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**Dietary quality of school-aged children and teenagers in Ireland by
demographic characteristics and eating location**

A thesis presented to

**The National University of Ireland, Cork &
Munster Technological University**

for the degree of

Doctor of Philosophy (Nutrition)

presented by

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Table of contents

	Page
Title page	
Table of contents	i
Acknowledgements	iii
Declaration	iv
Personal contribution	v
Publications	vi
Abstract	vii
List of abbreviations.....	xi
Chapters	
1. Literature Review	1
References	33
Aims and objectives	41
2. Methodology for the National Children’s Food Survey II (2017-18) and the National Teens’ Food Survey II (2019-20)	42
References	52
3. Dietary quality of school-aged children (5-12y) in Ireland and differences in dietary quality between sex, age group, socio-economic status and weight status	54
References	86
4. The association between eating location and dietary quality in school- aged children (5-12y) in Ireland.....	91
References	125

5. Dietary quality of teenagers (13-18y) in Ireland and differences in dietary quality between sex, age group, socio-economic status and weight	129
References	160
6. The association between eating location and dietary quality in teenagers (13-18y) in Ireland	165
References	199
7. General Discussion.....	201
References	213

Appendices:

Appendix I: NCFS II New Food Groups (NFG).....	219
Appendix II: NTFS II New Food Groups (NFG)	220
Appendix III: NTFS II New Food Groups (NFG)	221

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To my parents, thank you for always cheering me on and offering endless support and understanding these past few years.

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Declaration

This is to certify that the work I am submitting is my own and has not been submitted for another degree, either at University College Cork, Munster Technological University or elsewhere. All external references and sources are clearly acknowledged and identified within the contents. I have read and understood the regulations of University College Cork concerning plagiarism and intellectual property.



Ioana Rusu

Personal contribution

This thesis is based on data from the National Children's Food Survey II (NCFS II) (2017-18) and the National Teens' Food Survey II (NTFS II) (2019-20) of school-aged children (5-12 years) (n 600) and teenagers (13-18 years) (n 428) living in the Republic of Ireland. These surveys were carried out by the nutrition units in University College Cork (UCC), Munster Technological University (MTU), University College Dublin (UCD) and Technological University Dublin (TUDublin), which form part of the Irish Universities Nutrition Alliance (IUNA). All analyses in this thesis were performed by me. The attached work is entirely my own original work.

Contribution to the research group

During the timeframe of my PhD, I worked as a research nutritionist with the National Dietary Surveys Research Team in UCC and MTU on the NTFS II survey for which fieldwork and data collection were carried out between March 2019 and March 2020.

In this role, I collected data from 83 participants and their parents/guardians, including data related to dietary intake, health & lifestyle, eating behaviour, anthropometric measurements and spot urine samples. I was involved in the management of blood clinics for blood sample collection and in the batch processing of urine and blood samples. Following data collection, I entered the dietary intake data into Nutritics[®] and the questionnaire data into DaSurvey[®]. I was also involved in the quality control of these data.



Ioana Rusu

Publications

Conference abstracts

Rusu, I., Kehoe, L., Buffini, M., Kearney, J., McNulty, B.A., Flynn, A., & Walton, J. (2021). The role of breakfast in the diets of school-aged children (5–12Y) in Ireland. Proceedings of the Nutrition Society, 80(OCE1), E38. doi:10.1017/S0029665121000392

Rusu, I., Kehoe, L., McNulty, B.A., Nugent, A.P., Flynn, A., & Walton, J. (2020). The role of breakfast in the diets of Irish adults (18–90y). Proceedings of the Nutrition Society, 79(OCE2), E458. doi:10.1017/S0029665120004061

Summary report

Irish Universities Nutrition Alliance (2021) *National Teens' Food Survey II: Summary report on Food and Nutrient Intakes, Body Weight, Physical Activity and Eating Behaviours in Teenagers Aged 13-18 Years in Ireland* (contributing author)

Training/contributions during this training period

Modules

January 2020: UW1201 Global Sustainable Development: Interdisciplinary Perspectives (UCC) 5 ECTS

January 2020: STAT9006 Data Analysis with R (MTU) 10 ECTS

October 2020: EDUC9039 Research Skills Development (MTU) 5 ECTS

Other training/contributions

December 2019: REQUIRED - Research Ethics in QUestionnaIRE Design (MTU)

December 2019: Epigeum Research Integrity Training (online)

Abstract

Background: Childhood nutrition has been shown to have an influence on the development or progression of diet related chronic diseases such as obesity and cardiovascular disease later in life as dietary habits acquired in childhood can be carried into adulthood. Furthermore, the teenage years are a unique life stage differentiated from childhood by an increase in independence in all aspects of the lifestyle but also increased ownership surrounding dietary patterns and food choice, which can lead to a diet which is high in energy-dense, nutrient-poor foods. Data from nationally representative dietary surveys of children and teenagers across Europe have shown that intakes of saturated fat, free sugar and salt are above recommendations, while intakes of polyunsaturated fatty acids (PUFA), dietary fibre, iron, vitamin D and folate are below recommendations. Furthermore, demographic characteristics such as sex, age, socio-economic status and weight status have been shown to have an influence on dietary quality in children and teenagers. It has also been shown that eating location can influence dietary quality, with some locations such as ‘home’ and ‘school’ being associated with better dietary quality than other locations, such as ‘restaurants’, ‘takeaways’ and ‘shops’.

Objectives: The overall aim of this thesis was to examine the dietary quality of school-aged children and teenagers in Ireland by demographic characteristics and eating location using data from the National Children’s Food Survey II (NCFS II) (2017-18) and the National Teens’ Food Survey II (NTFS II) (2019-20).

Methods: The analyses for this thesis were based on data from the NCFS II and the NTFS II which are two nationally representative dietary surveys of children (5-12 years, n 600) and teenagers (13-18 years, n 428) living in the Republic of Ireland. Dietary intake data were collected at brand level using a 4-day weighed food diary for both surveys. Energy and nutrient intakes were estimated using Nutritics© based on food composition data from McCance & Widdowson’s *‘The Composition of Foods’* 7th edition (and 6th edition for a small number of foods). During both surveys, modifications were made to the food composition database to include recipes of composite dishes, fortified foods, dietary supplements, generic Irish foods and new foods on the market. Dietary quality was determined using energy-adjusted (%E or /10MJ) intakes of nutrients and food groups. The mean daily intakes (MDI) of food groups, energy and each individual nutrient were calculated using SPSS® Version

27.0 for Windows for each participant by obtaining the sum of the food weight (for food groups) and energy and nutrient content from each food consumed (for energy and nutrient intakes) over the recording period and dividing it by the number of recording days (four). The mean, standard deviation, median and interquartile range for each food group, energy and nutrients are presented in this study. Differences in the MDI of energy and nutrients between sexes and age groups were calculated using independent sample t-tests regardless of normality (due to large sample size). Differences in the MDI of energy and nutrients between social class and parental education groups were assessed using a Kruskal-Wallis test to determine overall differences in intakes between groups and post-hoc Mann-Whitney U Tests to identify where these differences occurred. Differences in food group intakes (e.g., 'white bread' vs. 'wholemeal & brown bread') were determined using Wilcoxon Signed Rank tests.

'Eating location' was defined as the location where food was prepared or obtained, irrespective of where it was consumed. For eating location analysis, consumers were defined as those who consumed food at a given location at least once during the four-day recording period. Differences in the contribution (%) of energy at each location to total energy intake in the total population between sexes, age groups and BMI classifications in the total population were calculated using Mann-Whitney U Tests. Differences in the contribution (%) of energy at each location to total energy intake in the total population between social class and parental education groups were calculated using a Kruskal-Wallis test to determine overall differences in intakes between groups and post-hoc Mann-Whitney U Tests to identify where these differences occurred. Differences in the MDI of energy, nutrients and food groups between 'home' and 'outside of the home' and between 'participant's own home' and 'other homes' were calculated using Mann-Whitney U Tests. Differences in the MDI of energy nutrients and foods between multiple locations (e.g., 'restaurants & coffee shops', 'shops', 'fast food/takeaways' and 'school') were calculated using Kruskal-Wallis tests to determine overall differences and post-hoc Mann-Whitney U Tests to identify where these differences occurred. For all analyses, the Bonferroni adjustment was used to minimise type 1 errors (as a result of multiple testing) by dividing the alpha level (0.05) by the number of comparisons, thus resulting in a significance value of $P < 0.001$.

Results: The overall dietary quality of children and teenagers in Ireland was found to be unfavourable with intakes of food groups not in line with current food-based dietary guidelines (FBDG) for either children or teenagers. There were very few differences observed across sex, age groups, categories of socio-economic status and weight status. For school-aged children, boys had higher intakes of energy than girls (1595kcal vs. 1400 kcal, $P < .001$) and older children had higher intakes of energy than younger children (1611kcal vs. 1384kcal, $P < .001$), but there were very few differences in the intakes of nutrients and food groups across sex, age group and categories of socio-economic or weight status.

In both children and teenagers, dietary intakes were driven by the ‘home’ location. While the majority of children (73%) and teenagers (78%) consumed food from ‘outside of the home’, most eating occasions took place at ‘home’ for both children (89%) and teenagers (85%), accounting for a large proportion of the energy consumed (88% in children and 81% in teenagers). The contribution of food consumed from ‘outside of the home’ was higher in teenagers than in children (19% vs. 12%, $P < .001$). Younger children had higher intakes of energy from food consumed from ‘other homes’ than older children (6.0% vs. 3.0%, $P < .001$) and both children and teenagers of parents with primary/intermediate education only had higher intakes of energy from food consumed from ‘fast food/takeaways’ than children and teenagers of parents with tertiary education (8.0% vs. 2.5%, $P < .001$ in children and 13.6% vs. 6.1%, $P < .001$ in teenagers). There were no other differences observed in these eating patterns across sex, age group or categories of weight or socio-economic status in children or teenagers. Overall, food consumed from ‘home’ and the ‘participant’s own home’ was better in terms of dietary quality than food consumed from ‘outside of the home’ and ‘other homes’ in both children and teenagers. Of all ‘out of home’ locations, ‘school’ provided the best dietary quality for children, but this was not seen in teenagers. ‘Shops’ were generally associated with poorer dietary quality in teenagers, but not in children.

Conclusion

This thesis has shown that the overall dietary quality of children and teenagers in Ireland was unfavourable and there were few differences found across demographic characteristics. Dietary intake was driven by the home environment, with ‘home’ and

the ‘participant’s own home’ being associated with better dietary quality than ‘other homes’ and ‘outside of the home’. The findings of this thesis can be of use to policy makers when introducing healthy eating policies aimed at school-aged children and teenagers. These policies could include school food policies, income support for vulnerable population groups and implementing a comprehensive policy on nutrition standards for food and beverages provided in the public sector.

Abbreviations

COVID-19	Coronavirus Disease
DEIS	Delivering Equality of Opportunity in Schools
DFE	Dietary Folate Equivalents
DOH	Department of Health
DRV	Dietary Reference Value
EFSA	European Food Safety Authority
FBDG	Food-Based Dietary Guidelines
IQR	Interquartile Range
IUNA	Irish Universities Nutrition Alliance
MDI	Mean Daily Intake
MTU	Munster Technological University
MUFA	Monounsaturated Fatty Acids
NCFS	National Children's Food Survey
NCFS II	National Children's Food Survey II
NDNS	National Diet and Nutrition Survey
NHANES	National Health and Nutrition Examination Survey
NNR	Nordic Nutrition Recommendations
NTFS II	National Teens' Food Survey II
PUFA	Polyunsaturated Fatty Acids
RTEBC	Ready-To-Eat Breakfast Cereals
SACN	The Scientific Advisory Committee on Nutrition
SOP	Standard Operating Procedure
SPSS	Statistics Package for Social Sciences
SSB	Sugar-Sweetened Beverages
UCC	University College Cork
UCD	University College Dublin
UK	United Kingdom
US	United States

Chapter 1

Literature Review

Introduction

The prevalence of childhood overweight and obesity is a growing issue globally, with 340 million children and teenagers aged 5-19 years currently living with overweight and obesity worldwide (World Health Organization, 2021). The World Health Organization has identified that a global increase in the intakes of energy dense foods together with an increase in physical inactivity is a key contributor to these rates of overweight and obesity (World Health Organization, 2021). Childhood nutrition has an influence on the progression of diet related chronic diseases such as obesity and cardiovascular disease later in life as eating habits developed during childhood are often carried into adulthood (Liberali et al., 2020, Kaikkonen et al., 2014, Eilender, 2016). Furthermore, the teenage years are a unique life stage differentiated from childhood by the increase in independence when it comes to food choice, which can lead to a diet which is high in energy-dense, nutrient-poor foods (Neufeld et al., 2022).

