as a healthier alternative, there was a need to debunk the myth that carbohydrates are the "enemy" and that a healthy diet comprises of eating less carbohydrates. They were not convinced that those high protein diets were the normal way humans were wired to eat. They also felt that teenagers needed to be told in schools that higher protein diets were less sustainable (with that topic being a concern), and that it made sense to go whole grain -- it was less processed. That was healthier (going in line with the previously mentioned beliefs on less-processed being healthier) as well as more energy and time saving for companies.

"*First I think teenagers must be told that if you want to be healthier then you must not stop eating you just have to eat healthier. Some teenagers think that healthier means almost no food, or no carbohydrates. Tell them to eat the right carbohydrates, not to eliminate them!*" (Participant 3, female, aged 15 years)

"*I think a whole session in class should tackle this whole grain issue. It makes more sense in every single way: less processing, healthier, more environmentally friendly. It is convincing in every way, and it would lead to lots of discussions on how industry makes something less healthy the norm and people just follow through. These things don't get discussed in class and I feel they should. I hadn't even heard half the things I learnt about fibre today in school!*" (Participant 6, female, aged 12 years) This shows the importance of young people getting the needed awareness and support to counter the promoted culture and be a savvy health customer.

**Availability, products, and cost**

### 3.4.21 Increasing availability and accessibility -- more on making whole grains a norm

When it comes to wholegrain availability and varieties, participants thought it played a key role in "normalising" the wholegrain product, which they felt played a more important role than increased awareness on its own.

"*I think if I had that kind of budget and that kind of power I'd sort of force shops to reduce stocks of white bread, increase stock of brown bread and make that more often on the shelf and more obvious than white bread. I want white bread to be a lot rarer in shops. I don't care if people don't know what brown bread is and the benefits of it, I* *just want it to be available. It sort of makes it the norm.*" (Participant 2, male, aged 11 years)

"*I think the easiest way would be to get them to change the restaurant venues around the school which students flood out for lunch for to have brown bread. Oh and Change the canteen!*" (Participant 8, female, aged 14 years)

### 3.4.22 Decrease the cost of wholegrain foods -- remove the" luxury" perception

Participants also commented on cost, saying that white bread should be made more expensive than whole grain, and the money that is made through sales of white bread would offset the extra cost of increased wholegrain production. They felt that cheaper products are usually the staple and that the more expensive ones were the "extra" or luxury products. That was what they felt would make people go for wholegrain since it becomes the standard product, in addition to its increased availability.

### 3.4.23 Product appeal and ease of identification are important

The main comments on product packaging and presentation were around the fact that wholegrain products seemed like the more serious ones on the shelf and were lower in number as well as looked "boring". That, the participants felt, needed to be changed, as it fed into the impression that wholegrain products were for people with special interests -- very "picky" and associated with certain conditions such as free-from products. They felt that whole-grain products were not normalised that way, and that they should be like the normal products or even look more fun. "*We want flashy colours, big fonts, and loads of colour. Why does the whole grain cereal look so much more dull and serious than a chocolate cereal?*" (Participant7)

As for a whole grain label, the general discussions were in direction of starting off with that for the time being, but then making wholegrain so popular and available that it would just be the norm of grain-based food and thus such labels would not be needed, just like white-bread doesn't need a flashy label to define it, for example. After explaining ways to identify wholegrain products, one of the participants noted:

"*Why should it be such a riddle to figure it out? There should be a large clear stamp, like a government-regulated thing, that says WHOLE GRAIN. Then, after we make whole grains the norm, in a few years, that stamp would not be needed anymore, because everyone is already eating whole grain without thinking twice about it.*" (Participant1)

### 3.4.24 Increasing wholegrain varieties

Participants also felt that there should be a focus in efforts on increasing varieties of wholegrain products and raising awareness in that way. As mentioned previously, the participants always associated wholegrain products with wholemeal toast, and that brought about negative feelings due to the undesirable texture or flavour to some. They felt there should be stress on the presence of other varieties such as brown rice, brown pasta, wholemeal wraps, buns, bulghur wheat, quinoa, among many other examples. Moreover, in addition to including more captivating and "young-people-tailored" product packaging, there was an interesting suggestion by one of the participants to integrate whole grains in products that adolescents already enjoyed.

"*Maybe they should make a pizza with wholegrain dough, whole grain ice cream cone, or oatmeal chocolate wafers. More whole grain choco-puffs and tea biscuits too -- and don't make them the more expensive ones. They should think of more subtle and exciting ways to fit it in our everyday life!*" (Participant3)

### 3.4.25 The SenseCam experience

As for participant engagement and the SenseCam experience, apart from an initial parental concern in the case of some participants, all of the participants approached were keen and excited to take part – especially expressing interest in the novelty of SenseCam technology use.

The adolescents expressed excitement at recruitment stage towards SenseCam, citing it as "original", "exciting", and "cool". Moreover, when asked during the interviews about their experience of using SenseCam, they expressed favourable attitudes and said this is definitely the type of research that adolescents would be interested in engaging in. Participants were excited to be the first to try something new, which not many people their age have engaged in. They were also pleased at the notion that science was “using their language”, as a large portion of their daily life revolved around communicating with and around photos of their day.

“*For us it’s all about [communicating with] pictures and uploading loads of them every day. And we just do it for fun, so it’s great to see that science is also catching up!*” (Participant 6, female, aged 12 years)

These positive expressions were supported by observations during the actual interview, as the adolescents’ engagement with the picture viewing and commenting on contextual settings was high. Participants said they did not mind wearing it for three days, and were not bothered by privacy or any unwanted attention (which only few of them reported), as reporting on everyday life in photos was a common norm in this age group as a result of social media.

## 3.5 Discussion

This section will discuss the main points covered in the results section, draw in some relevant comparisons from the literature, as well as highlight and elaborate on key issues as implied in the interview data.

### 3.5.1 Adolescents, health and whole grains

In-depth conversations with adolescents reveal that they are a pro-active age group, interested and receptive to health messages. The statements made, the questions asked, and the way they discussed the topics served to counteract the conception of adolescents as aloof, disinterested, or negligent towards their health.

Adolescents were generally aware of wholegrain foods, and despite a few misconceptions and issues in identification, they knew the whole grain was healthier than refined grain, but were unsure exactly why. However, adolescents primarily related wholegrain foods with whole meal toast, which they linked to dry texture. They were surprised to find out about other sources of wholegrain, and had no clue that sources they already enjoyed, such as bulgur, rotis, whole meal rolls, brown rice, and quinoa were whole grain as well.

Learning about the different varieties of whole grain, as well as the health benefits associated with whole grain consumption delighted the participants, as they started realising that they consumed more whole grain than they thought they did. As for those who did not regularly do so, knowing that a certain desirable variety was in fact whole grain seemed to motivate them to try it in the future, and making them express intention to start consuming more whole-grain foods. This is definitely a point that should be stressed in any program promoting whole grain consumption, as not only do people lack knowledge on whole grain health benefits, but learning of the different varieties (other than the seemingly less desirable wholemeal bread) certainly helps increase consumption and creates a positive appeal in their mind regarding this food group. This is particularly important, especially due to the fact that there was often emphasis on enjoyment of foods and the importance of taste and sensory appeal to this age group, which had also been expressed in previous research with adolescents on wholegrain foods (Larson et al., 2010; Pohjanheimo et al., 2010)

Although sensory appeal was ranked highly by adolescents, an appreciation of the healthiness of food does emerge as well in these years (O'Neil et al., 2011), and was especially highlighted by the older participants in this study. With regards to their views on healthy foods, adolescents in their school education and generally focused in their classification of healthy and unhealthy on concepts of processed vs. less processed, preservative and artificial colouring-free. There was less focus on the nutrient content of the food, although it was mentioned and acknowledged (proteins and vitamins being seen as healthy, including fruits and vegetables). However, the same meals made at home or in restaurants (such as fish and chips) were seen as more acceptable health-wise than any ready meals or fast food, which confirmed the notion of healthy equals fresh and less processed ingredients in the adolescents point of view. This perception may be attributed to the trends being promoted online and in schools regarding preservatives and processing of foods. These results seem to go in line with previous similar statements in focus groups with adolescents (Kamar et al., 2016), and would be useful in efforts to promote wholegrain to this age group, by focusing on it being less processed than its refined counterpart.

### 3.5.2 Family as highly influential

The data from the interviews show that the majority of the participants were influenced directly by their family members regarding food habits, nutritional information and were actively encouraged to improve the quality of their diet. In the case of most participants, there was a general recognition of the healthiness of whole-grain foods by both the adolescents and their parents, and some sort of attempt to consume them, even if minimal and occasional, was always present. A few of the participants, however, were not influenced directly by their families regarding healthy food habits, but rather consumed simply whatever was available in the house (indirect influence). Direct guidance and encouraging to healthier eating habits were absent in these cases, although home-cooked meals were available on a daily basis which allowed for somewhat healthy eating habits. However, while some whole-grain foods may have been present as part of the cooked meals, this did not allow whole-grain consumption at a regular basis, as parents or siblings did not urge the adolescents in these cases to make healthier options, nor did peers whom they consume their other meals with when going out for sports and leisure activities during the day.

It was evident in the interviews that there was a difference in knowledge, attitudes and consumption of wholegrain foods between participants who were actively encouraged and supported in healthy eating at home, and those who weren't. The proactive or absent parental influence had impact on home availability of wholegrain foods, consumption, and knowledge and attitudes of the adolescents, as implied by the participants.

This observed prominence of parental influence goes hand in hand with the adolescents' statements about trusting their parents as a top source of health information and valuing their opinions and guidance when it came to healthy eating. Moreover, there was consistent mention of the importance of habit, and that habitual consumption of food from a young age helped develop acceptability and regular consumption, whether that was for wholegrain or refined grain. Participants also cited accompanying their parents to food shopping, which was also evident in most participants' photos as captured by the SenseCam device. They would discuss items to be purchased and help in making choices. Therefore, with the right education for both parents and adolescents, this active participation in shaping family (and personal) meals could be developed and directed towards an increased wholegrain food availability and consumption. The conclusions drawn from these data goes in line with those of existing whole grain research with adolescents, where, habitual consumption, home availability of wholegrain foods and family meal frequency were positively associated with wholegrain food intake (Larson et al., 2010; Pohjanheimo et al., 2010).

All the above highlights the influence of parental and family role on food choice and whole grain consumption in this age group. The participants' statements, along with the observed relations between whole grain consumption and different households, may contradict with common beliefs that peers were the most influential group for adolescents -- at least when it comes to health and nutritional information (Shepherd et al., 2006).Therefore no intervention or programme targeted at increasing wholegrain intake would be possible without the full involvement and education of parents due to the vital role they play in shaping adolescents' perceptions of healthy eating, habits, and subsequent food choices.

The positive parental influence appeared ever more prominently in its absence, when the adolescents ate outside the house during weekends, or even during meals consumed at school. This issue was further augmented by the lack of availability of wholegrain foods outside the house. Availability of wholegrain foods at home was not a problem for most, but it was "near impossible" to obtain any whole grain while eating out, even in school(O'Neil et al., 2011; Shepherd et al., 2006).The participants reported a difference in wholegrain availability and eating habits between weekends and weekdays, and home versus eating out. They were “more likely to healthy at home than at school, and definitely more than eating out”. This points to the need to target adolescents with convenient products for use on the days where there might be less frequent family meals that allow wholegrain inclusion, as well as in school and venues around the school.

### 3.5.3 School as a good starting point for whole grain promotion

In addition to increasing wholegrain product availability in canteens, it seemed like schools would be a perfect setting to start wholegrain awareness and promotion discussions, as well as making the students research the topic and as an example to lead the “food processing”, “product normalising”, “low carbohydrates diets” debates. The participants in this research critiqued the school system for adherence to syllabi and lack of focus on useful well-being and general knowledge discussions, a phenomenon which has been recognised in the literature (Moon et al., 1999). Adolescents seemed to value the topics that the school brings up, as they expressed trust towards their teachers and academic sources. Integrating this basic knowledge with some of the much-loved online researching to spark debate certainly would bring about positive change.

### 3.5.4 Teenage culture and importance of social media

When it comes to teenage culture, it was evident in the discussions that peer groups did have an influence on food choices, albeit not as prominent – a trend observed in a systematic review on adolescent healthy eating interventions (Shepherd et al., 2006). It was unclear why peers were not considered as a major source for dietary advice specifically, but a greater level of peer pressure was present in the case of the younger adolescents, where everything that fell outside of the general norm may be mocked. Older adolescence was marked by emergence of “interest” groups, which allowed for less pressure to conform and an increased level of autonomy and friendships based on shared norms and lifestyles, including food choices (Contento et al., 2006). These trends or differences between adolescence age stages should be accounted for in interventions targeting adolescents (Shepherd et al., 2006). Younger adolescents can be targeted by creating an ambiance where wholegrain consumption in school is the norm, and thus is not “uncool” or mocked by their peers. Parental influence could also be targeted, which could aid in creating a new norm through home-made school lunches. However, in the case of the older groups, each group’s priorities and therefore behaviour is very different, and one-size-fits-all may not be the best way to approach or target adolescents in their later years.

However, regardless of age groups, the majority of adolescents face some pressure on self and body-image. Social media plays a vital role in creating trends and bring forth priorities through celebrities sharing live images of their daily life and advise on YouTube, Instagram and other sources. There is a potent focus on exercising, healthy eating, and fitness on social media. While that would normally be considered a positive trend, but it does come with some troubling notions, such as promoting healthiness using extreme fad diets, along with creating a culture of obsession, pressure to be skinny or “buffed”, and body image issues. However, as teenagers are receptive and do trust their social media celebrities it would be helpful to make use of their credibility to pass a healthier whole grain message that could counteract some of the extreme diet tips and fads being promoted. Normalising or integrating wholegrain promotion in an appealing way for this age group should include it being a food that would help empower their efforts in weight maintenance or physical activity/sports programmes – an intervention element suggested in a systematic review on adolescents and healthy eating (Shepherd et al., 2006). Moreover, efforts to promote wholegrain foods based on general healthiness may be hindered by misconceptions or rumours surrounding avoiding all “carbohydrates” in the media, as mentioned by the participants. Acknowledging the body-image challenges facing this age group (which draws to an increased interest in such discussions) as well as the abundance of low-carbohydrate dietary advice in the media is important, and efforts to increase wholegrain intake in this age group must recognise and address these issues.

### 3.5.5 SenseCam as a valuable tool with adolescents

The use of SenseCam photos  during the interviews helped in shifting the focus of discussions, as they started with participant claims of autonomy and opinion-driven motivations for food choice. These claims were similarly noted in focus groups conducted by the research group with adolescents on whole grain intake correlates, where family influence, home availability and environmental factors were underestimated – possibly an influence of peer presence in group discussions (Kamar et al., 2016). The individual interviews started off in a similar direction, only to have the SenseCam images reveal details of daily life that shifted the conversations into acknowledging the family and home influence on food choices and highlighting it remarkably. The SenseCam images certainly helped the conversations move from being idealistic/theoretical in the beginning, with participants answering in ways they thought they were expected to answer, to emerge into more spontaneous and realistic as the interviews proceeded and contexts of daily choices were revealed. They also helped remind them of certain missed out details of the day, such as time spent on social media or instances of label reading (denied previously), starting new interesting discussions on health and lifestyle that would have not been possible otherwise. They also revealed details of dietary intake which were missed out on during the traditional 24 hour interviews (conducted just prior to the interviews), such as drinks, after-school snacks, and the fact that some choices were not whole grain, as assumed. This final point highlights the potential use of the SenseCam device to support dietary assessment. While it may be inconvenient to go through a total of 6,194 images generated in 3 days for every participant, but using SenseCam images to support 24-hour recalls may help eliminate the memory burden and inaccuracies that come as a result of self-reporting in traditional 24-hour recalls. Images generated by SenseCam during a dietary assessment session may also have the potential to aid in recall of food items consumed which would otherwise be forgotten or missed out in the case of traditional 24-hour recalls. SenseCam-aided 24-hour recalls have been explored in two previous studies so far (Gemming et al., 2015b; Gemming et al., 2013) and would be a suggestion for further examination of the data and SenseCam as a tool in subsequent work on this research, especially given the distinct adolescent age group.

Perhaps one of the interesting points that arose from the use of SenseCam images during the interviews was the challenge of wholegrain identification by the participants. There would be instances where participants would report consuming wholegrain foods during the 24 hour recall, or where they would cite purchasing wholegrain varieties while food shopping, but the images would reveal otherwise. It would often be the result of misconceptions, as some images from the SenseCam revealed consumption of seeded white bread varieties with a slightly darker colour (one of the *Warburton* varieties), which the participants assumed were whole grain, or alternatively brown-coloured crackers. Difficulties in wholegrain identification are a common challenge highlighted in whole grain studies throughout the literature with various age groups, and it is mainly attributed to an ongoing process of whole grain definition agreement worldwide and reinforcing official recommendations (Ross et al., 2015; Ferruzzi et al., 2014; Mozaffarian et al., 2013). An official definition and intake recommendations for whole grains in the UK have not yet been established nor promoted, thus such misconceptions and difficulties are to be expected(Seal et al., 2016; Seal and Brownlee, 2015). While previous studies in the literature have cited self-reported whole grain identification difficulties, the current study, with its use of SenseCam images, highlights the potential for this tool to explain and further understand the magnitude and complexities related to whole grain identification, as well as in the case of other food categories.

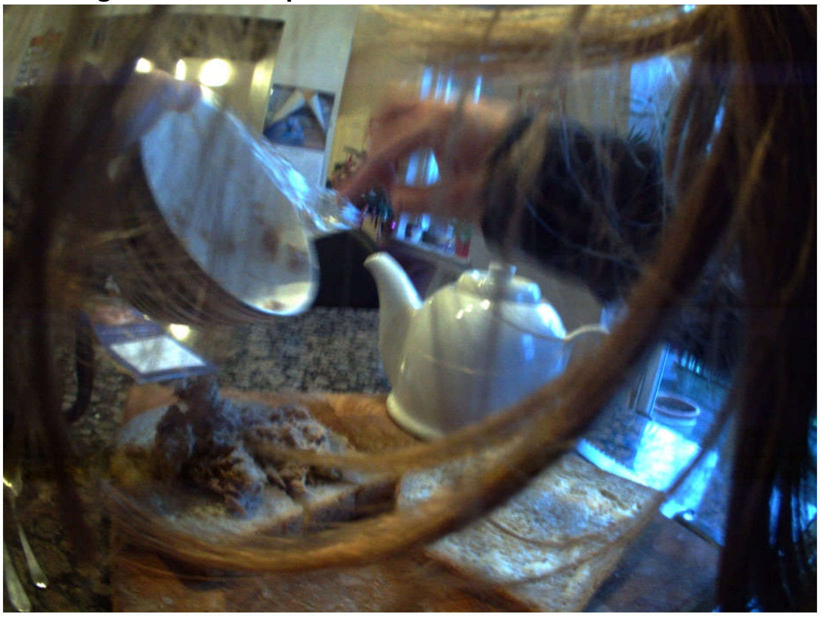
Therefore the feedback on SenseCam-assisted interviews was very positive in this age group, specifically in relation to it being a novel technology that included photography – a language which adolescents these days speak too well. The use of photography to report and communicate on daily settings is an approach adolescents in this study reported to be comfortable with, and rather cited it as the “norm” of daily life for them. They also recommended the utilising of innovative technology for purposes of scientific research, as it would encourage adolescents to engage in more research. This preference among young people to trying new technologies had been cited in previous studies (Barr et al., 2015; Boushey et al., 2009), and the integration of technology in research with adolescents may allow for higher participation interest, a more pleasant experience, as well as favourable attitudes towards research, for future research interests.

### 3.5.6 Study Limitations

Although the use of SenseCam in this study helped disclose valuable information which may have been otherwise unattainable using classical interviews or 24-our recalls, there were some limitations to its practical use. The process of obtaining ethical approval for conducting this research on this vulnerable age group was particularly challenging, due to the multitude of privacy, confidentiality and participant inconvenience concerns that had to be tackled and addressed in detail (Kelly et al., 2013). There were concerns over privacy raised by some participants' family members, which had to be explained thoroughly, and in some cases, participant use of the SenseCam device was inappropriate in some settings such as family and friend gatherings. The participants, in compliance with the ethical guidelines of the study, were given the option to remove the SenseCam where the need arose. Moreover, there were objections from some schools, where the participants, with the help of the researcher tried obtaining consent from the schools but still managed to get resistance in some cases –resulting in only 3 out of 8 participants being able to wear it to school. The remaining participants wore the SenseCam after school and/or on weekends. This was recognized as a possible source of bias in the data produced, and the absence of such an obstacle would have helped obtain further information on school-related correlates of whole grain and healthy eating from the participants.

With regards to SenseCam as a device, the lifetime of the SenseCam battery was a common participant complaint, as it was drained sometime around 7 or 8 pm, thus participants had to recharge it before wearing it again. Participants were asked if they had consumed anything during that time gap and if so, details were noted during 24 hour recalls and discussed further during the interviews. SenseCam battery lifetime is meant to last for 16 hours, according to reports in the literature (Gemming et al., 2015c), but this was one of the common participant remarks in this study. Last but not least, the size of the SenseCam strap posed a limitation, as the SenseCam was probably designed with an adult frame in mind, thus the strap only allowed it to be adjusted to a certain height which still hung too low down the adolescents' chest. This did not allow full capturing of the meals in some positions, where the images were blocked by high tables and other obstacles. Some obstructions included items of clothing or hair blocking the lens **(see Figure 3-12)**. Such issues need to be addressed in the future design to allow SenseCam to serve its full potential in use as a dietary assessment tool.

**Figure 3-12 Example of obstacles to the SenseCam lens**



Other limitations of this study were related to bias of the participant sample. Although the study is qualitative and does not claim to be representative of UK adolescents, but the type of adolescent keen on volunteering in scientific research may not represent the typical UK teenager, who may be less interested in health and have a completely different lifestyle and views. Another factor that plays a role in result bias is parental socioeconomic status and education, whereby most participants seemed to come from middle-class backgrounds with most parents holding university degrees or at least leading stable careers. Outcomes of the study may (or may not) have been too different, had there been a more diverse small interview sample, but the possibility of such variation in outcomes would be explored in the coming section of the PhD research project, in questionnaires with a more diverse and representative sample.

## 3.6 Conclusion

This innovative study provided insight into the adolescent daily life and contexts surrounding their dietary choices, with particular interest in whole grain awareness, attitudes and consumption. Adolescents are a pro-active age group, interested and receptive to health messages – in need of targeting in ways which are relevant to their world. SenseCam is useful tool in exploring new topics in-depth, and as an interview prompt with adolescents. Future research based on this study could further assess the promising potential of SenseCam-assisted 24 hour recalls.

# Chapter 4 : STUDY III - Cross-sectional survey of whole grain intake correlates in British adolescents aged 11-16 years

## 4.1 Aims

This Chapter reports on Study III of this research, which was a cross-sectional survey with 160 adolescents recruited from three middle schools in a northern UK city. This study aimed to develop, test and administer a survey based on the RAA model, Studies I and II, as well as previous research, and identify whole grain intake correlates in a larger sample of UK adolescents.

## 4.2 Methods

### 4.2.1 Ethical approval and ethical issues

The University of Leeds MEEC Faculty Research Ethics Committee approved this study's protocol (MEEC 15-043). This study adhered to the guidelines laid down in the Declaration of Helsinki. Surveys, information sheets, consent forms, and all materials used were presented to the Ethics Committee in order to obtain ethical clearance.

Head teachers and all adolescent participants provided written informed consent along with parental/legal guardian assent. Assistant researchers were postgraduate students, with experience in field research and working with adolescents, with appropriate clearance for working with young people. The researchers had no prior contact with the participants. The aim of the research was presented on participant information sheets with researchers' academic affiliations. It was stated that the research was not influenced by any funders or third parties.

Participants were assigned with participants codes at the start of the survey session to maintain anonymity of the research. The codes consisted of a letter-number combination, with the letters corresponding to each participating school and the numbers indicating the participant number (e.g.: ABB001, ABB002, etc.…). The purpose of the codes was to maintain anonymity of the data, whilst allowing to trace participant data through PART 1 and PART 2 of the survey – as will be clarified in the following section. This allowed participants to answer honestly without the fear of being judged, which was further verbally highlighted as the questionnaires were conducted. Refer to **Appendix 7.4.1 - 1.1.1** for full details of all ethical issues addressed, the ethical approval document, information sheets, consent forms, and educational material used . The survey content will be discussed in the following section.

### 4.2.2 Questionnaire design

In this study, the survey developed comprised of two questionnaires:

- Part 1: a Food Frequency Questionnaire (FFQ) assessing whole grain intake
- Part 2: A newly devised questionnaire to measure whole grain intake correlates based on RAA

A full copy of the survey questions can be found in the **Appendix 7.4.6**. After the questionnaires and FFQs were completed and ethical approval obtained, the final online version was constructed using Bristol Online Survey[1]. The choice of online administration of the survey was to provide a fun, interactive classroom experience, allow for inclusion of easy-to-follow educational content, as well as ensure the accuracy of responses entered (such as where a minimum number of selections was required, or where comments were encouraged). The final online content was colourful and structured into a user-friendly and easy-to-follow style. The following section outlines the process of the questionnaire construction, along with examples from the final online version, displayed as screenshots from the Bristol Online Survey.

Before conducting the questionnaire with participants, and after obtaining ethical approval, the final online version of the full survey (Part 1 and Part 2) was piloted with a convenience sample of five adolescents. The final version of the questionnaire consisted of two main parts, and required approximately 40-45 minutes to complete, in total.

[1] Bristol Online Survey: https://www.onlinesurveys.ac.uk/

#### 4.2.2.1 Part 1: Food Frequency Questionnaire to measure whole grain consumption

The first part of the online questionnaires (Part 1) was a Food Frequency Questionnaire (FFQ) which attempted to measure weekly whole grain intake among the participants. The FFQ allowed for exploring associations between the various personal, socio-demographic, and lifestyle factors and whole grain consumption trends. The FFQ was conducted prior to Part 2 to ensure the lack of bias towards overestimating whole grain intake, which might be the case when participants are questioned about the benefits of whole grain and their consumption.

There was a need for a UK-based FFQ, and as not many studies have focused on whole grains in the UK, it was a challenge to design a FFQ for the purpose of this study. US-based FFQs have different food types/brands which may not be as applicable for use with British participants, and more general UK-based FFQs were too long and detailed to use with adolescents and had few wholegrain foods listed in them.

The literature was searched for FFQs targeting whole grain intake in the UK, which were scarce. One such FFQ  was found to be used in the WHOLEheart study (Ross et al., 2012; Brownlee et al., 2010), which was the HNR-MRC (Human Nutrition Research unit of the Medical Research Council) version of the EPIC FFQ (European Prospective Investigation into Cancer and Nutrition), with wholegrain food additions. The research team at Newcastle University were contacted by email and they kindly agreed to provide a copy of the FFQ used in their study. The FFQ was further adapted for use with adolescents in this research. All non-grain food items were eliminated in order to shorten the FFQ, as the original was considered too long for use with adolescents aged 11-16 years. This was especially true given the fact that they would need to complete a long Part 2 questionnaire after the FFQ. The final version used in this study consisted of a total of 49 food items, categorised into four main sections, with a section falling on each page of the online version. The four main sections/pages were: Bread and savoury biscuits, cereals, potatoes rice and pasta, and sweets and snacks.

The online FFQ started with instructions on how to fill out the FFQ (see **Figure 4-1**). It contained a reminder that all information provided will be kept completely confidential, and that they should indicate how often, on average, they have eaten each food item during the past week. The first question of the FFQ asked the participants to provide their unique “participant code”, which was allocated to them at the start of the session (see **Figure 4-2**).

**Figure 4-1 Sample screenshot of the online FFQ instruction page**

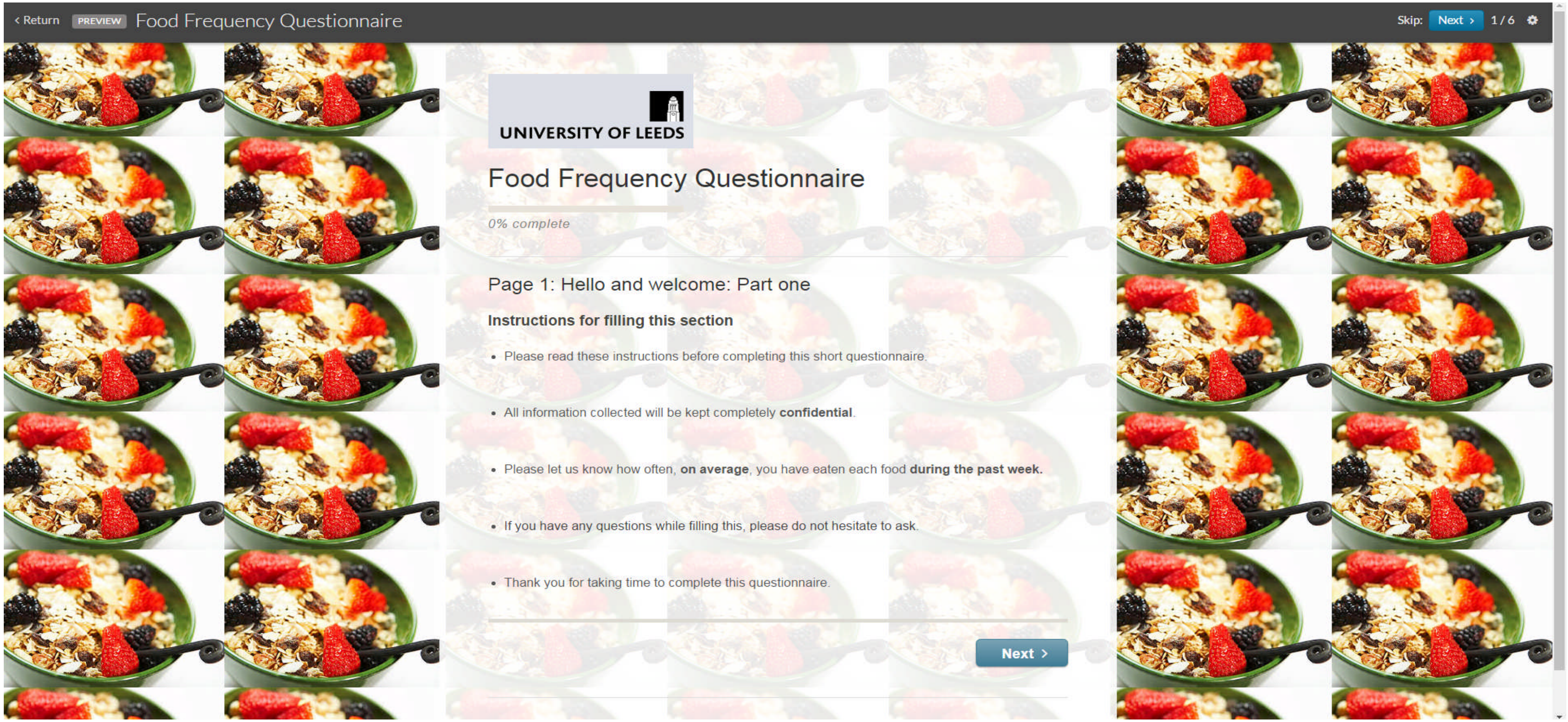


**Figure 4-2 Sample screenshot of the online FFQ first page**

The FFQ questions asked the participants how often they had eaten from the listed foods in the past week. A certain food type and a single serving quantity (e.g. white bread and rolls, white pitta bread (one slice/roll)) was provided at the far left of a grid, along with the option to tick a single box along the same row, indicating frequency of consumption per week. The options were: None, Once a week, 2-4 per week, 5-6 per week, Once a day, 2-3 per day, 4-5 per day, and 6+ per day. This allowed for an approximate quantification of participant weekly whole grain intake.

Each of the FFQ sections fell on a single page of the online version. At the end of each section/page, the participants were asked, in an open-ended question, to mention any food items of the same category that were not mentioned or any specific brands they often consumed which were not specified. They were also encouraged to indicate quantities and how often they consumed those (see **Figure 4-3**).

After the participants completed the FFQ, they were instructed to show the researcher(s) their completion receipt, and move on to the following section, Part 2 (see **Figure 4-4**).

**Figure 4-3 Sample screenshot of the end of each FFQ section/page**

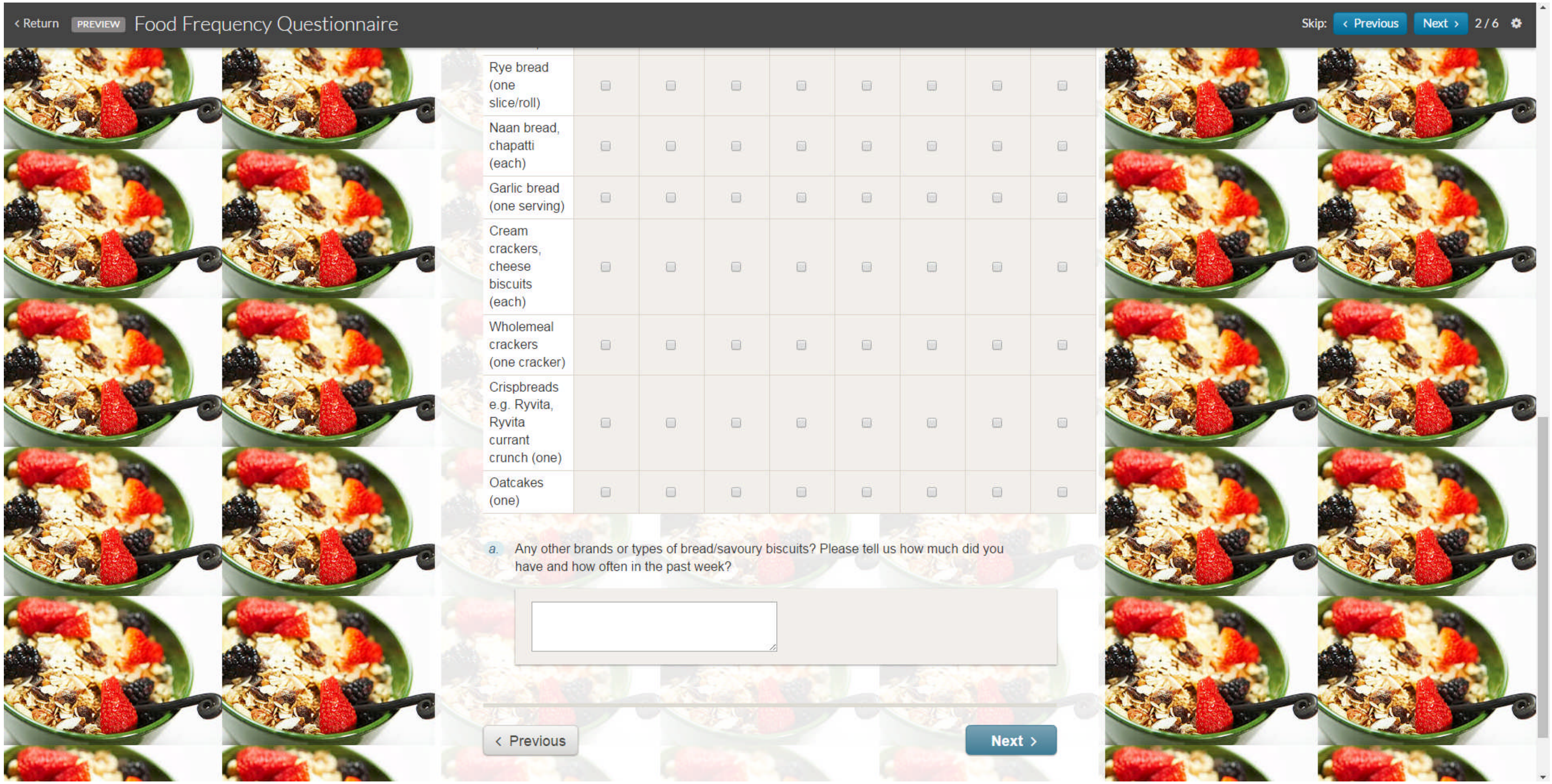
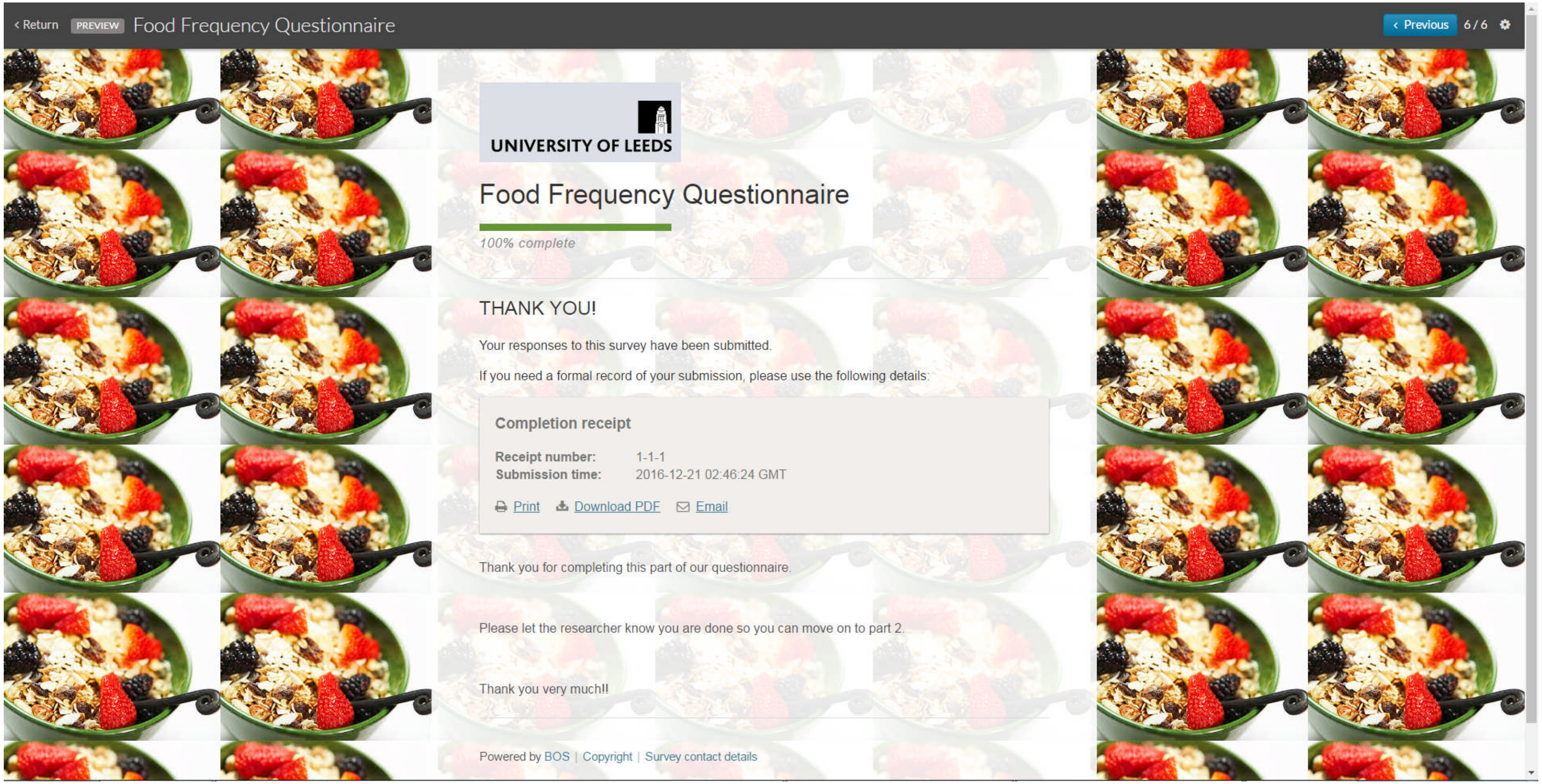


**Figure 4-4 Sample screenshot of the final page of the FFQ**



#### 4.2.2.2 Part 2: Correlates of whole grain intake

PART 2 of the questionnaire aimed to measure whole grain intake correlates. Questionnaire items were partially informed by Studies I and II (the focus groups and interviews). Some of the questions served to fill gaps in the answers to the research question, which were not possible to determine via focus groups and interviews, while others served as an addition and quantitative confirmation to information obtained in the previous formative stages. Examples of the former would be where focus group data appeared different to that generated in personal interviews (e.g. extent of parental influence on adolescent dietary choices, which may have been talked about differently in the focus groups due to peer influence). This Part 2 questionnaire aimed to generate self-report data on: whole grain identification, consumption levels and identification of popular varieties, as well as trends across gender, demographics, lifestyle and age groups.

Questionnaire items were also inspired by previous work with non-UK adolescents on whole grain intake (Bruening et al., 2012; Larson et al., 2010; Pohjanheimo et al., 2010) and other nutritional and health topics, as well as research on whole grains targeting other age groups (Kuznesof et al., 2012; McMackin et al., 2012; Muhihi, 2012; Rosen et al., 2011; Brownlee et al., 2010; Burgess-Champoux et al., 2008b; Burgess-Champoux et al., 2006; Croy and Marquart, 2005).

Use of the RAA theory constructs (see Chapter 1, **Figure 1-2**) as a base for the items was guided by a book published by the developers of the theory (Fishbein and Ajzen, 2011). Moreover, a questionnaire on a series of health behaviours, which was based on TPB and RAA (as RAA theory is relatively new and has not been used in many published studies) helped provide an example on the practical use of the theories in designing survey questions (McEachan et al., 2010). The psychometric measures/variables used to assess correlates of whole grain consumption in the questionnaire are fully described in **Appendix 7.4.7**, listed under the main RAA constructs, along with the corresponding survey questions, means, standard deviations, and ranges where applicable. A few non-RAA lifestyle factors were included to the questionnaire to explore possible associations with whole grain intake. Such factors were participants' frequency of eating out and whether they brought their lunch from home or bought it from school. Some of these factors were studied in relation to whole grain intake in the literature (Larson et al., 2010) and did not seem to fit under any of the described RAA constructs – thus were listed separately in the results.

The questions consisted of: multiple choice questions allowing for a single answer (n= 14); multiple-choice questions allowing for multiple answers (n=6); five-point Likert scale questions (n=4, with sub-questions); open-ended questions which followed multiple choice questions (n=8) (such as clarifications in case "other" was selected and suggestions); and stand-alone open-ended questions (n=2). There was a total of 25 questions.

Five-point Likert scale questions were mostly used to measure constructs of RAA theory, with many of the sub-questions measuring different aspects of the same construct, adding up to form an overall score for each participant. These were displayed in a grid, with answers ranging from Strongly Agree to Strongly Disagree, or from Always to Never – depending on the nature of the question.

The online main survey (Part 2) started with instructions on how to complete the questionnaire **(Figure 4-5)**. Participants were reminded that the questionnaire data were anonymous, confidential, and would only be used for research purposes. Moreover, they were assured that there were no right or wrong answers, but rather a matter of personal opinion. They were also encouraged to answer the questionnaires individually and not be influenced by their neighbouring participants' answers. The first question asked participants to enter their unique participant ID, which was the same one used in the FFQ section, allocated to them at the start of the session.

The questionnaire first asked participants general questions about lifestyle, environment, and health opinions/behaviours (see **Figure 4-6**). Then it proceeded to ask questions on whether they have heard of whole grains before, and what the first words that came to their minds were, when they hear the word "whole grain". If they had not heard of whole grains before, or were not sure, they were urged to give their best guess for this question.

**Figure 4-5 Sample screenshot of the online main questionnaire instruction page**

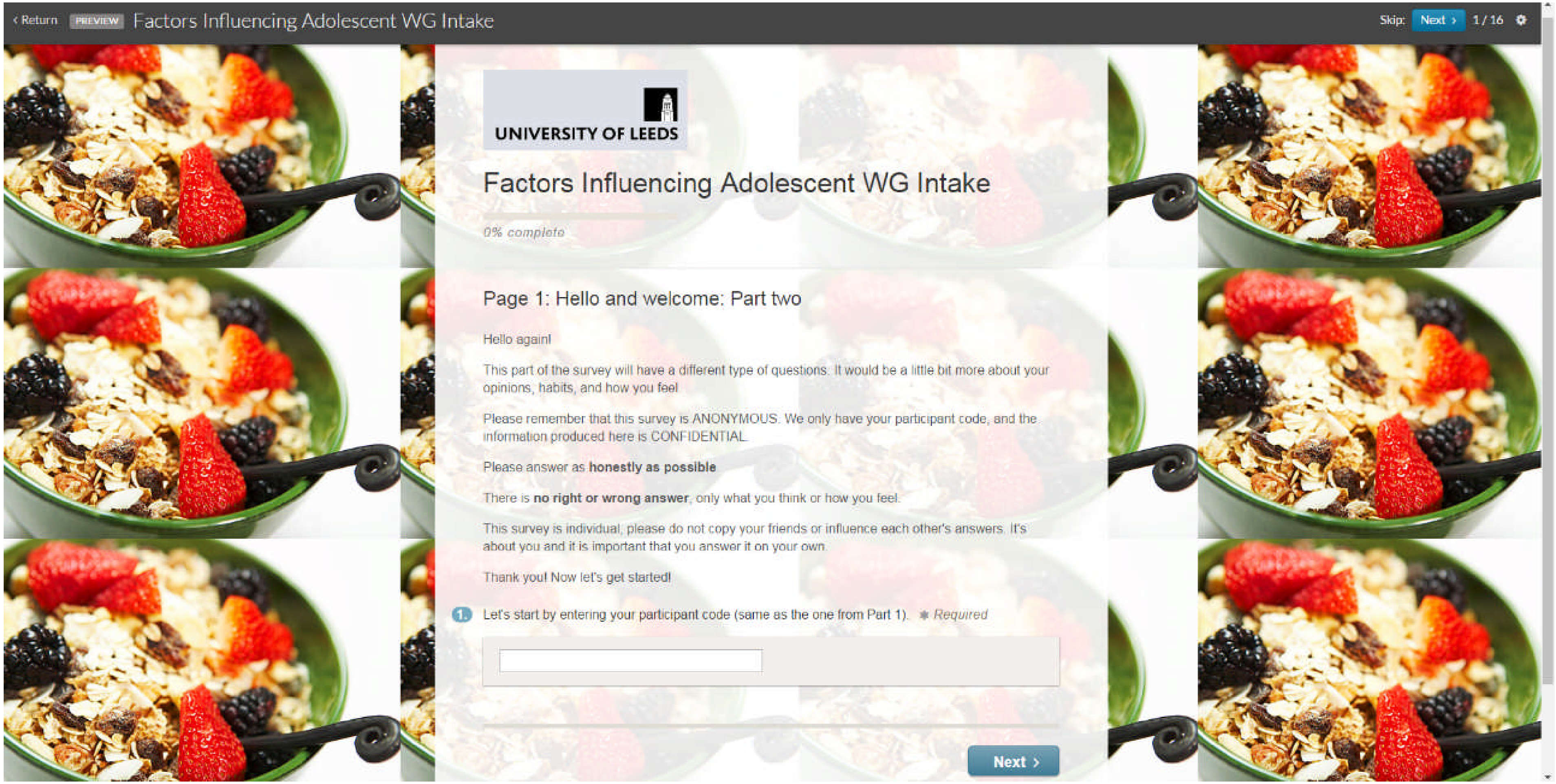
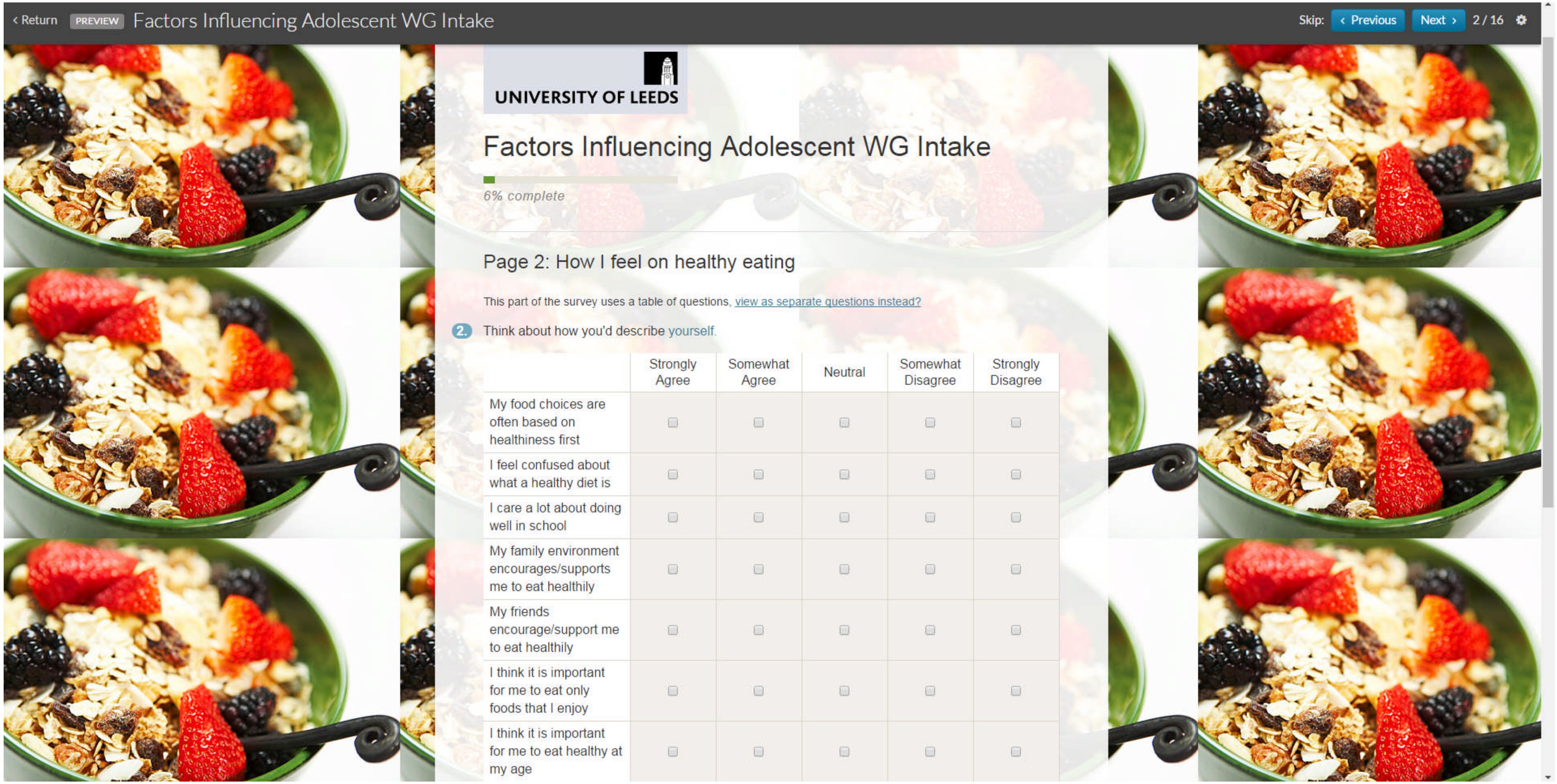


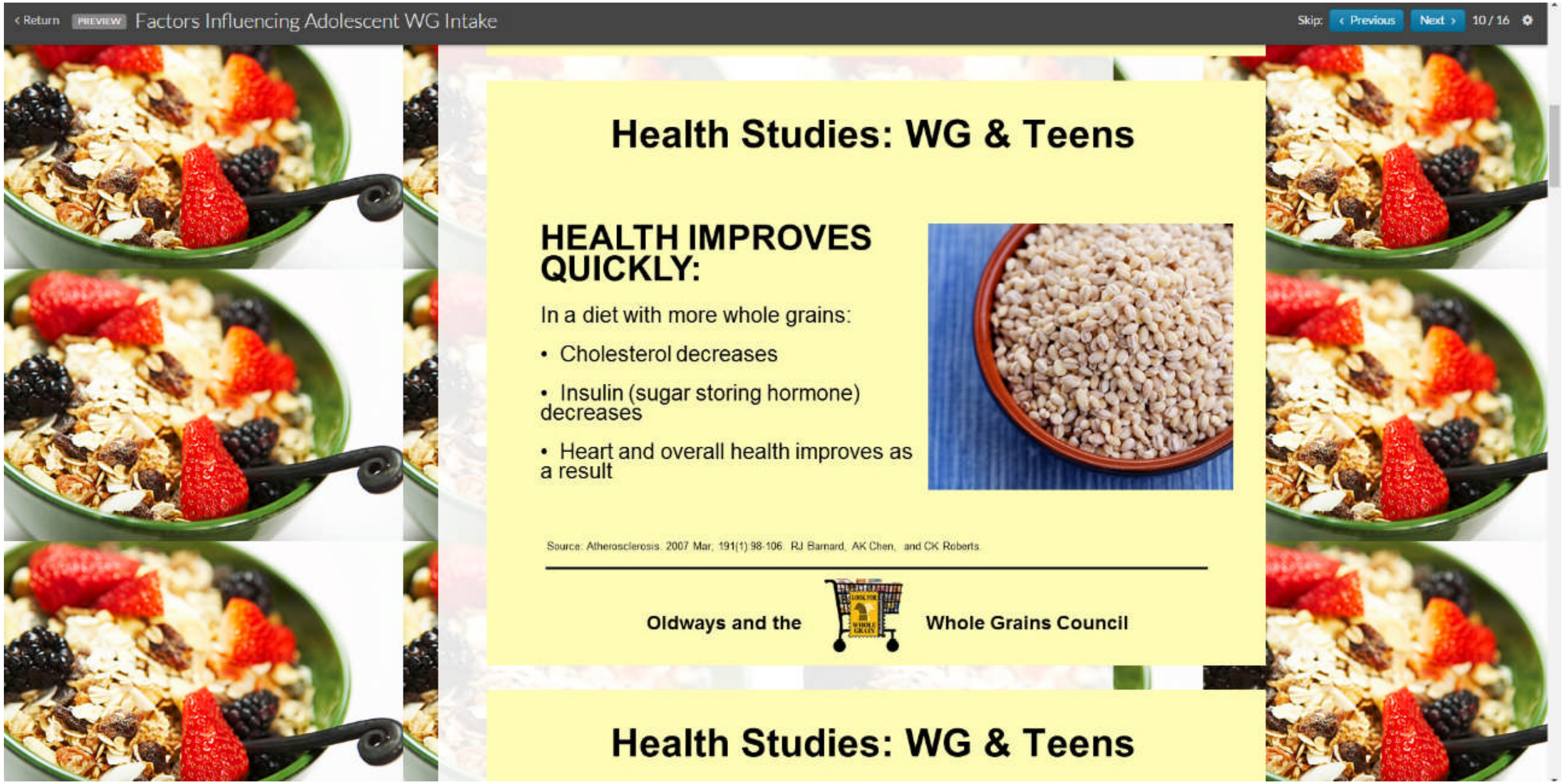
Figure 4-6 Sample screenshot of the online main questionnaire second question -- a five-point likert scale set of sub-questions



At this point, the questionnaire took the participants to view a few educational slides, with a brief definition of whole grains and some common examples. The slides were obtained from the Whole Grain Council website (Oldways and the Whole Grains Council, 2016) with very few additions to include whole grains commonly consumed in the UK. This educational section would allow the participants to answer the questionnaire further, without giving away too much at a given stage (such as health benefits of whole grains) as knowledge would need to be further explored in the questionnaire. It would familiarise the participants with the concept of whole grains, or act as a reminder for those who were previously aware.

The following questions focused on whole grain attitudes, knowledge, identification, and all the various personal, environmental and social factors which might influence its consumption. Questions on barriers to consumption and health benefits of whole grains were asked, followed by a second educational section (see **Figure 4-7**) . This section educated on or confirmed the health benefits, as listed in the previous question, as well as allowed the participants to learn about the portion sizes and whole grain identification techniques.

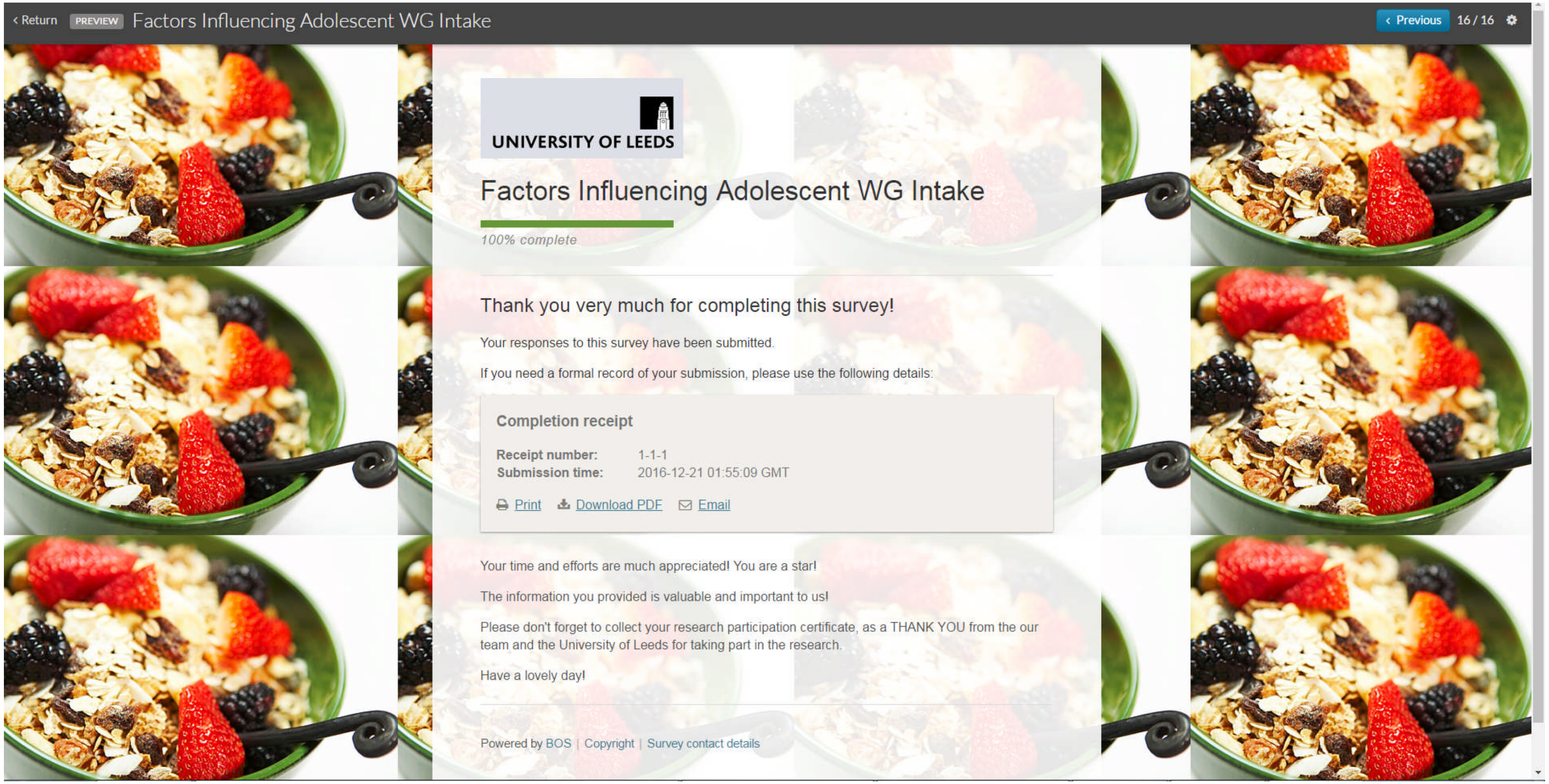
**Figure 4-7 Sample screenshot of the second educational section of the online main questionnaire**



Following the full education on the health benefits of whole grains, the participants were asked to suggest facilitators to consumption from a long list of facilitators (inspired from the formative part of the research study). They were also encouraged to suggest their own ideas. It was assumed that this question would best be placed directly after the education on health benefits, as the participants might be keen on making a change and improving whole grain awareness (as observed in the previous focus groups and interviews).

The questionnaire then asked more RAA theory-related questions surrounding whole grain consumption, such as those related to perceived behavioural control and the intention to consume more whole grains in the future. The questionnaire ended with demographic questions. The final page of the online questionnaire thanked the participants for their time and participation (see **Figure 4-8**), and reminded them to collect their research participation certificate (see **Appendix 7.2.4**). An educational Whole Grain Fact Sheet (see **Appendix 7.4.3**) was distributed to the participants at the end of the session. This was obtained from the British Dietetic Association website (BDA, 2016), being the latest published version (date reviewed: January 2016).

**Figure 4-8 Sample screenshot of the final page of the online main questionnaire**



### 4.2.3 School and participant recruitment

A total of 160 adolescents, aged 11-16, of mixed gender, ethnicity, and socioeconomic background participated in this study. They were recruited through schools within the Leeds City area. Exclusions were made to participants who did not speak the English language well – two students in the participating classes -- as an intermediate level of English understanding was required to fill the questionnaires.

The minimum sample size to be used in this study to enable an important difference was determined by power calculations (n=140). The main outcome was whole grain intake. One portion of wholegrain is 20g. Mean intake obtained from previous studies was 13g and the standard deviation was 18g (Thane et al., 2005).

In order to detect a difference of a half portion of 10 g, using a power of 90%, 69 participants would be needed in each group =140 participants. This would be the minimum to compare for example differences in wholegrain intake in males and females or differences in wholegrain intake between adolescents with high consumption of takeaway foods compared with those with low consumption. It assumes approximately equal size group. Therefore at least 140 participants would be needed for this study.

Participants were recruited through secondary schools using purposive sampling. The details of 42 secondary schools in the Leeds city area were researched and sorted in an excel spreadsheet. Twenty five schools were contacted by email. The schools were within the city of Leeds geographic area, coeducational, had a minimum of 20% ethnic minorities, and more than 1000 pupils aged 11 years plus, to ensure maximum representativeness and diversity of the sample. Four out of the twenty five contacted schools responded; however, one out of the four withdrew during the course of the research, and the study was conducted with the remaining three schools.

Schools that indicated an interest in taking part in this research received further information along with school information sheets and consent forms that had to be signed by the school head teacher. Participant information sheets and consent forms were also provided, which class teachers then delivered to pupils from school years 7 to 11 (approximate age 11 – 16 years). Signed consent forms from the young persons and their parent/guardian were required for study participation.

### 4.2.4 Conducting the questionnaires – data collection

The participating schools booked on-site computer rooms/school libraries for the online questionnaire sessions, whereby students would participate in groups of 20-25 participants per session, filling up the available allocated space. The arranged sessions took place during school hours, and a total of 8 sessions were needed for the completion of questionnaires by a total of 160 participants (in three different schools). The main researcher led the questionnaire sessions, with the help of two assistants (attending different sessions one at a time) and in presence of the corresponding class teacher.

The sessions started with the main researcher introducing the research team and giving a brief summary of the purpose of the study. The participants logged into the computers, as the research assistant collected the consent forms and allocated to each their unique participant ID code (see previous *Questionnaire design* section). Participants were reminded that the study was completely anonymous, as no names would be used, and were encouraged to answer as honestly as possible. Moreover, they were assured that the data would be stored and handled confidentially and that it would only be used for the purposes of this research.

Participants went through the online FFQs, raising their hands when help was needed or in case of any ambiguities. The main researcher and the assistant went around attending to the questions. Feedback was recorded, and especially in the case of the first session, some wordings of the FFQs and main questionnaire were altered accordingly to make them clearer after the session was complete.

After completing the main questionnaire (part 2), participants were required to show the research team the final “thank you page” before closing the window. They were then handed their Whole Grain Fact Sheet  (see previous *section 4.2.2*) and asked to tick their name off a class register, provided by the school. This allowed for the printing of their full names on their Certificate of Participation, which were posted to the school after the end of the research. However, it might be worth noting that the names were not traceable to the data, as they would have already submitted their answers and closed the window by time they ticked their names off. Only participant codes were used within the online questionnaires.

As mentioned, research participation certificates, signed and sealed by the University of Leeds School of Food Science and Nutrition, were posted to the participating students. Special certificates of appreciation (see **Appendix 7.2.5)** were also posted to the participating school teachers and staff, as a token of appreciation for their time and efforts.

### 4.2.5 Data input and preparation

Questionnaire data were downloaded from Bristol Online Survey and extracted into excel files. Data organising and coding was performed by the main researcher and a research assistant, a Masters student in Nutrition.

Data from both survey parts (Part 1: FFQs, and Part 2: Main Questionnaire) were merged into one excel file. The datasheet started with participant ID codes as the first column, and each participant had a long row containing all their answers, in raw form (as they appeared in the questionnaire). A certain set of codes was agreed on, a data dictionary was designed (eg: code 0=female, 1=male), and the coding process was commenced. **Appendix 7.4.8** details the legend/codes used for the purpose of the data analysis.

Ethnicity categories used in the questionnaires were obtained from the latest classifications on the Office for National Statistics website (Office for National

Statistics, 2011). As for socioeconomic status classifications, an article exploring whole grain intake in the latest NDNS (Mann et al., 2015) was used for reference, as well as a quick online search in recent relevant publications. All the searches lead to using the classification guidelines listed in the Office of National Statistics website (NS-SEC, re-based on SOC2010) (Office for National Statistics, 2016), to provide the best approximate socio economic status (according to profession). There were no data on income in this study, so the type of profession was used to obtain an estimate of SES for the participants' households, based on their guardians' occupations. Details of how the final SES index was calculated, which included parental/guardian education levels, can be found in **Appendix 7.4.8**.

Some survey items required reverse coding prior to analysis. This coding process comprised of allocating the lowest score to the highest outcome of the question. For example, a negative statement was required in some instances in the wordings of a question, such as: *I feel it is inconvenient to eat wholegrain foods,* where the participants chose the extent to which they agree/disagree with the statement on a five-point scale. When this question was included as part of a score on total attitudes towards whole grains, reverse coding was required in order to obtain a score that consistently reflected total whole grain attitude per participant (amidst a group of positive-statement questions measuring attitudes).

Data from the FFQ was refined, as some of the food items were not whole grain but included as part of the original FFQ (see section *4.2.2.1 Part 1: Food Frequency Questionnaire to measure whole grain consumption*). Moreover, some food items were not consumed (thus selected) by participants, or had very few selections. Therefore some of these had to be eliminated, while others had to be condensed into common categories – to allow for reasonable consumption levels per category. New categories were also built, based on commonly frequently consumed food items, which were indicated in the comment sections within the FFQ. An example would be the category "Other snacks, like cereal bars and Belvita", which many participants cited frequent consumption. **Table 4-1** lists the final categories/food items following data refining, comprising of a total of 21 items.

**Table 4-1 Final FFQ categories after data sorting and regrouping food items**

| | | | | |
|---|---|---|---|---|
| Brown bread and rolls | Weetabix | Wholemeal bread and rolls | Porridge | Readybrek |
| Cheerios | Flapjacks | Naan bread, chapatti | Wholemeal pasta spaghetti | Shredded Wheat Shreddies |
| Other snacks, like cereal bars and Belvita | wholegrain Cereal with fruits | Wholemeal pitta bread | Wholegrain crackers or rice cakes | Crispbreads like Ryvita |
| Brown rice | Branflakes | Meusli | Oatcakes | Granary bread |
| Rye bread | | | | |

After the process of coding and data preparation was complete, the dataset was copied into STATA 13.1 software (StataCorp., 2013) in preparation for examination of the data, cleaning and final sorting of the data, followed by statistical analysis.

### 4.2.6 Statistical analysis and data exclusion

All analysis of this study data – descriptive and regression – was conducted using STATA 13.1 software. Some graphs and figures were generated with the aid of excel – to enable more flexible editing and labelling of figures.

Descriptive statistics were used to examine the demographic characteristics of the study sample and explore correlates such as knowledge, some attitude aspects, barriers, and facilitators of whole grain intake. Normality of the whole grain intake curve obtained was assessed by kurtosis and skewness coefficients, and a positive skewness was observed. Therefore, a log transformation was used for the total whole grain intake variable, which produced an approximately normal curve (see *Results section 4.3.2.11*). The log-transformed data was used for analysis purposes, and will be the assumed data used when reference is made to whole grain intake throughout this study (unless explicitly stated otherwise).

T-tests and ANOVA tests were carried out on mean whole grain intake across basic demographic characteristics such as age, gender and SES groups, to assess the differences in mean intake. This was followed by regression analysis, with the main main outcome being: whole grain intake, servings per week (as measured through the FFQ). This was treated as the dependant variable to be regressed against all the independent variables or predictors of intake (the rest of the variables/RAA constructs). Data of the whole grain intake (outcome/dependant variable) were back-transformed during the regressions to obtain the final presented results.

Separate multilinear regression models were carried out for each variable to examine it against whole grain intake (see **Appendix 7.4.7** for complete list of variables). Then, the models were adjusted for confounders (listed in the following paragraph). After that, residuals were checked. All of the residuals were normally distributed. **Appendix 7.4.9** provides an example of one variable's regression analysis and residual checking as screenshots obtained from STATA, along with data outputs. At the end of the analysis, all of the variables (RAA constructs) were regressed together against the main outcome, to assess the overall variance explained by the RAA model.

The confounders which were adjusted for in the regression analysis were common demographic characteristics that have been found to be related to whole grain intake in previous research with adolescents, such as the study on project EAT cohort (Larson et al., 2010) and the latest NDNS analysis (Mann et al., 2015). Variables that were adjusted for were gender, age and family socioeconomic status. Ethnicity may have been used, however, the data on ethnicity in this study may not be reliable, as many participants seemed to choose the "other" option and write jokes in the space provided. Thus, ethnicity as a variable was excluded in this study. This is discussed in further detail later in the thesis.

A few other exclusions were made to the data, which included unclear guardian occupations in the open-ended demographics question. However, as the SES score was a composite of guardian occupation and education, no participant included unclear answers to both. It was possible to obtain an estimated score for all 160 participants. As for the FFQ data, there were not enough FFQ entries of more than two portions per day for most foods to justify having distinct intake codes beyond 2 portions per day (eg: 2-3 per day=17.5, and 4-5 per day=17.5, 6+ per day=17.5). Thus all selections indicating 2+ portions per day were allocated a single intake code of 17.5 (becoming: 2-3 per day=17.5, and 4-5 per day=17.5, 6+ per day=17.5) (refer to **Appendix 7.4.8** for data coding dictionary). After that, data were checked for exclusions to outliers in FFQ data, such as extremely high total whole grain intake (such as total intake that exceeded 42). A total intake exceeding 42 meant that the participant consumed 42/7=6+ portions of wholegrain foods every day. To check the assumption, the entries of participants who had scores of over 42 were examined individually and checked for errors in data entry. However, after the above coding adjustments were made (regarding 2+ portions per day=17.5), no participants had total whole grain intake scores exceeding 42. Thus no FFQ exclusions were made and 160 participant entries were included in the analysis.

Questions which were designed for regression analysis were mostly based on five-point Likert scales. Prior to the regression analysis, internal consistency was tested between related questions/sub-questions using Cronbach's alpha, where a score of >0.7 was considered acceptable (eg: questions testing attitudes towards whole grains). The questions whose combined scores produced an acceptable Cronbach's alpha were summed into a single total score and used as a measure of the corresponding factor (such as total attitude towards whole grain, for example). Several combinations were tested and combinations with acceptable internal consistencies were used in the regression analysis as predictors using total scores. The rest of the questions which did not produce acceptable Cronbach's alpha scores (total <0.7) were used individually as categorical variables in the regression analysis. Details of psychometric measures used in this study (RAA factors) and results of internal consistency testing for related questions (acceptable >0.7) can be found in **Appendix 7.4.7**.

As mentioned, when the data of a variable displayed an approximately normal distribution, such as the *attitudes towards whole grain* factor, the data was used as continuous in the regression analysis. However, in the case of non-normal distribution (as was the case of many variables) the data were cut into quantiles. This was achieved through examining distributions in descriptive statistics of the data. Most of the variables were divided into three or four tertiles or quartiles. For example: age range scores (three age categories), physical activity level scores (three physical activity categories), eating out frequency scores (three eating out frequency categories), etc...

The results of both descriptive and statistical analysis of the questionnaire data are presented in the following *Results* section.

## 4.3 Results

### 4.3.1 Demographic and lifestyle characteristics

The participants of this study (*n=160*) were mostly of white English ethnicity (75%), with a mean age of 14 years (range 11-16, sd ±1) and an almost equal number of both genders (males 51.3%, females 48.8%) (see **Table 4-2** for descriptive characteristics of study sample). The participants were all recruited through three secondary schools in the Leeds city area (see *Methods*) and evenly distributed among the four allocated socioeconomic status categories.

There were few participants with special diets – only 7.5% reported being vegetarian (with the exception of one participant who had a peanut allergy) (see **Table 4-3** for lifestyle characteristics). None of the participants had gluten intolerance or allergy, thus no exclusions based on special diet were necessary. Most of the participants reported a low level of habitual eating out (57%) and moderate to high levels of physical activity (26.9% and 39.4%, respectively). The majority of participants also reported to have heard of whole grains before (92.5%). There was a variety of answers when participants were asked to report whether their parents/guardians/family had encouraged them to eat more whole grains (directly or indirectly), with answers ranging from yes (38.1%), no (28.8%) to 33.1% claiming they were unsure or don't remember. When asked whether they believed they consumed the recommended three portions of whole grain a day, the majority of the participants answered in the negative (81.9% of participants). Only 18.1% claimed they consumed three servings of wholegrain food on most days.