Recent reviews exploring nutrient intakes among children and teenagers (0-18y) in Europe have shown that intakes of total fat, saturated fat and free sugars are above recommendations, while intakes of carbohydrate, dietary fibre, poly-unsaturated fat (PUFA), sodium, vitamin D, folate and iron are below recommendations (Rippin et al., 2019, Walton et al., 2021). There is evidence in the literature to suggest that sex, age, socio-economic status and weight status are linked to dietary quality in children and teenagers (Rasmussen et al., 2006, Novaković et al., 2014, Pérez-Escamilla et al., 2012). For example, a global review of fruit and vegetable intakes in children and teenagers has shown that increasing age is associated with lower fruit and vegetable intakes and that girls have higher intakes of fruit and vegetables than boys (Rasmussen et al., 2006). A systematic review on the socio-economic determinants of micronutrient intake in Europe using education, occupation and income as indicators of socio-economic status found that children with a higher socio-economic status have been found to be more likely to have better micronutrient intakes (Novaković et al., 2014). Additionally, studies in the US, Sweden and Greece have found that children and teenagers classified as having overweight and obesity had less favourable dietary quality in terms of dietary quality scores and food-group intakes including higher intakes of ‘fruits, vegetables and legumes’, and lower intakes of processed snack foods such as ‘pizza’, ‘sausages’ and ‘potato chips’ ‘sugar-sweetened beverages (SSB)’.

‘milk’ and ‘fruit juice’ resulting in less favourable intakes of macronutrients and dietary fibre (Watowicz et al., 2015, Moraeus et al., 2020, Hassapidou et al., 2006).

Reviews of the literature have identified that over the last fifty years, there has been an increase in the consumption of meals ‘outside of the home’ across all population groups, including children and teenagers (Lachat et al., 2012). It has been identified that some demographic characteristics such as sex, age and socio-economic status may influence the consumption of meals ‘outside of the home’ and that the food environment may have an influence on weight status (Janssen et al., 2018, Adams et al., 2015). Furthermore, there is a growing body of evidence which shows that dietary quality can be influenced by eating location in most population groups, including children and teenagers with the ‘home’ location (particularly the ‘participant’s own home’) providing better dietary quality than ‘out of home’ locations (Poti et al., 2014, Poti and Popkin, 2011, Toumpakari et al., 2016, Ortega et al., 2020, Golper et al., 2021, Ziauddeen et al., 2018).

Although the energy and nutrient intakes of children and teenagers across Europe has previously been examined in relation to guidelines and differences have been identified between sex and age groups (Rippin et al., 2019), there are currently no literature reviews which examine the dietary quality of children and teenagers with respect to energy adjusted intakes of nutrients and food groups. The aim of this review is to examine the dietary quality of school-aged children and teenagers across Europe and to identify any differences in dietary quality between sex, age group, socio-economic status and weight status. A second aim of this review was to investigate the association between eating location and dietary quality in school-aged children and teenagers in the western world and to identify any differences in eating location characteristics between sex, age groups, socio-economic status and weight status across different eating locations.

Inclusion criteria

This review includes data from nationally representative dietary surveys or from other large studies of dietary intake in school aged children and teenagers published as reports, online web pages or in peer-reviewed journal articles. For inclusion in this review, the studies were published post 2000 and dietary intake data were collected via food diary or 24hr dietary recall. The review includes studies on dietary quality of

school-aged children and teenagers from nationally representative surveys in European countries only. However, due to the limited data available in Europe on the association between dietary quality and demographic characteristics and also the association between eating location and dietary quality, the review is extended to also include studies (nationally representative and non-representative) carried out in the western world. In order to remove energy as a confounding factor, nutrient and food group intakes were presented as energy-adjusted intakes (% of energy for macronutrients and intakes per 10MJ for dietary fibre, salt, micronutrients and food groups). Where this was not available in the original publication, it was crudely calculated using available data.

Dietary Quality

Energy

Tables 1 and 2 present mean intakes of energy and nutrients in children and teenagers in Europe using data from nationally representative dietary surveys. For surveys which provided results both including and excluding supplements, the latter was used. Where it was not specified, it was assumed that intakes excluded supplements. The intake of energy in European children ranged from 5.7MJ/day to 9.2MJ/day and boys generally had higher intakes than girls (6.0-9.2MJ/day vs. 5.7-8.2MJ/day) and older children (9-13y) had higher energy intakes than younger children (4-9y) (7.0-9.2MJ/day vs. 6.3-8.0MJ/day) (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Joffe et al., 2009, Hansen et al., 2015, Lopes et al., 2017, Ruiz et al., 2016, Van Rossum et al., 2020, Bates et al., 2020).

The intake of energy in European teenagers was 6.5-10.8MJ, with boys generally having higher energy intakes than girls (7.4-10.8MJ/day vs. 6.5-8.7MJ/day) (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Joffe et al., 2009, Hansen et al., 2015, Lopes et al., 2017, Ruiz et al., 2016, Van Rossum et al., 2020, Bates et al., 2020). Unlike with children, nationally representative nutrition surveys do not seem to split teenagers into age groups, with the exception of Turkey, where older teenagers (15-18y) had higher energy intakes than younger teenagers (12-14y) (7.1-9.6MJ/day vs. 7.2-8.4MJ/day) (Turkey Ministry of Health, 2014).

Protein

Protein requirements are determined by body weight for the total population, including children and teenagers (i.e., 0.83-0.92g per kg of body weight, depending on age, in children and teenagers aged 5-18y) (EFSA Panel on Dietetic Products Nutrition Allergies, 2012) but are often reported as a percentage of energy intake. The Nordic Nutrition Recommendations (NNR) recommend a protein intake of 10-20% of energy (%E) for children, teenagers and adults (2-64y) (Nordic Council of Ministers, 2014). Protein intakes in children and teenagers across Europe were within this recommendation and ranged from 12.1%E to 19.4%E (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Hansen et al., 2015, Lopes et al., 2017, Ruiz et al., 2016, Van Rossum et al., 2020, Bates et al., 2020).

Total fat

High intakes of energy dense foods which are high in fat and sugar have been shown to be associated with the rise in overweight and obesity in recent years (World Health Organization, 2021). As the recommendations for fat intake set by EFSA and the NNR are intended for individuals, the average population guidelines set by SACN were used to compare to intakes in each country in this review (EFSA Panel on Dietetic Products Nutrition Allergies, 2010b, Nordic Council of Ministers, 2014). The UK Scientific Advisory Committee on Nutrition (SACN) recommends an average population intake of total fat of <35% (Scientific Advisory Committee on Nutrition, 2019). The mean intakes of total fat in children in Austria, Cyprus (younger boys and younger girls), France, Norway, Portugal, the Netherlands, the UK and Turkey were in line with this recommendation (31.2%E – 34.9%E) (Elmadfa et al., 2012, Tornaritis et al., 2014, ANSES, 2017, Hansen et al., 2015, Lopes et al., 2017, Van Rossum et al., 2020, Bates et al., 2020, Turkey Ministry of Health, 2014). However, mean intakes of total fat in Cyprus (older boys and older girls), Denmark, Italy and Spain, were above this recommendation (35.0%E-39.2%E) (Tornaritis et al., 2014, Pedersen et al., 2015, Sette et al., 2011, Ruiz et al., 2016).

In teenagers, the mean intakes of total fat were in line with the UK SACN recommendation in Denmark (girls only), France, Norway, Portugal, the Netherlands, the UK and Turkey (31.2%E – 34.8%E) (Pedersen et al., 2015, ANSES, 2017, Hansen

et al., 2015, Lopes et al., 2017, Van Rossum et al., 2020, Bates et al., 2020, Turkey Ministry of Health, 2014). However, the mean intakes of total fat in Austria, Belgium, Cyprus, Denmark (boys only), Italy and Spain (35.0%E - 39.6%E) exceeded the UK SACN recommendation (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, Sette et al., 2011, Ruiz et al., 2016).

Saturated fat

Saturated fat intake is linked to increased LDL cholesterol and risk of cardiovascular disease in adult populations (Aranceta and Pérez-Rodrigo, 2012). Further evidence shows a link between lower saturated fat intakes and reduced HDL cholesterol in adults; however, this has not been found in children (Scientific Advisory Committee on Nutrition, 2019). Additionally, adherence to dietary patterns composed of ‘obesogenic foods’ (many of which are high in saturated fat) have been shown to contribute to childhood obesity (Liberali et al., 2020). The UK SACN recommends an average population intake of saturated fat of <10%E and EFSA recommend that saturated fat levels should be as low as possible (Scientific Advisory Committee on Nutrition, 2019, EFSA Panel on Dietetic Products Nutrition Allergies, 2010b). Mean intakes of saturated fat in school-aged children and teenagers across Europe were above this recommendation and ranged from 11.5%E to 16.0%E for children and 10.9%E and 16.0%E in teenagers (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Hansen et al., 2015, Lopes et al., 2017, Ruiz et al., 2016, Van Rossum et al., 2020, Bates et al., 2020, Turkey Ministry of Health, 2014).

MUFA

A diet rich in mono-unsaturated fatty acids (MUFA) aids HDL production and decreases LDL in adults (EFSA Panel on Dietetic Products Nutrition Allergies, 2010b). There have been no long-term studies that have made this association in children; however, it has been established that dietary habits formed in childhood persevere through adulthood. The UK Department of Health (DOH) recommends a minimum average population intake of 12% for MUFA (UK Department of Health, 1991). Mean intakes of MUFA in children in Austria, France, Norway, and Turkey were below this recommendation (10.7-11.7%E) (Elmadfa et al., 2012, ANSES, 2017,

Hansen et al., 2015, Turkey Ministry of Health, 2014) however mean intakes in children in Belgium, Cyprus, Denmark, Italy, Portugal and the UK met this recommendation (12.0%E -17.4%E) (De Ridder et al., 2016, Pedersen et al., 2015, Sette et al., 2011, Tornaritis et al., 2014, Lopes et al., 2017, Bates et al., 2020).

Mean intakes of MUFA in teenagers in France, Norway and Turkey were below this recommendation (10.8-11.8%E) (ANSES, 2017, Hansen et al., 2015, Turkey Ministry of Health, 2014, Bates et al., 2020). Mean intakes of MUFA in teenagers in Austria, Belgium, Cyprus, Denmark, Italy, Portugal, Spain and in the UK (boys only) were in line with this recommendation (12.0-18.1%E) (Elmadfa et al., 2012, De Ridder et al., 2016, Pedersen et al., 2015, Tornaritis et al., 2014, Sette et al., 2011, Lopes et al., 2017, Bates et al., 2020).

PUFA

There is strong evidence to suggest that adequate PUFA intake is associated with physiological benefits to blood pressure, heart rate and inflammation in adults and while there are no long term studies to show this effect on children, it is assumed that children also benefit from a diet low in saturated fat and high in PUFA (EFSA Panel on Dietetic Products Nutrition Allergies, 2010b). The UK DOH recommends a minimum average population intake of PUFA of 6%E (UK Department of Health, 1991). In children, mean intakes of PUFA ranged from 4.1%E to 10.1%E. In most European countries, the mean intake of PUFA is below this recommendation for school aged children. This includes Austria (younger boys and older girls only), Belgium, Cyprus, Denmark, France, Italy, Norway, Portugal (3.9-5.9%E) (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Hansen et al., 2015, Lopes et al., 2017). The mean intakes of PUFA in Turkey and in Austrian younger girls and older boys were in line with this recommendation (6.0-10.1%E) (Elmadfa et al., 2012, Turkey Ministry of Health, 2014).

In teenagers, mean intakes of PUFA ranged from 4.1%E to 9.8%E and, as with children, was below the DOH recommendation in many countries. This included Cyprus, Denmark, France, Italy, Norway and Portugal (4.1-5.9%E) (Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Hansen et al., 2015, Lopes et al., 2017). Mean intakes of PUFA in teenagers in Austria, Belgium and

Turkey were in line with recommendations (6.0-9.8%E) (Elmadfa et al., 2012, De Ridder et al., 2016, Turkey Ministry of Health, 2014).

Carbohydrate

Intervention studies provide evidence that diets which are high in fat (>35%E) and low in carbohydrate (<50%E) have been shown to have a negative effect on body weight, while diets which are high in carbohydrate have been shown to have adverse effects on the blood lipid profile (EFSA Panel on Dietetic Products Nutrition Allergies, 2010a). As energy balance is the ultimate goal and so dietary reference values for carbohydrate are set to meet the energy needs in the context of acceptable intake levels of fat and protein (EFSA Panel on Dietetic Products Nutrition Allergies, 2010a). The UK SACN recommends an average population intake of carbohydrate of 50%E (Scientific Advisory Committee on Nutrition, 2015). Mean intakes of carbohydrate were above this recommendation in Austria, France (boys only), Norway, Portugal, the Netherlands, the UK and Turkey (50.1%E – 53.8%E) (Elmadfa et al., 2012, ANSES, 2017, Hansen et al., 2015, Lopes et al., 2017, Van Rossum et al., 2020, Bates et al., 2020). Mean intakes of carbohydrate were below this recommendation in Belgium, Cyprus, Denmark, France (girls only), Italy and Spain (40.8%E – 49.4%E) (De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Ruiz et al., 2016).

In teenagers, mean intakes of carbohydrate were above the UK SACN recommendation in the Netherlands (girls only), the UK (girls only) and Turkey (50.1%E – 54.7%E) (Van Rossum et al., 2020, Bates et al., 2020, Turkey Ministry of Health, 2014). Mean intakes of carbohydrate were below this recommendation in Austria, Belgium, Cyprus, Denmark, France, Italy, Norway, Portugal, Spain, the Netherlands (boys only) and the UK (boys only) (41.3%E – 49.6%E) (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Hansen et al., 2015, Lopes et al., 2017, Ruiz et al., 2016, Van Rossum et al., 2020, Bates et al., 2020).

Sugars

Public Health England defines free sugars as all mono- and di-saccharides added to food or drinks by the manufacturer, cook or consumer, plus sugars naturally present

in honey, syrups and unsweetened fruit juices (Public Health England, 2016). The UK SACN recommends an average population intake of free sugars <5%E based on the effect of free sugars intake on the risk of dental caries and total energy intake (Scientific Advisory Committee on Nutrition, 2015), while the WHO have recommended that intakes of free sugars should be <10%E for individuals, based on low to moderate evidence of a relationship between free sugar intake and body weight and dental caries (World Health Organization, 2015). In children, the mean intake of free sugars in Portugal, Spain, the Netherlands and the UK was 9.1%E -19.5%E, which is above the UK SACN recommendation (Lopes et al., 2017, Ruiz et al., 2017, Bates et al., 2020, Van Rossum et al., 2020). Similarly, in teenagers, the mean intake of free sugars was above the UK SACN recommendation in Portugal, Spain, the Netherlands and the UK (9.1%E -16.6%E) (Lopes et al., 2017, Ruiz et al., 2018, Van Rossum et al., 2020, Bates et al., 2020).

Dietary Fibre

Dietary fibre has an essential role in bowel function and normal laxation (EFSA Panel on Dietetic Products Nutrition Allergies, 2010a). The EFSA have set an adequate intake (AI) for dietary fibre for children and teenagers aged 1-17 years of 2-2.5g/MJ (EFSA Panel on Dietetic Products Nutrition Allergies, 2010a). In children, mean intakes of dietary fibre were above 2.0g/MJ (or 20g/10MJ) in Austria, Belgium, Denmark, France, Latvia, Norway, Portugal, the Netherlands, the UK and Turkey (20.6g/10MJ – 26.0g/10MJ) (Elmadfa et al., 2012, De Ridder et al., 2016, Pedersen et al., 2015, ANSES, 2017, Joffe et al., 2009, Hansen et al., 2015, Lopes et al., 2017, Van Rossum et al., 2020, Bates et al., 2020, Turkey Ministry of Health, 2014). Mean intakes of dietary fibre were below this recommendation in Cyprus and Italy (18.0g/10MJ – 19.3g/10MJ) (Tornaritis et al., 2014, Sette et al., 2011).

In teenagers, mean dietary fibre intakes were above 2.0g/MJ (or 20g/10MJ) in Belgium, Denmark, France, Latvia, Norway, Portugal (girls only), the Netherlands, the UK and Turkey (20.0g/10MJ – 26.6g/10MJ) (De Ridder et al., 2016, Pedersen et al., 2015, ANSES, 2017, Joffe et al., 2009, Hansen et al., 2015, Lopes et al., 2017). Mean intakes of dietary fibre were below this recommendation in Austria, Cyprus, Italy, Portugal (boys only) and Spain (14.7g/10MJ – 19.0g/10MJ) (Elmadfa et al., 2012, Tornaritis et al., 2014, Sette et al., 2011, Ruiz et al., 2016).

The contribution of different food groups to dietary fibre intakes were reported in Italy, Spain, the Netherlands and the UK (Sette et al., 2013, Ruiz et al., 2016, Van Rossum et al., 2020, Bates et al., 2020). Overall, the main contributors to dietary fibre intakes in these countries were ‘cereals and grains’ (41-49%), ‘vegetables’ (14-26%) and ‘fruit’ (6-23%) (Sette et al., 2013, Ruiz et al., 2016, Van Rossum et al., 2020, Bates et al., 2020).

Differences by sex and age group

Sex and gender are often (incorrectly) used interchangeably, and it has been proposed that when conducting health research, both should be considered (Peters and Norton, 2018). In the context of nutrition research which focuses on the biological requirements and attributes of the population, it is possible that the term ‘gender’ may have been incorrectly used in some studies, particularly as gender identities other than male and female (e.g., transgender and gender nonconforming) were not included in the analysis. However, a sex- and gender- informed approach can enhance scientific research by taking into consideration both the biological and psychosocial factors, however, this would require changes to existing data collection methodologies which do not include separate variables for sex and gender (Linsenmeyer and Waters, 2021).

The majority of studies across Europe in school-aged children reported intakes of macronutrients split by sex and age group (**Table 1**). In children, boys and older children had higher energy intakes than girls and younger children, however, the percent energy derived from macronutrients was similar amongst boys and girls and among younger children and older children. There were some exceptions to this, however, as in the Netherlands, girls had higher intakes of total fat (32.9-33.1%E vs. 31.7-31.8%E) and lower intakes of total carbohydrate (51.0-51.6%E vs. 53.1-53.5%E) and total sugar (24.0-24.3%E vs. 25.8%E vs. 26.0%E) than boys, in Latvia, where girls had higher intakes of dietary fibre than boys (24.8g/10MJ vs. 22.7g/10MJ) and in Norway where girls had higher intakes of total sugar than boys (12.4%E vs. 11.4%E) and (Van Rossum et al., 2020, Joffe et al., 2009, Hansen et al., 2015). Additionally, in Austria, older children (10-12y) had higher intakes of protein (14.0%E vs. 13.0%E) and lower intakes of saturated fat (14.0-15.0%E – 15.0-16.0%E) and total sugars (10.0-11.0%E vs. 11.0-12.0%E) than younger children (7-9y) (Elmadfa et al., 2012). In Belgium younger children (6-9y) had higher intakes of total

sugar (25.5%E vs. 23.9%E) than older children (10-13y) (De Ridder et al., 2016). In Cyprus older children (9-13.5y) had higher intakes of total fat (35.9-36.6%E vs. 34.1-34.7%E) and MUFA (16.1-16.5%E vs. 15.1-15.2%E) and lower intakes of total carbohydrate (46.5-46.6%E vs. 48.7-49.3%E) than younger children (6-8.9y) (Tornaritis et al., 2014). In the Netherlands, younger children (4-8y) had higher intakes of free sugars (19.0-19.5%E vs. 17.4-17.9%E) than older children (9-13y) (Van Rossum et al., 2020).

The majority of studies across Europe in teenagers reported intakes of macronutrients split by sex, however, intakes split by age group were only reported in Turkey (**Table 2**). Teenage boys had higher intakes of energy than girls, and as with children, intakes of macronutrients were generally similar between boys and girls. There were some exceptions to this, however, as in Austria girls had higher intakes of protein (15.0%E vs. 14.0%E), total fat (37.0%E vs. 36.0%E), saturated fat (16.0%E vs. 15.0%E) and total sugars (11.0%E vs. 10.0%E) and lower intakes of PUFA (6.0%E vs. 7.0%E) than boys (Elmadfa et al., 2012), Cyprus where boys had higher intakes of protein (17.7%E vs. 16.3%E), total fat (39.6%E vs. 37.3%E), saturated fat (15.3%E vs. 14.3%E), and MUFA (18.1%E vs. 17.0%E) and lower intakes of total carbohydrate (42.3%E vs. 46.0%E) than girls (Tornaritis et al., 2014), Denmark, where boys had higher intakes of total fat (35.0%E vs. 34.0%E) than girls (Pedersen et al., 2015), Norway where boys had higher intakes of protein than girls (16.8%E vs. 15.9%E) (Hansen et al., 2015), Spain where girls had higher intakes of total carbohydrates (42.3%E vs. 41.3%E) and total sugar (17.8%E vs. 16.0%E) than boys (Ruiz et al., 2016) and Turkey, where girls had higher intakes of total fat (34.3-34.8%E vs. 32.7-33.3%E) and lower intakes of total carbohydrates (53.6-53.6%E vs. 53.9-54.7%E) than boys (Turkey Ministry of Health, 2014). Additionally, teenage girls generally had higher intakes of fibre than boys (14.7-26.6g/10MJ vs. 13.6-25.0g/10MJ). In Turkey, there were no differences in the intakes of macronutrients between younger (12-14y) and older (15-18y) teenagers (Turkey Ministry of Health, 2014).

A review of the determinants of children's eating behaviour has found that maternal control over eating practices was more prevalent in girls than in boys, particularly following weight gain, which is believed to be a result of the current social value attached to female thinness (Scaglioni et al., 2011). With regard to teenagers, a review

of the literature exploring the influences on adolescent eating behaviours has found that girls are more likely to be engaging in dieting and weight loss behaviour than boys (Story et al., 2002).

Sodium

Tables 3 and 4 present the mean energy-adjusted intakes of micronutrients in children and teenagers respectively. The amount of salt consumed is an important determinant of blood pressure levels, hypertension and overall cardiovascular risk (World Health Organization, 2012). The WHO recommends a reduction to <2g/day of sodium in adults (equivalent to 5g/day of salt), which should be adjusted downwards for children, based on their energy (World Health Organization, 2012). Energy-adjusted mean intakes of sodium in children ranged from 2.1g/10MJ to 3.7g/10MJ and were similar among boys and girls (2.3-3.7g/10MJ vs. 2.1-3.7g/10MJ) and among younger (4-9y) and older (9-13.5y) children (2.1-3.0g/10MJ vs. 2.3-3.1g/10MJ) (De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Hansen et al., 2015, Lopes et al., 2017, Van Rossum et al., 2020, Turkey Ministry of Health, 2014). Similarly, in teenagers, mean sodium intakes ranged from 2.2g/10MJ to 4.0g/10MJ and was similar among boys and girls (2.4-4.0g/10MJ vs. 2.2-3.9g/10MJ) (De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Hansen et al., 2015, Lopes et al., 2017, Van Rossum et al., 2020, Turkey Ministry of Health, 2014). Sodium intakes were also similar among younger (13-15y) and older (15-18y) teenagers (2.3-2.8g/10MJ vs. 2.2-2.8g/10MJ) (Turkey Ministry of Health, 2014).