**Table 4-2 Descriptive characteristics of research participants (*n=160*)**

| Demographic characteristic | N (%) |
|---|---|
| **Sex** | |
| **Female** | 78 (48.8%) |
| **Male** | 82 (51.3%) |
| **Age** | |
| **11-13** | 46 (28.8%) |
| **14** | 60 (37.5%) |
| **15-16** | 54 (33.8%) |
| **Mean (SD)** | 14 (1) |
| **Median (95% CI)** | 14 (0.15) |
| **Ethnicity** | |
| **White English** | 120 (75%) |
| **White Irish** | 1 (0.6%) |
| **White Gipsy** | 4 (2.50%) |
| **White Other** | 9 (5.6%) |
| **Mixed White and Black African** | 2 (1.3%) |
| **Mixed White and Black Caribbean** | 1 (0.6%) |
| **Asian (Indian)** | 2 (1.25%) |
| **Asian (Pakistani)** | 4 (2.5%) |
| **Asian (Chinese)** | 1 (0.6%) |
| **Black African** | 7 (4.4%) |
| **Black Caribbean** | 2 (1.3%) |
| **Other (Arab)** | 2 (1.3%) |
| **Other** | 5 (3.13%) |
| **SES distribution (ascending order – lowest to highest categories)*** | |
| **1** | 33 (25.2%) |
| **2** | 29 (22.1%) |
| **3** | 42 (32.1%) |
| **4** | 27 (20.6%) |

* SES categories assigned are explained in previous *Methods* section

**Table 4-3 Lifestyle characteristics of research participants (n=160)**

| Lifestyle characteristic | N (%) |
|---|---|
| **Physical activity** | |
| **Low activity** | 54 (33.8%) |
| **Moderate activity** | 43 (26.9%) |
| **High activity** | 63 (39.4%) |
| **Participants with a special diet*** | |
| **Yes** | 12 (7.5%) |
| **No** | 148 (92.5%) |

| | |
|---|---|
| **Eating out frequency** | |
| **Low/not often** | 92 (57.5%) |
| **Moderate** | 43 (26.9%) |
| **High/more often** | 25 (15.6%) |
| **Participants aware of whole grains** | |
| **Yes** | 148 (92.5%) |
| **No** | 12 (7.5%) |
| **Parental/guardian/familial encouragement to eat wholegrain foods (direct or indirect)** | |
| **Yes** | 61 (38.1%) |
| **No** | 46 (28.8%) |
| **Not sure/ don't remember** | 53 (33.1%) |
| **Participants believing they meet whole grain intake recommendations** | |
| **Yes** | 131 (18.1%) |
| **No** | 29 (81.9%) |

* As no participants had gluten allergy, no exclusions were made based on special diet

### 4.3.2 Results of descriptive analysis

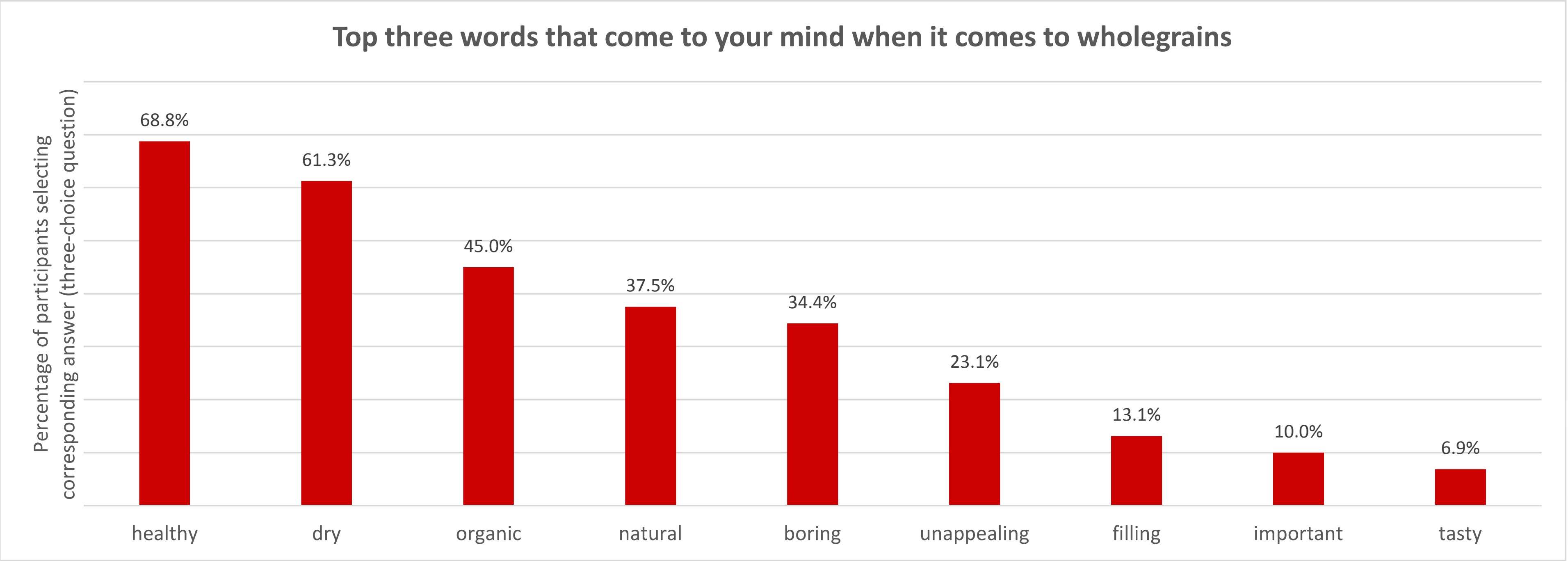
The questions included in the survey consisted of both descriptive and statistical analysis types, for a complete exploration of opinions as well as identification of correlations and predictors (refer to **Appendix 7.4.6.2** for full survey). The following results are the descriptive analysis questions exploring opinions of the participants, as well as common barriers and facilitators to whole grain consumption.

#### 4.3.2.1 Initial impressions on whole grains

After a few general healthy-eating related questions, participants were asked whether they had heard of whole grains (results listed in **Table 4-2**). This was followed by: "what are the top three words that come to your mind when it comes to whole grains?", with the option to select exactly three choices. **Figure 4-9** illustrates the percentage of participants indicating each of the choices, listed in descending order. Most of the participants immediately thought of whole grains as "healthy" (68.8%), which was a valid and positive impression. However, that was followed by thoughts that wholegrain food was "dry" (61.3%), and that whole grains were "organic" (45.0%) – with the latter being a common misconception. The top three choices make it hard to decide whether the general impression towards whole grains was positive or negative, and may indicate mixed feelings towards whole grains as a food group. These top three choices were followed by impressions that whole grains were natural (37.5%), boring (34.4%), unappealing (23.1%), filling (13.1%), important (10.0%), and finally tasty (6.9%). A closer look at the selection rates might indicate a higher level of negative feelings towards wholegrains by adolescents, whilst acknowledging their natural and healthy attributes.

An "other" option was available with this question, and while not all participants completed it, most of the answers revolved around whole grains being equal to bread or wholemeal toast. In the survey, this question was followed by a few slides familiarising the participants with the concept of whole grains, albeit as a brief, general definition withy some examples. It did not answer any of the following questions, but clarified the concept of whole grains with pictures of examples, to allow participants to proceed if their existing knowledge was poor.

**Figure 4-9 Percentages of participant selections in the question asking about the first impressions that come to mind about whole grains (three selections per participant)**

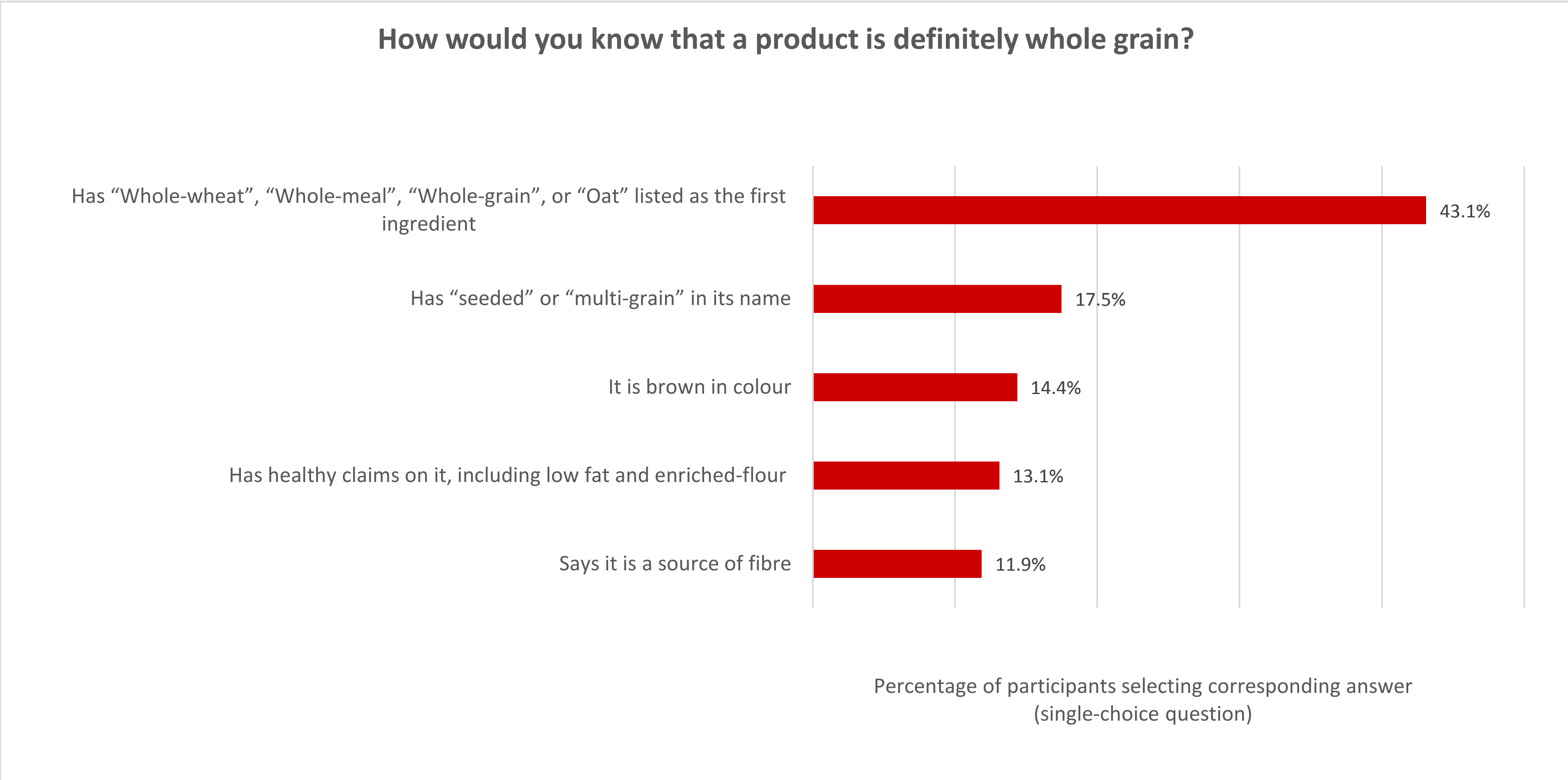


#### 4.3.2.2 Whole grain identification

The next question asked about whole grain identification, asking: “How would you know that a product is definitely whole grain?” Participants were only able to choose one statement which they believe best indicated that a product is whole grain **(Figure 4-10)**.

The results of this question showed a positive majority of the participants giving the correct answer, which was that a product would have “Whole-wheat, wholemeal, wholegrain or oat listed as the first ingredient” (43.1%). The rest of the answers listed properties that *could be* found in wholegrain foods but were not the definite identifiers. The second most highly guessed answer was that a product would have “seeded or multi-grain in its name” (17.5%) – a common misconception among adolescents in whole grain identification. Other answers were that the product would be “ brown in colour” (14.4% of the selections), “has healthy claims on it, including low fat and enriched flour” (13.1%), and finally that “it is a source of fibre” (11.9%).

**Figure 4-10 Percentages of participant selections in the whole grain identification question (single-choice question)**

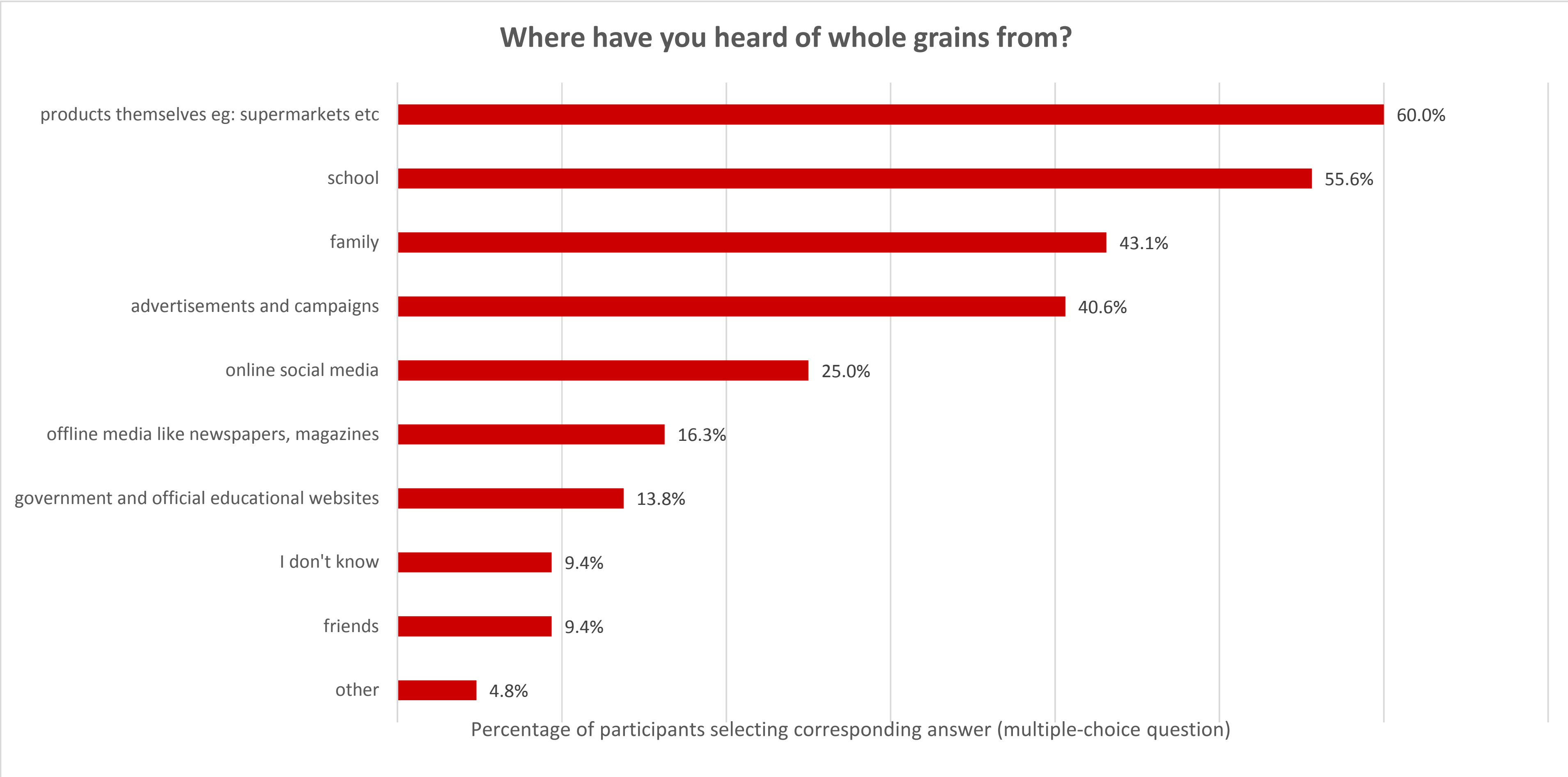


#### 4.3.2.3 Sources of whole grain knowledge

Participants were asked next: “where have you heard of whole grains from?”, with the option to select several answers **(Figure 4-11)**. The top sources of wholegrain knowledge among the participants were from products, such as in supermarkets and purchases (with 60% of participants selecting that option), from school (selected by 55.6%) and from family (selected by 43.1%). These were closely followed by advertisements and campaigns being major sources of whole grain knowledge (selected by 40.6%).

Participants also learnt about whole grains through online social media, such as Facebook, Instagram (selected by 25%), followed by offline media such as newspapers and magazines (selected by 16.3%) and sources like government and official educational websites (selected by 13.8%). A total of 9.4% were not sure where they heard of whole grains from, and a similar number indicated it was through friends. There was an “other” option which was selected by 4% of the participants. Open ended-answers were allowed for this option, but only two participants filled that in (with a meaningful answer). One of them reported having learnt about whole grains through some restaurant menus, and  the other said he heard about whole grains in the gym.

**Figure 4-11 Percentages of participant selections in the question asking about their source(s) of whole grain knowledge (multiple selections possible)**



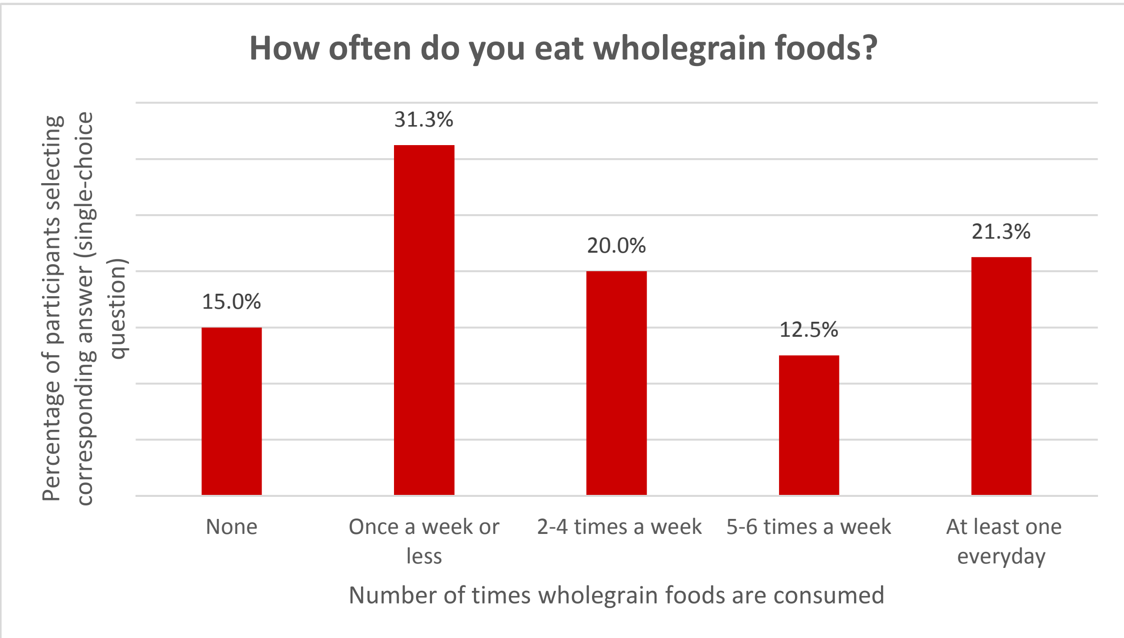
#### 4.3.2.4 Estimated self-reported levels of whole grain intake

Following the questions on knowledge of whole grains, the participants were asked to estimate their whole grain intake (see **Figure 4-12**). A single selection was allowed in this question. Note that this is different from measuring whole grain intake through the FFQ.

Starting from the most frequent consumption levels of at least one portion every day, 21.3% of the participants reported such frequent intake. This value seems logical when compared with the 18.1% of participants claiming to consume the recommended 3 portions of wholegrain foods daily in a previous question measuring whole grain consumption (see previous *section 4.3.1*). A further examination of consumption levels was carried out in the FFQs, and all self-reported consumption claims will be compared in the subsequent *discussion* section of this chapter.

As for the rest of the selections in this question, a lower number (12.5%) reported consuming wholegrain foods 5-6 times a week. A total of 20% consumed wholegrain foods 2-4 times a week. On the lower scales of consumption, 31.3% reported consuming wholegrain foods once a week or less, and 15% of the participants did not consume wholegrain foods at all.

**Figure 4-12 Percentages of participant selections in the estimated levels of whole grain intake question (single selection possible)**



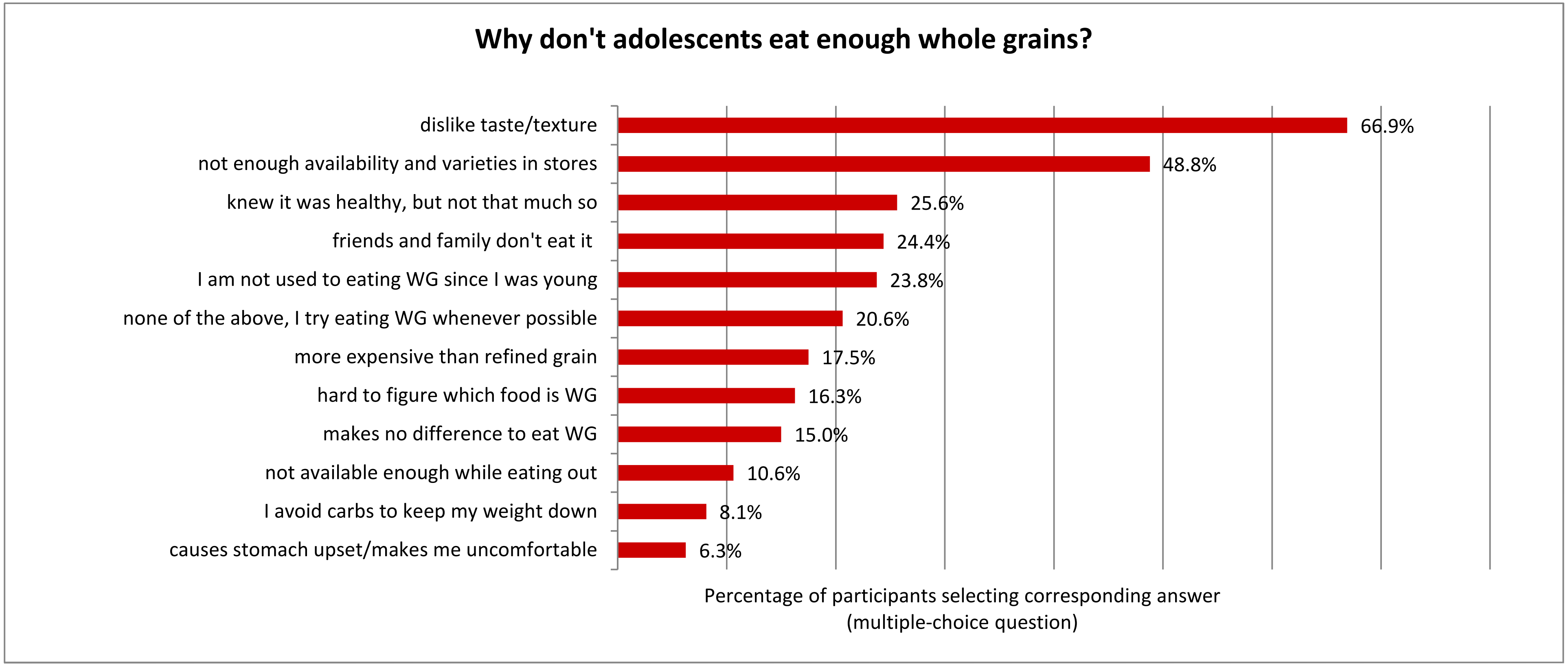
#### 4.3.2.5 Barriers to adolescent whole grain intake

Participants were asked what they felt were the barriers to achieving the recommended three servings per day, or to whole grain consumption as a whole **(Figure 4-13)**. The question allowed multiple selections per participant, and included an “other/comments” space for open-ended answers. Barriers are listed here in descending order of participant choice, starting from the most highly chosen one. The top barriers indicated by most of the participants were: Undesirable taste/texture of wholegrain foods (selected by 66.9% of the participants), the lack of whole grain availability and product varieties in stores (48.8% of the participants, of which 39.4% included the variety issue in their answer), and the fact that they knew it was somehow healthy, but not so much to make it worth the effort (25.6%). Closely following is the fact that friends and family don’t eat whole grains (24.4%), and then there was the issue of habit and that they were not used to eating wholegrains since they were young (23.8%). This is followed in percentage by the positive answer, being that none of these listed barriers are a major problem, and that they would eat whole grains whenever possible (23.8%).

Barriers of practicality and convenience followed, as 17.5% of the participants indicated that whole grain was more expensive than refined products, and 16.3% attributed identification as a barrier, and that it is “hard to figure out which food is whole grain”. A total of 15% of the participants thought that it made no difference to eat whole grain, thus didn’t realise that they were supposed to be doing so. This barrier was followed by availability, as 10.6% of the participants reported that whole grains weren’t available enough while eating out, and another 9.4% felt they were not available enough in supermarkets, shops, or bakeries. The final two (and least selected) barriers were carbohydrate-consciousness, as 8.1% reported not eating whole grains to avoid carbohydrates in their diet, and 6.3% cited that whole grains cause stomach upset or discomfort.

The “other/comments” option allowed participants to add their own barriers and make clarifications. Some of the participants felt that they liked to eat different varieties of food during the day, and not all varieties were available in “wholegrain”. Others mentioned that they didn’t like the colour, taste and that “there is never anything that tastes nice with it”. There was further emphasis on avoiding carbohydrates for weight loss purposes in the comments. Some paticipants said they could not be bothered thinking of what they ate, and others mentioned that they only eat whatever is available at home or in school, and would not want to make extra efforts. Availability at school was specifically mentioned by three of the participants. One participant said that she was the only one consuming whole grains at home, so it could be a waste to buy a whole loaf of bread just for her. A few said that they have heard of whole grains but didn’t know exactly what they were. One participant also mentioned that they had irritable bowel syndrome, thus would not eat high fibre diets.

**Figure 4-13 Percentages of participant selections in the barriers to whole grain consumption question (multiple selections possible)**



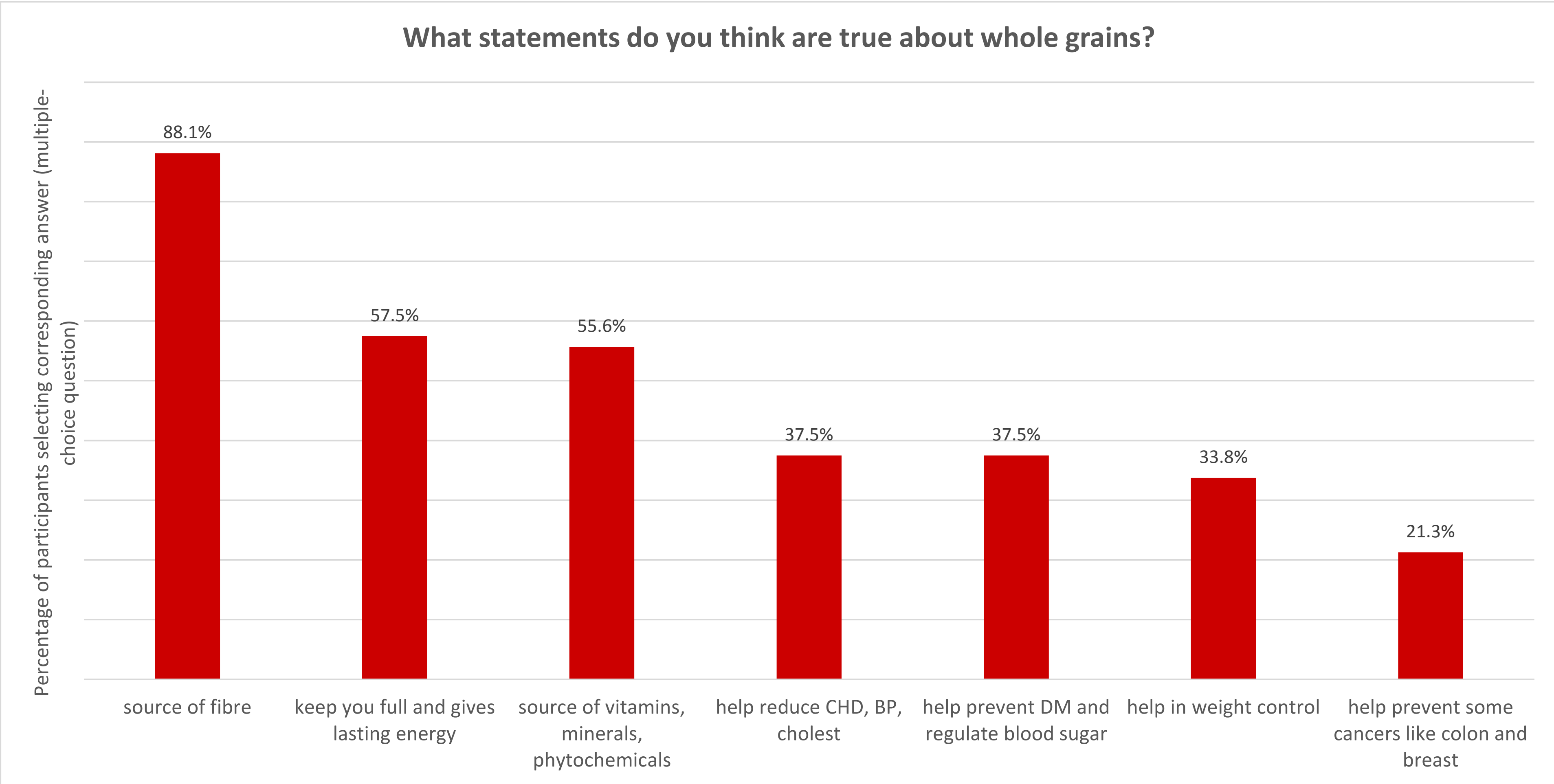
#### 4.3.2.6 Knowledge of whole grain health benefits

Participants were asked to select which statements they thought were true regarding whole grains, with a list of all the whole grain health benefits reported in the literature **(Figure 4-14)**. Participants were asked to select as many as they thought were true, and the correct answer was to select them all. Participants were also encouraged to add what other facts they thought were true about whole grains in a subsequent open-ended part of the question. This question served the double purpose of learning about adolescent whole grain awareness, as well as raising awareness through an educational slideshow confirming all these health benefits, which appeared after the question.

The whole grain health benefit most recognised by the participants was that whole grains were a source of dietary fibre (selected by 88.1% of the participants), followed by their satiety properties and providing long-lasting energy (57.5%), and that whole grains were a source of healthy carbohydrates, proteins, vitamins, minerals, antioxidants, and phytochemicals (55.6%). Some of the less recognised health benefits were that whole grains helped reduce the risks of cardiovascular disease, blood pressure, and high cholesterol (37.5%), as well as helping reduce risks of diabetes and regulating blood pressure (37.5%). Fewer participants believed whole grains helped in weight control and in reducing acne (33.8%) as well as reducing the risks of some cancers like breast and colon cancer – with that being the least selected answer (21.3% of participants).

When it came to the open-ended part of the question, where participants were encouraged to list what else they thought was true about whole grain and health, the majority of the participants simply said that they believed they were "somehow healthier" than other foods, because they felt they were "natural" and that they "make you stronger". Some participants expanded on their selection on whole grains being high in fibre and stated that high fibre foods help digestion and "keep the digestive system healthy" and "light". One of participants guessed that they must be a good addition to a balanced healthy diet "if they were good for you", and another guessed that they must be lower in harmful fat since they were dry in texture.

**Figure 4-14 Percentages of participant selections in the whole grain health benefits awareness question (multiple selections possible)**



#### 4.3.2.7 Suggested facilitators to whole grain intake by adolescents

The next question asked about facilitators to increased whole grain intake in adolescents, as suggested by adolescents themselves **(Figure 4-15)**. The question asked: "If you could do absolutely anything to increase whole grain intake in people your age, what do you think you'd do (the most effective)? Choose your top three". Participants would select three answers from the provided list, and add their own suggestion if they wished .

The top facilitators to increased whole grain intake among adolescents (in descending order) were: promoting the whole grain message through social media, with the help of popular celebrities (YouTube, Facebook, Instagram, etc.., selected by 43.8% of participants), educating parents/guardians about whole grains (selected by 39.4% of participants), and whole grain education in school subjects (selected by 31.3% of participants). Moreover, targeting TV celebrities was suggested (such as singers, bands, athletes, popular TV shows, etc.., selected by 26.9% of participants) along with increasing availability and varieties in shops and restaurants (26.3%).

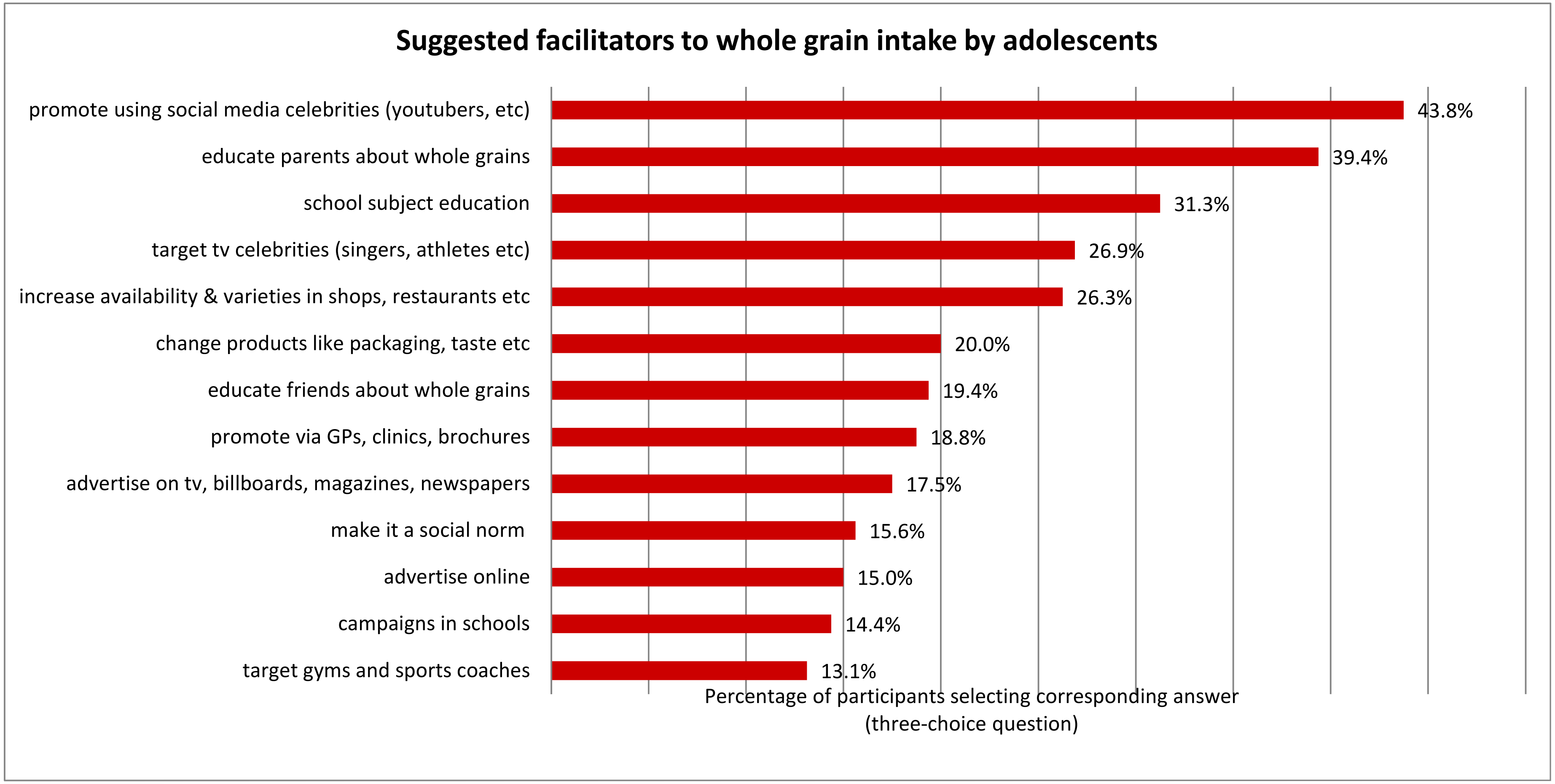
Following these top suggestions, changes in products such as packaging was selected by 20% of the participants, followed by educating friends about whole grains (19.4%), and promoting the whole grain message through GP's, nurses and brochures in clinics (18.8%). Participants also thought advertisements on TV, billboards, magazines and newspapers would help in promoting whole grains (selected by 17.5% of the participants), followed by making whole grains more of a social norm (selected by 15% of the participants) and using online advertisements (15%). Only 14.4% of the participants felt that campaigns in schools would be useful in promoting the whole grain message, and targeting gyms and sports coaches was the options with least selections, a total of 13.1% of the participants.

A large number of the participants left comments in the open-ended section, which were grouped and summarised qualitatively. Many of the participants' comments were related to taste, suggesting that wholegrain products should be made to "taste better" and should be included in foods that teenagers enjoy, "without them knowing" or noticing the difference. Examples such as chocolate wafers, desserts and "fun foods" were given. There was much emphasis on introducing new and interesting varieties, which was the highest chosen option (above) and was further stressed on in the comments section. Adolescents also felt that whole grains should be introduced in a gradual way to increase acceptance, and be mixed with refined popular foods, citing the example of 50-50 bread. Many participants also mentioned issues relating to developing a habit of consuming whole grains from a young age, suggesting that fun recipes should be promoted and given to parents, including ingredients and meals that "go best with whole grain" options. They felt that parents should be educated and try to introduce wholegrain varieties "in a fun way" at a young age, to help children get used to the taste and develop a habit from a young age.

Suggestions for increasing whole grain awareness included teaching about whole grains in school classes such as science and nutrition lessons, and creating campaigns in schools and nationwide "similar to the 5-a-day" fruit and vegetables campaign. Many participants stressed the need to clarify why wholegrains were better than refined grains, as people knew they were healthy but did not realise how much healthier they were and why. Participants thought that promoting such a message or campaign should be done in places which adolescents spend "waiting time", such as leaflets in bus stops and at GP clinics as well as a few slides in school assemblies. Some also suggested that the method of promotion should go "viral" and, in line with the top-chosen facilitator in the list (above), would thus be discussed by popular you tube channel celebrities if it became a "trending" topic. Fear-based promotion was mentioned by one of the participants as a method of "going viral", where comparisons between the outcomes of eating whole grains vs. the opposite lifestyle is made with exaggerations – just to "start the discussion". On the other hand, there was quite some mention of fun-based promotion which targets young people – using fun messages, jokes, or phrases – mostly mentioned with further suggestions on making the products themselves more "fun" as well, in terms of packaging, "as they were too "boring and basic".

Increased availability was also touched on in the suggestions, as several participants thought whole grains should be much more available in school canteens (which they did not feel promoted healthy eating as they should) and at a cheaper price (as they are currently the more costly option). One participant even felt that whole grains should be the only option available in school, which would be explained to students – thus allowing them to learn about whole grains, get at least two of their daily portions, as well as develop the habit and taste for wholegrain foods in their school years. Distributing samples of tasty wholegrain foods to take home was also suggested, which might get the adolescents to encourage their parents to purchase these products. Finally, one participant said that a whole aisle in the shops should be dedicated to wholegrain products (with explanations and informative boards), which would raise awareness as well as curiosity among customers.

**Figure 4-15 Percentages of participant selections in the facilitators to whole grain intake question (multiple selections possible)**



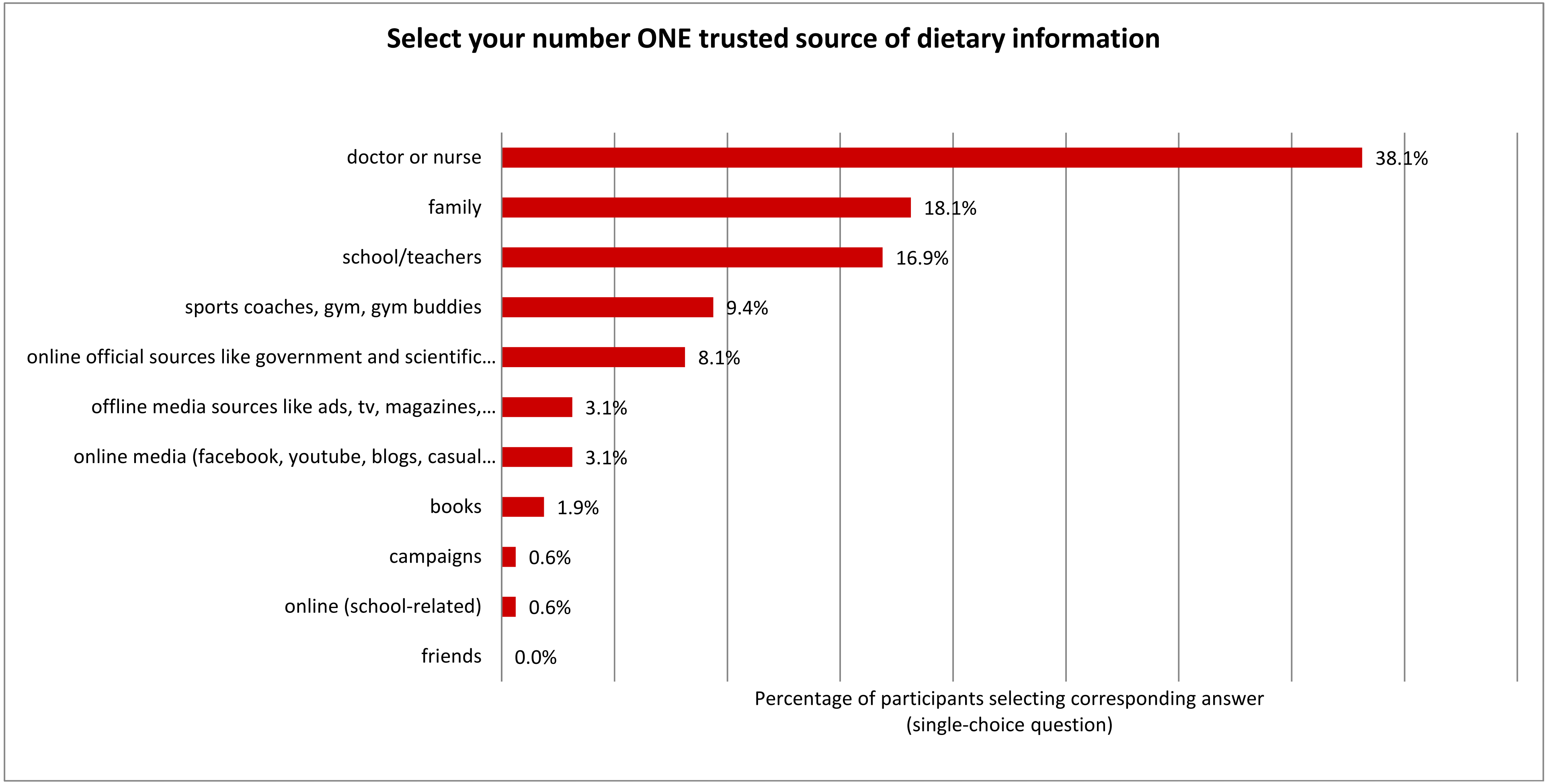
#### 4.3.2.8 Trusted sources of dietary information among adolescents

Further to learning what approaches might work best in promoting whole grains to this age group, adolescents were also asked about their most trusted sources of dietary advice and information **(Figure 4-16)**. This would help in exploring the means which young people were most receptive to – in addition to the methods explored in the previous section. Thus the following question was: "What source would you believe the most when you hear information about how healthy a specific food is? Read the whole list, then select your top choice." Participants would select their single top trusted source off the provided list.

The top three sources of dietary information among adolescents were (in descending order of choice): Doctors or nurses (selected by 38.1% of the participants), followed by family (18.1% of total selections), and school or teachers (16.9% of total selections).

The next sources indicated by participants were sports coaches and gym buddies (favoured by 9.4% of the participants), followed by media sources such as official government and scientific websites (8.1% of total selections). Next were social media sources such as Facebook, You Tube, blogs, etc (3.1%), as well as offline media sources such as mainstream ads, television, magazines, etc (3.1% of all selections). Online social media sources came at the lower end of the trusted-sources choices, despite being cited as the most effective means to deliver a whole grain promotion message to adolescents in the previous question (this is explored further in the *discussion*). Sources such as books were selected by 1.9% of the participants, and campaigns and school-related online websites by 0.6% (only one participant each). Friends were ranked as the least trusted of all sources when it came to dietary information, with no one selecting that option.

**Figure 4-16 Percentages of participant selections indicating their top trusted source of dietary information (single selection possible)**

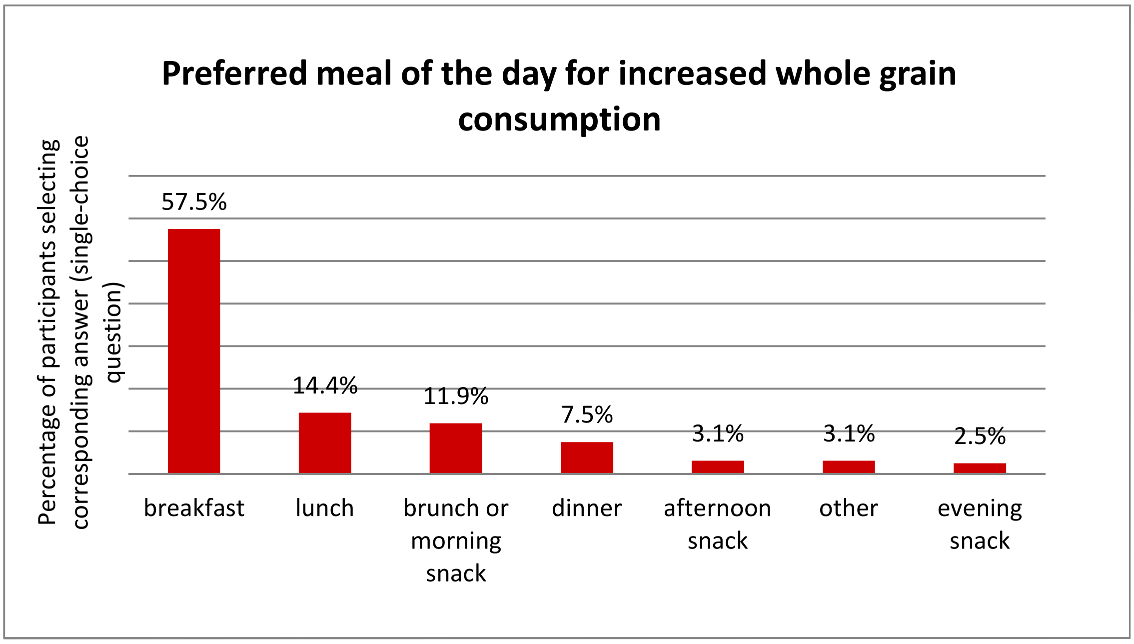


#### 4.3.2.9 Preferred meal of the day for whole grain inclusion/consumption

The next question probed into the most preferable time for whole grain consumption or inclusion in the adolescents' diet **(Figure 4-17)**. Participants were able to make one selection, along with an "other" option where they could explain further in the space below it.

Most of the participants chose breakfast as the best meal to include more whole grains (57.5% of the participants). This was followed by lunch (14.4%) and brunch or morning snack (11.9%) – both of which might be consumed at school on most days. A total of 7.5% of the participants thought dinner was the most favourable time of the day for whole grain inclusion, and 3.1% thought it would best be in an afternoon snack (perhaps after school?). A few participants selected "other" (3.1%), and finally, only four participants selected evening snack time (2.5%). All participants who chose "other" suggested that it could be at any time of the day.

**Figure 4-17 Percentages of participant selections indicating their preferred meal of the day for wholegrain consumption/inclusion (single selection possible)**



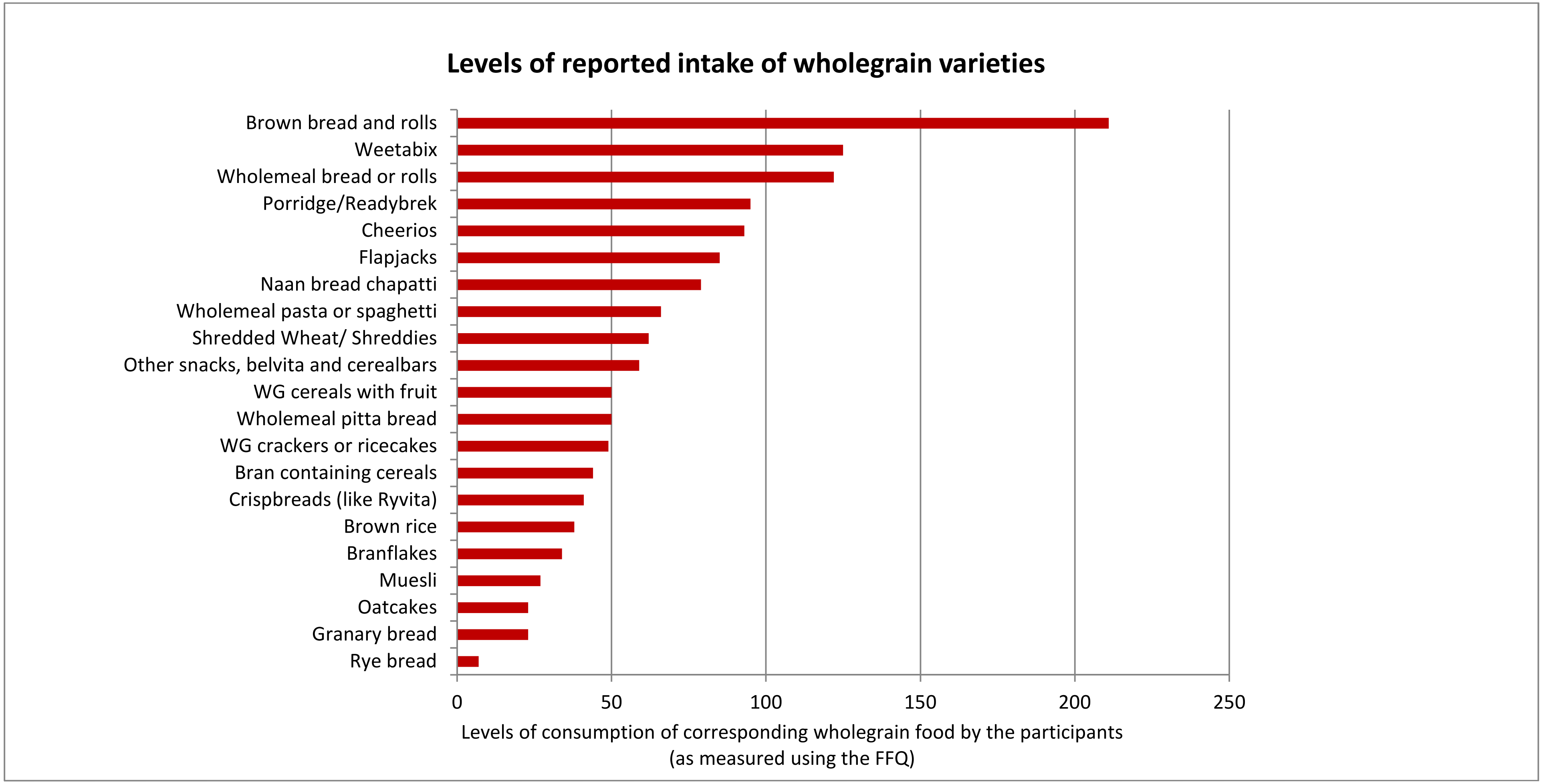
#### 4.3.2.10 Levels of reported intake of wholegrain varieties (FFQ data)

Participant consumption levels of wholegrain foods were measured using the FFQ, prior to completing the questionnaires (rationale explained in previous *methods* section).

The results are displayed in the following **Figure 4-18** in descending order of consumption levels (measured using a frequency-of-consumption six-point scale, refer to previous *methods* section).

According to the results obtained from the FFQs, the most highly consumed wholegrain foods among adolescents were wholegrain bread/rolls and wholegrain cereals – namely the brand *Weetabix* cereal variety. These two types form the top three most popular choices, of which the first and third were combined in the above statement, but serve as separate categories for other analysis purposes. Porridge and *Cheerios* breakfast cereals came next, with porridge being a category, but with *Cheerios* as the following top choice further serving to confirm the popularity of wholegrain cereals as a popular choice in this age group. Flapjacks rank next – usually consumed as a sweet snack, and is followed again by a bread type – the cultural Chapatti bread. Wholegrain pasta, cereal bars, wholegrain biscuits (with examples given by participants such as *Belvita* biscuits) fall within the middle range in terms of popularity in this age group. On the bottom of the list, among the least popular foods consumed by the adolescents in this study, were muesli cereals, oatcakes, granary bread, and rye bread.

**Figure 4-18: Levels of reported approximate intake of wholegrain varieties, as measured using the FFQ consumption range scores**



#### 4.3.2.11 Total whole grain intake (FFQ data)

Total whole grain intake was measured using the FFQ, which estimated weekly whole grain consumption per participant. This value was a sum of the consumption frequency scores of individual wholegrain food items in the FFQ (see **Appendix 7.4.8** for details).

Quantifying whole grain intake in grams was not possible in this study due to time limitations, as the composition tables with official whole grain content of foods consumed in the UK were officially published fairly recently (Jones et al., 2017). Therefore values obtained from the FFQ were used to indicate an estimated weekly whole grain intake, measured in servings/portions per week.

No exclusions were made to the data provided – with the exception of ethnicity, and 8 answers provided in the parental occupation question – which did not seem to be serious answers and thus had to be disregarded. There were no outliers in the FFQ total whole grain intake scores, with the cut-off for exclusions being a score above 30 (see *Methods* for exclusion criteria). Therefore, FFQ total whole grain intake data from all 160 participants were entered into the analysis.

As mentioned in the previous *Methods* section, the whole grain intake curve obtained was positively skewed, therefore, a log transformation was necessary to improve the normality of the curve. **Figure 4-19** illustrates the histogram of total whole grain intake after log-transformation. **Table 4-4** provides a descriptive summary of the trends in whole grain intake, by total whole grain intake, and grouped by gender, age groups, and socioeconomic status (SES). Both data from the original skewed data and the log transformed data are displayed (which was back-transformed to obtain original units).

Total whole grain intake ranged between 0 and 42 servings per week (*n=160*). The mean intake was 9.9 servings per week (95% CI 8.8-11.6) – approximately 1.4 servings per day – and 13.8% of all participants (22 out of 160) consumed no whole grain at all.

As can be seen in , upon testing differences between means of the different groups, whole grain intake varied significantly across gender groups (p<0.01) as well as SES categories (p<0.02). However, there were no significant differences across the different age groups or participants from the different recruited schools.

**Figure 4-19 Distribution of total whole grain intake (log-transformed)**

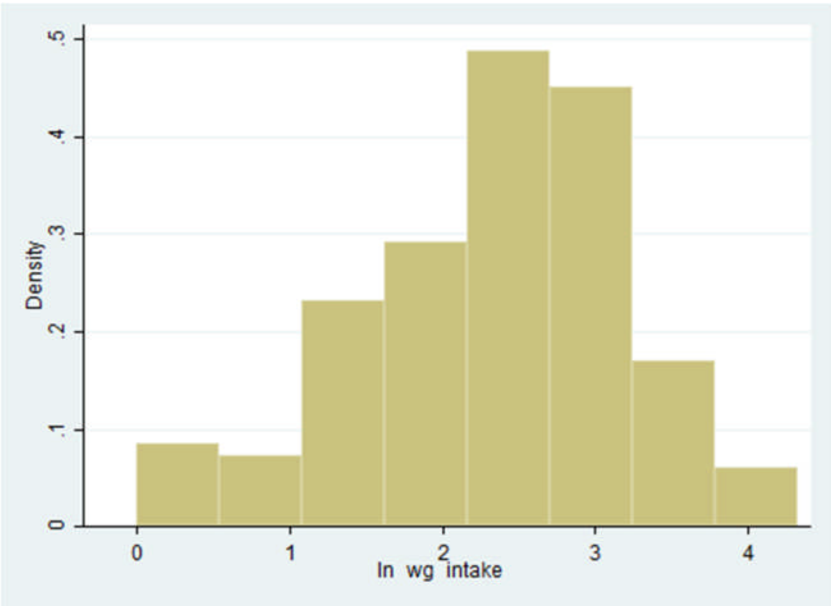


**Table 4-4 Descriptive summary of whole grain intake by total whole grain intake and then grouped by gender, age, SES. Both values from the original data and the geometric mean (back-trasnformed data) are displayed.**

| Variable | Total WG intake (original data) (servings per week) | | Geometric mean of total WG intake (back-transformed data) (servings per week) | | |
|---|---|---|---|---|---|
| | **Median** | **IQR** | **Mean*** | **95% CI** | **Test P Value (T-test or ANOVA)**** |
| **Total whole grain intake (n=160)†** | 12 | 5.3-17 | 9.9 | 8.8-11.6 | - |
| **Gender** | | | | | **Two sample t-test: p<0.01** |
| **Male (n=82)** | 15 | 7-22 | 12.3 | 10.2-15.0 | |
| **Female (n=78)** | 8.7 | 4-13 | 8.0 | 6.6-9.7 | |
| **Age group (years)** | | | | | ANOVA: P=0.24 |
| **11-13 (n=46)** | 12.5 | 5-19.5 | 11.4 | 8.6-15.1 | |
| **14 (n=60)** | 11.5 | 7-17 | 10.6 | 8.6-12.8 | |
| **15-16 (n=54)** | 11 | 4-16 | 8.6 | 6.5-11.2 | |
| **Socioeconomic status (lowest to highest)** | | | | | **ANOVA: P=0.02** |
| **Category 1 (n=33)** | 11 | 5-16 | 7.9 | 5.7-11.2 | |
| **Category 2 (n=29)** | 7 | 2-17 | 8.3 | 5.2-13.0 | |
| **Category 3 (n= 42)** | 11.5 | 7-16 | 10.8 | 8.7-13.5 | |
| **Category 4 (n=27)** | 15 | 12.5-25.5 | 14.9 | 11.1-20.2 | |
| **School attended** | | | | | ANOVA: p=0.08 |
| **School 1 (n=71)** | 10 | 5-17 | 8.8 | 7.1-10.9 | |
| **School 2 (n=43)** | 12.5 | 8-26 | 13.0 | 9.9-17.2 | |
| **School 3 (n=46)** | 12 | 5-15 | 9.8 | 7.6-12.6 | |

* Significant values displayed in **bold**
** The differences in the ratio of the population geometric means (back transformed)
† Range= 0-42

### 4.3.3 Predictors of whole grain intake

Results of the separate regression models with total whole grain intake (log-transformed) as the main outcome, followed by the adjusted values for age, gender, and family socioeconomic status (confounders), are displayed in **Table 4-5** at the end of this section. The factors are categorised in **Table 4-5** by the main RAA constructs and described below (for full RAA constructs: Chapter 1, *section 1.2.2*). Non-RAA factors are listed at end of the table (as well as this section), along with the results for the regression of all RAA construct variables to assess to what extent it explains the variance in whole grain intake. The marginally significant associations are highlighted in bold in the table *($p <0.05$)* and the significant ones highlighted in bold and underlined as well *($p \leq 0.01$)*. Due to multiple testing, the significant associations with a value *$p \leq 0.01$* after adjusting for confounders will be considered as the most important associations in this study.

#### 4.3.3.1 Background factors:

Gender differences in whole grain intake were significant when regressed against total whole grain intake, with males having a significantly higher whole grain intake than females in this study sample (exp coef.=1.56, *$p \leq 0.01$, adj $R^2$*=0.057) as well as after adjusting for confounders (exp coef.=1.47, *$p \leq 0.01$, , adj $R^2$*=0.098). Moreover, there were significant differences in whole grain intake between adolescents from the highest to the lowest socioeconomic status categories (exp coef.=1.89, *$p \leq 0.01$, adj $R^2$*=0.049), as well as after adjusting for confounders (exp coef.=1.88, *$p \leq 0.01$, adj $R^2$*=0.098). There were no significant differences in whole grain intake levels across age categories or the participating schools in this study.

Physical activity was significantly associated with increased whole grain intake (exp coef.=1.96, *$p \leq 0.01$, adj $R^2$*=0.093), as well as after adjusting for confounders (exp coef.=1.83, *$p \leq 0.01$, adj $R^2$*=0.169). Concern and prioritising healthy eating was also significantly associated with increased whole grain intake, explaining a relatively high level of variance (exp coef.=2.23, *$p \leq 0.01$, adj $R^2$*=0.178), as well as after adjusting for confounders (exp coef.=1.67, *$p$=0.02, adj $R^2$*=0.18).

A higher level of self-estimated whole grain consumption was also significantly associated with increased measured whole grain intake (exp coef.=2.39, *p ≤0.01, adj* $R^2$=0.088), but only marginally significant after adjusting for confounders (exp coef.=1.85, *p =0.04, adj* $R^2$=0.146). Participants were asked to select their estimated level of whole grain consumption, in a question separate from the administered FFQ. The results of this question served to confirm the FFQ outputs and the associations were significant (thus confirming the consistency of measured whole grain intake throughout the study).

#### 4.3.3.2 Attitudinal/behavioural beliefs and attitudes

Almost all factors measuring attitude towards whole grain were significantly and positively associated with increased levels of whole grain intake. There were several questions which added up to form a whole grain attitude score (instrumental), and they were tested in combination with other questions as well to generate more attitude scores (all combinations were internally validated for consistency using Cronbach's alpha, see this chapter's *Methods*). A few questions were tested separately as well (related to experiential attitude), since they had low internal consistency values when combined and could not be grouped.

An overall positive attitude (experiential) towards wholegrain foods was significantly associated with increased whole grain intake (exp coef.=1.05, *p ≤0.01, adj* $R^2$=0.044), as well as after adjusting for confounders (exp coef.=1.05, *p ≤0.01, adj* $R^2$=0.13). This was a total score of all questions measuring experiential attitude. This score was added to the score of another question measuring the importance of whole grain promotion and increased intake (experiential + instrumental), and also yielded a significant positive association with whole grain intake (exp coef.=1.04, *p ≤0.01, adj* $R^2$=0.039), as well as after adjusting for confounders (exp coef.=1.04, *p ≤0.01, adj* $R^2$=0.126). Furthermore, the score for the attitude questions was also added to scores from two questions measuring perceived barriers of time, convenience and cost. In spite of these barriers, positive attitudes to whole grain were still significantly associated with increased whole grain intake (exp coef.=1.06, $p \leq 0.01$, *adj* $R^2$=0.077), as well as after adjusting for confounders (exp coef.=1.05, $p \leq 0.01$, *adj* $R^2$=0.163).

Two questions on attitudinal factors were regressed on its own in order to test if RAA's instrumental aspect of attitude was associated with behaviour (especially since most other questions and combinations were related to experiential attitudes). The perceived importance of promoting the whole grain message and of increasing whole grain intake was significant when regressed against whole grain intake (exp coef.=1.10, $p \leq 0.01$, *adj* $R^2$=0.030), but not after adjusting for confounders. The second instrumental attitude factor showed significant association with increased whole grain intake: a sense of regret if whole grain was not consumed as recommended; being marginally significant only before adjusting for confounders (exp coef.=2.22, $p = 0.03$, *adj* $R^2$=0.03).

#### 4.3.3.3 Normative beliefs and perceived norms

Most of the factors under normative beliefs (referring to the influence of social norms and important people in the surroundings) were only positively associated with whole grain intake before adjustment for confounders (with the exception of one factor, as explained below).

A perceived supportive family or friend environment (to whole grain intake) was not significantly associated with increased whole grain intake when tested separately. However, when both family and friend environments were supportive and encouraged increased whole grain intake (a separate question), the association with increased whole grain intake was both positive and significant, before adjusting (exp coef.=2.47, $p \leq 0.01$, *adj* $R^2$=0.073), and after adjusting for confounders (exp coef.=1.79, $p \leq 0.01$, *adj* $R^2$=0.187). This was the only normative factor which maintained a significant association to increased whole grain consumption after adjusting for confounders. These factors fall under injunctive norms.

Perceived whole grain consumption by family and friends (descriptive norm) was significantly associated with increased whole grain intake (exp coef.=2.27, *p ≤0.01, adj* $R^2$=0.043), but not after adjusting for confounders.

When both perceived supportive friend and family environment, as well as consumption of wholegrain foods (by family and friends) were combined, a significant association was found (exp coef.=1.08, *p ≤0.01, adj* $R^2$=0.023). However, when adjusted for confounders, the association was not significant. Therefore a combination of both injunctive and descriptive norms was not more powerful – and injunctive norms on their own had stronger associations and explained a higher variance in whole grain intake.

#### 4.3.3.4 Control beliefs and perceived behavioural control

Most of the factors that fall under RAA theory's control beliefs and perceived behavioural control (which are mainly equivalent to self-efficacy and autonomy: perceived degree of control over doing the behaviour), did not yield significant associations with increased whole grain intake.

The only factor which was significantly associated with increased whole grain intake was helping in making food decisions related to their meals and the family meals. This factor could be used as a measure of autonomy in young people, and participants who had scored higher on it were more likely to consume whole grains, after adjustment to confounders (exp coef.=1.09, *p =0,03, adj* $R^2$=0.127).

#### 4.3.3.5 Actual control: skills/abilities/environment

When it came to RAA factors measuring *actual control,* perceived barriers of time, cost and inconvenience were not significantly associated with whole grain intake. However, one of the factors strongly associated with increased levels of whole grain intake, was the availability of wholegrain foods in the home and surrounding environment – being significant both before adjusting for confounders (exp coef.=2.88, *p ≤0.01, adj* $R^2$=0.116) and after adjusting (exp coef.=3.00, *p ≤0.01, adj*

$R^2$=0.210). As can be noted, it explained the highest variance in whole grain intake among all factors in this study.

#### 4.3.3.6 Intention

Being the last and most direct RAA factor related to a changed behaviour (mediated by *actual control*), the intention to an increased whole grain consumption (near present and future) was significantly associated with increased whole grain intake only after adjusting for confounders (exp coef.=1.38, *p ≤0.01, adj* $R^2$=0.11). Before adjusting, it was only marginally significant (exp coef.=1.31, *p =0.02, adj* $R^2$=0.06).

#### 4.3.3.7 Non-RAA-construct factors

Additional factors were added to test non-RAA-related influences on whole grain intake, based on interesting points raised in the interviews (Study II). Bringing lunch from home was not significantly associated with increased whole grain intake. Conversely, getting lunch from school was negatively associated with whole grain intake – significant before adjusting for confounders (exp coef.=-1.91, *p ≤0.01, adj* $R^2$=0.058), as well as after (exp coef.=-2.28, *p ≤0.01, adj* $R^2$=0.148).

Similarly, frequency of eating out was negatively associated with whole grain intake (exp coef.=-0.40, *p ≤0.01, adj* $R^2$=0.072), remaining significant when adjusted for age, gender and SES (exp coef.=-0.38, *p ≤0.01, adj* $R^2$=0.172).

#### 4.3.3.8 RAA as a predictor of whole grain intake

Upon regression of all the RAA constructs against the main outcome (whole grain intake), it was evident that the model explained 19.9% of the variance in whole grain intake (*adj* $R^2$*=0.199*).

The variance in whole grain intake explained by the factors in this study consistently improved upon adjusting for confounders.

**Table 4-5 Associations of lifestyle, personal, social and background factors with whole grain intakea (the main outcome), listed under the main RAA constructs, and a few non-RAA constructs (end of the table). Overall predictability of RAA model is indicated at the end of the table.**

| Factor | Regression (Unadjusted for confounders) | | | | Regression (After adjusting for confounders[a]) | | | |
|---|---|---|---|---|---|---|---|---|
| | Exp (Coef.) | 95% CI | P value[b] | Adjusted $R^2$ | Exp (Coef.) | 95% CI | P value[b] | Adjusted $R^2$ |
| **Background factors: individual, information and social background** | | | | | | | | |
| Gender | **1.56** | **1.18-2.06** | **<0.01** | **0.057** | **1.47** | **1.08-2.00** | **0.01** | **0.098** |
| Age | 0.73 | 0.51-1.06 | 0.09 | 0.007 | 0.74 | 0.49-1.09 | 0.12 | 0.098 |
| Family socioeconomic status | **1.89** | **1.19-2.99** | **0.01** | **0.049** | **1.88** | **1.19-2.95** | **0.01** | **0.098** |
| Physical activity | **1.96** | **1.42 2.69** | **<0.01** | **0.093** | **1.83** | **1.29 2.60** | **<0.01** | **0.169** |
| Prioritising healthy eating in food choices | **2.23** | **1.14 4.39** | **<0.01** | **0.178** | **1.67** | **0.77 3.63** | **0.01** | **0.18** |
| Prioritising taste and enjoyment in food choices | 0.50 | 0.26 0.96 | 0.05 | 0.021 | 0.49 | 0.23 1.04 | 0.06 | 0.115 |
| Uncertainty on what comprises a healthy diet | 0.95 | 0.57 1.59 | 0.84 | 0.035 | 0.92 | 0.52 1.63 | 0.780 | 0.112 |
| Caring about doing well in school | 0.63 | 0.18 2.18 | 0.46 | 0.026 | 0.32 | 0.05 1.85 | 0.20 | 0.123 |
| Self-estimated whole grain consumption (measured through survey not FFQ) | **2.39** | **1.45 3.94** | **<0.01** | **0.088** | **1.85** | **1.03 3.32** | **0.04** | **0.146** |
| Ability to identify wholegrain foods | 1.17 | 0.88 1.57 | 0.27 | 0.001 | 1.19 | 0.87 1.64 | 0.28 | 0.099 |
| Knowledge of whole grain health benefits | 1.04 | 0.97 1.12 | 0.3 | 0.00 | 1.01 | 0.93 1.10 | 0.74 | 0.092 |
| **Behavioural/attitudinal beliefs, and Attitudes** | | | | | | | | |
| Positive attitudes on whole grains (experiential) | **1.05** | **1.01 1.09** | **<0.01** | **0.044** | **1.05** | **1.01 1.09** | **0.01** | **0.13** |

| Factor | Regression (Unadjusted for confounders) | | | | Regression (After adjusting for confounders[a]) | | | |
|---|---|---|---|---|---|---|---|---|
| | Exp (Coef.) | 95% CI | P value[b] | Adjusted $R^2$ | Exp (Coef.) | 95% CI | P value[b] | Adjusted $R^2$ |
| Positive attitudes on whole grains plus thinking promoting whole grains is important (experiential+ instrumental) | **1.04** | **1.01 1.07** | **<0.01** | **0.039** | **1.04** | **1.00 1.07** | **0.01** | **0.126** |
| Positive attitudes on whole grains despite perceived barriers of time, convenience and cost | **1.06** | **1.02 1.09** | **<0.01** | **0.077** | **1.05** | **1.01 1.10** | **<0.01** | **0.163** |
| Perceived importance of increased whole grain intake (instrumental) | **1.10** | **1.02 1.19** | **0.01** | **0.030** | 1.08 | 0.99 1.18 | 0.1 | 0.111 |
| Feeling regret if they don't eat whole grains (instrumental) | **2.22** | **1.09 4.54** | **0.03** | **0.03** | 1.47 | 0.69 3.16 | 0.32 | 0.09 |
| Feeling that eating more whole grains is a moral issue (instrumental) | 0.96 | 0.33 2.83 | 0.95 | 0.03 | **0.75** | 0.25 2.28 | 0.61 | 0.097 |
| **Normative beliefs and perceived norm** | | | | | | | | |
| Perceived supportive family environment (injunctive norm) | 1.58 | 0.76 3.30 | 0.22 | 0.065 | 1.72 | 0.59 4.97 | 0.31 | 0.126 |
| Perceived supportive friends environment (injunctive norm) | 2.08 | 0.73 5.94 | 0.17 | 0.025 | 1.85 | 0.64 5.33 | 0.25 | 0.111 |
| Perceived overall supportive family and friend environment (injunctive norm) | **2.47** | **1.38 4.41** | **<0.01** | **0.073** | **1.79** | **0.96 3.33** | **0.01** | **0.187** |
| Perceived whole grain consumption by family and friend environment (descriptive norm) | **2.27** | **1.18 4.39** | **0.01** | **0.043** | 1.67 | 0.83 3.34 | 0.15 | 0.101 |
| Perceived support and consumption of wholegrain foods by family and friends (overall perceived norm) | **1.08** | **1.00 1.14** | **0.01** | **0.023** | 1.04 | 0.96 1.11 | 0.25 | 0.098 |
| **Control beliefs and perceived behavioural control** | | | | | | | | |
| Perceived capacity to eat more whole grains, if it were entirely up to them (capacity) | 1.11 | 0.57 2.15 | 0.77 | -0.005 | 0.93 | 0.44 1.99 | 0.86 | 0.085 |

| Factor | Regression (Unadjusted for confounders) | | | | Regression (After adjusting for confounders[a]) | | | |
|---|---|---|---|---|---|---|---|---|
| | Exp (Coef.) | 95% CI | P value[b] | Adjusted $R^2$ | Exp (Coef.) | 95% CI | P value[b] | Adjusted $R^2$ |
| change their behaviour, if they wanted to (capacity) | 1.10 | 0.49 2.48 | 0.81 | 0.047 | 0.99 | 0.4 2.45 | 0.97 | 0.114 |
| Perceived control on whether to eat whole grain or not to (autonomy) | 1.38 | 0.73 2.6 | 0.3 | 0.01 | 1.33 | 0.64 2.75 | 0.44 | 0.091 |
| Helping in decisions regarding personal and family food shopping (autonomy) | 1.06 | 0.98 1.14 | 0.15 | 0.007 | **1.09** | **1.01 1.18** | **0.03** | **0.127** |
| **Actual control: skills/ abilities/ environment** | | | | | | | | |
| Perceived barriers of time/ convenience | 1.18 | 0.53 2.59 | 0.68 | -0.015 | 1.36 | 0.61 3.05 | 0.45 | 0.089 |
| Perceived barriers of cost | 0.68 | 0.33 1.42 | 0.3 | 0.031 | 0.77 | 0.35 1.69 | 0.52 | 0.124 |
| Availability of whole grain (home and surrounding environment) | **2.88** | **1.70 4.90** | **<0.01** | **0.116** | **3.00** | **1.70 5.29** | **<0.01** | **0.210** |
| **Intention** | | | | | | | | |
| Intention to eat more whole grain (likely to eat more whole grain in the future) | **1.31** | **0.7 2.33** | **0.02** | **0.06** | **1.38** | **0.74 2.61** | **0.01** | **0.11** |
| **Non RAA Construct factors** | | | | | | | | |
| Bringing lunch from home | 0.63 | 0.44 0.92 | 0.05 | 0.012 | 0.64 | 0.41 1.01 | 0.06 | 0.10 |
| Getting lunch from school | **-1.91** | **1.28 2.87** | **<0.01** | **0.058** | **-2.28** | **1.37 3.82** | **<0.01** | **0.148** |
| Frequency of eating out | **-0.40** | **0.20 0.81** | **0.01** | **0.072** | **-0.38** | **0.17 0.83** | **<0.01** | **0.172** |
| **Variance in whole grain intake explained by the RAA model** | | | | | | | | 0.199 |

**[a] Associations between each factor and whole grain intake (main outcome) were tested separately (unadjusted for confounders), and then adjusted for confounders: age, gender and family socioeconomic status. Note: whole grain intake data were log-transformed, then back-transformed during this analysis.**

**[b] Marginally significant associations are shown in bold (p<0.05), and statistically significant ones are bold-underlined (p≤0.01)**

## 4.4 Discussion

This survey study explored the main factors influencing adolescent whole grain intake, based on the reasoned action approach, which was proven to be useful in predicting whole grain intake in adolescents in the formative stages of this study (focus groups, Study I). It also examined consumption trends in this age group, as well as associations of socioeconomic, demographic, environmental and personal factors to whole grain intake. The questions used in the survey were mainly informed by previous research (see *Methods*) as well as by in-depth interviews with an adolescent sample (second formative stage of this research, Study II). To our knowledge, this is the first survey exploring whole grain intake correlates in British adolescents.