Micronutrients

Adequate intakes of vitamins and minerals are necessary for achieving and maintaining optimum health across all life stages and particularly for teenagers who are undergoing a crucial period of growth and development characterised by a rapid growth trajectory second only to that of infancy (Das et al., 2017). This review has found that according to results of nationally representative surveys carried out across Europe, mean energy-adjusted intakes of folate in children ranged from 197-401µg/10MJ. Intakes of vitamin D ranged from 1.3-46.1µg/10MJ and was particularly high in Portugal (19.6µg/10MJ in boys and 46.1µg/10MJ in girls), which could be due to an outlier as the median intake of vitamin D was much closer to the mean intake values of the other age groups examined. Additionally, it is worth noting that in this

Portuguese cohort, among children who took a dietary supplement (6.2%), 40% took a multivitamin supplement, which frequently contained vitamin D (Lopes et al., 2017). Mean intakes of calcium ranged from 782mg/10MJ to 1337mg/10MJ. Mean intakes of iron ranged from 10.1mg/10MJ to 14.7mg/10MJ. Micronutrient intakes were generally similar among boys and girls, with the exception of vitamin D, where mean intakes were higher in girls than in boys, even when the Portuguese values were excluded (1.3-10.7µg/10MJ vs. 1.4-8.4µg/10MJ). There were generally no differences in the mean intakes of micronutrients between younger (5-9y) and older (9-13.5) children (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, Anses, 2017, Sette et al., 2011, Hansen et al., 2015, Lopes et al., 2017, Van Rossum et al., 2020, Bates et al., 2020, Turkey Ministry of Health, 2014).

For teenagers, mean intakes of vitamin A ranged from 267µg/10MJ to 1172µg/10MJ. Mean intakes of vitamin D ranged between 1.1µg/10MJ and 7.5µg/10MJ. Mean intakes of riboflavin ranged from 1.3mg/10MJ to 2.3mg/10MJ. Mean intakes of vitamin B6 ranged from 1.0mg/10MJ to 2.5mg/10MJ. Mean intakes of folate ranged between 166µg/10MJ to 407µg/10MJ. Mean intakes of vitamin C ranged from 51.2mg/10MJ to 147mg/10MJ. Mean intakes of calcium ranged from 715mg/10MJ to 1214mg/10MJ. Mean intakes of iron ranged between 10.2mg/10MJ and 14.3mg/10MJ. Micronutrient intakes were generally similar among boys and girls, with the exception vitamin C where overall, mean intakes were slightly higher in girls when compared to boys (64.9-147mg/10MJ vs. 51.2-126g/10MJ) (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Hansen et al., 2015, Lopes et al., 2017, Van Rossum et al., 2020, Bates et al., 2020, Turkey Ministry of Health, 2014). Micronutrient intakes were only reported split by age group in teenagers in Turkey and intakes of vitamin A, vitamin D, riboflavin, vitamin B6, folate, vitamin C, calcium and iron were found to be similar among younger (12-14y) and older (15-18y) teenagers (Turkey Ministry of Health, 2014).

Food groups

While Food-Based dietary Guidelines (FBDG) differ from one country to another, in general national and international FBDG provide the following recommendations: a varied, balanced diet achieved by eating a wide range of food products from different

food groups; a diet based mainly on plant-based food such as fruits, vegetables, minimally processed tubers, wholegrain cereals, unsalted seeds and nuts, as well as oils and fats with a beneficial omega 3:6 ratio; moderate consumption of meat and dairy products; limiting consumption of foods which are rich in fats, simple sugars and salt and low in micronutrients; intake of water as the main beverage and limiting the intake of other drinks, particularly sugary soft drinks (Cámara et al., 2021).

Mean intakes of ‘bread’, ‘breakfast cereals’, ‘potatoes’, ‘milk’, ‘meat and meat dishes’, ‘fruit and vegetables’, ‘confectionery and snacks’ and ‘soft drinks’ in children and teenagers were reported in Austria, Belgium, Denmark, France Italy, Norway, Portugal, Spain the Netherlands and Turkey (**Tables 5a & b**) (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Hansen et al., 2015, Van Rossum et al., 2020). Food group intakes were presented as energy-adjusted intakes (per 10MJ) to remove energy as a confounder. Where the corresponding energy intake values were available, the energy-adjusted intakes of these food groups were calculated.

When examining the energy adjusted intakes of food groups there were no differences in the intakes of food groups between boys and girls in children, with the exception of Turkey, where compared to girls, boys had a higher MDI of ‘total meat’ (61.2-70.1g/10J vs. 37.6-57.9g/10MJ) and a lower MDI of ‘total fruit and vegetables’ (449-599g/10MJ vs. 555-629g/10MJ) (Pedersen et al., 2015, Van Rossum et al., 2020, Turkey Ministry of Health, 2014). Findings from Belgium and Turkey show that older children (9-13y) had a higher MDI of ‘total meat’ than younger children (6-9y) (57.9-132.2g/10MJ vs. 37.6-126g/10MJ). Intakes of ‘total fruit’ were higher in younger children in Belgium (173g/10MJ vs. 140g/10MJ) compared to older children, while intakes of ‘total fruit and vegetables’ were higher in older children than in younger children in Turkey (599-629g/10MJ vs. 449-555g/10MJ). Younger children in Belgium also had higher mean intakes of ‘total milk’ than older children (358g/10MJ vs. 266g/10MJ) (De Ridder et al., 2016, Turkey Ministry of Health, 2014).

In teenagers, boys generally had higher mean intakes of ‘total bread’(267-277g/10MJ vs. 222-229g/10MJ) and ‘total meat’(64.7-250g/10MJ vs. 50.8-224g/10MJ) and lower intakes of ‘total fruit and vegetables’ (453-576g/10MJ vs. 598-630g/10MJ), ‘total fruit’ (69.8-132g/10MJ vs. 89.3-197g/10MJ) , fruit juice’(79g/10MJ vs. 98g/10MJ)

and ‘total vegetables’(110-59g/10MJ vs. 84.0-178g/10MJ) when compared to girls (Elmadfa et al., 2012, Pedersen et al., 2015, Turkey Ministry of Health, 2014). Findings from Turkey show that when compared to younger teenagers, older teenagers had higher intakes of ‘total bread’ (222-277g/10MJ vs. 229-267g/10MJ) and ‘total fruit and vegetables’ (453-630g/10MJ vs. 576-598g/10MJ), but lower intakes of ‘total meat’ (50.8-64.7g/10MJ vs. 52.4-80.2g/10MJ) (Turkey Ministry of Health, 2014). Moreover, findings from Sweden show that ‘discretionary food’ (e.g., sweets, chocolate, pizza, cakes and SSB) were consumed consistently by all age groups examined (Lindroos et al., 2021).

Socio-economic status

Reviews of the literature have shown that children and teenagers with a lower socio-economic status had poorer dietary quality than those with a higher socio-economic status in terms of ‘fruit and vegetable’ and ‘soft drinks’ intakes as well as intakes of fat, refined sugar, calcium, iron and folate (Hanson and Chen, 2007, Rasmussen et al., 2006, Darmon and Drewnowski, 2008, Novaković et al., 2014).

Findings from the UK show that household socio-economic status is a strong predictor of fruit and vegetable consumption in children, especially when comparing the highest to the lowest SEC group, however, other sociodemographic variables (such as number of adults per household) had less of an influence on fruit and vegetable intakes (Mak et al., 2013). A study from Cyprus found that higher socio-economic status, assessed using mother’s education, was associated with better dietary outcomes, with children and teenagers of mothers with tertiary education being less likely to have intakes of vitamin B1 and B6 below recommendations, but also more likely to consume more cholesterol than recommended (Tornaritis et al., 2014). The association between socio-economic status has also been more recently examined by surveys carried out in France, Portugal and Sweden. These studies have also found that indicators of socio-economic status, particularly parental education, have been shown to have an influence on dietary quality. Children and teenagers in a higher socio-economic group generally had better dietary quality than those in a lower socio-economic group, particularly in terms of percent energy from fat and added sugar and daily intakes of food groups such as ‘fruit and vegetables’, ‘processed meat’ and ‘SSB’ as well as

dietary quality scores based on adherence to nutrient guidelines and FBDG (Drouillet-Pinard et al., 2017, Vilela et al., 2020, Moraeus et al., 2020).

Similar associations between socio-economic status and dietary quality were found in countries outside of Europe. Findings from Australia show that there is an association between dietary quality and household education level in younger children (4-7y) and with household income in adolescents (12-16y). Both education level and household income were associated with dietary quality in children aged 8-11 years. In the whole sample, household income was positively associated with dietary quality (Golley et al., 2011). In Canada, an increase in dietary quality was observed with increasing education level, however, there were mixed results observed when looking at neighbourhood deprivation. This study concludes that parental education has a higher impact on dietary quality than other indicators of socio-economic status (Olstad et al., 2021). Findings from the US show that ethnicity and household income did not have an effect on sodium intakes in school-aged children, however, ethnicity was associated with the frequency of salt use at the table (Quader et al., 2017, Quader et al., 2016). When looking at non-nationally representative studies, a study based in Texas focused on Hispanic children and adolescents, showed that household food security and parental education were not found to be related to dietary quality and nutrient adequacy, however, family income was positively associated with sodium intakes (Wilson et al., 2009).

In summary, there is mixed evidence in the literature regarding the link between dietary quality and socio-economic status, which could be partially attributed to the differences in the indicators of socio-economic status, as well as the indicators of dietary quality used. Moreover, some indicators of socio-economic status, such as parental education, tended to have a more consistent impact on dietary quality than other measures used, with higher parental education generally being associated with better dietary quality.

Weight status

A systematic review examining the link between energy density and adiposity has found moderately strong evidence to suggest that there is a positive association between dietary energy density and increased adiposity in children and adolescents (Pérez-Escamilla et al., 2012).

A study carried out in Sweden investigated the link between BMI classification and dietary quality and found that teenagers that were classified as having overweight and obesity had lower dietary diversity scores based on adherence to nutrient recommendations and FBDG than teenagers classified as having a healthy BMI (Moraes et al., 2020). Findings from Greece show that teenagers classified as having overweight and obesity had lower daily intakes of dietary fibre, as well as lower intakes fruits, vegetables, legumes, brown bread and yogurt and higher intakes of snack foods and processed foods such as pizza, sausages and potato chips, but similar intakes of carbohydrate and protein when this was expressed as a percentage of energy intakes when compared to teenagers classified as having a healthy BMI. This study also found that although teenagers classified as having overweight and obesity had lower intakes of niacin and iron, both in teenagers classified as having a healthy BMI and those classified as having overweight and obesity, there was a significant proportion of teenagers in both BMI classifications that did not meet recommendations for folate, vitamin A and iron (Hassapidou et al., 2006). A smaller, non-nationally representative study carried out in Poland which recruited equal numbers of participants with a healthy BMI as with overweight/obesity have found that those with overweight/obesity had higher proportions of energy intakes from fatty acids (saturates and MUFA) than children with a healthy BMI (Koziół-Kozakowska et al., 2020).

Findings from New Zealand showed that there were no differences in the MDI of energy and energy-adjusted intakes of fat and carbohydrate between children and teenagers with overweight and obesity and the general population in New Zealand in the same age group, however, this study reported having issues with data collection and identified that misreporting had very likely occurred (Anderson et al., 2016). Finding from two separate studies in Australia showed that children and teenagers with a higher BMI z-score had higher energy intakes, but only modest correlations

were found between BMI z-scores and the energy adjusted intakes of protein, carbohydrate, free sugars and fat between children and teenagers classified as having a healthy BMI and those with overweight and obesity and weak positive associations between dietary quality scores and BMI z-scores (i.e., those with a higher BMI z-score had a better dietary quality score) (Elliott et al., 2011, Golley et al., 2011, Wong and Louie, 2018). Findings from Portugal show an inverse relationship between calcium intakes from food sources and BMI in girls and not in boys (Moreira et al., 2005).

Eating Location

A review of the literature indicated that definitions of eating locations vary between studies (**Table 6**). The two definitions widely used in the literature include: where the food was prepared (i.e., where the food was obtained, regardless of where it was eaten) and where the food was consumed (i.e., the location at which the food was eaten, regardless of where it was prepared). Regardless of the definition used, ‘home’ generally includes the study participants’ own home as well the homes of other people where the study participant may obtain food from (e.g., friend’s home, relative/family home, child minder’s home). ‘Home’ is generally subdivided into ‘own home’ and ‘other homes’. Out of home eating locations comprise any locations other than the participant’s own home or other homes where the participant may have obtained their food, for example restaurants (both sit down and takeaway), cafés, shops, school, after school clubs, etc. These subcategories may differ among different studies but are generally aggregated into ‘home’ and ‘outside of the home’.

Eating location characteristics

Table 7 presents definitions of eating location, percent consumers at each location, percent of energy obtained from foods consumed at each eating location and the percent of eating occasions at each eating location according to the studies included in this review. There has been a global increase in the consumption of food ‘outside of the home’ in recent years in the total population, including children and teenagers, which has been associated with poorer dietary quality (Lachat et al., 2012, Janssen et al., 2018). Despite this increase in consuming meals from ‘outside of the home’ and significant proportions of children and teenagers consuming food from ‘outside of the

home’, studies show that the majority of energy for both population groups was consumed at the ‘home’ location .

When looking at the first definition of eating location (i.e., where the food was prepared, irrespective of where it was consumed), a large nationally representative study in Canada has shown that over 90% of children and teenagers consumed food from ‘home’. Meanwhile, in the same study, less than 20% of children consumed food from ‘fast food/takeaways’ with just over 20% of children consuming food from other locations and around 30% of teenagers consuming food from ‘fast food’ locations and around 30% of teenagers consuming food from ‘other’ locations (Nishi et al., 2018) **(Table 7)**. This study also reported a contribution to energy intake from ‘home’ of 54-62% in children and teenagers, with 16-26% coming from ‘fast food/takeaways’ and 18-23% coming from ‘other’ locations (Nishi et al., 2018). Similarly, a large nationally representative study in the US has shown that the ‘home’ location (which included ‘home’ and ‘store bought’) contributed 68% of daily energy intake for children and 65% for teenagers (Poti and Popkin, 2011). Findings from a study carried out on low- and middle- income Chilean children and teenagers show that almost all teenagers consumed food prepared at ‘home’, while 72% consumed food from ‘out of home’ locations with the ‘home’ locations contributing 78% to energy intakes and ‘out of home’ locations contributing 22% (Rebolledo et al., 2019).

When looking at the second definition of ‘eating location’ (i.e., where the food was consumed, rather than where it was prepared), the ‘home’ location remains the place where most eating occasions took place in children and teenagers in the UK, according to findings from the National Diet and Nutrition Survey (NDNS) (69% in children aged 4-10y and 71% in teenagers aged 11-18y) (Mak et al., 2013, Palla et al., 2020). Similar results were found in Mexico where the majority (82%) of kilocalories were consumed at ‘home’ by children aged 6-13 years (Taillie et al., 2017). Findings from Brazil show that 85% of kilocalories were consumed at ‘home’, however 52% of teenagers consumed food at other locations (Bezerra et al., 2021). Findings from a US study show that in teenagers, 61% of energy intakes occurred at ‘home’, 24% at ‘school’ and 14% at ‘other locations’ (including restaurants/fast food and friend’s houses) (Ortega et al., 2020).

In summary, according to the studies discussed above, irrespective of the definition of ‘eating location’ used, 90-100% of children and teenagers consumed food at ‘home’, while 20-72% consumed food ‘outside of the home’. The ‘home’ location contributed 54-82% to energy intakes, while ‘out of home’ locations contributed 16-24%. This suggests that despite the significant proportions of children and teenagers consuming food from ‘outside of the home’, the majority of kilocalories were both prepared and consumed in the ‘home’ environment.

Eating location characteristics by demographics

A recent review of the literature examining the influence of demographic characteristics on consumption of food from ‘outside of the home’ has shown mixed findings regarding differences between sex, age group and socio-economic status, however, many of the studies available were carried out in adults only (Janssen et al., 2018). Findings from the National Children’s Food Survey (NCFS) (2003-04) in Ireland showed that older children (9-12y) had higher energy intakes from food consumed from ‘outside of the home’, particularly from ‘takeaways’ and ‘shops’ compared to younger children (5-8y) (Burke et al., 2007). Findings from the NDNS in the UK have found that there were no differences in the frequency of eating take-away meals at home when children were split by sex or age group, but it reported that children and teenagers living in households of higher occupational social class were significantly less likely to consume take-away meals at home once a week or more than those living in less affluent households, but no association was found between categories of parental education (Adams et al., 2015).

Dietary quality by eating location

‘According to a recent study carried out by Safefood, parents across Ireland have reported that one of the major burdens faced when trying to promote a healthy relationship with food for their children is the other adults involved in the child’s life (through childcare, playdates and grandparents) undoing the dietary habits instilled in the home by offering an excess of ‘treat foods’ (Safefood, 2022). Findings from the Irish NCFS (2003-04) showed that the quality of the diet was better when food was obtained from the ‘participant’s own home’ than from ‘other homes’ in terms of intakes of protein, calcium, iron, folate and vitamin C (Burke et al., 2007). Similarly, findings from the NDNS in the UK show that in teenagers, most of the energy coming from

‘non-core foods’ (foods which were classified using specific cut-off points for fat and sugar content using the healthy eating guidelines) was consumed with ‘friends’, whilst the least amount of energy coming from ‘non-core foods’ was consumed with ‘parents/carers’ and that percent ‘non-core’ energy was higher at ‘friend’s/relative’s house than at ‘home’ (Toumpakari et al., 2016). Additional findings from the NDNS (2008-2014) in the UK shows that dietary quality was lower when food was consumed ‘outside of the home’ than at ‘home’ in terms of higher intakes of discretionary foods/non-core foods. Meals consumed ‘outside of the home’ were higher in ‘non-core foods’ such as ‘red and processed meat’, ‘sugar-sweetened beverages’, ‘non-milk extrinsic sugars’ (Ziauddeen et al., 2018).

Findings from the National Health and Examination Survey (NHANES) in the US also showed that, in children and teenagers aged 2-17 years, dietary quality of food consumed from ‘home’ is more favourable in terms of intakes of saturated fat, added sugar, dietary fibre and iron when compared to ‘outside of the home’, however, intakes of sodium were found to be similar at ‘home’ and ‘outside of the home’ (Guthrie et al., 2002). Further findings from NHANES in the US show that frequent consumption of meals prepared ‘outside of the home’ has been associated with lower intakes of nutrients such as vitamin D, dietary fibre, folate and iron as well as lower intakes of fruit and vegetables in teenagers (Golper et al., 2021). A study carried out in low- and middle- income Chilean children and teenagers show that while foods obtained at home were less energy dense, energy adjusted intakes of sodium were higher from foods consumed from ‘home’ compared to foods consumed from ‘outside of the home’, percent energy from saturated fat and total sugars was similar from food consumed from the ‘home’ locations and from food consumed from ‘outside of the home’. This study also found that the top calorie contributors for foods consumed from ‘home’ were ‘cereal-based foods’, ‘grain-based desserts’, ‘mixed dishes’ and ‘sugar-sweetened beverages (SSB)’, while the top calorie contributors ‘outside of the home’ were ‘mixed dishes’, ‘sandwiches’, ‘grain-based desserts’, ‘SSB’ and ‘cereal based foods’ (Rebolledo et al., 2019).

Overall, the dietary quality from food ‘outside of the home’ is not as favourable as at home, however, the dietary quality from different ‘out of home’ locations can vary with ‘school’ generally being associated with better dietary quality and more similar to ‘home’, while ‘fast food/takeaways’ are generally associated with poorer dietary

quality than other ‘out of home’ locations based on data from the NHANES in the US (Poti et al., 2014, Tyrrell et al., 2017). When comparing the different ‘out of home locations’, findings from the NHANES in the US show that intakes of total sugar’ and ‘added sugar’ were higher from food consumed from ‘shops’ than from all other ‘out of home locations’ and that the percent energy from added sugar was higher from ‘stores’ than from ‘schools’ or ‘fast food’ (Poti et al., 2014). Additional findings from NHANES show that both ‘fast food’ and ‘full-service restaurants’ were associated with increased intakes of protein, saturated fat and sodium as well as SSB in children and teenagers. For children, ‘full-service restaurants’ were associated with higher intakes of sugar than ‘fast food’, however, the opposite was found for teenagers (Powell and Nguyen, 2013). A more recent study carried out in the UK and Ireland has found that children’s menu items at fast food restaurants had lower energy, total fat, saturated fat and salt content compared with full-service restaurants, however, fast food restaurants offered fewer courses and side orders, which could reduce the energy content of the meal as a whole (Young et al., 2019).

Misreporting

Misreporting, particularly under-reporting is a known limitation of all dietary data collection. Moreover, sex, age, socio-economic status and weight status may be among the identifying characteristics of under-reporters according to findings from large, nationally representative studies in Europe as well as Australia and Canada (Lioret et al., 2011, Bel-Serrat et al., 2016, Rangan et al., 2011, Garriguet, 2008). Notwithstanding differences in the methods of data collection as well as differences in defining under reporters, teenagers, girls, children and teenagers classified as having overweight or obesity and those whose parents have a lower education level have been found to be more likely to be energy under reporters than children, boys, those classified as having a healthy BMI and those with parents with a higher education level (Lioret et al., 2011, Bel-Serrat et al., 2016, Rangan et al., 2011, Garriguet, 2008).

Under-reporting has been identified as a limitation in many of the studies discussed in this review, particularly those which analysed dietary intakes and indicators of weight status or socio-economic status (Elliott et al., 2011, Hassapidou et al., 2012, Moraes et al., 2020, Golley et al., 2011, Wong and Louie, 2018, Moreira et al., 2005, Tornaritis et al., 2014, Drouillet-Pinard et al., 2016, Vilela et al., 2020, Olstad et al., 2021, Wilson

et al., 2010). While some studies have excluded under-reporters from some of their analyses (Elliott et al., 2011, Golley et al., 2011, Moreira et al., 2005, Wilson et al., 2010), others have not (Hassapidou, 2012, Moraeus et al., 2020, Wong and Louie, 2018, Tornaritis et al., 2014, Drouillet-Pinard et al., 2016, Vilela et al., 2020, Olstad et al., 2021). It has been suggested that it is possible for under-reporters to have a plausible energy intake and thus only removing those with unpalatable energy intakes may introduce bias and that it is possible that participants who may have been identified as under-reporters may actually be under-eaters, in cases of weight-loss dieting (Drouillet-Pinard et al., 2016).

Conclusion

This review aimed to examine the dietary quality of school-aged children and teenagers across Europe and to identify any differences in dietary quality between sex, age group, socio-economic status and weight status. A second aim of this review was to investigate the association between eating location and dietary quality in school-aged children and teenagers in the western world and to identify any differences in dietary quality between sex, age groups, socio-economic status and weight status across different eating locations.

Overall, the dietary quality of school-aged children and teenagers in Europe was unfavourable, particularly for saturated fat, free sugars and salt (sodium), where the intakes reported in every country included in this review exceeded recommendations. Boys and older children/teenagers had higher energy intakes than girls/younger teenagers, however, energy-adjusted intakes of macro or micronutrients did not vary greatly between these groups. The link between categories of weight status and socio-economic status and dietary quality was unclear, although parental education was found to have more of an effect on dietary quality than other indicators of socio-economic status.

Despite an increase in eating outside of the home in the last decades, the majority of food consumed by school-aged children and teenagers was prepared/consumed in the home. The home location was the largest provider of energy for both children and teenagers, and it was associated with better dietary quality than the food consumed outside of the home. Demographic characteristics such as age and socio-economic status may have an influence on the amount of energy consumed outside of the home.

Dietary quality differs across different ‘out of home’ locations. ‘School’ was associated with better dietary quality, while other locations such as ‘shops’ and ‘restaurants’ have been associated with less favourable dietary quality.

This review has provided an overview of the dietary quality of children and teenagers and the association between eating location and dietary quality. Further research is required in order to assess the factors associated with dietary quality in children and teenagers in Ireland using the most up to date dietary data. It is important to continue to monitor dietary intakes of children and teenagers and to identify any differences in dietary intakes across different demographic characteristics to inform policy makers in providing targeted policies to encourage healthy eating this age group.