### 4.4.1 Whole grain consumption patterns

Although this study did not quantify daily whole grain intake in grams, the results from the survey and FFQ showed that the wholegrain consumption was low in this age group, an approximate 9.9 servings of wholegrain foods per week (equivalent to 1.4 servings per day). If a serving of wholegrain foods is assumed to roughly contain 16g whole grain (Mann et al., 2015), then 1.4 servings per day would translate to an approximate intake 22.6 g of whole grain per day. These estimated values are roughly in line with the latest analysis of the NDNS (Mann et al., 2015), which reported adolescent daily intake as 20.3 g/10MJ per day. Note that this value is a rough estimate based on standard assumptions, purely for comparison purposes, and the whole grain content of foods consumed by participants in this study has not been analysed. The current study's survey contained two questions asking about whole grain intake, along with measured whole grain intake through an FFQ. The measured intake through the survey questions was significantly associated with increased intake in the FFQ (before and after adjusting for confounders), thereby confirming the consistency of the measured whole grain intake throughout this study. The responses to one of the survey questions showed that 18.1% of participants consumed the recommended three servings per day. The other question asked about specific estimated intake (see results section *4.3.2.4. Estimated self-reported levels of whole grain intake*, **Figure 4-12**), where 21.3% of participants reported consuming at least one serving of whole grain daily. The mentioned recent NDNS analysis (Mann et al., 2015) showed that 26% of British children/ adolescents consumed one serving of whole grain every day – an intake slightly higher than the findings of our survey. However, the published NDNS analysis also reported 15% of children/adolescents are not consuming any wholegrain products at all, which was the exact figure obtained in our survey (see results **Figure 4-12**); thus might serve to confirm this sample's representativeness. Our FFQ results showed 13.8% reported not consuming any whole grains (slightly lower than the survey), but that might also be attributed to the tendency of FFQs as a dietary assessment tool to overestimate intake (Burrows et al., 2010). Low whole grain intake was observed in another study on UK female adolescents, where only 16% of the girls consumed "brown" bread daily and 8% whole grain cereal (Rees et al., 2010). Moreover, in a study conducted on Malaysian participants, only 19% of children and adolescents consumed wholegrain products (Norimah et al., 2015).

The most popular wholegrain products among adolescents in this study, as demonstrated by the FFQ results, were breads and breakfast cereals. This is in agreement with the previous parts of this research, as well as the latest NDNS analysis (Mann et al., 2015) and various studies conducted on adolescents (Norimah et al., 2015; Pohjanheimo et al., 2010) and other age groups (Neo et al., 2016; Bellisle et al., 2014; Burns et al., 2013; McMackin et al., 2012; Muhihi, 2012; Croy and Marquart, 2005; Chase et al., 2003b). The results of the mentioned studies all included, but were not exclusive to, bread and breakfast cereal as the most popular whole grain sources.

### 4.4.2 Awareness and attitudes towards wholegrain foods

Adolescents in this survey were aware of whole grains as a concept, although this was self-reported and the presence of misconceptions further complicated the findings. Nearly half of the participants did correctly identify a wholegrain product, although it was interesting that a similar majority also related the word "whole grains" to “organic” in another question about first impressions. These observations were also apparent in the formative parts of this research (Study I and II), as well as other assumptions such as that wholegrain products had “seeded or multi-grain” in their name. Few also believed that the main indicator would be that a product was brown in colour. Other common “misconceptions” were identified, as participants in this study seemed to link wholegrain foods mainly to wholemeal toast in their comments, despite the large variety of other products – a trend also verbalised in the interview part of this research (Study II). Participants also found difficulty and confusion between the terms “brown bread” and “whole grain”, an issue apparent in all parts of this current research as well as few others (Rees et al., 2010) . In a study with Tanzanian adults, brown rice was related to “diabetic food” (Muhihi, 2012) and Irish adults thought whole grains had “nothing else added” to the product (McMackin et al., 2012). Misconceptions around wholegrain products, awareness and identification issues, and the need for a standardised universal definition have been recognised as important challenges in the whole grain literature, and are vital steps for efforts to promote whole grains among consumers (Seal et al., 2016; Ferruzzi et al., 2014; Mozaffarian et al., 2013; Jones & Engleson, 2010).

There were mixed feelings towards wholegrain foods as participants thought of whole grains as healthy and natural, yet dry. The fact that whole grains were a source of fibre and the satiety they provided were the health benefits most recognised by participants in this study, in agreement with reported findings in the literature (Arvola et al., 2007). In other studies, British and American adults viewed whole grains as healthy and natural (Kuznesof et al., 2012; Croy and Marquart, 2005), and Finnish adolescents (Pohjanheimo et al., 2010), Irish adults(McMackin et al., 2012), and American adults and children (Rosen et al., 2011; Burgess-Champoux et al., 2006), also perceived whole grains as healthy and filling.

### 4.4.3 Barriers and facilitators to whole grain consumption

The top five barriers to whole grain consumption among adolescents identified in this study (and the corresponding comparable studies in the literature) were as follows:

**(1)** Undesirable taste/texture of wholegrain products (McMackin et al., 2012; Muhihi, 2012; Chase et al., 2003b; Adams and Engstrom, 2000), although some adolescents reported a preference to rye bread taste in a Finnish study (Pohjanheimo et al., 2010)
**(2)** The lack of availability and varieties of wholegrain products in stores (Kuznesof et al., 2012; McMackin et al., 2012; Muhihi, 2012; Croy and Marquart, 2005; Adams and Engstrom, 2000)
**(3)** Not knowing that whole grains were healthy enough to make it worth the "effort" (McMackin et al., 2012; Pohjanheimo et al., 2010; Croy and Marquart, 2005; Chase et al., 2003b; Adams and Engstrom, 2000)
**(4)** Friends and family did not eat it (may result in lower home availability) (Kuznesof et al., 2012; McMackin et al., 2012; Rosen et al., 2011; Larson et al., 2010; Pohjanheimo et al., 2010)
**(5)** Not being used to eating whole grains from a young age (habit) (Pohjanheimo et al., 2010)

Other barriers to whole grain consumption were identified in the literature as well as this study, but were not among the top barriers. Examples were the inability to identify wholegrain products (McMackin et al., 2012; Croy and Marquart, 2005; Chase et al., 2003b), perceived higher cost of wholegrain products (Kuznesof et al., 2012; McMackin et al., 2012; Muhihi, 2012; Chase et al., 2003b), the incorporation of whole grains into daily lifestyle and the usual eating habits (Kuznesof et al., 2012; Croy and Marquart, 2005; Chase et al., 2003b). Studies with younger participants (elementary school children) cited issues like appearance and packaging of wholegrain products (Burgess-Champoux et al., 2006).

Furthermore, the comments section in the survey questions served to accentuate some of the top selected barriers, as well as shed light on overlooked details which research might simplify. In this question enquiring barriers to consumption, most of the participants indicating that friends and family did not eat whole grains, also followed it up in the comments section with comments on resulting low home availability. Moreover, some of the participants mentioned that they liked to eat different varieties of grain during the day rather than just bread all the time, and that such other varieties were not considered “wholegrain”. This comment may be initially seen to fall under lack of available varieties (listed among the top barriers above), but may also reflect the fact that adolescents associated whole grains with wholemeal bread only (awareness). Participants in the interview study (Study II) of this research were pleasantly surprised to learn about other wholegrain varieties than wholemeal toast; such comments in this survey reveal a common pattern. Therefore in efforts to increase consumption, it is important to recognise that several factors may interact and need to be addressed simultaneously, despite the fact that they may manifest themselves as a single barrier in the reported literature.

This survey, as a result of being based on a qualitative detailed exploration, was able to capture the majority of the barriers cited in the literature, and reveal the need of specific target areas in this age group. For example, cooking skills and preparation time were barriers highlighted in studies with adult participants; but were not raised in this current study (Kuznesof et al., 2012; McMackin et al., 2012; Croy and Marquart, 2005; Adams and Engstrom, 2000). This could be attributed to the participants’ young age and the nature of lifestyle in those years.

Similarly, all facilitators to increased whole grain consumption identified in the literature were revealed in this survey’s results. When it came to suggested facilitators to increased whole grain consumption in this age group, the top five suggestions (and corresponding comparable studies in the literature) were:

**(1)** Promoting the whole grain message through social media celebrities (like YouTubers etc)

**(2)** Educating parents about whole grains, which may relate to increased home availability, as well as familiarising children with whole grains at a younger age (Pohjanheimo et al., 2010; Croy and Marquart, 2005)
**(3)** Education in school subjects about whole grains
**(4)** Targeting television celebrities such as movie stars, singers, and athletes
**(5)** Increase availability and varieties in shops, restaurants, etc (Muhihi, 2012)

Other studies in the literature highlighted the importance of raising awareness of the health benefits of whole grains for increased consumption among various age groups (Kuznesof et al., 2012; McMackin et al., 2012; Pohjanheimo et al., 2010; Croy and Marquart, 2005; Chase et al., 2003b; Adams and Engstrom, 2000). However, this survey was based on in-depth interviews with adolescents, which shed light on the difference in receptiveness of this age group to various approaches and sources of information. Therefore, such a general statement (as increasing awareness) was not enough, and the interview discussions informed the inclusion of a question to specify which method of raising awareness was viewed as more effective in these adolescents' point of view. For example, the role of social media was highlighted strongly in the interviews (Study II of this research), which was further confirmed as the top facilitator to whole grain promotion in this survey. However, there was a conflict in this survey between adolescents suggesting social media as the most effective approach for interventions, while at the same time citing it among their least trusted sources for health information in another question (see *4.3.2.8.Trusted sources of dietary information among adolescents*). Doctors came as the top trusted source of health information in that latter question, whereby it ranked low among suggested facilitators. This raises the question of whether the quality of the source plays more importance or the amount of time of being exposed to it (Doctors vs. social media), and what combination would be the most effective for interventions.

In the mentioned question of trusted sources of health information, doctors/nurses, family, and school/teachers ranked as top sources. These findings are in agreement with another whole grain study which explored trusted sources of health information in adolescents, where parents, school and magazines were cited as top sources (Pohjanheimo et al., 2010).

Whole grain studies in the literature cited a few other influencing factors, many of which were present in this study, albeit not among the top choices. Examples were changes in product packaging in younger participants, promotion of foods through sampling, peer influence, and providing incentives (Burgess-Champoux et al., 2006) Product packaging and advertisement, conversely, were not viewed as important among Finnish adolescents (Pohjanheimo et al., 2010) – points with mixed importance levels in this study. Cost and sensory appeal were also key facilitators in previous research (Muhihi, 2012; Chase et al., 2003b) – with a weaker presence among suggested facilitators in the current survey.

In regards to the preferred meal for increased whole grain consumption, breakfast was selected by American adolescents (Bruening et al., 2012) as well as in an analysis of Irish adults' diets (Burns et al., 2013). The WHOLEheart study in the UK uncovered an incorporation of wholegrain foods mainly through the breakfast meal (Kuznesof et al., 2012). Such preferences were reflected in the responses of this survey as well.

### 4.4.4 Main predictors of whole grain intake and RAA theory

All constructs of the RAA theory were associated with increased whole grain intake in adolescents, whether fully or partially (certain elements within the constructs). Only the factors that remained significant after adjusting for confounders (value $p \leq 0.01$, due to multiple testing) will be taken into this discussion.

When it came to background factors, male gender and higher family socioeconomic status were significantly associated with increased whole grain consumption in this study (as evident through t-test and ANOVA testing, as well as the regression analysis). Lower socioeconomic status has been consistently associated with reduced whole grain intake in the literature (Mann et al., 2015; Norimah et al., 2015; McMackin et al., 2012; Lang and Jebb, 2003; Lang et al., 2003). Education levels rather than overall SES were measured in a French study, and the differences favouring the higher SES were significant (Bellisle et al., 2014). As for gender, a recent British NDNS analysis found that female adults had higher whole grain intake after adjusting for total energy intake (considering foods with ≥51% whole grain content), whereas for British adolescents, males had a significantly higher intake, which was removed after adjusting for total energy intake (Mann et al., 2015). Similarly, and in contrast to our study, other studies in the literature did not report significant differences in whole grain intake between the two genders (Bellisle et al., 2014; Larson et al., 2010) or other psychosocial factors (Rosen et al., 2011).

Background factors like physical activity and the tendency to prioritise healthy eating were also associated with higher levels of whole grain intake in the current study. Such associations when it came to physical activity contradicted with those reported in a study on Singaporean children (Neo et al., 2016). However, Finnish adolescents displayed similar trends when it came to prioritising healthy eating and higher whole grain intake (Pohjanheimo et al., 2010). Project EAT male participants, an American adolescent cohort, showed a significant tendency to eat more wholegrains when there was higher concern for health (Larson et al., 2010).

Normative beliefs, or the influence of the social norms, were only associated significantly with whole grain intake, after adjusting for confounders, in the case of an overall supportive friend and family environment (RAA's injunctive norm). This explained 18.7% of the variance in whole grain intake. Family or friends support separately, whether through consumption (descriptive norm) or psychologically (injunctive norm), were not significant after adjusting for confounders in this study. Adolescent studies in the literature did report significant associations with friends' and best friends' whole grain intake (Bruening et al., 2012), although this question was not asked in such detail in this study. The current study's findings confirm on findings in the literature (Contento et al., 2006) as well as some of the statements from the formative interview results (Study II), where familial environment and peer choice intertwined to create an overall environment in either direction – toward or away from healthy eating choices and behaviours.

Perceived behavioural control factors, which related to self-efficacy and autonomy of the individual, were associated to increased whole grain intake only if the adolescents participated in decision making with regards to food shopping (related to a higher sense of personal autonomy). But even those results were marginally significant after adjusting for confounders. Self-efficacy as a measure on its own was not associated with increased whole grain intake in this study, which contrasts with findings among the project EAT adolescents (Larson et al., 2010).

Intention to increase whole grain intake, being the most direct construct to a behaviour in the RAA model, was associated with increased consumption levels in this study and explained 11% of the variance in whole grain intake. Intention as a factor was not explicitly measured in most studies and did not display significant association with whole grain intake in a study with younger children (Rosen et al., 2011).

The frequency of eating out, a non-RAA construct, was negatively associated with whole grain intake in this study, which is in agreement with associations found with the project EAT adolescents (Larson et al., 2010). Therefore adolescents who ate out often consumed less wholegrain foods, and this could be either related to lack of availability of whole grain options in restaurants, or the tendency to choose less healthy foods, as eating out might be viewed as an “occasional treat” for this age group (as pointed out in the interviews, Study II of this research). It could also be due to a presence of a household lifestyle where time is spent outside the house or lack of cooked meals at home, which was also a point discussed in detail in the interviews part of this research (Study II). Another non-RAA factor associated negatively with whole grain intake was buying lunch from school. Such findings related to lower nutritional quality of school meals have been reported in the literature (Burgess-Champoux et al., 2006), as well as the interview part of this research (Study II) and within the comments section of this survey (see results sections *4.3.2.5* and *4.3.2.7*). The significance of the results points to the importance of addressing this issue in future interventions.

When it came to the RAA construct of attitudes, all positive attitude measures pointed towards significant associations with whole grain intake, in line with studies in the literature (Kuznesof et al., 2012; Larson et al., 2010; Pohjanheimo et al., 2010). Adding time, cost or convenience barriers to the model did not affect the results, which may imply on one hand that interventions should focus on improving attitudes towards wholegrain products. However, while time, cost and convenience barriers were highlighted as important in adult studies (Kuznesof et al., 2012; Croy and Marquart, 2005; Adams and Engstrom, 2000), it may be that the current study participants were of an age group that did not have to provide financially, do the family cooking, nor hold complete responsibility for household food shopping – thus other factors like attitudes and home availability (below) were verbalised more prominently.

Perhaps the strongest association of all, in terms of explaining 20% of the variance in whole grain intake, was the availability of whole grains in the home and surrounding environment. This factor falls under the construct of actual control (which mediates intention and behaviour in the RAA). Home availability was expressed in the interview part of this research (Study II), and the comments section of this survey (see results sections *4.3.2.5* and *4.3.2.7*), as well as listed in the main findings of other studies (Rosen et al., 2011; Larson et al., 2010). In line with the implications of this study, parents were viewed as the "gatekeepers" throughout the literature (Pohjanheimo et al., 2010; Croy and Marquart, 2005), and their role in the promotion of the whole grain message, along with emphasis on an improved attitude in this age group, are recommended focal points for future interventions.

Therefore out of all the associations mentioned above, a personal tendency to prioritise heathy eating, along with a supportive friend and family environment, and home availability of wholegrain foods were the top three associations, explaining the highest level of variance in whole grain intake (18%, 18.7% and 21%).

In terms of the overall application of the RAA theory (which is an extension of the TPB), the constructs significantly associated with whole grain consumption in this study were in line with results in the literature on adolescent eating habits based on the theory of planned behaviour. For example, positive attitudes towards healthy eating, familial and friends influence, knowledge, availability and intentions to eat a healthful diet were predictors of healthier dietary intake in a TPB-based study among adolescents (Backman et al., 2002). Moreover, in a recent meta-analysis on TPB and RAA constructs' utility in predicting health behaviours (McEachan et al., 2016), it was found that intention, experiential attitudes (under attitudes), capacity (under PBC) and descriptive norms were significant predictors of behaviour. This study's results were in agreement with this meta-analysis's findings, with the exception of capacity (self-efficacy), which was not found to be significantly associated with increased whole grain intake.

Furthermore, the RAA as a model explained 19.9% of the variance in whole grain intake. A similar figure was also reported for diet behaviours in a meta-analysis on the Theory of Planned Behaviour (21.2%) (McEachan et al., 2011). Future reviews based on the RAA model specifically may serve to further confirm or contrast with these results. However, these mentioned observations serve to generally validate the successful application of the theory base in this survey despite the scarcity of guiding literature (on RAA as a theory).

### 4.4.5 Study limitations:

This study was among the first to explore whole grain intake correlates in the UK, and the first to target adolescents and quantitatively measure associations between personal, socio-demographic and lifestyle factors and whole grain intake. It was also based on in-depth technology-assisted interviews with adolescents and focus groups, and among the early studies that explored and are based on the RAA theory of health behaviour.

There were some limitations to this study. First of all, the time which the schools were contacted was a tight and challenging time, as it fell in June. This was right before the final examinations and at the end of the academic year, which is a busy time for schools due to exams. This resulted in a reduced response rate from the schools and difficulty in recruitment. Intensive efforts had to be made in contacting schools, facilitating the recruitment, and accommodating school requests to ensure they stayed on board. The critical recruitment timing was also taken into account while designing the questionnaire, as it was made to last a maximum of 50 minutes in total (Part 1: FFQ + Part 2: Main questionnaire). Thus the FFQ had to be reduced and some questions from the survey eliminated, to allow for a lower time burden on the participating schools and students.

Therefore, time restrictions in this study did not allow for recruitment of a larger number of schools to allow for more diversity in the study sample. Moreover, quantifying whole grain intake in grams was not possible, as the composition tables with official whole grain content of foods consumed in the UK were officially published fairly recently (Jones et al., 2017). Therefore consumption levels obtained from the FFQ were used to generate an estimation of whole grain consumption, in servings per week. Whole grain consumption may have also been overestimated due to inclusion of items such as brown bread and cereal bars in the FFQ, which may or may not have been wholegrain products.

A further development of this research would entail a detailed analysis of the FFQ results and conversion of serving scores into grams using the mentioned database (Jones et al., 2017). A detailed quantification of intake in the Leeds region and comparing to intake on a national level could be a subject for exploration in future research on the topic. Moreover, results from the latest NDNS analysis (Mann et al., 2015) suggested the importance of adjusting for energy intake when whole grain intake is described, as the difference in intake between genders may account for the whole grain consumption differences. Although gender was adjusted for in this study, but it was not possible to further adjust for energy intake differences, as energy intake was not fully measured and the FFQ only included wholegrain food items (again as a result of the time and recruitment restrictions in this study).

A few details in the survey could have been designed in a more informative way. Normative beliefs (the perceived social norms) were separated into friends vs family in the case of injunctive norms (perceived support of significant others), but not in the case of descriptive norms (perceived consumption/behaviour of significant others). Separate questions examining perceived consumption of friends vs. family may have provided insight into which group's descriptive norm was more impactful on adolescents, as opposed to a combined result. Moreover, while the taste of wholegrain foods was mentioned as a key barrier in the literature as well as other parts of this research, the need for a shorter survey required the elimination or combination of some question items. This entailed cutting down some of the options in the question on facilitators of whole grain consumption (see *results* section *4.3.2.7*), and creation of an option which included improvements to both product packaging and taste. Many of the participants went on to suggest taste improvements as well as product packaging enhancements in the comments section (whether they had made this selection or not). This implied that these may have been popular and important answer options on their own, and that it would've been favourable to list them separately.

Another limitation of this survey may be the lack of inclusion of ethnicity as a factor associated with whole grain intake levels. The method of recruitment attempted to include a diverse sample of participants, however that data was not reliable for use in the analysis. The reason was that many of the participants seemed to choose the "other" option and write jokes in the space provided. Thus, ethnicity as a variable was excluded in this study. This is worth reporting as a shortcoming, or as a possible outcome of doing research with adolescents. It may be suggested that when working with adolescents, an "other" and open-ended answer option in an important demographic question could be avoided, to ensure that more valid and reliable answers are obtained. A similar issue was also encountered with the "guardian occupation" section, although not as profound. These questions fell at the end of the questionnaire, which may generally be assumed to be good research practice in surveys, as participants may be tired by the end of the survey. However, this same exhaustion or boredom towards the end may have caused them to answer the final demographics question less seriously.

## 4.5 Conclusion

This chapter aimed to develop and administer a survey which examined whole grain awareness, attitudes, consumption trends, and the various factors which influence whole grain consumption in a representative sample of UK adolescents. It was based on the findings of the formative parts of this research (Chapters 2 and 3), as well as the constructs of the RAA health behavioural model. All constructs of the RAA were associated with increased whole grain intake in adolescents, to varying extents, and the strongest predictors of wholegrain consumption were home availability, personal dietary-consciousness, and a supportive friend and family environment, followed by a personal positive attitude to whole grains, physical activity, and intention to consume more wholegrain foods. Being male and from a higher family socioeconomic status were associated with greater whole grain consumption. Findings of this study suggest future interventions should address a broad range of factors, in particular awareness to improve parental and adolescent attitudes and increased home availability of wholegrain foods.

# Chapter 5 Conclusions and research implications

This thesis successfully answered all the research questions and added a wealth of information to whole grain research and invaluable insights into the adolescent world and processes surrounding their decision-making and behaviour. This chapter highlights how this thesis effectively answered the main research questions, as laid out in the early stages of the research. It will articulate the ways in which the original design was key to achieving this purpose – particularly in light of the deficiency in the relevant literature – as well as how it took the exploratory work a step further by leading the way in innovative technology use and employing a new health behavioural theory. The main research questions of this thesis were the following:

**What are UK adolescents' general awareness, attitudes, and consumption levels of wholegrain foods?**

**What are the barriers, possible facilitators, and factors that influence adolescent wholegrain intake?**

This thesis identified factors that influence whole grain intake among UK adolescents and determined personal, socio-demographic and environmental correlates to whole grain intake, as well as barriers and potential facilitators to increased consumption. This original exploratory study provided in-depth insights into the determinants of whole grain consumption, a topic in its early research stages in the UK, and formed a base for further research into the topic and future interventions. It is the first to address this age group in the UK.

This research was among the early ones to employ psychological theories of health behaviour to whole grain consumption correlates, namely the reasoned action approach (RAA), and novel research technology including SenseCam and an online-administered-survey. Participants were adolescents in a city in the North of England, Leeds, aged 11-16 years of both genders and mixed ethnicities, recruited mainly through middle schools. This thesis consisted of three main studies, with the first two studies being of qualitative nature – focus groups and interviews (Chapter 2: Study I, and Chapter 3: Study II) – both of which have informed the building of the final questionnaire (Chapter 4: Study III) to obtain quantitative associations of determinants to whole grain intake, based on the RAA health behavioural model.

## 5.1 Recommendations in light of the research findings

The findings of each of the thesis studies have been reported in individual chapters, and comparisons with prior research results have been drawn in the corresponding discussions (Chapters 2, 3, and 4). This section provides a summary of the main research findings across the three studies (in answer to the research questions), and expands on targeted discussion points. It also provides recommendations to promoting whole grain intake, based on the findings of this research.

This research revealed that most of the participating adolescents had heard of whole grains, and had tried or consumed them in the past. These findings may be positive but should be taken with caution, as the participants' definition and knowledge of whole grains appeared to be problematic. While many participants across the three studies were able to correctly identify wholegrain products to some extent, comments and terminologies used indicated otherwise. This has also been identified as a problem with adult populations. "Brown bread" was used by participants to refer to wholemeal bread in the three present studies, and this interchangeable use of terms points to the need for education regarding wholegrain products. Despite the fact that the mentioned difference was explained to them during the research sessions, it is likely that correct use of the terms might take some time. The problems with identifying wholegrain foods may be partially due to the terms used to advertise products, which may confuse consumers. Some descriptions such as "brown", "seeded", "wheat", "whole", "enriched" may mislead consumers into believing the product is whole grain (Jones & Engleson, 2010; Marquart et al., 2006). Most of the participants in the present studies were not aware that products must have at least 51% whole grain content to qualify for classification as whole grain (Seal et al., 2016). Perhaps these findings are to be expected, as an official whole grain definition, guidelines and specific recommendations have yet to be established in the UK (Seal et al., 2016; Seal et al., 2006).

In agreement with previous research, this research has also established that the most popular as well as the commonly consumed wholegrain products were wholemeal bread and ready to eat breakfast cereal products. This finding may be deemed as positive in terms of promotion of increased whole grain consumption, as these varieties are widely available and can be easily integrated into existing eating habits and meals by substitution. On the other hand, the interviews revealed that many adolescents related whole grains to wholemeal bread (toast) exclusively (or brown bread, as mentioned above), and were not aware that other varieties they already consumed, such as popcorn, quinoa and brown rice, were whole grain as well. In fact, they felt were was not enough wholegrain varieties available, and that was one of the major barriers to whole grain consumption across all studies of this research. This association (of whole grains to wholemeal toast) was confirmed in the comments section of the survey study, and raises a point of concern, whereby wholemeal toast has also been described as dry and undesirable in texture. This perception would impede increased consumption of other enjoyable varieties to adolescents, and should be specifically tackled while raising awareness in any programme or intervention targeting this age group.

When it came to recognition of health benefits of whole grain consumption, all studies in this research indicated that participants were aware that wholegrain foods were "somehow" more natural, healthy, a source of dietary fibre, and that they were associated with satiety and improved digestive health. Other established health benefits related to reductions of heart disease risk, cholesterol, elevated blood sugar, weight gain, and some cancers were not recognised by many. This may be due to the fact that these diseases may be considered as "adult" diseases and participants of this study may not relate to them at this age. Nevertheless, this  this should also be acknowledged as a major point to accentuate in any future educational programmes, as whole grains are currently seen as "somewhat healthy" and not as important as other promoted foods, such as fruits and vegetables. This same issue was conveyed throughout the literature (Adams and Engstrom, 2000), and highlighted in a study across European countries, including the UK, on cereal-based products, whereby "the presence of wholegrain, appeared to be the least decisive dimension for perceiving a food as healthy and for showing the willingness to buy it."(Saba et al., 2010) Moreover, this research revealed that adolescent perceptions of healthy food were related to it being perceived as less processed and more natural, and to a lesser extent related to nutrient content. Thus, promotion of whole grain intake should capitalise on its non-processed characteristics (in terms of conserving the natural components of the grain) and multitude of health benefits it confers, to further establish its status in the minds of consumers as an important component of a healthy diet (Adams and Engstrom, 2000).

Common barriers and facilitators to whole grain consumption were identified across the three studies, and were mostly in agreement with prior research on whole grain with various age groups (detailed comparisons are provided in the individual discussions of Chapter 2, 3, and 4). The barriers and facilitators to whole grain intake cited by participants were intertwined, in that the same top barriers were also listed as top facilitators to intake once addressed. These, along with the major influencing factors associated with increased consumption (as generated from the regression analysis in Chapter 4), will now be discussed as key focal points to be addressed in future research and interventions on whole grain intake in adolescence.

The top barriers/facilitators to whole grain consumption among adolescents included negative perceptions of their sensory properties such as taste, texture, and visual appeal. Visual appeal was not only related to the products themselves, but also to the packaging which was often described as boring and in need of tailoring to appeal to young people. As noted previously, all findings of this study may be susceptible to the common misconceptions among participants about what whole grain were and the possibility that they only had wholemeal toast in mind. Nevertheless, improving the sensory and visual appeal of wholegrain products appears a viable route to improve intake (Bakke and Vickers, 2007; Shepherd et al., 2006). Until policy changes (regarding official UK whole grain recommendations) and the healthy whole grain alternative to refined products becomes more promoted, available, and cheaper –

marketing techniques such as working on appeal to consumers would be the recommended starting point.

Availability was also a key determinant of intake, as established in this study as well as prior research with all age groups (refer to Chapters 2,3, and 4 discussions for a detailed comparison with the literature). Increased availability has also been identified as a key facilitator to increased consumption of healthy foods by adolescents throughout the literature (Shepherd et al., 2006; Backman et al., 2002). Availability appeared a particular barrier for adults when eating out, but did not emerge as a dominant concern for adolescents in the present studies. This point could be justified by the fact that the majority did not report eating out very often. Therefore, for this age group, it may be more worthwhile to focus on promoting home, school and local retail availability (surrounding home and school).

Awareness of whole grains (i.e. what they are) and their health benefits appeared to be another key determinant of intake, and influences other determinants. Building knowledge about the health benefits of wholegrains has the potential to improve attitudes towards wholegrain intake (McMackin et al., 2012; Mancino et al., 2008; Ellis et al., 2005). Numerous studies on healthy eating habits in this age group support attitudes to be among the strongest predictors to intention and improved consumption (Backman et al., 2002), and attitudes were the strongest predictors of whole grain intake as identified throughout this research. Building a more positive attitude may lead to a desire to have the products available at home – another one of the strongest predictors to intake identified in this research. Furthermore, if understanding and awareness of wholegrains is promoted in schools, this may shift peers' norms. Education about the health benefits, available varieties, and identification techniques in this age group is proposed through parents, school subject education, social media celebrities and catchy ads.

The present studies report a lack of knowledge about whole grains among secondary school staff and pupils. The majority of the teachers in the schools approached were unaware of the important health benefits of whole grains. Therefore it was expected that, according to the interview study participants, the whole grain message was not included as part of nutrition education in many schools and was briefly mentioned to the students in more casual generalised contexts. This lack of whole grain education may also impact school availability of wholegrain foods, as there was persistent reporting of the lack of whole grain availability (at least as they understood wholegrain) in school canteens. As noted previously, these observations might be attributed to the current status of whole grain policy in the UK, but future research aiming to promote whole grains in this age group should recognise these shortcomings – especially given the value and trust adolescents attributed to schools in health education. Students consume at least one meal of their day in school, and while school-based interventions are faced with challenges including competition with other school priorities, resources, and issues with coordination and communication between teachers, school staff, and parents, but multi-component interventions with increased availability and peer leader involvement appear to be promising (Rosen, 2009; Burgess-Champoux et al., 2008a; Knai et al., 2006).

Across the studies in this research, the influence of parents and home life on food choice and whole grain consumption was apparent. Parental awareness of the benefits of wholegrain consumptions appears key, as they: are capable of facilitating habitual consumption in their children from an early age; are regarded as the gatekeepers for household meals; and are perceived to be a trusted source of dietary information source for this age group. This finding, along with the observed relations between whole grain consumption and parental encouragement, appears at odds with claims that peers are the dominant influence on adolescent behaviour, particularly in relation to health and nutritional information (Shepherd et al., 2006). Adolescents in this research reported eating with their families frequently (Contento et al., 2006; Neumark-Sztainer et al., 2000); SenseCam images specifically encouraged discussions around this topic. Moreover, in a study on determinants of healthy eating in this age group, it was proposed that adolescents may tend to “balance out” unhealthy foods eaten outside the house with healthful meals eaten at home with family, which brings about a balance between their desire for personal autonomy, and that of being “good to themselves” and part of the family (Contento et al., 2006).

Therefore, parents appear to be an important target for interventions to increase adolescent whole grain intake. The positive parental influence in this study appeared ever more prominently in its absence, when the adolescents ate outside the house during weekends, or even during meals consumed at school. Therefore, there is also a need to target adolescents with convenient products for use on the days where there might be less frequent family meals that allow wholegrain inclusion, as well as in school and venues around the school.

Peer influence, though, remains important. This fact is even more prominently apparent when multiplied with parental/familial impact, as identified in the interviews and survey regression analysis (see Chapter 4: *Results: 4.3.3.3*). It appears that adolescent food choice is a delicate interplay between parental and peer influences, and interventions should tactfully target both (Contento et al., 2006). Changing social norms could be achieved through school education and social media. As many teenagers appear to be influenced by social media celebrities, they could be a means by which to promote a healthier whole grain message that could counteract some of the extreme diet tips and fads being promoted online. These celebrities can help by creating discussions around the topic and initiating “viral” online content, as suggested by the participants during the interviews and in the survey comments. Normalising or integrating wholegrain promotion in an appealing way for this age group should include it being a food that would help empower their efforts in weight maintenance or physical activity/sports programmes – an intervention element suggested in a systematic review on adolescents and healthy eating (Shepherd et al., 2006). Although, ideally, these points should not be the primary concern, but in working with adolescents, it may be important to "speak their language", and such concerns have certainly been verbalised, especially in the interviews (Study II). Acknowledging the body-image challenges facing this age group (which draws to an increased interest in such discussions) as well as the abundance of low-carbohydrate dietary advice in the media is important, and efforts to increase wholegrain intake in this age group must recognise and address these issues.

## 5.2 Recommendations in light of research strengths and limitations

This section proposes recommendations to future research while drawing on this research's key strengths and limitations. A more detailed description of limitations to the individual studies to have been outlined in the corresponding chapters, and this section serves as a summary to draw conclusions and recommendations based on the main points.

### 5.2.1 Strengths of this research

This study adds to our understanding of the factors influencing food choice in British adolescents, who are at the lower end of whole grain intake at the national level and in particular need of targeting to improve consumption (Mann et al., 2015; Nelson et al., 2007). This study is among the few which adopt a theory-led approach to the study of whole grain intake correlates (Kuznesof et al., 2012; McMackin et al., 2012; Larson et al., 2010; Smith et al., 2001), the early use of novel SenseCam technology to facilitate data collection, and the first to explore adolescent whole grain intake among adolescents in the UK. A further strength of the study was the inclusion of a socially and ethnically diverse sample of young people.

Research on whole grains in the UK is in its early stages. Over the past few years, an increasing interest has been shown in the topic, and a multitude of studies have emerged since the start of this research. This research was one of the early studies in the published literature about whole grain intake correlates in the UK. Therefore this thesis's methodology was autonomously developed from the wealth of literature available on fruit and vegetable consumption correlates in the adolescent age group, while adding the use of novel extended health behavioural theory (RAA) and technology (SenseCam) to ensure an extensively detailed capturing of this new research area. A mixed methods approach was utilised, employing both focus groups and in-depth interviews (with inductive analysis for both) to derive a non-presumptive and participant-centered narrative; followed by a quantitative survey. The use of three different approaches for the exploration of whole grain consumption correlates in this age group, which is a relatively un-explored and new topic in the UK allowed for building a more complete picture, whereby the shortcomings of one approach were compensated for by the strengths of another. For example, the possible drawbacks of peer influence during focus groups (where participants may have felt reluctant to openly express some opinions) were overcome by the personalised and amiable nature of the interview study. Enhanced representativeness were ensured through the increased sample size recruited in the survey study. Moreover, most of the main findings, in terms of perceptions, knowledge, attitudes, barriers and facilitators to whole grain intake were common across the three studies of this research. This consistence further serves to confirm the effectiveness of the approaches and robustness of analysis methodologies employed in this research.