Table 1: Mean intake of energy, macronutrients and dietary fibre (%E, /10MJ) in school-aged children in Europe using data from national surveys

Country	Study name	Study years	Sex	Age group (years)	Energy*	Protein (%E)*	Total Fat (%E)*	Saturated fat (%E)*	MUFA (%E)*	PUFA (%E)*	Total Carbohydrates (%E)*	Total Sugars (%E)*	Free sugars (%E)*	Dietary fibre (g/10MJ)*
Austria ^a	Austrian Nutrition Report	2010-2012	Boys	7-9y	8.0	13.0	34.0	16.0	11.0	5.0	51.0	12.0	-	23.0
			Boys	10-12y	8.1	14.0	34.0	14.0	11.0	6.0	51.0	10.0	-	22.0
			Girls	7-9y	8.0	13.0	34.0	15.0	11.0	6.0	52.0	11.0	-	22.0
			Girls	10-12y	7.2	14.0	33.0	15.0	11.0	5.0	52.0	11.0	-	23.0
Belgium ^b	The Food Consumption Survey 2	2014-2015	Total	6-9y	6.9	14.4	35.0	13.2	12.5	5.6	49.4	25.5	-	21.1
			Total	10-13y	7.6	14.5	35.1	13.0	12.7	5.9	48.2	23.9	-	20.9
			Boys	6-8.9y	7.8	16.2	34.7	14.0	15.2	5.0	48.7	-	-	19.1
Cyprus ^c	-	2009-2010	Boys	9-13.5y	7.9	17.2	35.9	14.0	16.1	5.4	46.5	-	-	18.5
			Girls	6-8.9y	7.6	16.2	34.1	13.7	15.1	4.8	49.3	-	-	19.3
			Girls	9-13.5y	7.5	16.4	36.6	14.4	16.5	5.3	46.6	-	-	18.7
Denmark ^d	Dietary Habits of the Danes	2011-2013	Boys	4-9y	8.5	14.0	35.0	14.0	12.0	5.5	49.0	-	-	25.0
			Girls	4-9y	7.7	14.0	35.0	14.0	12.0	5.5	49.0	-	-	25.0
France ^e	Individual and National Food Consumption Survey	2015-2017	Boys	0-10y	6.6	14.6	32.7	14.7	10.9	3.9	50.3	27.1	-	21.0
			Girls	0-10y	6.0	14.6	33.8	15.2	11.1	4.1	49.2	27.5	-	21.2
Italy ^f	The third Italian National Food Consumption Survey	2005-2006	Total	3-9.9	8.0	15.7	37.4	11.9	17.4	4.5	46.8	-	-	18.0
Latvia ^g	The National Food Consumption Survey of Latvia	2007-2009	Boys	7-16y	6.9	-	-	-	-	-	-	-	-	22.7
			Girls	7-16y	8.2	-	-	-	-	-	-	-	-	24.8
Norway ^h	Nationwide Dietary Survey Among Students in 4th and 8th Grade in Norway	2015	Boys	9y	7.8	16.1	31.9	13.1	10.9	4.9	50.1	11.4	-	22.0
			Girls	9y	6.9	15.6	31.7	13.1	10.7	4.8	50.9	12.4	-	22.0
Portugal ⁱ	National Food and Physical Activity Survey	2015-2016	Boys	<10y	6.9	16.8	31.2	12.2	12.0	4.5	51.3	25.3	9.1	21.3
			Girls	<10y	6.7	18.9	31.6	12.2	12.1	4.8	50.9	24.3	9.6	20.6
Spain ^{j,k}	Anthropometry, Intake and Energy Balance in Spain	2013	Boys	9-12y	8.4	16.1	39.2	12.0	-	-	40.8	17.5	9.9	-
			Girls	9-12y	7.9	15.5	39.0	12.4	-	-	41.3	17.5	9.6	-
			Boys	4-8y	7.6	13.1	31.7	11.8	-	-	53.1	25.8	19.0	21.0
The Netherlands ^l	The Dutch National Food Consumption Survey	2012-2016	Boys	9-13y	9.2	13.2	31.8	12.0	-	-	53.5	26.0	17.9	21.0
			Girls	4-8y	6.8	13.5	33.1	11.8	-	-	51.0	24.0	19.5	22.0
			Girls	9-13y	7.5	13.5	32.9	11.9	-	-	51.6	24.3	17.4	22.0
The UK ^m	National Diet and Nutrition Survey	2016/17-2018/19	Boys	4-10y	6.4	14.7	34.1	13.0	12.5	-	51.2	-	12.4	23.4
			Girls	4-10y	5.7	14.9	34.2	13.1	12.5	-	50.9	-	11.8	23.7
			Boys	6-8y	6.6	12.8	34.8	12.0	11.4	9.5	52.4	-	-	24.3
Turkey ⁿ	Turkey Nutrition and Health Survey	2010	Boys	9-11y	7.0	12.5	34.9	11.7	11.3	10.1	52.5	-	-	25.0
			Girls	6-8y	6.3	13.1	34.7	12.0	11.7	9.4	52.2	-	-	25.0
			Girls	9-11y	7.0	12.5	33.8	11.5	11.7	8.8	53.8	-	-	26.0

a (Elmadfa et al., 2012); b (De Ridder et al., 2016); c (Tornaritis et al., 2014); d (Pedersen et al., 2015); e (ANSES, 2017); f (Sette et al., 2011); g (Joffe et al., 2009); h (Hansen et al., 2015); i (Lopes et al., 2017); j (Ruiz et al., 2016); k (Ruiz et al., 2017); l (van Rossum et al. 2020); m (Bates et al. 2020); n (Turkey Ministry of Health, 2014)

- Data not available. * Where energy in MJ and percentage energy (%E) or energy adjusted intakes (/10MJ) of nutrients were not provided, this was calculated using standardised conversion factors. Intakes not reported by sex in Italy.

Table 2: Mean intake of energy, macronutrients and dietary fibre (%E, /10MJ) in teenagers in Europe using data from national surveys

Country	Study name	Study years	Sex	Age group (years)	Energy*	Protein (%E)*	Total fat (%E)*	Saturated fat (%E)*	MUFA (%E)*	PUFA (%E)*	Total carbohydrates (%E)*	Total sugars (%E)*	Free sugars (%E)*	Dietary fibre (g/10MJ)*
Austria ^a	Austrian Nutrition Report	2010-2012	Boys	13-14y	7.5	14.0	36.0	15.0	12.0	7.0	48.0	10.0	-	19.0
			Girls	13-14y	8.6	15.0	37.0	16.0	12.0	6.0	48.0	11.0	-	19.0
Belgium ^b	The Food Consumption Survey 2	2014-2015	Total	14-17y	8.1	14.6	35.1	12.9	12.8	6.1	47.2	22.7	-	20.8
Cyprus ^c	-	2009-2010	Boys	14.0-18.9y	9.1	17.7	39.6	15.3	18.1	5.9	42.3	-	-	16.7
			Girls	14.0-18.9y	7.5	16.3	37.3	14.3	17.0	5.4	46.0	-	-	18.9
Denmark ^d	Dietary Habits of the Danes	2011-2013	Boys	10-17y	9.9	15.0	35.0	14.0	12.0	5.2	48.0	11.0	-	20.0
			Girls	10-17y	7.8	15.0	34.0	14.0	12.0	5.2	48.0	11.0	-	22.0
France ^e	Individual and National Food Consumption Survey	2015-2017	Boys	11-17y	8.9	15.9	32.6	14.0	11.0	4.2	49.3	21.0	-	20.4
			Girls	11-17y	7.6	16.1	32.0	13.6	10.8	4.1	49.6	21.5	-	21.2
Italy ^f	The third Italian National Food Consumption Survey	2005-2006	Boys	10-17.9y	10.8	15.6	36.9	11.5	17.3	4.8	47.2	-	-	16.8
			Girls	10-17.9y	8.7	15.8	37.2	11.5	17.6	4.9	46.8	-	-	19.0
Latvia ^g	The National Food Consumption Survey of Latvia	2007-2009	Boys	7-16y	6.9	-	-	-	-	-	-	-	-	22.7
			Girls	7-16y	8.2	-	-	-	-	-	-	-	-	24.8
Norway ^h	Nationwide Dietary Survey Among Students in 4th and 8th Grade in Norway	2015	Boys	13y	8.6	16.8	32.8	13.5	11.4	4.9	48.8	11.9	-	20.0
			Girls	13y	7.4	15.9	32.5	13.5	11.1	4.9	48.9	12.8	-	21.0
Portugal ⁱ	National Food and Physical Activity Survey	2015-2016	Boys	10-17y	9.4	18.1	31.2	11.6	12.5	5.7	49.1	20.1	9.1	19.4
			Girls	10-17y	7.6	19.4	32.4	12.0	12.8	5.1	48.8	20.2	10.1	20.7
Spain ^{j,k}	Anthropometry, Intake and Energy Balance in Spain	2013	Boys	13-17y	8.9	16.0	38.5	12.7	15.8	6.5	41.3	16.0	9.2	13.6
			Girls	13-17y	7.6	15.5	37.9	12.4	15.4	6.6	42.3	17.8	10.0	14.7
The Netherlands ^l	The Dutch National Food Consumption Survey	2012-2016	Boys	14-18y	10.1	13.8	33.9	12.1	-	-	49.3	24.0	16.6	21.0
			Girls	14-18y	7.8	13.8	33.6	12.1	-	-	50.1	24.3	15.8	22.0
The UK ^m	National Diet and Nutrition Survey	2016/17-2018/19	Boys	11-18y	7.4	16.2	34.0	12.7	12.7	-	49.6	-	12.1	22.2
			Girls	11-18y	6.5	15.3	34.5	12.5	13.0	-	50.1	-	12.5	23.7
			Boys	12-14y	8.4	12.8	33.3	11.4	11.3	9.2	53.9	-	-	25.0
Turkey ⁿ	Turkey Nutrition and Health Survey	2010	Boys	15-18y	9.6	12.5	32.7	11.5	11.8	9.7	54.7	-	-	24.2
			Girls	12-14y	7.2	12.6	34.8	11.3	11.5	8.4	52.6	-	-	26.0
			Girls	15-18y	7.1	12.1	34.3	10.9	11.4	9.8	53.6	-	-	26.6

a (Elmadfa et al., 2012); b (De Ridder et al., 2016); c (Tornaritis et al., 2014); d (Pedersen et al., 2015); e (ANSES, 2017); f (Sette et al., 2011); g (Joffe et al., 2009); h (Hansen et al., 2015); i (Lopes et al., 2017); j (Ruiz et al., 2016); k (Ruiz et al., 2017); l (van Rossum et al. 2020); m (Bates et al. 2020); n (Turkey Ministry of Health, 2014)

- data not available

* Where energy in MJ and percentage energy (%E) or energy adjusted intakes (/10MJ) of nutrients were not provided, this was calculated using standardised conversion factors

Table 3: Mean intake of micronutrients (/10MJ) in school-aged children in Europe using data from national surveys

Country	Study name	Study years	Sex	Age group (years)	Sodium (g/10MJ)*	Folate (µg/10MJ)*	Vitamin D (µg/10MJ)*	Calcium (mg/10MJ)*	Iron (mg/10MJ)*
Austria ^a	Austrian Nutrition Report	2010-2012	Boys	7-9y	-	205	2.6	1095	12.1
			Boys	10-12y	-	209	1.9	930	13.0
			Girls	7-9y	-	214	2.1	991	11.8
Belgium ^b	The Food Consumption Survey 2	2014-2015	Girls	10-12y	-	197	1.7	938	12.1
			Total	6-9y	2.7	261	4.8	1033	11.2
			Total	10-13y	2.7	253	4.5	941	11.1
Cyprus ^c	-	2009-2010	Boys	6-8.9y	3.0	-	-	1232	14.7
			Boys	9-13.5y	3.1	-	-	1170	14.5
			Girls	6-8.9y	3.0	-	-	1228	14.4
Denmark ^d	Dietary Habits of the Danes	2011-2013	Girls	9-13.5y	3.1	-	-	1167	14.3
			Boys	4-9y	3.7	343	3.3	1248	11.1
			Girls	4-9y	3.7	354	3.4	1276	11.0
France ^e	Individual and National Food Consumption Survey	2015-2017	Boys	0-10y	2.8	369	8.4	1302	13.2
Italy ^f	The third Italian National Food Consumption Survey	2005-2006	Girls	0-10y	2.8	380	10.7	1337	12.8
Latvia	The National Food Consumption Survey of Latvia	2007-2009	Total	3-9.9	-	-	2.5	936	11.3
			Boys	7-16y	-	-	-	-	-
Norway ^g	Nationwide Dietary Survey Among Students in 4th and 8th Grade in Norway	2015	Girls	7-16y	-	-	-	-	-
			Boys	9y	3.2	246	5.3	1110	11.5
Portugal ^h	National Food and Physical Activity Survey	2015-2016	Girls	9y	3.2	254	5.2	1096	10.1
			Boys	<10y	3.3	262	19.6	1310	13.5
Spain	Anthropometry, Intake and Energy Balance in Spain	2013	Girls	<10y	3.3	263	46.1	1157	13.6
			Boys	9-12y	-	-	-	-	-
The Netherlands ⁱ	The Dutch National Food Consumption Survey	2012-2016	Girls	9-12y	-	-	-	-	-
			Boys	4-8y	2.8	296	5.5	1072	11.1
			Girls	9-13y	3.0	261	3.8	986	10.5
The UK ^j	National Diet and Nutrition Survey	2016/17-2018/19	Girls	4-8y	2.6	296	6.2	1046	10.4
			Boys	9-13y	3.0	289	4.3	989	10.9
			Boys	4-10y	-	276	3.7	1210	13.2
Turkey ^k	Turkey Nutrition and Health Survey	2010	Girls	4-10y	-	288	4.0	1188	12.8
			Boys	6-8y	2.3	365	2.3	833	13.1
			Boys	9-11y	2.3	401	1.4	790	13.2
			Girls	6-8y	2.1	381	1.7	855	13.2
			Girls	9-11y	2.3	395	1.3	782	13.6

a (Elmadfa et al., 2012); b (De Ridder et al., 2016); c (Tornaritis et al., 2014); d (Pedersen et al., 2015); e (ANSES, 2017); f (Sette et al., 2011); g (Hansen et al., 2015); h (Lopes et al., 2017); i (van Rossum et al. 2020); j (Bates et al. 2020); k (Turkey Ministry of Health, 2014)

- Data not available

* Where energy adjusted intakes (/10MJ) of nutrients were not provided, this was crudely calculated using available data from the original publication. Intakes not reported by sex in Italy.

Table 4: Mean intake of micronutrients (/10MJ) in teenagers in Europe using data from national surveys

Country	Study name	Study years	Sex	Age (years)	Sodium (g/10MJ) *	Vitamin A (µg/10MJ) *	Vitamin D (µg/10MJ) *	Riboflavin (mg/10MJ) *	Vitamin B6 (mg/10MJ) *	Folate (µg/10MJ) *	Vitamin C (mg/10MJ) *	Calcium (mg/10MJ) *	Iron (mg/10MJ) *
Austria ^a	Austrian Nutrition Report	2010-2012	Boys	13-14y	-	698	1.6	1.3	2.0	166	93.0	755	12.0
			Girls	13-14y	-	933	2.4	1.3	2.1	183	90.7	939	11.3
Belgium ^b	The Food Consumption Survey 2	2014-2015	Total	14-17y	2.8	-	4.3	1.6	1.9	239	98.0	900	11.2
Cyprus ^c	-	2009-2010	Boys	14.0-18.9y	3.2	1073	-	2.2	1.9	-	101	1127	14.3
			Girls	14.0-18.9y	3.1	1149	-	2.3	1.9	-	125	1153	14.0
Denmark ^d	Dietary Habits of the Danes	2011-2013	Boys	10-17y	4.0	1172	3.2	1.9	1.5	315	98.0	1214	11.0
			Girls	10-17y	3.9	1115	3.1	1.8	1.5	332	120	1197	10.8
France ^e	Individual and National Food Consumption Survey	2015-2017	Boys	11-17y	3.2	-	3.4	2.0	1.9	338	98.2	98	12.0
			Girls	11-17y	3.1	-	3.7	2.0	2.1	355	110	110	11.7
Italy ^f	The third Italian National Food Consumption Survey	2005-2006	Boys	10-17.9y	-	743	2.4	1.6	-	-	126	826	11.3
			Girls	10-17.9y	-	863	2.8	1.6	-	-	147	885	12.2
Latvia	The National Food Consumption Survey of Latvia	2007-2009	Boys	7-16y	-	-	-	-	-	-	-	-	-
			Girls	7-16y	-	-	-	-	-	-	-	-	-
Norway ^g	Nationwide Dietary Survey Among Students in 4th and 8th Grade in Norway	2015	Boys	13y	3.1	837	5.0	1.7	1.4	244	51.2	1067	10.5
			Girls	13y	3.1	862	4.7	1.8	1.5	247	64.9	1018	10.8
Portugal ^h	National Food and Physical Activity Survey	2015-2016	Boys	10-17y	3.4	862	5.1	2.1	2.3	239	107	988	12.4
			Girls	10-17y	3.6	959	7.5	2.2	2.5	272	130	1014	14.1
Spain	Anthropometry, Intake and Energy Balance in Spain	2013	Boys	13-17y	-	-	-	-	-	-	-	-	-
			Girls	13-17y	-	-	-	-	-	-	-	-	-
The Netherlands ⁱ	The Dutch National Food Consumption Survey	2012-2016	Boys	14-18y	3.0	267	3.4	1.9	1.0	253	115	946	10.2
			Girls	14-18y	3.1	326	4.1	2.1	1.0	281	135	1001	11.5
The UK ^j	National Diet and Nutrition Survey	2016/17-2018/19	Boys	11-18y	-	786	3.2	2.1	-	277	-	1129	13.3
			Girls	11-18y	-	822	3.2	1.8	-	263	-	1006	12.7
Turkey ^k	Turkey Nutrition and Health Survey	2010	Boys	12-14y	2.4	-	1.4	-	-	407	-	715	13.7
			Boys	15-18y	2.5	-	1.2	-	-	375	-	728	12.6
			Girls	12-14y	2.3	-	1.4	-	-	393	-	756	13.4
			Girls	15-18y	2.2	-	1.1	-	-	399	-	789	13.7

a (Elmadfa et al., 2012); b (De Ridder et al., 2016); c (Tornaritis et al., 2014); d (Pedersen et al., 2015); e (ANSES, 2017); f (Sette et al., 2011); g (Hansen et al., 2015); h (Lopes et al., 2017); i (van Rossum et al. 2020); j (Bates et al. 2020); k (Turkey Ministry of Health, 2014)

- data not available

* Where energy adjusted intakes (/10MJ) of nutrients were not provided, this was crudely calculated using available data from the original publication

Table 5a: Mean intake of food groups (g/10MJ) in children and teenagers in Europe using data from national surveys

Country	Study name	Study years	Sex	Age (years)	Total bread	White bread	Brown bread	Breakfast cereals	Total potatoes	Boiled, baked & mashed potatoes	Fried, roasted & processed potatoes	Total milk	Whole milk	Reduced fat milk
g/10MJ														
Austria ^a	Austrian Nutrition Report	2010-2012	Total	7-9y	-	-	-	-	203	-	-	-	-	-
			Total	10-12y	-	-	-	-	190	-	-	-	-	-
			Boys	13-14	-	-	-	-	162	-	-	-	-	-
			Girls	13-14	-	-	-	-	161	-	-	-	-	-
Belgium ^b	The Food Consumption Survey 2	2014-2015	Total	6-9y	175	-	-	-	-	-	-	358	-	-
			Total	10-13y	175	-	-	-	-	-	-	266	-	-
			Total	14-17y	174	-	-	-	-	-	-	214	-	-
			Boys	4-9y	-	-	-	-	59.0	-	-	-	-	-
Denmark ^c	Dietary Habits of the Danes	2011-2013	Girls	4-9y	-	-	-	-	50.0	-	-	-	-	-
			Boys	10-17y	-	-	-	-	82.0	-	-	-	-	-
			Girls	10-17y	-	-	-	-	85.0	-	-	-	-	-
			Total	0-10y	-	61.1	2.7	12.2	37.2	-	-	159	-	-
France ^d	Individual and National Food Consumption Survey	2015-2017	Total	11-17y	-	85.7	4.4	18.3	53.5	-	-	167	-	-
			Total	3-9.9y	92.0	-	-	-	59.0	-	-	-	-	-
Italy ^e	The third Italian National Food Consumption Survey	2005-2006	Total	10-17.9y	112	-	-	-	63.6	-	-	-	-	-
			Boys	9y	214	63.0	69.9	9.6-12.3	39.7	32.9	5.5	-	16.4	130
Norway ^f	Nationwide Dietary Survey Among Students in 4th and 8th Grade in Norway	2015	Girls	9y	199	57.0	69.8	9.3-12.8	34.9	27.9	4.7	-	17.4	121
			Boys	1-18y	-	-	-	-	75.9	-	-	-	-	-
The Netherlands ^g	The Dutch National Food Consumption Survey	2012-2016	Girls	1-18y	-	-	-	-	77.1	-	-	-	-	-
			Boys	6-8y	213	-	-	-	-	-	-	-	-	-
			Boys	9-11y	232	-	-	-	-	-	-	-	-	-
			Boys	12-14y	267	-	-	-	-	-	-	-	-	-
Turkey ^h	Turkey Nutrition and Health Survey	2010	Boys	15-18y	277	-	-	-	-	-	-	-	-	-
			Girls	6-8y	198	-	-	-	-	-	-	-	-	-
			Girls	9-11y	226	-	-	-	-	-	-	-	-	-
			Girls	12-14y	229	-	-	-	-	-	-	-	-	-
			Girls	15-18y	222	-	-	-	-	-	-	-	-	-

a (Elmadfa et al., 2012); b (De Ridder et al., 2016); c (Pedersen et al., 2015); d (ANSES, 2017); e (Sette et al., 2011); f (Hansen et al., 2015); g (van Rossum et al. 2020); h (Turkey Ministry of Health, 2014)
 All values were crudely calculated using available data, with the exception of Denmark, where food group intakes were originally reported in g/10MJ

Table 5b: Mean intake of food groups (g/10MJ) in children and teenagers in Europe using data from national surveys

Country	Study name	Study years	Sex	Age (years)	Total meat	Meat dishes	Processed meat	Total fruit & vegetables	Total Fruit	Fruit Juice	Total vegetables	Vegetable dishes	Biscuits, etc.*	Chocolate etc.**	Soft drinks (added sugar)	Soft Drinks (no added sugar)
g/10MJ																
Austria ^a	Austrian Nutrition Report	2010-2012	Total	7-9y	114	-	-	-	133.75	-	92.5	-	-	-	-	-
			Total	10-12y	153	-	-	-	110	-	101	-	-	-	-	-
			Boys	13-14	250	-	-	-	69.8	-	110	-	-	-	-	-
			Girls	13-14	224	-	-	-	89.3	-	84	-	-	-	-	-
Belgium ^b	The Food Consumption Survey 2	2014-2015	Total	6-9y	126	-	-	-	173	-	139	-	-	-	-	-
			Total	10-13y	132	-	-	-	130	-	135	-	-	-	-	-
			Total	14-17y	133	-	-	-	105	-	136	-	-	-	-	-
			Boys	4-9y	107	-	-	-	228	71	186	-	-	-	-	-
Denmark ^c	Dietary Habits of the Danes	2011-2013	Girls	4-9y	107	-	-	-	243	75	206	-	-	-	-	-
			Boys	10-17y	149	-	-	-	132	79	159	-	-	-	-	-
			Girls	10-17y	122	-	-	-	197	98	178	-	-	-	-	-
			Total	0-10y	-	17.2	-	-	108	112	91.3	29.7	97.3	19.4	-	-
France ^d	Individual and National Food Consumption Survey	2015-2017	Total	11-17y	-	16.4	-	-	90.4	129	96.9	23.0	89.4	22.7	-	-
			Total	3-9.9y	124.5	-	29.1	-	170	-	168	-	-	-	-	-
Italy ^e	The third Italian National Food Consumption Survey	2005-2006	Total	10-17.9y	134	-	37.5	-	129	-	172.5	-	-	-	-	-
			Boys	9y	141	-	-	-	-	111	111	-	-	-	199	68.5
Norway ^f	Among Students in 4th and 8th Grade in Norway	2015	Girls	9y	133	-	-	-	-	113	97.7	-	-	-	169	53.5
			Boys	1-18y	102	-	-	-	-	-	96.4	-	47.0	26.5-47.8	-	-
The Netherlands ^g	The Dutch National Food Consumption Survey	2012-2016	Girls	1-18y	94.3	-	-	-	-	-	111	-	54.3	25.7-44.3	-	-
			Boys	6-8y	61.2	-	-	449	-	-	-	-	-	-	-	-
			Boys	9-11y	70.1	-	-	599	-	-	-	-	-	-	-	-
			Boys	12-14y	80.2	-	-	576	-	-	-	-	-	-	-	-
Turkey ^h	Turkey Nutrition and Health Survey	2010	Boys	15-18y	64.7	-	-	453	-	-	-	-	-	-	-	-
			Girls	6-8y	37.6	-	-	555	-	-	-	-	-	-	-	-
			Girls	9-11y	57.9	-	-	629	-	-	-	-	-	-	-	-
			Girls	12-14y	52.4	-	-	598	-	-	-	-	-	-	-	-
			Girls	15-18y	50.8	-	-	630	-	-	-	-	-	-	-	-

a (Elmadfa et al., 2012); b (De Ridder et al., 2016); c (Pedersen et al., 2015); d (ANSES, 2017); e (Sette et al., 2011); f (Hansen et al., 2015); g (van Rossum et al. 2020); h (Turkey Ministry of Health, 2014)