Other major strengths of this research comprised the use of novel technology such as SenseCam. SenseCam represents a promising breakthrough in dietary assessment accuracy, and its use in exploring determinants of whole grain intake has been inspired by its unique contributions to determinants of other health research topics such as physical activity and lifestyle (Gemming et al., 2015b; Chen et al., 2013; Gemming et al., 2013; Sheats et al., 2013; Kelly et al., 2012; Kelly et al., 2011a; Matthews et al., 2011). During the course of this research, published work emerged which revealed a growing interest in exploring the usefulness of SenseCam as a tool for exploring the determinants of dietary intake and dietary assessment (Barr et al., 2015; Gemming et al., 2015b; Gemming et al., 2013). Therefore this research is among the early studies which unravelled the exciting potential of this novel and powerful technology in nutritional research. SenseCam offers a solution to one of the most challenging aspects of dietary assessment by relieving the burden of memory reliance as well as capturing food items which may have otherwise been forgotten or missed out (Gemming et al., 2015c). Although the evaluation of SenseCam as a dietary assessment tool was not possible in this study, but this would be a topic of future research based on the data generated in this research. SenseCam-assisted interviews allowed an insight into the real-time moments of adolescent daily life, providing environmental and social contexts to  eating behaviours (Gemming et al., 2015a), and helped in alleviating the hierarchical nature of the relation between the researcher and the young participants (Lachal et al., 2012; Epstein et al., 2006). Moreover, SenseCam elicited topics of discussion that may have not been possible without the assistance of the images, such as the media which adolescents were most receptive to – through examination of the amount of time spent on social media and specific programmes and activities which followed (as captured by SenseCam). This allowed the inclusion of survey items uniquely informed by these discussions (of trusted sources/media of dietary information), and the importance of the credibility and trustworthiness of the source of information to the target population in delivering of a health message has been cited in the literature (Kroeze et al., 2006). Moreover, while previous studies in the literature have cited self-reported whole grain identification difficulties, the current study, with its use of SenseCam images, highlighted the potential for this tool to explain and further understand the magnitude and complexities related to whole grain identification. The extent of the role of family and home environment influences on food choices and whole grain consumption was capitalised on due to SenseCam-prompted discussions – which triggered a personal and more detailed exploration of these important influences. Other studies in the literature have explored whole grain intake correlates in adolescents (Norimah et al., 2015; Bruening et al., 2012; Chu et al., 2011; Keast et al., 2011; Larson et al., 2010; Pohjanheimo et al., 2010; Rees et al., 2010). However, such detailed and insightful findings were not presented; those were only enabled by the unique methodologies employed in this research. The excitement of young people to trying new technologies, especially those incorporation photography, had been cited in previous research ((Boushey et al., 2009)), and the integration of technology in research with adolescents allows for higher participation interest, more pleasant experience, as well as a favourable attitudes towards research, for future research interests  (Barr et al., 2015; Sheats et al., 2013).

Another major strength of this research comprised the use of a health behavioural theory base, as well as the choice of the RAA as a novel and comprehensive theory. There is increasing evidence pointing to the merits of using of theory in designing interventions and understanding the determinants of health behaviour (Michie et al., 2008). There is a lack of qualitative research in relation to the RAA in the domain of nutrition in particular, despite evidence that such approaches could elucidate important personal, situated, and cultural influences on dietary behaviour (Zoellner et al., 2012; Harris et al., 2009; Hardeman et al., 2002). The embarking of using this recently developed theory with no sufficient examples in literature accounts for the original and leading approaches undertaken in this research. Moreover, as highlighted in the discussion of study III (see C*hapter 4 Discussion, section 4.4*), the constructs most strongly associated with whole grain consumption were in line with results in the literature on adolescent eating habits based on the theory of planned behaviour, as well as the overall variance explained by the model; this further serves to validate the successful application of the theory base despite the scarcity of guiding literature (on RAA). Although the theory of planned behaviour (which the RAA is based on) appears to be an effective model for predicting food choice among adults (McEachan et al., 2011; Conner et al., 2002) and adolescents (Conner et al., 2011; Blanchard et al., 2009a), the RAA contributes new environmental and knowledge-related variables that were not explicit in the TPB model. In this study, those variables or factors were key correlates to whole grain consumption, such as awareness and availability which were components of the background factors and actual control added in the RAA. Furthermore, all constructs of the RAA were identifiable in the data, suggesting that the factors influencing whole grain intake in adolescents are well captured by this model. Some components of the model were present in varying potency from that suggested in the model. For example, *background factors* appeared to have a stronger influence on whole grain consumption in this age than proposed by the model. Further studies using the RAA with this age group may enhance the understanding of the representativeness of this model in its current form to explain determinants of dietary behaviour in adolescents.

Overall the choice of RAA and drawing on its usefulness in capturing whole grain intake correlates comprises one of the main strengths of this research. Better knowledge of how adolescents contextualise and personally articulate their experiences of determinants of behaviours may help in improving the effectiveness of new RAA-informed interventions for that demographic.

Further strengths of this research included methodological techniques in each of the Studies I, II, and III. In the focus groups (Study I), questions were derived from previous research, building on useful questions and topics raised in prior studies, and the participants were not educated on whole grains until after first impressions were recorded. These same tactics were used in the interviews and survey studies as well. The use of separate-gender sessions in the focus groups may have allowed a more relaxed expression of opinions, particularly in this age group where peer pressure may be a concern. However, the inclusion of a single mixed-gender session (to be viewed like a control group in a way) may have also elicited enriching discussions resulting from interaction with the opposite sex. As for the SenseCam-assisted interviews (Study II), some methodological strengths included single-blinding the research topic and conducting 24 hour recalls prior to the interviews and viewing of SenseCam images (eliminates bias). Moreover, the choice of the third day for dietary assessment and SenseCam image viewing/discussions was an additional strength, where the participants were less conscious of the fact that they were wearing SenseCam (Wilson et al., 2016; Barr et al., 2015), allowing for capturing of more naturalised daily behaviour. With regards to the survey study, perhaps its most powerful point was the derivation of its questions from: (1) Previous literature (2) a novel and comprehensive theory base like RAA (3) results of two participant-led in-depth exploratory studies on the topic. This contributed to building more specific questions and an exploration of whole grain consumption correlates on a level exceeding generalised assumptions. One question which demonstrated this was that inquiring on suggested facilitators to consumption. Adolescent receptiveness to various means of delivering the whole grain message was acknowledged and taken into account while building the question, which allowed the revelation of intriguing findings (see C*hapter 4 Discussion, section 4.4*). Furthermore, conducting the FFQs prior to the questionnaires reduced possibilities of bias in reporting whole grain intake – as the latter included educational material. Finally, the online administration of the whole survey (which allowed for inclusion of educational content) along with its anonymity (encouraging comfortable expression) can be further added to the numerous strengths of this study.

### 5.2.2 Recommendations in light of research limitations

Perhaps the first and most evident limitation of this research, along with other whole grain studies, is the perplexity surrounding the definition of the word “whole grain”, whole grain identification, and what comprises of a wholegrain product. As all data in this research were self-reported, any resulting findings were subject to the misconceptions and complications surrounding the whole grain definition, such as over-estimation or under-reporting of consumption and confounded participant opinions as to what they perceived as a wholegrain product. Similar challenges were acknowledged throughout the whole grain literature (Kuznesof et al., 2012; McMackin et al., 2012; Mancino et al., 2008; Chase et al., 2003b; Kantor et al., 2001; Adams and Engstrom, 2000; Slavin, 2000), and efforts are ongoing to settle this research and consumer controversy by agreeing on a standardised whole grain definition and clear recommendations (Ross et al., 2015). Researchers and organisations have adopted and proposed many definitions, with varying percentages of whole grain content in foods required to qualify as a wholegrain product (Korczak et al., 2016; Ross et al., 2015; Ferruzzi et al., 2014; van der Kamp et al., 2014; Bjorck et al., 2012; Richardson, 2003). However, until definitive steps towards clear and straightforward whole grain definitions and product labelling take place, findings in such exploratory studies remain susceptible to the controversies and difficulties surrounding whole grain identification.

Further possible limitations of this research were related to the limited time and resources, which did not allow for a few enhancements to the research methods. It would have been useful to recruit a larger number of schools in the focus groups and survey studies, allowing for a more diverse sample representativeness. Moreover, as reported in Study III, the questionnaire content was restricted due to the recruitment time challenges, thus FFQs had to be narrowed down to wholegrain foods only, which did not allow for a complete dietary assessment through the FFQs (thus adjusting for energy intake was not possible, which might have accounted for gender differences in intake). Moreover, some questions from the survey had to be eliminated, which are outlined in the discussion of Study III (see C*hapter 4 Discussion, section 4.4*). This was done to allow for a lower time burden on the participating schools and students. Time limitations also did not allow for accurate whole grain quantification in the survey study (by conversion of weekly serving estimates into grams of whole grain consumed), as the composition tables with official whole grain content of foods consumed in the UK were officially published fairly recently (Jones et al., 2017).

Other methodological limitations included the use of FFQs to measure whole grain intake, as the tool does entail some bias, overestimation, and reporting inaccuracies (Magalis et al., 2016; Brownlee et al., 2010; Burrows et al., 2010), but imposes lower participant burden than more robust but tedious dietary assessment methods such a food diaries. These self-reporting issues may have been further confounded by the challenges in whole grain identification faced by the participants, and presented a limitation in measuring wholegrain intake and drawing accurate trends with the available data.

Future research could explore some valuable areas which were not possible to cover in this research. The intake trends from the FFQ survey could be quantified accurately and compared with the latest NDNS national reports on whole grain intake (Mann et al., 2015). Also, piloting of products and educational material in such pre-intervention studies could help explore the possibility of improved attitudes towards wholegrain foods through approaches like education exposure and habitual consumption – whereby the latter proved promising in research with other age groups (Kuznesof et al., 2012). In the SenseCam-assisted interviews study, future research could possibly expand on socio-environmental exploration by interviewing parents and school health educators to provide a more complete understanding of factors that influence adolescent wholegrain intake. Moreover, the use of SenseCam as a novel tool for health research is in its early stages, and studies which unravel its potential are starting to emerge in the literature. This study made use of SenseCam to gain insight into the adolescent world and aid in inspiring and prompting enlightening conversations with the participants; however, time limitations did not allow unravelling the full potential of SenseCam as a dietary assessment tool by comparing the results to the traditional 24 hour recall records. SenseCam-aided 24-hour recalls have been explored in two previous studies (Gemming et al., 2015b; Gemming et al., 2013) and would be a suggestion for further examination of the data and SenseCam as a tool in subsequent work, especially given the distinct adolescent age group. Quantitative examination of how well RAA predicts whole grain intake as a behaviour in adolescents was beyond the time and objectives scope of this research, and could be a possible suggestion for further research on the data generated in this study. Finally, this research was a cross-sectional study, and no follow-up was included; therefore it does not provide statements about the causality of associations. This thesis does not present an intervention study, but its studies answer the exploratory and methodological questions that would guide future intervention work.

## 5.3 Conclusion

This thesis presented one of the early studies that explore wholegrain intake correlates, and the first in the UK to target adolescents. This research systematically applied a phased approach, building on person-centered accounts through to a large representative survey. It further explored the usefulness of health behaviour theory to this dietary practice; and utilised SenseCam-led interviews to understanding dietary choice, practice and personal relevance. The participant-led approaches and original techniques employed for exploring wholegrain intake correlates on various levels (personal, socio-demographic, and environmental) make this research a valuable window into the adolescent lifestyle and the influences that drive their dietary choices and behaviour. The findings of the studies within this thesis offer novel insights into adolescent understanding and consumption of whole grains, as well as key information for designing interventions to increase whole grain intake in this population.

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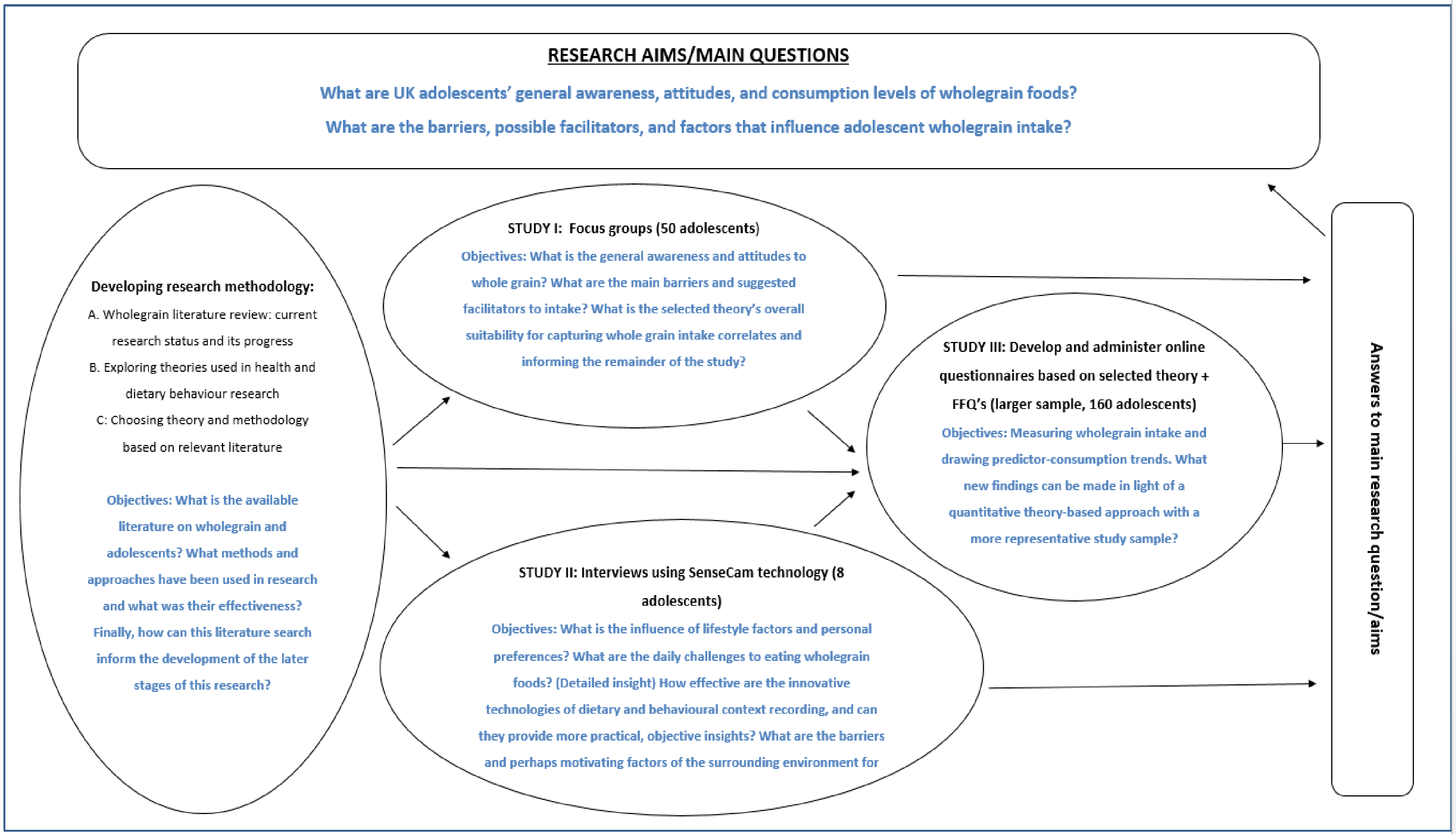
# Chapter 7 Appendices

## 7.1 Chapter 1 Appendices

### 7.1.1 Outline of research methodology, aims and objectives

See next page


RESEARCH AIMS/MAIN QUESTIONS
What are UK adolescents' general awareness, attitudes, and consumption levels of wholegrain foods?
What are the barriers, possible facilitators, and factors that influence adolescent wholegrain intake?
Developing research methodology:
A. Wholegrain literature review: current research status and its progress
B. Exploring theories used in health and dietary behaviour research
C: Choosing theory and methodology based on relevant literature
Objectives: What is the available literature on wholegrain and adolescents? What methods and approaches have been used in research and what was their effectiveness? Finally, how can this literature search inform the development of the later stages of this research?
STUDY I: Focus groups (50 adolescents)
Objectives: What is the general awareness and attitudes to whole grain? What are the main barriers and suggested facilitators to intake? What is the selected theory's overall suitability for capturing whole grain intake correlates and informing the remainder of the study?
STUDY II: Interviews using SenseCam technology (8 adolescents)
Objectives: What is the influence of lifestyle factors and personal preferences? What are the daily challenges to eating wholegrain foods? (Detailed insight) How effective are the innovative technologies of dietary and behavioural context recording, and can they provide more practical, objective insights? What are the barriers and perhaps motivating factors of the surrounding environment for
STUDY III: Develop and administer online questionnaires based on selected theory + FFQ's (larger sample, 160 adolescents)
Objectives: Measuring wholegrain intake and drawing predictor-consumption trends. What new findings can be made in light of a quantitative theory-based approach with a more representative study sample?
Answers to main research question/aims

## 7.2 Chapter 2 Appendices

### 7.2.1 Study I participant information sheet

UNIVERSITY OF LEEDS

**WOULD YOU LIKE TO REPRESENT YOUNG PEOPLE YOUR AGE?**

**DO YOU WANT TAKE BE PART IN RESEARCH AT A PRESTIGIOUS UNIVERSITY?**

**>>> WHAT IS IT?**

- A research by the University of Leeds about whole-grain food.

**WHY YOU ???**

- We are interested in young people your age (in year 7 to 11)
- Because what you think MATTERS!

***WHAT DOES IT INVOLVE?***

- You will take part in a group discussion for about an hour.
- It will take place in the school.
- It will all be about your opinion, what you think and how you feel about whole-grain foods (even if you haven't heard of it!!)

**WHAT'S IN IT FOR YOU!**

You will:

- ✓ Be a representative of young people your age.
- ✓ Be a part of an important research project in the University of Leeds.
- ✓ Help bring about a change for the future of science.
- ✓ Help scientific researchers understand young people and approach them in a way that is tailored to their needs.
- ✓ Learn more about nutrition and healthy foods.
- ✓ Receive a Research Participation Certificate as a thank-you for your time and special contribution – good on the CV!

- IF YOU ARE INTERESTED IN THIS NEW RESEARCH PLEASE RETURN THE CONSENT FORMS TO YOUR YEAR TUTOR.
- WE WILL CONTACT YOU THEN AND ORGANISE A TIME. WE WOULD ALSO NEED TO BE SURE YOUR PARENTS/GUARDIANS ARE OKAY WITH YOU TAKING PART IN THIS RESEARCH. GET IN TOUCH!
- TO FIND OUT MORE CONTACT US ON fs11mk@leeds.ac.uk 07858610060

University of Leeds Research Ethics Ctte: MEEC 13-003

### 7.2.2 Study I school and participant consent forms

UNIVERSITY OF LEEDS

**WHOLE-GRAIN INTAKE IN ADOLESCENTS:**

**FOCUS GROUPS SCHOOL CONSENT FORM**

Please tick and sign below to confirm:

- ☐ I have been given the research study information sheet with contact details.
- ☐ I have had the study fully explained to me.
- ☐ I confirm that I was able to discuss the study with the research team.
- ☐ I confirm that any questions or concerns I had were answered in full.
- ☐ I understand that school and individuals' names will not be identifiable in the reports that result from the research.
- ☐ I give permission for members of the research team to have access to school to advertise the project and carry out the focus groups.

**Name of School:**

**Head school teacher name:**

**Head school teacher signature:**

**Date:**

**THANK YOU!**

University of Leeds Research Ethics Ctte: MEEC 13-003

Participant Number: _____

UNIVERSITY OF LEEDS

# WHOLE-GRAIN INTAKE IN ADOLESCENTS

## FOCUS GROUPS PARTICIPANT CONSENT FORM

In order to participate in this research, and to comply by the **ethical guidelines**, you must read the consent form below.

If you agree to take part in this research, please **tick the boxes** and **sign in the box** at the bottom of the page. Parents/Legal guardians must also sign if they are happy for you to take part in this study.

- ☐ I understand that my participation in this study is completely voluntary.
- ☐ I have been given an information sheet with contact details.
- ☐ I have had the study fully explained to me.
- ☐ I confirm that any concerns or questions I had were answered in full.
- ☐ I understand that I can stop taking part in the study at any point and without giving any reasons.
- ☐ I am aware that the focus groups will be audio-recorded for research purposes only.
- ☐ I understand that this study is anonymous and all personal details provided in this study are strictly confidential and will only be used for research purposes.
- ☐ I agree to take part in this research study.

**For parents/legal guardians, are you happy that your son/daughter take part in this study? Yes / No**

**Participant's full name and signature:**

_______________________________

**Parent/Legal guardian's full name and siganture:**

_______________________________

**Researcher's full name and signature:**

_______________________________

University of Leeds Research Ethics Ctte: MEEC 13-003

### 7.2.3 Ethical issues of concern in Study I (focus groups) and ethical approval letter

_Ethical issues of concern and how they would be addressed:_

- Participants will be fully informed of the purpose, methods and intended possible uses of the research, what their participation in the research entails and what risks, if any, are involved. Information relating to the focus group and its purpose will be clearly outlined in the information letters when seeking participant consent.
- As the participants will be under 16 years of age, a signed consent form will be obtained from the participants' parents/legal guardian to ensure that they fully understand and agree for their son/daughter to participate in the study.
- It will be clear in all forms of communication that participation is voluntary.
- Participants will be notified that the focus groups will be audio-recorded.
- The confidentiality of personal information supplied by the research participants will be maintained at all times. Any quotes used when analysing the research will be anonymised and not directly attributed to any one individual. Participants will be advised at the start that the topics discussed in the focus groups should not be discussed outside. The Nutritional Epidemiology Group confirms to the requirements of the Data Protection Act.
- No physical, social or psychological harm is anticipated to the research participants. The focus group discussions will be taking place in the schools and at a time approved by the schools..
- It will be made clear to all participants on consent forms and in all stages of the research that they have the right to withdraw from the research at any time without giving any reasons and without there being any negative consequences.
- To ensure that the adolescents read and understand the information sheet before signing the consent form, the researcher or her assistant will read the information sheet to them if required and explain the study further to them according to their level of understanding.
- To protect and ensure the safety of the adolescents, the Disclosure and Barring Service (DBS) for all researchers will be checked.
- To ensure that all participants understand the questions, the researchers will rephrase questions and all research content to suit this age group.

Performance, Governance and Operations
Research & Innovation Service
Charles Thackrah Building
101 Clarendon Road
Leeds LS2 9LJ Tel: 0113 343 4873
Email: ResearchEthics@leeds.ac.uk

UNIVERSITY OF LEEDS

Maya Kamar
School of Food Science and Nutrition
University of Leeds
Leeds, LS2 9JT

**MaPS and Engineering joint Faculty Research Ethics Committee (MEEC FREC)**
**University of Leeds**

23 June 2017

Dear Maya

| | |
|---|---|
| **Title of study** | **Whole grain intake correlates in adolescents: A theory-based qualitative study** |
| **Ethics reference** | **MEEC 13-003** |

I am pleased to inform you that the application listed above has been reviewed by the MaPS and Engineering joint Faculty Research Ethics Committee (MEEC FREC) and following receipt of your response to the Committee's initial comments, I can confirm a favourable ethical opinion as of the date of this letter. The following documentation was considered:

| *Document* | *Version* | *Date* |
|---|---|---|
| MEEC 13-003 Maya_Ethical_Review_Form_V3.doc | 2 | 23/09/13 |
| MEEC 13-003 Low Risk Fieldwork RA form1.doc | 2 | 23/09/13 |
| MEEC 13-003 Information sheet.docx | 2 | 23/09/13 |
| MEEC 13-003 Consent form schools.doc | 2 | 23/09/13 |
| MEEC 13-003 Consent form participants.doc | 2 | 23/09/13 |

Please notify the committee if you intend to make any amendments to the original research as submitted at date of this approval, including changes to recruitment methodology. All changes must receive ethical approval prior to implementation. The amendment form is available at http://ris.leeds.ac.uk/EthicsAmendment.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited. There is a checklist listing examples of documents to be kept which is available at http://ris.leeds.ac.uk/EthicsAudits.

We welcome feedback on your experience of the ethical review process and suggestions for improvement. Please email any comments to ResearchEthics@leeds.ac.uk.

Yours sincerely

Jennifer Blaikie
Senior Research Ethics Administrator, Research & Innovation Service
On behalf of Professor Gary Williamson, Chair, MEEC FREC
CC: Student's supervisor(s)

### 7.2.4 Sample certificate of research participation (for participants)

THE UNIVERSITY OF LEEDS

UNIVERSITY OF LEEDS

SCHOOL OF FOOD SCIENCE AND NUTRITION, NUTRITIONAL EPIDEMIOLOGY GROUP

# Certificate of Participation

THIS CERTIFICATE IS AWARDED TO:

------------------------------------------------------------------------

IN RECOGNITION OF YOUR ACTIVE PARTICIPATION IN THE BEHAVIOURAL NUTRITION RESEARCH PROJECT "FACTORS INFLUENCING ADOLESCENT WHOLEGRAIN INTAKE: A THEORY-BASED STUDY", WITH MANY THANKS AND APPRECIATION OF THE TIME AND INFORMATION YOU CONTRIBUTED TO INFORM THE RESEARCH STUDY.

11 JULY 2016

PROFESSOR JANET CADE,
PROFESSOR OF NUTRITIONAL EPIDEMIOLOGY AND PUBLIC HEALTH

Janet Cade

DR. CHARLOTTE EVANS,
LECTURER IN NUTRITIONAL EPIDEMIOLOGY

Charlotte Evans

DR. SIOBHAN HUGH-JONES,
ASSOCIATE PROFESSOR IN APPLIED HEALTH PSYCHOLOGY

SHughJones

MS. MAYA KAMAR
RESEARCHER IN BEHAVIOURAL NUTRITION

### 7.2.5 Sample certificate of research appreciation (for participating school staff)

THE UNIVERSITY OF LEEDS

SCHOOL OF FOOD SCIENCE AND NUTRITION, NUTRITIONAL EPIDEMIOLOGY GROUP

UNIVERSITY OF LEEDS

# Certificate of Appreciation

THIS CERTIFICATE IS AWARDED TO:

IN RECOGNITION OF HER EXTRAORDINARY EFFORTS AND SUPPORT IN ACCOMPLISHING THE BEHAVIOURAL NUTRITION RESEARCH PROJECT "FACTORS INFLUENCING ADOLESCENT WHOLEGRAIN INTAKE: A THEORY-BASED STUDY", WHICH WILL ENHANCE RESEARCHERS' ABILITY TO PROMOTE WHOLEGRAIN FOOD CONSUMPTION AND IMPROVE HEALTH IN SECONDARY SCHOOL CHILDREN.

12 JULY 2016

PROFESSOR JANET CADE,
PROFESSOR OF NUTRITIONAL EPIDEMIOLOGY AND PUBLIC HEALTH

Janet Cade

DR. CHARLOTTE EVANS,
LECTURER IN NUTRITIONAL EPIDEMIOLOGY

Charlotte Evans

DR. SIOBHAN HUGH-JONES,
ASSOCIATE PROFESSOR IN APPLIED HEALTH PSYCHOLOGY

S Hugh Jones

MS. MAYA KAMAR
RESEARCHER IN BEHAVIOURAL NUTRITION

Maya

## 7.3 Chapter 3 Appendices

### 7.3.2 Study II participant information sheet

**WOULD YOU LIKE TO REPRESENT YOUNG PEOPLE YOUR AGE?**

**DO YOU WANT TO TAKE PART IN RESEARCH AT A PRESTIGIOUS UNIVERSITY?**

UNIVERSITY OF LEEDS

**>>> WHAT IS IT?**

- A research by the University of Leeds about young people's lifestyle, opinions, and dietary choices.

**WHY YOU ???**

- We are interested in lifestyles of young people your age.
- Because what you think MATTERS!

***WHAT DOES IT INVOLVE?***

- You will wear a camera that takes automatic shots throughout the day, for three days.
- You will be interviewed by a University of Leeds researcher for around 75 minutes, where you will discuss lifestyle and food choices.

**WHAT'S IN IT FOR YOU!**

You will:

- ✓ Be a representative of young people your age
- ✓ Be a part of an important research project in the University of Leeds
- ✓ Help bring about a change for the future of science
- ✓ Help scientific researchers understand young people and approach them in a way that is tailored to their needs
- ✓ Learn more about nutrition and healthy lifestyles
- ✓ Receive £25 and a Research Participation Certificate as a thank-you for your time and contribution – good on the CV!

- **IF YOU ARE INTERESTED IN THIS NEW RESEARCH PLEASE RETURN THE CONSENT FORMS TO THE RESEARCHER/YOUR TEACHER.**
- **WE WILL CONTACT YOU THEN AND ORGANISE A MEETING TIME. WE WOULD ALSO NEED TO BE SURE YOUR PARENTS/GUARDIANS ARE OKAY WITH YOU TAKING PART IN THIS RESEARCH.**
- **TO FIND OUT MORE CONTACT MAYA :** fs11mk@leeds.ac.uk, **OR DR. EVANS:** C.E.L.Evans@leeds.ac.uk

This project has been approved by the University of Leeds Research Ethics Ctte: MEEC 13-015

**INTERESTED IN TAKING PART IN THIS RESEARCH?**

There are a few things you need to know first:

- The device you will be wearing for three days is called SenseCam. It is a camera that takes automatic shots every 20 seconds.
- It is a new, innovative scientific tool, used in many fields. In this study, it will be used to give researchers an idea about adolescent lifestyle, opinions, and dietary choices.
- There will be a large number of images taken every day, and you will get the chance to remove any private or unwanted photos before the researchers have access to them.
- You will be able to pause the device and remove it whenever you wish.
- You will not be getting copies of the images to keep.
- A team of trained researchers will have access to the images after they have been submitted.
- This research is confidential and images will be used for research purposes only. Identifying places or faces will be digitally obscured (blurred) before being used for research purposes.
- We will be helping and preparing you with brief explanations to use when asked in public about the device you are wearing.
- You are advised to seek consent from family members or the people you live with before using SenseCam.
- You are also advised to let your classmates and teachers know if they asked you about SenseCam, and offer to remove the device in case they are uncomfortable with it.
- You may remove SenseCam in situations of discomfort or unwanted attention.
- SenseCam is programmed securely and no one can access the data inside it.
- Data of illegal activities may be passed to law, depending on nature of activity.

**IF YOU HAVE ANY QUESTIONS PLEASE DO NOT HESITATE TO GET IN TOUCH!**

This project has been approved by the University of Leeds Research Ethics Ctte: MEEC 13-015

### 7.3.3 Study II school and participant consent forms

UNIVERSITY OF LEEDS

**LIFESTYLE & DIETARY CHOICES OF ADOLESCENTS:**

**INTERVIEW SCHOOL CONSENT FORM**

Please tick and sign below to confirm:

- ☐ I have been given the research study information sheet with contact details.
- ☐ I have had the study fully explained to me.
- ☐ I confirm that I was able to discuss the study with the research team.
- ☐ I confirm that any questions or concerns I had were answered in full.
- ☐ I understand that school and individuals' names will not be identifiable in the reports that result from the research.
- ☐ I give permission for members of the research team to have access to the school to advertise the project and carry out their research.

**Name of School:**

**Head teacher name:**

**Head teacher signature:**

**Date:**

**THANK YOU!**

This project has been approved by the University of Leeds Research Ethics Ctte: MEEC 13-015

UNIVERSITY OF LEEDS

# LIFESTYLE & DIETARY CHOICES OF ADOLESCENTS

## INTERVIEW PARTICIPANT CONSENT FORM

In order to participate in this research, and to comply by the **ethical guidelines**, you must read the consent form below.

If you agree to take part in this research, please **tick the boxes** and **sign in the box** at the bottom of the page. Parents/Legal guardians must also sign if they are happy for you to take part in this study.

- ☐ I understand that my participation in this study is completely voluntary.
- ☐ I have been given an information sheet with contact details.
- ☐ I have had the study fully explained to me.
- ☐ I confirm that any concerns or questions I had were answered in full.
- ☐ I understand that I can stop taking part in the study at any point and without giving any reasons.
- ☐ I am aware that this research requires wearing a passive-image-capturing device for three days, and that I will have the opportunity to eliminate any private or undesirable photos before they are used in the research.
- ☐ I am aware that the interviews will be audio-recorded for research purposes only.
- ☐ I understand that this study is anonymous and all personal details and images provided in this study are strictly confidential and will only be used for research purposes.
- ☐ I understand that I will be receiving a research participation certificate and a £25 voucher in appreciation of my participation in this study.
- ☐ I agree to take part in this research study.

**For parents/legal guardians, are you happy that your son/daughter take part in this study? Yes / No**

**Participant's full name and signature:**

______________________________

**Parent/Legal guardian's full name and signature:**

______________________________

This project has been approved by the
University of Leeds Research Ethics Ctte: MEEC 13-015

### 7.3.4 Ethical issues of concern in Study II (SenseCam-assisted interviews) and ethical approval letter

| Ethical Issue | Details of the Issue | How it will be addressed |
|---|---|---|
| **Participants are under 16 years of age** | They are categorised as vulnerable individuals by law | - As the participants will be under 16 years of age, a signed consent form will be obtained from the participants' parents/legal guardian to ensure that they fully understand and agree for their son/daughter to participate in the study.<br>- To protect and ensure the safety of the adolescents, a Disclosure and Barring Service (DBS) for all researchers has been obtained.<br>- Regarding SenseCam: Two studies involving children in the literature have used SenseCam. |
| **Informed and written consent** | Are the participants mature enough to understand the research and any implications for them and consent to it, or should parental/legal guardian consent be obtained as well? | - Participants will be fully informed of the purpose, methods and intended possible uses of the research, what their participation in the research entails and what risks, if any, are involved. Information relating to SenseCam use and the interview and its purpose will be clearly outlined in the information letters when seeking participant consent.<br>- Participants will be notified and reminded that the interviews will be audio-recorded.<br>- To ensure that the adolescents read and understand the |

information sheet before signing the consent form, the researcher or her assistant will read the information sheet to them if required and explain the study further to them according to their level of understanding.

- Regarding SenseCam: Participant information should explicitly detail the following:
  - how many images and how much information will be collected
  - the nature and type of data that can be collected by wearing an automated, wearable camera (images will depict where you go, what you do, and for how long) with examples
  - participants can forget they are wearing the device and record unwanted and unflattering images with examples provided (e.g., bathroom visits, online banking)
  - data of illegal activities may not be protected by confidentiality and may be passed to law enforcement depending on the national law and nature of the activity
  - no individual will be identifiable in any research dissemination without their consent
  - participants will have the opportunity to view (and delete if necessary) their images in privacy
  - participants are able to remove the device or temporarily pause image capture whenever they wish
  - participants will not get copies

| | | |
|---|---|---|
| | | of their images<br>o a team of trained researchers will have access to the image data |
| **Psychological harm** | This might happen indirectly through the recruitment process (pressure), or privacy invasion via SenseCam use. Also there is a possibility of psychological harm (though minimal) in the interviews. | - The interviewer would be trained, neutral and must not react or influence participants' answers<br><br>- It will be clear in all forms of communication that participation is voluntary. It will be made clear to all participants on consent forms and in all stages of the research that they have the right to withdraw from the research at any time without giving any reasons and without there being any negative consequences.<br><br>- Regarding SenseCam:<br><br>o Participants should be prepared for questions by the public with a short sentence that explains the device and concludes with an offer to remove if they are feeling uncomfortable<br>o Participants should be instructed to remove device in any situation where it is attracting unwanted attention, or they feel threatened or uneasy wearing the device |
| **Physical harm** | It is minimal, as the SenseCam is lightweight, thus is not expected to burden the | - No physical, social or psychological harm is anticipated to the research participants. |

| | | |
|---|---|---|
| | participants. | |
| **Inconvenience** | Inconvenience may arise due to meeting/interview times or locations, or may be related to SenseCam use. | - Inconveniences of meetings will be minimised by having the meetings during school hours and on the school premises if the participant prefers that. Similarly, University premises could be another option.<br>- Participant convenience will be the main deciding factor when choosing meeting locations and times.<br>- Regarding SenseCam: Participants will be given all details surrounding SenseCam use possible inconveniences and any questions or concerns will be discussed in full. |
| **Privacy and confidentiality** | Data protection and ensuring that the personal information/details obtained in the research and details that potentially identify individuals are issues that must be managed. | - The confidentiality of personal information supplied by the research participants will be maintained at all times.<br>- Any quotes used when analysing the research will be anonymised and not directly attributed to any one individual.<br>- Participants will be advised at the start that the topics discussed in the research will not be discussed outside.<br>- The Nutritional Epidemiology Group confirms to the requirements of the Data Protection Act.<br>- Regarding SenseCam: |

| | | |
|---|---|---|
| | | o Devices should be configured so that data can only be retrieved by the research team. It should be impossible for participants or third parties who find devices to access images<br>o Data should be stored according to national data protection regulations<br>o Identifying images should not be used without express consent of those individuals who are depicted<br>o Devices should be configured to allow participants to cease recording for short periods.<br>o Participants should be allowed to remove the device at any time, with examples of where this might be appropriate (e.g., airport security)<br>o Appropriate training should be provided for all those in the research team who have contact with the image data |
| Autonomy of third parties | This would mostly be related to SenseCam use | - Participants should seek verbal permission from family members and cohabitants before study commencement<br>- Participants should seek verbal permission of school teachers and classmates. If possible, this should be prior to study commencement, but in reality may be a rolling process.<br>- Participants should inform friends and acquaintances of device when encountered and offer to remove device if they are uncomfortable<br>- Participants should be told to |

| | | |
|---|---|---|
| | | inform third parties that they also can request image deletion by asking the participant to inform the research team, or contacting them directly<br><br>- The privacy and anonymity of third parties must be protected; no image that identifies them should be published without their consent<br><br>- Photography may not inappropriate in some cultural settings and automated, wearable cameras should not be used in these instances |
| Safety and lone working issues | The research will take place in public settings or within school/university premises. | - School head-teachers will be aware of the research as it takes place (while in a school) as well as the research supervisors at all times.<br><br>- To protect and ensure the safety of the adolescents, the Disclosure and Barring Service (DBS) for all researchers has been checked. |

### 7.3.5 University ethical approval letter

Performance, Governance and Operations
Research & Innovation Service
Charles Thackrah Building
101 Clarendon Road
Leeds LS2 9LJ Tel: 0113 343 4873
Email: ResearchEthics@leeds.ac.uk

UNIVERSITY OF LEEDS

Maya Kamar
Ph.D. Student
Nutritional Epidemiology Group
School of Food Science and Nutrition
University of Leeds
Leeds, LS2 9JT

**MaPS and Engineering joint Faculty Research Ethics Committee (MEEC FREC)**
**University of Leeds**

23 June 2017
Dear Maya

| | |
|---|---|
| **Title of study** | **Factors influencing adolescent wholegrain intake: A theory-based study (Phase 2)** |
| **Ethics reference** | **MEEC 13-015** |

I am pleased to inform you that the application listed above has been reviewed by the MaPS and Engineering joint Faculty Research Ethics Committee (MEEC FREC) and I can confirm a favourable ethical opinion as of the date of this letter. The following documentation was considered:

| *Document* | *Version* | *Date* |
|---|---|---|
| MEEC 13-015 Maya_Ethical_Review_Form_interviews.doc | 1 | 24/03/14 |
| MEEC 13-015 Low Risk Fieldwork RA form1 interviews.doc | 1 | 24/03/14 |
| MEEC 13-015 Information sheet interviews.docx | 1 | 24/03/14 |
| MEEC 13-015 Consent form schools interviews.docx | 1 | 24/03/14 |
| MEEC 13-015 Consent form participants interviews.docx | 1 | 24/03/14 |

Committee members made the following comments and suggestions about your application:

1) This application is on a somewhat sensitive area, but has been well thought out and well written.
2) The consent forms should have space to be countersigned by the researcher.
3) The risk of misuse is perhaps not outlined enough - the final bullet point at the bottom of the information sheet could be written more clearly with an adolescent audience in mind.

Please notify the committee if you intend to make any amendments to the original research as submitted at date of this approval, including changes to recruitment methodology. All changes must receive ethical approval prior to implementation. The amendment form is available at http://ris.leeds.ac.uk/EthicsAmendment.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited. There is a checklist listing examples of documents to be kept which is available at http://ris.leeds.ac.uk/EthicsAudits.

We welcome feedback on your experience of the ethical review process and suggestions for improvement. Please email any comments to ResearchEthics@leeds.ac.uk.

Yours sincerely
Jennifer Blaikie
Senior Research Ethics Administrator, Research & Innovation Service
On behalf of Professor Gary Williamson, Chair, MEEC FREC

CC: Student's supervisor(s)

### 7.3.6 Framework of concepts* used as guidance and prompts during the interviews.

| General Question Pointers | Probing points |
|---|---|
| **Socio-demographic factors** | race/ethnicity – family socioeconomic status – living situation – economic barriers to healthy or whole grain eating |
| **Personal factors** | Knowledge/awareness – self efficacy – taste preference for whole grain – texture/mouth feel – appearance – familiarity with whole grains – perceived satiety value of whole grains – barriers to eating healthful foods – attitudes – perceived responsibility for healthful eating/body health/self identity/body image – lifestyle – trusted sources of nutritional information (youtubers? Social media? Friends? Parents? Teachers?) - what is the first thing you look at when checking ingredient labels? |
| **Socio-environmental factors** | support for healthful eating (from parents, friends, school, significant other) – social eating – family meal frequency – home wholegrain food availability/visibility – level of control over food choices/perceptions of control – availability of whole grain in neighbourhood food outlets and varieties |

| | |
|---|---|
| | there – type of school attended/availability of whole grain – tv/media – access to unhealthy alternatives – sources of nutritional information |
| **Behavioural factors** | breakfast frequency – lunch frequency – dinner frequency – fast food intake – eating on the run – food preparation/shopping – situational factors |
| | |
| **Perceived benefits of eating whole grains (outcome expectancies): long term vs short term** | Cognitive function/performance |
| | Physical sensation |
| | Psychological benefits |
| | Physical performance |
| | Increase in energy |
| | Physiological benefits: example weight maintenance, digestive health |
| **Major barriers and facilitators to whole grain consumption** | Convenience of less healthful alternatives |
| | Internal/physiological preference |
| | Social reinforcement |
| | Reward driven/mood enhancement |
| **Questions about SenseCam use** | |
| ***Concepts/ideas inspired from:(McMackin et al., 2012; Krolner et al., 2011; Larson et al., 2010; Zeinstra et al., 2007; Kubik et al., 2005; McKinley et al., 2005; Wind et al., 2005; O'Dea, 2003; Bissonnette and Contento, 2001; Dennison and Shepherd, 1995)** | |

## 7.4 Chapter 4 Appendices

### 7.4.1 Study III participant information sheet

## Would You Like To Represent Young People Your Age?

## Do You Want To Take Part In Research At A Prestigious University?

UNIVERSITY OF LEEDS

**>>> WHAT IS THE STUDY ABOUT?**

- A PhD research study by the University of Leeds about young people's lifestyle, opinions, and dietary choices.

***WHAT DOES IT INVOLVE?***

- You will be answering an online questionnaire for up to one hour.
- It will take place in school.
- It will all be about your lifestyle, opinions, and food choices.
- You participation is voluntary and you can withdraw at any point.
- This research is anonymous so no names would be asked in the questionnaires and you will be assigned a participant number to use throughout the research.
- All data will be stored and handled confidentially, and will only be used for research purposes.

**WHY YOU ???**

- We are interested in young people your age (11-16 years old)
- Because what you think MATTERS!

**WHAT IS IN IT FOR YOU?**

- ✓ Be a representative of young people.
- ✓ Be a part of an important research project in the University of Leeds.
- ✓ Help scientific researchers understand young people and approach them in a way that is tailored to their needs.
- ✓ Learn more about nutrition and healthy foods.
- ✓ Receive a Research Participation Certificate as a thank-you for your time and special contribution!
- ✓ An opportunity to visit the University of Leeds to explore and learn more!

- **If you are interested in this research please return the consent form to your teacher.**
- **We will then organise a time to do the survey. We would also need to be sure your parents/guardians are okay with you taking part in this research by signing the consent form.**
- **To find out more contact us on**

Researcher: Maya Kamar
fs11mk@leeds.ac.uk , 07858610060
Supervisor: Dr. Charlotte Evans
c.e.l.evans@leeds.ac.uk

University of Leeds Research Ethics Ctte: MEEC 15-043

### 7.4.2 Study III school and participant consent forms

Participant Name: ________________________________

UNIVERSITY OF LEEDS

**LIFESTYLE AND DIETARY CHOICES OF ADOLESCENTS**

**ONLINE QUESTIONNAIRES PARTICIPANT CONSENT FORM**

In order to participate in this research, and to comply by the **ethical guidelines**, you must read and sign this consent form.

If you agree to take part in this research, please **tick the boxes** and **sign in the box** at the bottom of the page. Parents/guardians must also sign to show that they are happy for you to take part in this study.

- ☐ I understand that my participation in this study is completely voluntary.
- ☐ I have been given an information sheet with the researchers' contact details.
- ☐ The study has been explained to me.
- ☐ I confirm that any concerns or questions I had were answered in full.
- ☐ I understand that I can stop taking part in the study at any point, without giving any reasons, and can withdraw all my information up to a week after filling the questionnaire.
- ☐ I am aware that the questionnaire data will be used for research purposes only.
- ☐ I understand that this study is anonymous and all data provided in this study are strictly confidential and will only be used for research purposes.
- ☐ I agree to take part in this research study.

**For parents/ guardians, are you happy that your son/daughter take part in this study? Yes / No**

**Participant's full name and signature:**

________________________________

**Parent/Legal guardian's full name and signature:**

________________________________

**Researcher's full name and signature:**

________________________________

Researcher: Maya Kamar: fs11mk@leeds.ac.uk

Supervisor: Dr Charlotte Evans: c.e.l.evans@leeds.ac.uk

University of Leeds Research Ethics Ctte: MEEC 15-043

UNIVERSITY OF LEEDS

## WHOLE-GRAIN INTAKE IN ADOLESCENTS:

### QUESTIONNAIRES SCHOOL CONSENT FORM

Please tick and sign below to confirm:

- ☐ I have been given the research study information sheet with the researchers' contact details.
- ☐ The study has been explained to me.
- ☐ I confirm that I was given the opportunity to ask questions about the study.
- ☐ If relevant: I confirm that any questions or concerns I had were answered in full.
- ☐ I understand that school and individuals' names will not be identifiable in the reports that result from the research.
- ☐ I give permission for members of the research team to have access to school to advertise the project and conduct the questionnaires.

**Name of School:**

______________________

**Head teacher name:**

______________________

**Head teacher signature:**

______________________

**Date:**

______________________

**THANK YOU!**

Contact details:

Researcher: Maya Kamar: fs11mk@leeds.ac.uk

Supervisor: Dr Charlotte Evans: c.e.l.evans@leeds.ac.uk

University of Leeds Research Ethics Ctte: MEEC 15-043

### 7.4.3 Handouts distributed to participants at the end of the survey session (two-sided leaflet)

BDA The Association of UK Dietitians

# Food Fact Sheet

## Wholegrains

### What are wholegrains?

A huge variety of cereal crops are grown for food throughout the world including wheat, rye, barley, oats and rice. Grains are the seeds of these cereal plants. The entire grain or 'wholegrain' is made up of three elements:

- a fibre-rich outer layer – the bran
- a nutrient-packed inner part – the germ; and
- a central starchy part – the endosperm.

During the milling process, the bran and the germ are often removed to give a 'whiter' cereal.

### What nutrients do wholegrains contain?

Most of the goodness in grains is in the outer bran layer and germ of the seed so wholegrains can contain up to 75% more nutrients than refined cereals. Wholegrains provide:

- fibre - both soluble (the type that dissolves in water) and insoluble (the type that doesn't)
- B vitamins and folic acid
- essential fatty acids (omega 3 fat)
- protein
- antioxidants including vitamin E, selenium
- micronutrients like copper
- other parts of the plant which may have health benefits.

### Why should we choose wholegrains?

Evidence is growing that eating wholegrains regularly as part of a healthy diet and lifestyle helps to keep us healthy and may assist to reduce the risk of many common diseases. It is not only the fibre that has health-promoting properties - it seems to be the 'complete package' of nutrients working together to offer protection.

**Research suggests that:**

- The risk of heart disease, stroke and type 2 diabetes may be up to 30% lower in people who regularly eat wholegrains as part of a low-fat diet and healthy lifestyle.
- The risk of developing some forms of cancer of the digestive system like bowel cancer may be reduced with higher intakes of wholegrains. Some of the fibre in wholegrains moves food along more quickly and

easily, reducing the time that damaging substances are in contact with the gut wall.
- Some of the fibre provides a food source for 'friendly' gut bacteria helping them to increase and produce substances which are thought to protect the gut wall, such as short-chain fatty acids.
- Wholegrains may help in maintaining a healthy body weight over time as part of a healthy diet and lifestyle.
- Wholegrains are usually low in fat but rich in fibre and starchy carbohydrate and often have a low glycaemic index (GI). This means they provide a slow release of carbohydrate into the blood which, together with fibre content, may help keep you feeling fuller for longer - aiding to control snacking and appetite.
- Most cereal foods eaten in the UK are refined and our intake of wholegrains is very low. Surveys show that 95% of adults don't eat enough wholegrains and nearly one in three of us get none at all.

### How can I increase my intake of wholegrains?

When choosing foods from the starchy food group, replace refined cereal foods such as white bread and rice with wholegrain varieties such as wholemeal bread and brown rice. Wheat, oats, barley, rye and rice are the most commonly available cereals which can be eaten in the wholegrain form. To find them, look for the word 'whole' before the name of the cereal e.g. whole-wheat pasta, whole oats and make sure they are high up/ first in the ingredients list. Multigrain is not the same as wholegrain – it means that the product contains more than one different type of grain. There is currently no advice on what amount of wholegrains to eat in the UK but many experts in other countries say to aim for three servings a day *(see table overleaf for portion size)*.

Most of us eat too few wholegrains to get the health benefits from the whole range of nutrients they contain

## List of wholegrains

### Cereals:

- wheats, including spelt and durums
- rice
- barley including hull-less or naked barley but not pearled
- maize (corn)
- rye
- oats, including hull-less or naked oats
- millets
- wild rice.

### Other grains:

- buckwheat
- quinoa
- 'ancient grains' e.g. kamut, freekah.

## Summary

Most of us eat too few wholegrains to get the health benefits from the whole range of nutrients they contain as we tend to eat more refined cereals.
However, given the wide variety of wholegrain foods now available, it is easier than ever to make them the tasty staples of a healthy diet.

## Further Information

Food Fact Sheets on topics including *Weight Loss and Allergies* can be downloaded at www.bda.uk.com/foodfacts

## Wholegrain foods and ideas for use

| Type of Food | Wholegrain varieties | Portion Size = 1 serving | Ideas for use |
|---|---|---|---|
| Breakfast cereal | Whole oats including rolled oats and oatmeal*; wholewheat cereals such as Weetabix, Shreddies, Shredded Wheat, bran flakes, puffed wholegrains, wholegrain muesli*; and wholegrain cereal bars. | One tablespoon uncooked oats<br>three Tbsp wholegrain cereal. | With milk or yoghurt and fruit for breakfast or as a snack, as a topping for crumbles, as a snack. Avoid those with added sugar and salt. |
| Bread and crackers | Wholemeal, granary, wheatgerm, wholegrain with multi-grain*, seeded*, mixed-grain*, soya* linseed*, rye (pumpernickel)*, pitta, wholewheat crackers, and rye crispbread*. | One medium slice bread<br>½ wholemeal tortilla<br>½ wholemeal pitta<br>two rye crisp bread<br>two oatcakes. | In place of white bread, cream crackers and sweet biscuits. |
| Flour | Wholemeal, wheat germ, buckwheat, unrefined rye*, barley*, oatmeal* and oat flour*. | n/a | In baking or recipes in place of white flour. |
| Meals | Brown rice, wholewheat pasta*, whole barley*, bulgur (cracked) wheat* , quinoa*, and barley (not pearl)*. | Two heaped Tbsp cooked brown rice<br>three Tbsp wholegrain pasta. | With casseroles, curries, sauces, in soups, and in salads. |
| Snacks | Wholegrain cereal bars, oats cakes, wholegrain rice cakes, popcorn (plain), wholemeal scone, and wholegrain breakfast cereals. | ½ scone<br>two oatcakes<br>two to three cups plain popcorn. | In place of sweets, crisps and savoury snacks, cream crackers and sweet biscuits. |

** Low GI varieties of wholegrains*

This Food Factsheet is a public service of The British Dietetic Association (BDA) intended for information only. It is not a substitute for proper medical diagnosis or dietary advice given by a dietitian. If you need to see a dietitian, visit your GP for a referral or: www.freelancedietitians.org for a private dietitian.
To check your dietitian is registered check www.hcpc-uk.org
This Food Fact Sheet and others are available to download free of charge at www.bda.uk.com/foodfacts
Written by Sian Porter, Dietitian.
The information sources used to develop this fact sheet are available at www.bda.uk.com/foodfacts

### 7.4.4 Ethical issues of concern in Study III (survey)

| Ethical Issue | Details of the Issue | How it will be addressed |
|---|---|---|
| Participants are under 16 years of age | They are categorised as vulnerable individuals by law | - As the participants will be under 16 years of age, a signed consent form will be obtained from the participants' parents/legal guardian to ensure that they fully understand and agree for their son/daughter to participate in the study.<br><br>- To protect and ensure the safety of the adolescents, a Disclosure and Barring Service (DBS) for all researchers has been obtained. |
| Informed and written consent | Are the participants mature enough to understand the research and any implications for them and consent to it, or should parental/legal guardian consent be obtained as well? | - Participants will be fully informed of the purpose, methods and intended possible uses of the research, what their participation in the research entails and what risks, if any, are involved. Information relating to the questionnaires and their purpose will be clearly outlined in the information letters when seeking participant consent.<br><br>- To ensure that all participants understand the questions, the researchers will rephrase questions and all research content to suit this age group.<br><br>- To ensure that the adolescents read and understand the information sheet before signing the consent form, the researcher or assistant will read the information sheet to them if required and explain the study further according to their level of understanding.<br><br>- Contact details of the researchers will be listed on the consent forms and information sheets. |
| Psychological harm | This might happen indirectly through the recruitment process (pressure). Also there might be a possibility of psychological | - It will be clear in all forms of communication that participation is voluntary.<br><br>- It will be made clear to all participants on consent forms and in all stages of |

| | | |
|---|---|---|
| | harm (though minimal) in the dietary assessment or questionnaire completion. | the research that they have the right to withdraw from the research at any time without giving any reasons and without there being any negative consequences.<br><br>- The participants will be able to withdraw from the study at any time, even if they wish to leave during the questionnaire itself or after the study has been completed. As one copy of the data with names and ID numbers would be kept in an encrypted file with a password (or a hardcopy in a locked drawer), it would always be possible to go back and eliminate the contribution of any participant who wishes to withdraw from the study. The participants would have the chance to withdraw up to a week of their survey completion, and will be informed of this clearly |
| Physical harm | It is minimal. | - No physical harm is anticipated to the research participants. |
| Inconvenience | Inconvenience may arise due to meeting/research participation times or locations.<br>Inconvenience might also arise due to the online administration of the questionnaires. | - Inconveniences of participation will be minimised by having them during school hours and on the school premises.<br><br>- The questionnaires will be taking place in the schools and at a time approved by the schools.<br><br>- A paper version of the questionnaires will be made available upon need/request. |
| Privacy and confidentiality | Data protection and ensuring that the personal information/details obtained in the research and details that potentially identify individuals are issues that must be managed. | - The confidentiality of any personal or identifying information supplied by the research participants will be maintained at all times.<br><br>- There would not be any personal data taken, as participants will be assigned with participant numbers/codes which they would use once answering questionnaires. Moreover, they would use these personal numbers in any following correspondence with the researchers regarding the research |

- Any quotes used when analysing the research will be anonymised and not directly attributed to any one individual.

- Participants will be assured at the start that the information mentioned in the research will not be discussed outside.

- Questionnaires will be conducted online using Bristol Online Survey, to ensure data is stored within the EEA, in line with the Data Protection Act.

- In terms of any other personal data, initially, the contact from potential participants will be made via the school in response to advertisements and to arrange meeting times. They would hand in the consent forms to their school. Thus no personal or identifying data would be obtained. Any quotes reported in the questionnaire comments would also be anonymous.

- All research data obtained from this research will be kept in a locked filing cabinet at the University of Leeds. The office where this data will be kept is a locked office only accessible to those with a key. Computers storing personal identifiable data will be encrypted and password protected. The storage and usage of data will at all times conform to the requirements of the Data Protection Act.

- The Nutritional Epidemiology Group confirms to the requirements of the Data Protection Act.

- In accordance with the university confidentiality policies and those related to storing and sharing research data, this study has no source of external funding, thus its data will be used by the researcher and the research team to produce a

| | | |
|---|---|---|
| | | PhD thesis that answers the research questions, and to publish related peer-reviewed articles of the work. No third parties will have access to the data itself, and the data will solely be used by the research team to produce results for this research project. |
| Safety and lone working issues | The research will take place within school premises. | - School head-teachers will be aware of the research as it takes place in the school as well as the research supervisors at all times.<br><br>- The main researcher and her assistant will make an effort to ensure they do not remain alone with a single participant.<br><br>- To protect and ensure the safety of the adolescents, the Disclosure and Barring Service (DBS) for all researchers has been checked. |
| Single-blinded nature of the study | The participants will not be fully informed of the research aims to explore whole grain intake correlates. | - The research aims to explore what the adolescents naturally know about whole grains, and the possibility that they would research the topic beforehand may bias the results of the exploratory study.<br><br>- Therefore this survey would be single-blinded, in such a way that the participants would not know that the researcher is interested in wholegrain intake, but rather just in their dietary choices in general. They would be told that the research is aiming to understand an adolescent's lifestyle and food choices. This will hopefully result in more natural and unaltered dietary intake and information. They will be informed of the research's interest in wholegrain during the online survey |

### 7.4.5 University ethical approval letter

Performance, Governance and Operations
Research & Innovation Service
Charles Thackrah Building
101 Clarendon Road
Leeds LS2 9LJ  Tel: 0113 343 4873
Email: ResearchEthics@leeds.ac.uk

UNIVERSITY OF LEEDS

Maya Kamar
School of Food Science and Nutrition
University of Leeds
Leeds, LS2 9JT

**MaPS and Engineering joint Faculty Research Ethics Committee (MEEC FREC)
University of Leeds**

23 June 2017

Dear Maya

| | |
|---|---|
| **Title of study** | **Factors influencing adolescent wholegrain intake: A theory-based study** |
| **Ethics reference** | **MEEC 15-043** |

I am pleased to inform you that the application listed above has been reviewed by the MaPS and Engineering joint Faculty Research Ethics Committee (MEEC FREC) and following receipt of your response to the Committee's initial comments, I can confirm a favourable ethical opinion as of the date of this letter. The following documentation was considered:

| Document | Version | Date |
|---|---|---|
| MEEC 15-043 Consent form participants questionnaires2.doc | 2 | 05/05/16 |
| MEEC 15-043 Consent form schools questionnaires2.doc | 2 | 05/05/16 |
| MEEC 15-043 Ethical_Review_Form_V3 (1).doc | 2 | 05/05/16 |
| MEEC 15-043 Information sheet questionnaires2.doc | 2 | 05/05/16 |
| MEEC 15-043 Low Risk Fieldwork RA form1 questionnaires.doc | 2 | 05/05/16 |
| MEEC 15-043 Response to Ethics Committee Provisional Decision--Questionnaires.doc | 1 | 05/05/16 |
| MEEC 15-043 FFQ.docx | 1 | 31/03/16 |
| MEEC 15-043 Questionnaires 4.docx | 1 | 31/03/16 |

Please notify the committee if you intend to make any amendments to the original application as submitted at date of this approval as all changes must receive ethical approval prior to implementation. The amendment form is available at http://ris.leeds.ac.uk/EthicsAmendment.

Please note: You are expected to keep a record of all your approved documentation. You will be given a two week notice period if your project is to be audited. There is a checklist listing examples of documents to be kept which is available at http://ris.leeds.ac.uk/EthicsAudits.

We welcome feedback on your experience of the ethical review process and suggestions for improvement. Please email any comments to ResearchEthics@leeds.ac.uk.

Yours sincerely

Jennifer Blaikie
Senior Research Ethics Administrator, Research & Innovation Service
On behalf of Professor Gary Williamson, Chair, MEEC FREC
CC: Student's supervisor(s)

### 7.4.6 FFQ (Part 1) and Survey (Part 2) questions

#### 7.4.6.1 PART 1: FFQ

Please read these instructions before completing this short questionnaire.
All information collected will be kept completely confidential.
Please let us know how often, on average, you have eaten each food during the past week.
If you have any questions while filling this, please do not hesitate to ask.
Thank you for taking time to complete this questionnaire.

Let's start by entering your participant code: ________________________________

How often did you eat from the following last week?

| FOODS & AMOUNTS | Average Use In LAST WEEK (Tick ONE per line) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BREAD & SAVOURY BISCUITS *(one slice or biscuit)* | None | Once a week | 2-4 per week | 5-6 per week | Once a day | 2-3 per day | 4-5 per day | 6+ per day |
| White bread and rolls, white pitta bread (per slice/roll) | | | | | | | | |
| Scones, teacakes, crumpets, muffins or croissants (each) | | | | | | | | |
| Brown bread and rolls (per slice/roll) | | | | | | | | |
| Wholemeal pitta bread (each) | | | | | | | | |
| Wholemeal bread/rolls (per slice/roll) | | | | | | | | |
| Granary bread (per slice/roll) | | | | | | | | |
| Rye bread (per slice/roll) | | | | | | | | |
| Naan bread, chapatti (each) | | | | | | | | |
| Garlic bread (per serving) | | | | | | | | |
| Cream crackers, cheese biscuits (each) | | | | | | | | |
| Wholemeal crackers (per cracker) | | | | | | | | |
| Crispbreads e.g. Ryvita, Ryvita currant crunch (one) | | | | | | | | |
| Oatcakes (one) | | | | | | | | |
| Any other brands or types of bread/savoury biscuits? Please tell us how much did you have and | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| tick how often in the past week. | | | | | | | | |
| FOODS & AMOUNTS | Average Use In LAST WEEK (Tick ONE per line) | | | | | | | |
| CEREALS<br>*(one bowl)* | None | Once a week | 2-4 per week | 5-6 per week | Once a day | 2-3 per day | 4-5 per day | 6+ per day |
| Porridge, Readybrek | | | | | | | | |
| Sugar coated cereals e.g. Sugar Puffs, Cocoa Pops, Frosties | | | | | | | | |
| Non-sugar coated cereals e.g. Cornflakes, Rice Crispies | | | | | | | | |
| Muesli | | | | | | | | |
| Bran containing cereals e.g. All | | | | | | | | |
| Cheerios | | | | | | | | |
| Branflakes | | | | | | | | |
| Weetabix | | | | | | | | |
| Shredded Wheat, Shreddies | | | | | | | | |
| Wholegrain cereals with fruit e.g. Sultana Bran, Fruit n Fibre | | | | | | | | |
| Any other brands or types of cereal products? Please tell us how much did you have and tick how often in the past week. | | | | | | | | |
| FOODS & AMOUNTS | Average Use In LAST WEEK (Tick ONE per line) | | | | | | | |
| POTATOES, RICE & PASTA *(medium serving)* | None | Once a week | 2-4 per week | 5-6 per week | Once a day | 2-3 per day | 4-5 per day | 6+ per day |
| Boiled, mashed, instant or jacket potatoes *(about 1/3 of a plate)* | | | | | | | | |
| Chips, potato waffles *(side order with meal – chip-shop portions count as 2)* | | | | | | | | |
| Roast potatoes *(3 – 5 potatoes)* | | | | | | | | |
| Yorkshire pudding, pancakes, dumpling *(each medium)* | | | | | | | | |
| Potato salad *(per small tub, c. 2 tablespoons)* | | | | | | | | |
| White rice *(1/2 plateful, or in a dish e.g. rice salad, risotto etc)* | | | | | | | | |
| Brown rice *(1/2 plateful, or in a dish e.g. rice salad, risotto etc)* | | | | | | | | |
| White or green pasta, e.g. | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| spaghetti, macaroni, noodles, *(1/2 plate)* | | | | | | | | |
| Tinned pasta, e.g. spaghetti, ravioli, macaroni *(1/2 standard tin)* | | | | | | | | |
| Super noodles, pot noodles, pot savouries *(per pot)* | | | | | | | | |
| Wholemeal pasta/spaghetti *(1/2 plate)* | | | | | | | | |
| Pasta dishes e.g. Lasagne, moussaka, cannelloni *(as individual ready-meal)* | | | | | | | | |
| Pizza *(10'' = 1, 12'' = 2, 12''+ = 3-4)* | | | | | | | | |
| Any other types of grain-based dishes not mentioned above (could be special cultural grains etc)? Please tell us how much did you have and tick how often in the past week | | | | | | | | |
| FOODS & AMOUNTS | Average Use In LAST WEEK (Tick ONE per line) | | | | | | | |
| SWEETS & SNACKS *(medium serving)* | None | Once a week | 2-4 per week | 5-6 per week | Once a day | 2-3 per day | 4-5 per day | 6+ per day |
| Chocolate coated sweet biscuits, e.g. Penguin, kit-kat, chocolate digestive *(one)* | | | | | | | | |
| Sweet biscuits, plain, e.g. Nice, ginger *(one)* | | | | | | | | |
| Cakes e.g. fruit, sponge, sponge pudding *(medium slice)* | | | | | | | | |
| Sweet buns & pastries e.g. doughnuts, Danish pastries, cream cakes *(each)* | | | | | | | | |
| Flapjacks (*each)* | | | | | | | | |
| Fruit pies, tarts, crumbles (per individual pie/medium serving) | | | | | | | | |
| Milk puddings, e.g. rice, custard, trifle *(medium serving)* | | | | | | | | |
| Ice cream, choc ices *(one)* | | | | | | | | |
| Chocolates,, toffee, sweets and other confectionary *(medium bar of chocolate, one snack bar, one packet)* | | | | | | | | |
| Sugar added to tea, coffee, cereal *(teaspoon)* | | | | | | | | |
| Crisps or other packet snacks e.g. | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Wotsits *(one packet)* | | | | | | | | |
| Peanuts<br>*(one packet)* | | | | | | | | |
| Walnuts (medium serving) | | | | | | | | |
| Other nuts (medium serving) | | | | | | | | |
| Any other types of grain-based sweets or snacks not mentioned above? Please tell us how much did you have and tick how often in the past week. | | | | | | | | |

Thank you for completing this part of our questionnaire.

Please let the researcher know you are done so you can move on to part 2.

Thank you very much!!

### 7.4.6.2 PART 2: Survey

This part of the survey will have a different type of questions. It would be a little bit more about your opinions, habits, and how you feel.
Please remember that this survey is ANONYMOUS. We only have your participant code, and the information produced here is CONFIDENTIAL.
Please answer as honestly as possible.
There is no right or wrong answer, only what you think or how you feel.
This survey is individual, please do not copy your friends or influence each other's answers. It's about you and it is important that you answer it on your own.

Thank you! Now let's get started!

Q1 Let's start by entering your participant code (same as the one from Part 1).

| Q2) Think about how you'd describe yourself. | | | | | |
|---|---|---|---|---|---|
| | Strongly agree | Somewhat agree | Neutral | Somewhat disagree | Strongly disagree |
| i. My food choices are often based on healthiness first | 1 | 2 | 3 | 4 | 5 |
| ii. I feel confused about what a healthy diet is* | 1 | 2 | 3 | 4 | 5 |
| iii. I care a lot about doing well in school | 1 | 2 | 3 | 4 | 5 |
| iv. My family environment encourages/supports me to eat healthily | 1 | 2 | 3 | 4 | 5 |
| v. My friends encourage/support me to eat healthily | 1 | 2 | 3 | 4 | 5 |
| vi. I think it is important for me to eat healthy at my age | 1 | 2 | 3 | 4 | 5 |
| vii. I think it is important for me to eat only foods that I enjoy* | 1 | 2 | 3 | 4 | 5 |

Q3 Do you follow a special diet? (example: vegetarian, gluten-free, etc..)

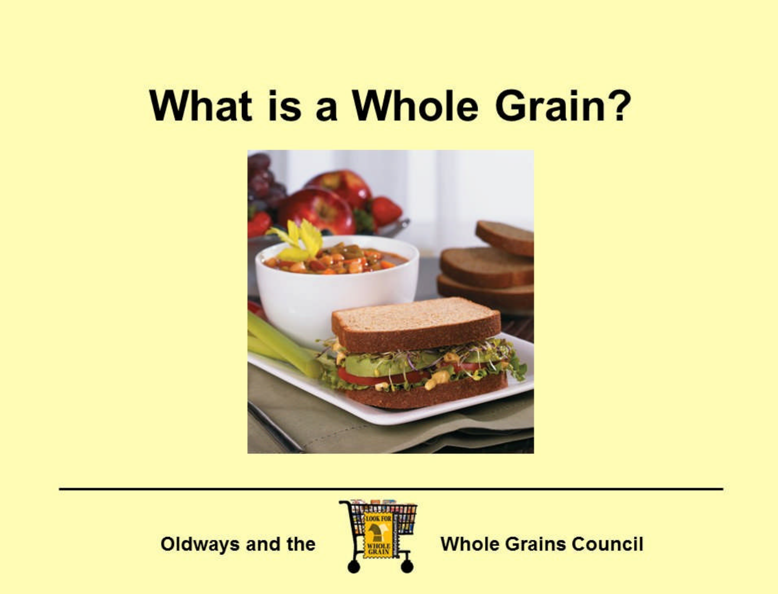
a) Yes
b) No

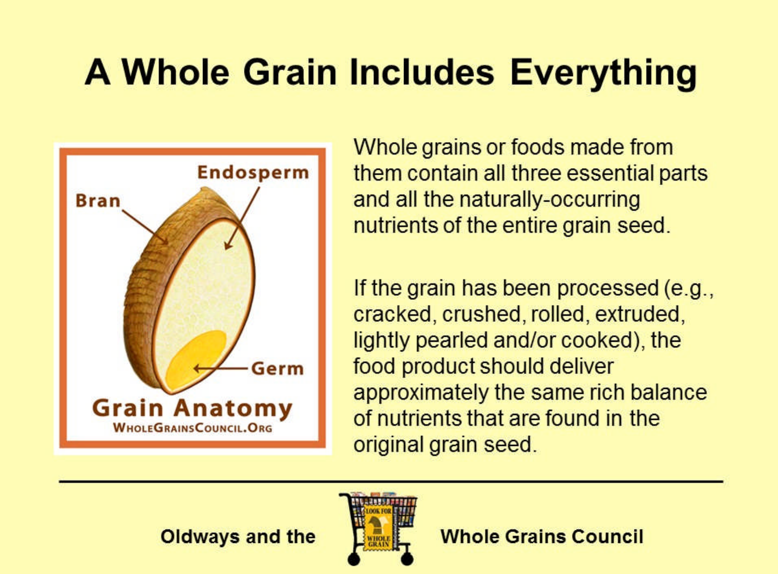
If yes, please tell us what it is:

| Q4 | Have you ever heard of whole grains before? |
|---|---|
| a) | Yes |
| b) | No |

| Q5 | What are the top three words that come to your mind when it comes to wholegrains? |
|---|---|
| a) | Tasty |
| b) | Dry |
| c) | Healthy |
| d) | Unappealing (look-wise) |
| e) | Boring |
| f) | Filling |
| g) | Organic |
| h) | Natural |
| i) | Important |

Q6) Please view these few slides, then click YES at the bottom of the page to confirm



# Some Examples of Whole Grains

*All of the following are whole grain, when eaten with ALL their bran, germ and endosperm:*

- Amaranth
- Buckwheat
- Millet
- Quinoa
- Rye
- Teff
- Wild rice
- Wheat, including varieties such as spelt, emmer, farro, einkorn, Kamut®, durum and forms such as bulgur, cracked wheat and wheatberries

- Barley (*not* including pearled barley)
- Corn, including whole cornmeal, popcorn
- Oats, including oatmeal
- Rice (brown and colored rice)
- Sorghum (also called milo)
- Triticale (a rye / wheat hybrid)

**Oldways and the** **Whole Grains Council**

Wholemeal bread

Whole-wheat pasta

Brown Rice

Wholegrain cereals

Oatmeal cookies

Popcorn

Quinoa

# What counts as a serving?

## 100% Whole Grains

This amount of **food** counts as a WG serving

- 1/2 cup pasta
- 1/2 cup rice/other grain
- 1 slice bread
- 1 cup cold cereal
- 1/2 cup hot cereal
- 1 small bagel, muffin

**Oldways and the** **Whole Grains Council**

| Q7 | How would you know that a product is definitely whole grain? Select one statement: |
|---|---|
| a) | It has “seeded” or “multi-grain” in its name |
| b) | It says it is a source of fibre |
| c) | It is brown in colour |
| d) | It has “Whole-wheat”, “Whole-meal”, “Whole-grain”, or “Oat” listed as the first ingredient |
| e) | It has healthy claims on it, including low fat and enriched-flour |

| Q8 | Where have you heard of whole grains from? (feel free to choose more than one) |
|---|---|
| a) | Family |
| b) | School |
| c) | Friends |
| d) | Online media – unofficial sources (facebook, youtube, instagram, blogs, websites, etc..) |
| e) | Government and official educational/scientific websites |
| f) | Offline media (television, newspapers, magazines, clinic bulletins, brochures, etc..) |
| g) | Advertisements, campaigns |
| h) | Products themselves (eg on supermarket shelf…) |
| i) | I don’t know |
| j) Other (please specify): | |

Q9) What are your views on wholegrain foods?
Please select a number from 1 (Strongly agree) to 5 (Strongly disagree) for each statement.

| | Strongly agree | Somewhat Agree | Neutral | Somewhat disagree | Strongly disagree |
|---|---|---|---|---|---|
| i. I feel generally positive about wholegrain foods | 1 | 2 | 3 | 4 | 5 |
| ii. I only eat wholegrain foods because I heard they are healthy* | 1 | 2 | 3 | 4 | 5 |
| iii. I enjoy eating wholegrain foods | 1 | 2 | 3 | 4 | 5 |
| iv. I would choose wholegrain food over other alternatives (like white bread, white rice) | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| v. I only eat wholegrain foods because of parents, friends, or others' encouragement* | 1 | 2 | 3 | 4 | 5 |
| vi. I believe wholegrain foods are good for my health | 1 | 2 | 3 | 4 | 5 |
| vii. I think it is important to eat wholegrain foods | 1 | 2 | 3 | 4 | 5 |
| viii. I think wholegrain foods cost more than refined grain foods* | 1 | 2 | 3 | 4 | 5 |
| ix. I feel it is inconvenient to eat wholegrain foods (hard to find/time inconvenience)* | 1 | 2 | 3 | 4 | 5 |

| Q10 | How often do you eat wholegrain foods? |
|---|---|
| a) | At least one portion everyday |
| b) | 5-6 times a week |
| c) | 2-4 times a week |
| d) | Once a week or occasionally |
| e) | Don't eat wholegrain |

| Q11 | Have your parents/family ever encouraged you to eat whole grains, directly or indirectly? |
|---|---|
| a) | Yes |
| b) | No |
| c) | Not so sure/can't remember |

It is advised that we eat 3 servings of wholegrain foods per day.

Examples of one serving of whole grain are:
- one slice of wholemeal toast
- one cup of wholegrain cereal
- half cup ready to eat porridge

It *has* to be wholegrain though (and not white bread/cereal etc..)

| Q12 | Do you think you eat 3 servings of whole grain on most days? |
|---|---|
| a) | Yes |
| b) | No |

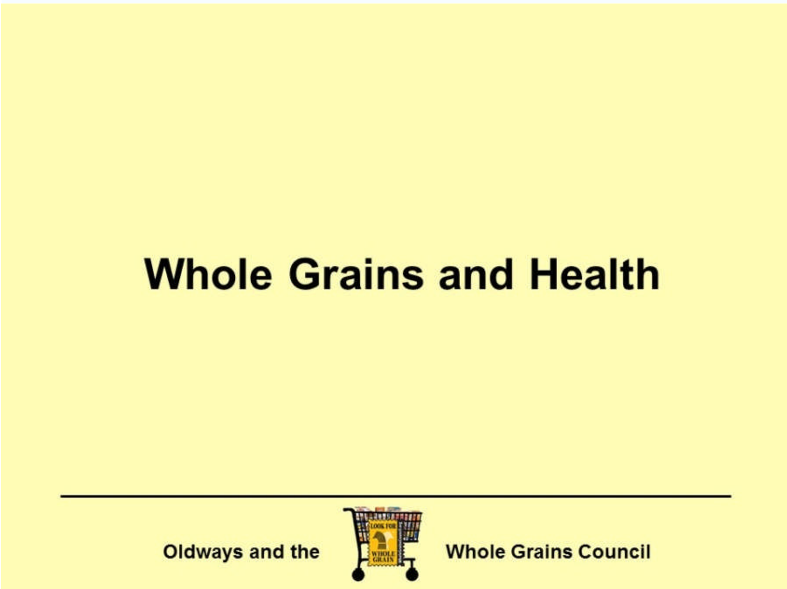
| Q13 | If not, why might you not eat three servings of wholegrain foods (Select all that apply and add your own too!) |
|---|---|
| a) | I don't like the texture or taste |
| b) | It is more expensive than refined grain (eg: white bread, white rice, etc..) |
| c) | Not available enough in stores/ not enough varieties |
| d) | Not available enough in restaurants/while eating out |
| e) | I don't see why I should be eating it/makes no difference |
| f) | It is hard to figure out which food is whole grain |
| g) | I knew it was a bit healthy, but just not enough to make it worth an effort |
| h) | My friends and family don't eat it |
| i) | I try to avoid bread and grain products to keep my weight down or for other reasons |
| j) | It causes stomach upset/makes me uncomfortable |
| k) | I am not used to eating wholegrain foods since I was young |
| l) | None of the above really, I try to choose whole grain whenever possible |
| Other reasons you can't or don't eat enough wholegrain foods: | |

| Q14 | Which statements do you think are true about wholegrain foods?(Select all that apply) |
|---|---|
| a) | They are a source of fibre |
| b) | They can help prevent heart disease, lower blood pressure and cholesterol |
| c) | They can help prevent some cancers like colon and breast cancer |
| d) | They can help prevent diabetes and regulate blood sugar levels |
| e) | They can help in keeping you full and gives long-lasting energy |
| f) | They can help in weight control |
| g) | They are a source of carbohydrates, proteins, vitamins, minerals, antioxidants and phytochemicals (help in fighting off cancer) |
| Other things you think are true about whole grains? | |

| Q15 | What source would you believe the most when you hear information about how healthy a specific food is? Read the whole list, then select your top choice. |
|---|---|
| | School/teachers |

| | |
|---|---|
| a) | Online (school-related), |
| b) | Online media – unofficial sources (facebook, youtube, instagram, blogs, websites, etc..) |
| c) | Government and official educational/scientific websites |
| d) | Family |
| e) | Friends |
| f) | Offline media sources (advertisements, tv generally, tv documentary, magazines, billboards, other..), |
| g) | Sports coach, gym, gym buddies |
| h) | Doctor or nurse |
| i) | Campaigns |
| j) | Books |
| k) | |

Q16) Please view these few slides, then click YES at the bottom of the page to confirm.



## Health Studies: WG & Teens

### HEALTH IMPROVES QUICKLY:

In a diet with more whole grains:

- Cholesterol decreases
- Insulin (sugar storing hormone) decreases
- Heart and overall health improves as a result

Source: Atherosclerosis. 2007 Mar; 191(1):98-106. RJ Barnard, AK Chen, and CK Roberts.

Oldways and the Whole Grains Council

## Health Studies: WG & Teens

### HEALTH IMPROVES QUICKLY:

In a diet with more whole grains:

- Lower risk of bowel cancer (healthy digestive system!)
- Leptin (appetite hormone) decreases
- Better weight control and fitness
- Long-lasting energy for many hours

Source: Atherosclerosis. 2007 Mar; 191(1):98-106. RJ Barnard, AK Chen, and CK Roberts.

Oldways and the Whole Grains Council

## Health Studies: WG & Teens

### ACNE IMPROVES:

•Acne "improves dramatically, by more than fifty percent" over 12 weeks with a diet including more whole grains

Sources: Journal of Dermatological Science, Apr 2008;50(1):41-52. Epub Jan 4, 2008.

Oldways and the Whole Grains Council

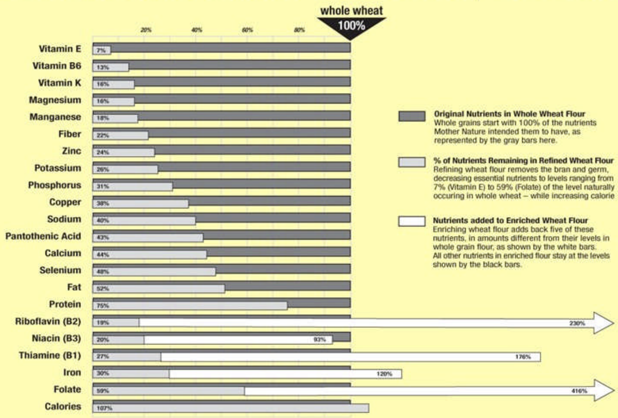
# Reasons for WG Health Benefits

- **Nutrients**
  *Whole grains have 3-5 times the vitamins and minerals found in refined grains. (See next slide for examples)*
- **Antioxidants**
  *Corn has almost twice the antioxidant activity of apples, while wheat and oats almost equal broccoli and spinach in antioxidant activity.*
- **Fiber**
  *Whole grain products offer 1g to 4g of fiber per serving. Fiber varies from 3.5% in brown rice to around 17% in barley.*
- **Long-lasting energy**
  *When you feel full longer, you're less likely to rush to the vending machine for junk food.*

---

Oldways and the Whole Grains Council

# Wheat Flour: Whole vs Refined, Enriched

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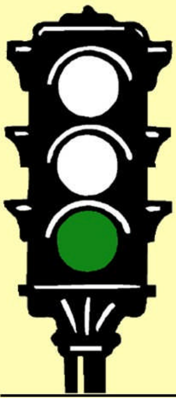
Oldways and the Whole Grains Council

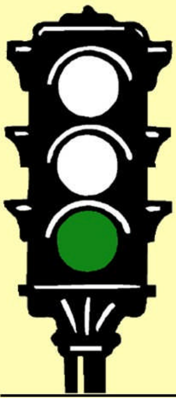
## These words mean whole grain



- Whole [name of grain]
- Whole [name of grain] flour
- Whole grain [name of grain]
- [name of grain] berries
- [name of grain] groats

Oldways and the Whole Grains Council

## These words mean whole grain



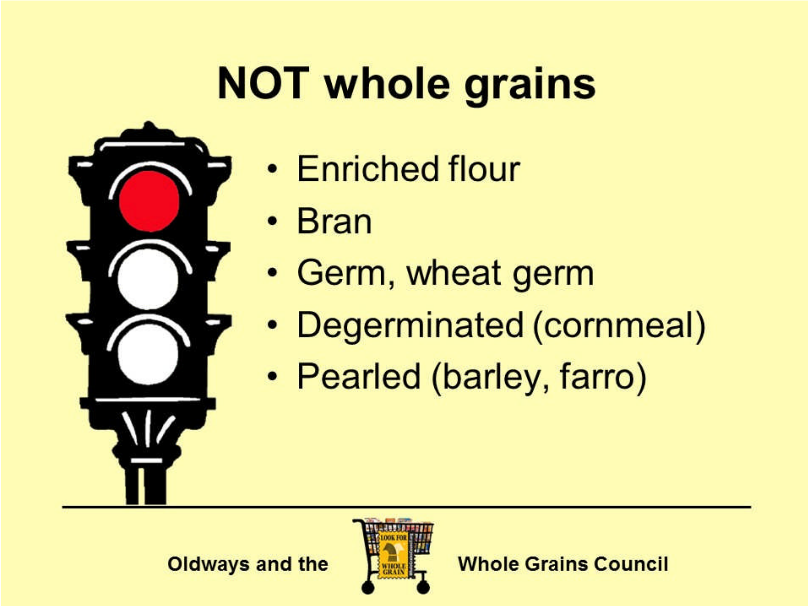
- Brown rice, wild rice
- Oats, oatmeal
- Bulgur
- Cracked or crushed wheat
- Hulled or hull-less barley
- Graham flour
- Whole white wheat

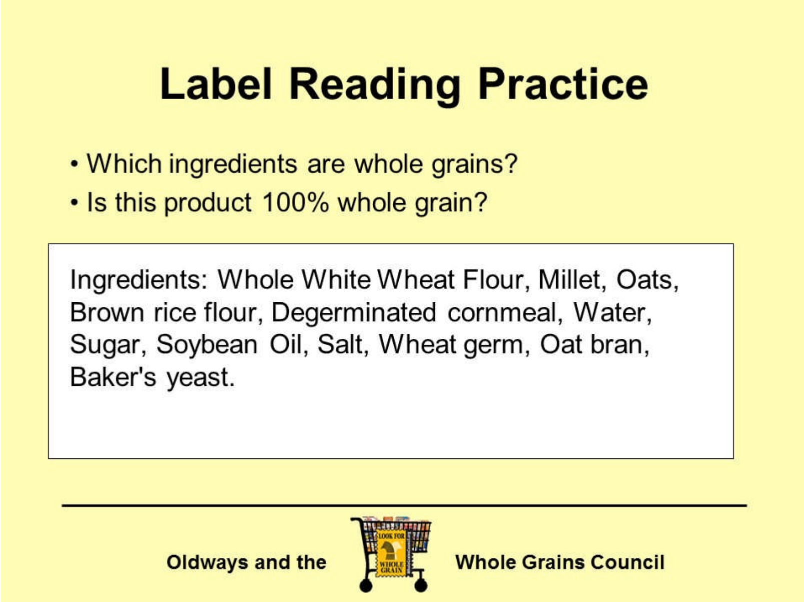
Oldways and the Whole Grains Council

## Maybe yes, Maybe no

- Flour
- Wheat flour
- Organic, natural
- Unbleached
- Semolina
- Multigrain
- Stoneground

Oldways and the Whole Grains Council




| Q17 | If you could do absolutely anything to increase whole grain intake in people your age, what do you think you'd do (most effective)?<br>Choose your top three |
|---|---|
| a) | Educate parents about whole grains |
| b) | Educate friends about whole grains |
| c) | Target social media such as YouTube and Instagram celebrities to promote whole grains |
| d) | Target TV based celebrities such as singers, sports champions, etc.. |
| e) | Target gyms and sports coaches |
| f) | Advertise online |
| g) | Advertise on tv, billboards, magazines, newspapers |
| h) | Promote in hospitals, clinics, through brochures also, etc.. |
| i) | Education in school subjects |
| j) | Campaigns in schools |
| k) | Make them more available in shops, supermarkets, restaurants, takeaways |
| l) | Change products (packaging, taste, etc) please specify below which would be the |

| | |
|---|---|
| | best one to change |
| m) | Make it a social norm |

We like to listen to young people's ideas. Suggest your own effective idea to help young people eat more wholegrain foods!

| Q18 | If you would like to eat more whole grains, in which meals of the day do you think would be easiest to include more wholegrain foods? |
|---|---|
| a) | Breakfast |
| b) | Brunch or morning snack |
| c) | Lunch |
| d) | Afternoon snack |
| e) | Dinner |
| f) | Evening Snack |
| g) Other: | |

Q19) To which extent do you agree with the following statements?

| | Strongly agree | Somewhat agree | Neutral | Somewhat disagree | Strongly disagree |
|---|---|---|---|---|---|
| i. I feel I am likely to eat more wholegrain foods in the future | 1 | 2 | 3 | 4 | 5 |
| ii. If it were entirely up to me, I feel it is possible for me to eat more wholegrains if I wanted to | 1 | 2 | 3 | 4 | 5 |
| iii. I feel I can change my behaviours if I want to | 1 | 2 | 3 | 4 | 5 |
| iv. Most people important to me eat wholegrain foods | 1 | 2 | 3 | 4 | 5 |
| v. Most people important to me encourage me to eat wholegrain foods | 1 | 2 | 3 | 4 | 5 |
| vi. My family environment makes it hard for me to eat more wholegrain foods* | 1 | 2 | 3 | 4 | 5 |
| vii. My friends make it hard for me to eat more wholegrain foods* | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| viii. I feel I might feel bad or regret if I don't eat wholegrain foods | 1 | 2 | 3 | 4 | 5 |
| ix. I have control on whether to eat wholegrain or not to | 1 | 2 | 3 | 4 | 5 |
| x. Wholegrain foods are not available in my house and surrounding environment* | 1 | 2 | 3 | 4 | 5 |
| xi. I think it is important to promote and increase wholegrain foods | 1 | 2 | 3 | 4 | 5 |
| xii. I think eating more wholegrain foods is a moral issue | 1 | 2 | 3 | 4 | 5 |
| xiii. I have intention to eat more wholegrain foods | 1 | 2 | 3 | 4 | 5 |

| Q21 | How often do you eat out? (any main meal from outside home such as ready sandwich/meal, restaurant or takeaway. School lunch doesn't count. Crisps and small snacks don't count.)* |
|---|---|
| a) | At least one meal per day |
| b) | 5-6 times a week |
| c) | 3-4 times a week |
| d) | 1-2 times a week |
| e) | Occasionally, but at least once every month |
| f) | Less than once a month |

(Note: numbering problem from this question was not resolvable in Bristol online survey)

| Q22) How often do you do the following? | | | | | |
|---|---|---|---|---|---|
| | Always | Most of the time | Sometimes | Not very often | Rarely or never |
| I bring my school lunch from home | 1 | 2 | 3 | 4 | 5 |
| I get my lunch from school | 1 | 2 | 3 | 4 | 5 |
| I help make decisions when it comes to my family food shopping | 1 | 2 | 3 | 4 | 5 |
| I help make decisions when it comes to my own food shopping (example food to take to school lunch or snacks) | 1 | 2 | 3 | 4 | 5 |

| Q23 | How often do you do sports? (20 minutes per day of exercise like football, running, biking, swimming, dancing, gym etc..) |
|---|---|
| a) | Everyday |

| | |
|---|---|
| b) | 5-6 times a week |
| c) | 3-4 times a week |
| d) | 1-2 times a week |
| e) | Less than once a week, but occasionally |
| f) | I have no time for exercise/ I am not into sports |

| Q24) What level in education have your parents/guardians reached? | | | |
|---|---|---|---|
| | Father/stepfather/guardian1 | | Mother/stepmother/guardian2 |
| a) | Pre-A level/GCSE | a) | Pre-A level/GCSE |
| b) | A level | b) | A level |
| c) | College | c) | College |
| d) | University | d) | University |
| e) | I don't know | e) | I don't know |

| Q25) What do your parents'/guardians do for a living? | |
|---|---|
| Father/stepfather/guardian1 | Mother/stepmother/guardian2 |
| | |

| Q26 | How old are you? |
|---|---|
| a) | 11 |
| b) | 12 |
| c) | 13 |
| d) | 14 |
| e) | 15 |
| f) | 16 |

| Q27 | What is your gender? |
|---|---|
| a) | Male |
| b) | Female |

| Q28 | And finally, what best describes your ethnicity? |
|---|---|
| | White |
| a) | English/Welsh/Scottish/North Irish/British |
| | Irish |
| | Gipsy or Irish Traveller |
| | Any other white background: ---------------------------------------------------------------- |
| | Mixed/multiple ethnic groups |
| b) | White and Black Caribbean |
| | White and Black African |
| | White and Asian |
| | Any other mixed/multiple ethnic group: ---------------------------------------------------------------- ------------------------------------------------------------------------------------------ |
| | Asian/Asian British |
| c) | Indian |
| | Pakistani |

| | |
|---|---|
| | Bangladeshi |
| | Chinese |
| | Any other Asian Background: ------------------------------------------------------------------- |
| | Black/African/Caribbean/Black British |
| d) | African |
| | Caribbean |
| | Any other Black/African/Caribbean background: ----------------------------------------------------- ---------------------------------------------------------------------------------------------- |
| | Other ethnic group |
| e) | Arab |
| | Any other ethnic group: --------------------------------------------------------------------------- |

Your time and efforts are much appreciated! You are a star!
The information you provided is valuable and important to us!
Please don't forget to collect your research participation certificate, as a THANK YOU from our team and the University of Leeds for taking part in the research.
Have a lovely day!

### 7.4.7 Description of psychometric measures used to assess correlates of whole grain intake among adolescent participants, based on the RAA

| Factor | Survey question number (*Cronbach's alpha if applicable and value >0.7*) | Mean | Standard Deviation | Range |
|---|---|---|---|---|
| **Background factors: individual, information and social background** | | | | |
| **Gender** | Q 27 | - | | Binary scores of 0 and 1 (males coded as 1) |
| **Age** | Q 26 | Mean: 14<br>Median (95% CI): 14 | 1<br>0.15 | 11-16 |
| **Family socioeconomic status** | Q 24+ 25 | - | - | - |
| **Differences in intake across participating schools** | | - | - | - |
| **Physical activity** | Q 23 | 3.12 | 1.47 | 0-5 |
| **Prioritising healthy eating in food choices** | Q 2i | 1.90 | 1.09 | 0-4 |
| **Prioritising taste and enjoyment in food choices**[C] | Q 2vi | 1.53 | 1.14 | 0-4 |
| **Uncertainty on what comprises a healthy diet*** | Q 2ii | 3.26 | 0.95 | 0-4 |
| **Caring about doing well in school** | Q 2iii | 3.41 | 0.83 | 0-4 |
| **Self-estimated whole grain consumption (measured** | Q 10 | 1.89 | 1.32 | 0-4 |

| Factor | Survey question number (*Cronbach's alpha if applicable and value >0.7*) | Mean | Standard Deviation | Range |
|---|---|---|---|---|
| **through survey not FFQ)** | | | | |
| **Ability to identify wholegrain foods** | Q 7 | - | - | Binary scores of 0 or 1 (correct answer coded as 1) |
| **Knowledge of whole grain health benefits** | Q 14 | 3.3 | 1.98 | 0-7 |
| **Behavioural/attitudinal beliefs, and Attitudes** | | | | |
| **Positive attitudes on whole grains (experiential)** | Q 9i +9ii *+9iii +9iv +9v *+ 9vi (*Cronbach's alpha=0.77*) | 16.41 | 3.99 | 0-28 |
| **Positive attitudes on whole grains plus thinking promoting whole grains is important (experiential+ instrumental)** | Q 9i +9ii * +9iii +9iv +9v * + 9vi + 9vii + 19xi (*Cronbach's alpha= 0.79)* | 19.10 | 4.56 | 0-32 |
| **Positive attitudes on whole grains despite perceived barriers of time, convenience and cost** | Q 9i +9ii * +9iii +9iv +9v * + 9vi +9viii +9ix (*Cronbach's alpha=0.71*) | - | - | - |
| **Perceived importance of increased whole grain intake (instrumental)** | Q9vii + 19xi (*Cronbach's alpha = 0.7)* | 5.5 | 1.79 | 0-8 |
| **Feeling regret if they don't eat whole grains** | Q 19viii | 1.52 | 1.18 | 0-4 |

| Factor | Survey question number (*Cronbach's alpha if applicable and value >0.7*) | Mean | Standard Deviation | Range |
|---|---|---|---|---|
| **(instrumental)** | | | | |
| **Feeling that eating more whole grains is a moral issue (instrumental)** | Q 19xii | 1.8 | 0.96 | 0-4 |
| **Normative beliefs and perceived norm** | | | | |
| **Perceived supportive family environment (injunctive norm)** | Q 2iv | 2.75 | 1.04 | 0-4 |
| **Perceived supportive friends environment (injunctive norm)** | Q 2v | 1.40 | 1.01 | 0-4 |
| **Perceived overall supportive family and friend environment (injunctive norm)** | Q 19v | 1.76 | 1.17 | 0-4 |
| **Perceived whole grain consumption by family and friend environment (descriptive norm)** | Q 19iv | 1.88 | 1.07 | 0-4 |
| **Perceived support and consumption of wholegrain foods by family and friends (overall perceived norm)** | Q 19iv +19v (*Cronbach's alpha = 0.84)* | 3.63 | 2.09 | 0-8 |
| **Control beliefs and perceived behavioural control** | | | | |
| **Perceived capacity to** | | | | |
| **eat more whole grains, if it were entirely up to them (capacity)** | Q 19ii | 2.67 | 1.07 | 0-4 |
| **change their behaviour, if they wanted to** | Q 19iii | 2.89 | 0.97 | 0-4 |

| Factor | Survey question number (*Cronbach's alpha if applicable and value >0.7*) | Mean | Standard Deviation | Range |
|---|---|---|---|---|
| **(capacity)** | | | | |
| **Perceived control on whether to eat whole grain or not to (autonomy)** | Q 19ix | 2.81 | 1.14 | 0-4 |
| **Helping in decisions regarding personal and family food shopping (autonomy)** | Q22iii + 22iv (*Cronbach's alpha =0.73)* | 5.28 | 1.93 | 0-8 |
| **Actual control: skills/ abilities/environment** | | | | |
| **Perceived barriers of time/ convenience** | Q 9ix | 2.46 | 1.04 | 0-4 |
| **Perceived barriers of cost** | Q 9viii | 1.65 | 1.03 | 0-4 |
| **Availability of whole grain (home and surrounding environment)** | Q19x* | 2.43 | 1.26 | 0-4 |
| **Intention** | | | | |
| **Intention to eat more whole grain (likely to eat more whole grain in the future)** | Q 19xiii | 2.21 | 1.18 | 0-4 |
| Non-RAA construct factors | | | | |
| **Bringing lunch from home** | Q 22i | 2.62 | 1.61 | 0-4 |
| **Getting lunch from school** | Q 22ii | 1.56 | 1.54 | 0-4 |
| **Frequency of eating out** | Q 21 | 3.41 | 1.17 | 0-5 |

***These factors have been reverse coded for the specified analysis**

### 7.4.8 Data dictionary for the questionnaire data

| Variable (question number) | Coding methods/rationale | Legend |
|---|---|---|
| **Gender (Q27)** | | Female____________________ 0<br>Male ______________________1 |
| **Age (Q26)** | Age was recorded in two columns for analysis:<br>Column 1: original values<br>Column 2: further coded into three age categories, using distribution data from STATA descriptive analysis, assigning approximately equal ranges of participants per category (see Legend column) | Column 2 codes:<br><br>13 or younger________________0<br>14 ________________________ 1<br>15 or older__________________ 2 |
| **Ethnicity (Q28)** | Recorded in one column. | White: English/Welsh/Scottish/North Irish/British___________________1<br>White: Irish:_________________ 2<br>White: Gipsy or Irish Traveller ___3<br>White: Any other white background (specify)______________________4<br><br>Mixed/multiple ethnic groups:<br>White and Black Caribbean______5<br>Mixed/multiple ethnic groups: White and Black African_____________6<br>Mixed/multiple ethnic groups: White and Asian___________________7<br>Mixed/multiple ethnic groups: Any other mixed/multiple ethnic group (specify below) _______________8<br><br>Asian/Asian British: Indian_______9<br>Asian/Asian British: Pakistani___10<br>Asian/Asian British: Bangladeshi_11<br>Asian/Asian British: Chinese____12<br>Asian/Asian British: Any other Asian Background (specify)__________13<br><br>Black/African/Caribbean/Black British: African________________14<br>Black/African/Caribbean/Black British: Caribbean_____________15<br>Black/African/Caribbean/Black British: Any other Black/African/Caribbean background (specify)__________16 |

| | | |
|---|---|---|
| | | Other ethnic group: Arab_______17<br><br>Other ethnic group (specify)____18 |
| **Guardian education (Q24)** | Two steps:<br>1- Individual guardian education score: Father and mother as separate columns<br>Coded into three categories: non-university level, university level, and I don't know (codes to the right)<br><br>2- Total household education score:<br>Obtained by using the score of the highest degree in the house (eg: Mother 1 + Father 2 = 2 as a total score for the household) | Codes for Individual guardian score:<br>Pre-A level/GCSE_____________1<br>A level______________________1<br>College_____________________ 1<br>University___________________ 2<br>I don't know_________________ 0 |
| **Guardian occupation (Q25)** | Two steps:<br>1- Individual guardian occupation score: Father and mother as separate columns<br>Occupation classification categories were obtained from the Office for National Statistics website, using the National Statistics Socio-economic Classification (NS-SEC), based on the reported parental occupation by the participants.<br><br>First the occupations were classified into the eight-class system, listed to the right.<br>The guide to refining categories into a three-class system was available on the website, therefore the data was further narrowed into three categories, also displayed to the right. | Eight Classes:<br>-Higher managerial and professional occupations_______ 1<br>-Lower managerial and professional occupations_______ 2<br>-Intermediate occupations______ 3<br>-Small employers and own account workers______________ 4<br>-Lower supervisory and technical occupations_________________ 5<br>-Semi-routine occupations ______6<br>-Routine occupations__________ 7<br>-Never worked _______________ 8<br><br>Three Classes:<br>-Higher managerial, administrative and professional occupations____1<br>-Intermediate occupations ______2<br>-Routine and manual occupations__________________3 |

| | | |
|---|---|---|
| | 2- Total household occupation score: Similar to education, obtained by using the score of the highest occupation score in the house (eg: Mother 1 + Father 2 = 2 as a total score for the household) | |
| **SES Index** | Sum of total household education score and total household occupation score (above) | Classified into four main categories, ranging from a total score of 2 till 5, with 2 being the lowest SES score (formed by the sum of the minimum household educational and occupation scores of 1+1) |
| **Special diet (Q3)** | | Yes__________________________ 1<br>No ____________________________0 |
| **Physical activity (Q23)** | Physical activity was recorded in two columns for analysis:<br>Column 1: original values<br>Column 2: further coded into three categories/scores, using distribution data from STATA descriptive analysis, assigning approximately equal ranges of participants per category (see Legend column) | Column 2 codes:<br>High activity (5+ times a week)_________________________2<br>Moderate activity (2-4 times a week)_________________________1<br>Low activity (0-1 times a week)_________________________0 |
| **Eating out frequency* (Q21)** | Eating out frequency was recorded in two columns for analysis:<br>Column 1: original values<br>Column 2: further coded into three categories/scores, using distribution data from STATA descriptive analysis, assigning approximately equal ranges of participants per category (see Legend column) | Column 2 codes:<br>High/often (3+ times a week)____0<br>Medium (1-2 times a week)_____1<br>Low/not often (less than once a week or occasionally)__________2 |
| **Heard of whole grains (Q4)** | | Yes__________________________ 1<br>No ____________________________0 |
| **Whole grain identification (Q7)** | All answers of multiple choice question were recorded. Only one answer was the correct choice:<br>*It has "Whole-wheat",* | Correct answer________________1<br>Incorrect answer_______________0 |

| | | |
|---|---|---|
| | *“Whole-meal”, “Whole-grain”, or “Oat” listed as the first ingredient* | |
| **Whole grain consumption (Q10)** | | At least one portion everyday____4<br>5-6 times a week ______________ 3<br>2-4 times a week_______________2<br>Once a week or occasionally_____1<br>Don’t eat whole grain ________0 |
| **Parental encouragement (Q11)** | | Not sure______________________2<br>Yes_________________________ 1<br>No ___________________________0 |
| **Meeting whole grain recommendations (Q12)** | | Yes_________________________ 1<br>No ___________________________0 |
| **Meal of day to include more whole grain (Q18)** | | Breakfast____________________1<br>Brunch or morning snack_______2<br>Lunch_______________________3<br>Afternoon snack______________4<br>Dinner_______________________5<br>Evening Snack_______________6<br>Other suggestions_____________7 |
| **Likert Scale questions (Q2, Q9, Q19, Q22)** | A scale of 0-4 was used (see legend column)<br><br>In many cases, a variable score would compose of the sum of several scale questions added (such as attitude, being a score of a minimum of five scale questions). In this case, a participant’s total score is the sum of their score for each question. Such sums were only applicable if Cronbach alpha was >0.7 for the set of questions. | For most scale questions (unless reverse coded):<br><br>Strongly agree_________________4<br>Somewhat agree_______________3<br>Neutral________________________2<br>Somewhat disagree_____________1<br>Strongly disagree______________0<br><br>In case of **Question 22**:<br>Always______________________4<br>Most of the time_______________3<br>Sometimes___________________2<br>Not very often_________________1<br>Rarely or never________________0 |
| **Single-choice Questions** | | Answer chosen________________1<br>Other answers_________________0 |
| **Multiple-choice Questions** | | Answer chosen________________1<br>Other answers_________________0 |
| **FFQs** | Each food item had the option of eight selections in the FFQ, which were coded into numeric values to indicate approximate levels of intake (see legends column). Medians were obtained for options indicating an intake range | For each food item:<br>None_________________________0<br>Once a week_________________1<br>2-4 per week_________________3<br>5-6 per week_________________5.5<br>Once a day___________________7<br>2-3 per day__________________17.5<br>4-5 per day__________________17.5<br>6+ per day___________________17.5 |

| | | |
|---|---|---|
| | (example 2-4 per week codes into 3)<br><br>Note: the final top three intake levels (2+ times per day) were all compressed into the code value of 5, as there were not enough entries on the higher intake levels to justify having their own categories. | |
| ***Reverse coding was used** | | |

### 7.4.9 Example of regression analysis and residual checking

Variable: Home/surrounding environment availability of whole grain products (STATA commands used highlighted in red font)

. xi: regress ln_wg_intake2 i.PBC__perceived_4rm_19x, level(95) eform(exp(Coef.))

```
. xi: regress ln_wg_intake2 i.PBC__perceived_4rm_19x, level(95) eform(exp(Coef.))
i.PBC__perc~19x    _IPBC__perc_0-4     (naturally coded; _IPBC__perc_0 omitted)

      Source |       SS       df       MS              Number of obs =     152
-------------+------------------------------           F(  4,   147) =    5.97
       Model |  16.7522107     4  4.18805268           Prob > F      =  0.0002
    Residual |  103.194057   147  .70200039            R-squared     =  0.1397
-------------+------------------------------           Adj R-squared =  0.1163
       Total |  119.946268   151  .794346146           Root MSE      =  .83785

------------------------------------------------------------------------------
ln_wg_intake2 | exp(Coef.)  Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
_IPBC__perc_1 |   1.689082  .4950742    1.79   0.076     .9464339    3.01447
_IPBC__perc_2 |   1.515884  .4109696    1.53   0.127     .8871194   2.590299
_IPBC__perc_3 |   2.471719  .6572835    3.40   0.001     1.461394   4.180525
_IPBC__perc_4 |   2.884592  .7740174    3.95   0.000     1.697411   4.902094
        _cons |    5.04385  1.172085    6.96   0.000     3.186536   7.983723
------------------------------------------------------------------------------
```

. xi: regress ln_wg_intake2 i.gender_27 i.age_categories i.ses_index_byC i.PBC__perceived_4rm_19x, level(95) eform(exp(Coef.))

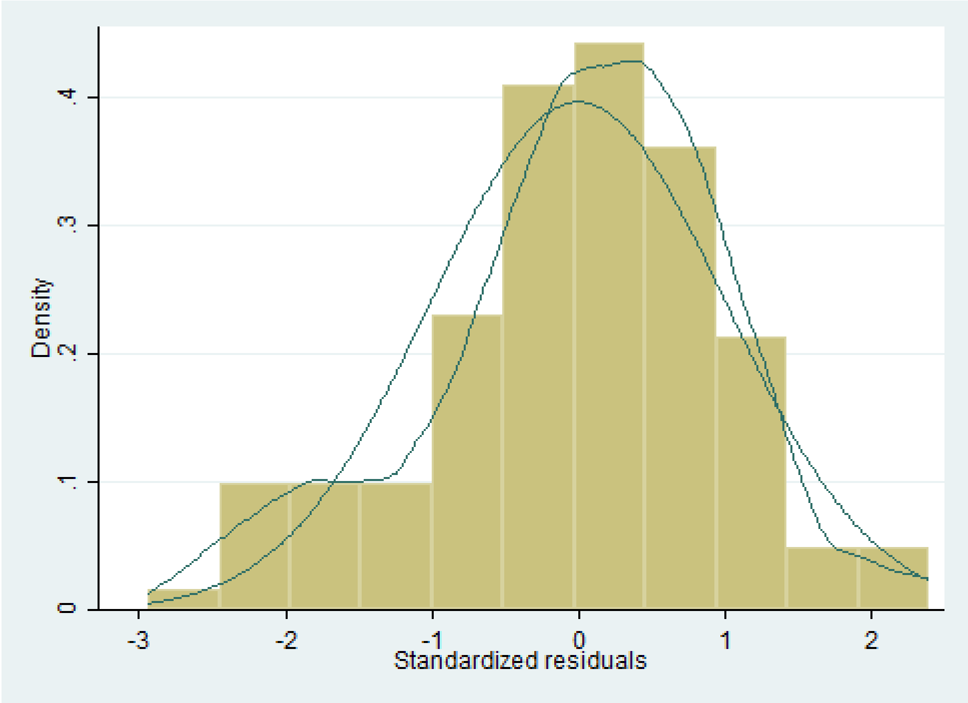
```
. . xi: regress ln_wg_intake2 i.gender_27 i.age_categories i.ses_index_byC i.PBC__
> perceived_4rm_19x, level(95) eform(exp(Coef.))
i.gender_27         _Igender_27_0-1     (naturally coded; _Igender_27_0 omitted)
i.age_categor~s     _Iage_categ_0-2     (naturally coded; _Iage_categ_0 omitted)
i.ses_index_byC     _Ises_index_2-5     (naturally coded; _Ises_index_2 omitted)
i.PBC__perc~19x     _IPBC__perc_0-4     (naturally coded; _IPBC__perc_0 omitted)

      Source |       SS       df       MS              Number of obs =     126
-------------+------------------------------           F( 10,   115) =    4.33
       Model |  28.5769891    10  2.85769891           Prob > F      =  0.0000
    Residual |  75.8876133   115   .65989229           R-squared     =  0.2736
-------------+------------------------------           Adj R-squared =  0.2104
       Total |  104.464602   125  .835716819           Root MSE      =  .81234

------------------------------------------------------------------------------
ln_wg_inta~2 |  exp(Coef.)   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_Igender_27_1 |   1.407359   .2070814     2.32   0.022     1.051539     1.88358
_Iage_categ_1 |   .9017203   .1706426    -0.55   0.586     .6198355    1.311799
_Iage_categ_2 |   .7234875   .1372712    -1.71   0.091      .496833    1.053542
_Ises_index_3 |   1.036351    .226219     0.16   0.870     .6725543    1.596933
_Ises_index_4 |   1.462252   .2818038     1.97   0.051     .9982396    2.141951
_Ises_index_5 |   1.482923   .3397314     1.72   0.088     .9419721    2.334528
_IPBC__perc_1 |   1.875678   .5704668     2.07   0.041     1.026884     3.42606
_IPBC__perc_2 |    1.45106   .4140167     1.30   0.195     .8245895    2.553484
_IPBC__perc_3 |    2.43748   .6598921     3.29   0.001     1.425762    4.167111
_IPBC__perc_4 |   2.997577   .8584921     3.83   0.000       1.6998    5.286194
        _cons |    4.00874   1.203795     4.62   0.000     2.211465    7.266675
------------------------------------------------------------------------------
```

. predict r70, rstandard

(155 missing values generated)

. histogram r70, bin(11) normal kdensity

(bin=11, start=-2.936702, width=.48517073)


Density
0
.1
.2
.3
.4
-3
-2
-1
0
1
2
Standardized residuals