All values were crudely calculated using available data, with the exception of Denmark, where food group intakes were originally reported in g/10MJ

Table 6 The definitions of eating location used in the studies included in this review

Title	Country (Reference)	Study name	Study years	Study population	Eating location definition
Contribution of away-from-home food to the energy and nutrient intake among Brazilian adolescents	Brazil (Bezerra <i>et al.</i> , 2021)	Study of Cardiovascular Risk in Adolescents (ERICA)	2013-2014	Teenagers (12-17y)	Away from home foods' were defined as foods which were prepared and consumed outside of the home
Assessing the Dietary Habits of Canadians by Eating Location and Occasion: Findings from the Canadian Community Health Survey, Cycle 2.2	Canada (Nishi <i>et al.</i> , 2018)	Canadian Community Health Survey	2004	General population (2+y)	Where food was prepared
Eating Away from Home: Influences on the Dietary Quality of Adolescents with Overweight or Obesity	Canada (Watts <i>et al.</i> , 2017)	-	-	Teenagers (11-16y)	Where food was prepared
Dietary Intake by Food Source and Eating Location in Low- and Middle-Income Chilean Preschool Children and Adolescents from Southeast Santiago	Chile (Rebolledo <i>et al.</i> , 2019)	Growth and Obesity Cohort Study (GOCS) and Food Environment Chilean Cohort (FECHIC)	2016	Preschool children (3-6y) and teenagers (12-14y)	Both
The contribution of at-home and away-from-home food to dietary intake among 2-13-year-old Mexican children	Mexico (Taillie <i>et al.</i> , 2017)	The Encuesta Nacional de Salud y Nutrición	2012	Children (6-13y)	Where food was consumed
An examination of the influence of eating location on the diets of Irish children	Ireland (Burke <i>et al.</i> , 2007.)	National Children's Food Survey	2003-2004	Children (5-12y)	Where food was prepared
Eating at food outlets and leisure places and "on the go" is associated with less-healthy food choices than eating at home and in school in children: cross-sectional data from the UK National Diet and Nutrition Survey Rolling Program (2008-2014)	UK (Ziauddeen <i>et al.</i> , 2018)	National Diet & Nutrition Survey	2008-2014	Children & teenagers (1.5-18y)	Where food was consumed
Frequency and socio-demographic correlates of eating meals out and take-away meals at home: cross-sectional analysis of the UK national diet and nutrition survey, waves 1-4 (2008-12)	UK (Adams <i>et al.</i> , 2015)	National Diet & Nutrition Survey	2008-2012	Children & teenagers (1.5-18y)	Where food was consumed (frequency of food consumed that was prepared outside of the home was obtained with the use of a questionnaire)
Assessing eating context and fruit and vegetable consumption in children: new methods using food diaries in the UK National Diet and Nutrition Survey Rolling Programme	UK (Mak <i>et al.</i> , 2013)	National Diet & Nutrition Survey	2008-2010	Children (1.5-10y)	Where food was consumed

Table 6 The definitions of eating location used in the studies included in this review

Title	Country (Reference)	Study name	Study years	Study population	Eating location definition
Adolescents' non-core food intake: a description of what, where and with whom adolescents consume non-core foods	UK (Toumpakari <i>et al.</i> , 2016)	National Diet & Nutrition Survey (NDNS)	2008-2011	Teenagers (11-18y)	Where food was consumed
Where Do Adolescents Eat Less-Healthy Foods? Correspondence Analysis and Logistic Regression Results from the UK National Diet and Nutrition Survey	UK (Palla <i>et al.</i> , 2020)	National Diet & Nutrition Survey (NDNS)	2008-2012	Teenagers (11-18y)	Where food was consumed
Role of food prepared away from home in the American diet, 1977-78 versus 1994-96: changes and consequences	USA (Guthrie <i>et al.</i> , 2002)	NFCS (1977-78) and CSFII (1994-96)	1977-1996	General population (2+y)	Where food was prepared
Trends in energy intake among US children by eating location and food source, 1977-2006	USA (Poti and Popkin, 2011)	NFCS77, CSFII98, CFSII94, NHANES 2003-2006	1977-2006	Children and teenagers (2-18y)	Both
Where are kids getting their empty calories? Stores, schools, and fast-food restaurants each played an important role in empty calorie intake among US children during 2009-2010	USA (Poti <i>et al.</i> , 2014)	National Health and Nutrition Survey	2009-2010	Children and teenagers (2-18y)	Where food was prepared
Energy intakes of US children and adults by food purchase location and by specific food source	USA (Drewnowski and Rehm, 2013)	National Health and Nutrition Survey	2003-2008	Children and teenagers (6-19y)	Where food was prepared
Fast-food and full-service restaurant consumption among children and adolescents: effect on energy, beverage, and nutrient intake	USA (Powell and Nguyen, 2013)	National Health and Nutrition Survey (NHANES)	2003-2008	Teenagers (12-19y)	Both
Frequency of Meals Prepared Away from Home and Nutrient Intakes among US Adolescents (NHANES 2011-2018)	USA (Golper <i>et al.</i> , 2021)	National Health and Nutrition Survey (NHANES)	2011-2018	Teenagers (12-19y)	Where food was prepared
Differences in adolescent activity and dietary behaviors across home, school, and other locations warrant location-specific intervention approaches	USA (Ortega <i>et al.</i> , 2020)	Teen Environment and Neighborhood (TEAN) Study	2007-2011	Teenagers (12-16y)	Where food was consumed

Table 7 Eating location definitions, percent consumers, percent energy and percent eating occasions at home and outside of the home according to the studies included in this review

Country (Reference)	Study population	Eating location definition	% Consumers at home	% Energy at home	% Eating occasions at home	% Consumers outside of the home	% Energy outside of the home	% Eating occasions outside of the home
Brazil (Bezerra et al., 2021)	Teenagers and adults (10-59y)	Away from home foods' were defined as foods which were prepared and consumed outside of the home	-	-	-	43% (total population)	11-23% (teenagers)	-
Canada (Nishi et al., 2018)	General population (2+y)	Where food was prepared	>90% (total population)	54-62%* (children and teenagers)		40-60% (total population) in children ~20% consumers of food from 'fast food' and ~20% consumers from 'other'; in teenagers >20% consumers of food from 'fast food' and >20%	16-26%* from 'fast food' and 18-23% from 'other' (children and teenagers)	
Canada (Watts et al., 2017)	Teenagers (11-16y)	Where food was prepared	-	-	-	-	-	-
Chile (Rebolledo et al., 2019)	Preschool children (3-6y) and teenagers (12-14y)	Both	100% (teenagers)	In teenagers 78% (where food was prepared) and 63% (where food was eaten)	-	72% (teenagers)	In teenagers 26% at 'school' (where food was eaten)	-
Mexico (Taillie et al., 2017)	Children (6-13y)	Where food was consumed	99%	82%	-	56%	18%	-
Ireland (Burke et al, 2007.)	Children (5-12y)	Where food was prepared	100%	85%	89%	77% 'outside of the home'; 49% 'takeaway'; 26% 'restaurant'; 31% 'shop'; 23% 'other locations'	11%* 'outside of the home'; 8%* 'takeaway'; 7%* 'restaurant'; 5%* 'shop'; 6%* 'other locations'	6% from 'outside of the home'; 2% from 'takeaway'; 2% from 'shop'; 1% from 'restaurant' and 1% from 'other locations' in children 17% at school; 2% at 'leisure places', 2% at 'food outlets' and 2% 'on the go'. In teenagers 12% at 'school'; 4% 'food
UK (Ziauddeen et al., 2018)	Children & teenagers (1.5-18y)	Where food was consumed	-	-	69% in children (4-10y); 71% in teenagers (11-18y)	-	-	

Table 7 Eating location definitions, percent consumers, percent energy and percent eating occasions at home and outside of the home according to the studies included in this review

Country (Reference)	Study population	Eating location definition	% Consumers at home	% Energy at home	% Eating occasions at home	% Consumers outside of the home	% Energy outside of the home	% Eating occasions outside of the home
UK (Adams et al., 2015)	Children & teenagers (1.5-18y)	Where food was consumed	-	-	-	-	-	outlets'; 2% at 'work', 2% at 'leisure places', 2% 'on the go'
UK (Mak et al., 2013)	Children (1.5-10y)	Where food was consumed			69% in children (4-10y)			14% at 'school'; 5-6% at 'friend's and relative's house'; 2% at 'other eateries' and '8-9% at 'other places'
UK (Toumpakari et al., 2016)	Teenagers (11-18y)	Where food was consumed	-	-	-	-	-	-
UK (Palla et al., 2020)	Teenagers (11-18y)	Where food was consumed	-	-		-	-	12% at 'school'; 5% at 'leisure clubs, cafes'; 4% at 'friends'/carers'/relatives' homes'; 4% at 'other locations'; 2% 'mobile: car, bus, train, etc.'; 2% at 'work'.
					71%		21-31% in children (6-11y) and 35% in teenagers (12-17y). In children and teenagers (2-17y) 9-11% 'school/day care' ; 2-10% 'fast food'; 5-8% 'miscellaneous'; 1-4% 'restaurant' and <0.5-1% 'other places'	
USA (Guthrie et al., 2002)	Genereal population (2+y)	Where food was prepared	-	-	-	-		-
USA (Poti and Popkin, 2011)	Children and teenagers (2-18y)	Both		Where food was eaten: 65-73% in children (7-12y) and 62-74% in teenagers (13-18y).	-	-	Where food was prepared: in children 10-12% 'school'; 9-11% 'fast food'; 3-4%	-

Table 7 Eating location definitions, percent consumers, percent energy and percent eating occasions at home and outside of the home according to the studies included in this review

Country (Reference)	Study population	Eating location definition	% Consumers at home	% Energy at home	% Eating occasions at home	% Consumers outside of the home	% Energy outside of the home	% Eating occasions outside of the home
				Where food was prepared: 68% in children and 64-65% in teenagers			'restaurant' and 7-8% 'other'. In teenagers 15- 17% 'fast food', 7% 'school', 6-7% 'restaurant' and 4-7% 'other'.	
USA (Poti et al., 2014)	Children and teenagers (2-18y)	Where food was prepared	-	-	-	-	-	-
USA (Drewnowski and Rehm, 2013)	Children and teenagers (6-19y)	Where food was purchased	-	-	-	-	In children (6-11y) 63% from 'stores', 12% from 'QSR', 10% from 'school cafeteria'. In teenagers (12-19y) 63% from 'stores', 18% from 'QSR', 7% from 'FSR'; 6% from 'school'	-
USA (Powell and Nguyen, 2013)	Teenagers (12-19y)	Both	-	-	-	-	-	-
USA (Golper et al., 2021)	Teenagers (12-19y)	Where food was prepared	-	-	-	-	-	-
USA (Ortega et al., 2020)	Teenagers (12-16y)	Where food was consumed	-	-	-	-	-	-

* Data is calculated from consumers at named location only

- Data not available

QSR: quick-service restaurant; FSR: full-service restaurant

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Aims and objectives

The overall aim of this thesis was to examine the dietary quality of school-aged children and teenagers in Ireland by demographic characteristics and eating location using data from the National Children's Food Survey II (NCFS II) (2017-18) and the National Teens' Food Survey II (NTFS II) (2019-20), which are two nationally representative dietary surveys of children and teenagers living in the Republic of Ireland and were carried out by the Irish Universities Nutrition Alliance (www.iuna.net).

Objectives:

1. To examine the dietary quality of school-aged children (5-12y) in Ireland and to identify any differences in dietary quality between sex, age group, socio-economic status and weight status.
2. To investigate the association between eating location and dietary quality in school-aged children (5-12y) in Ireland and to identify any differences in dietary quality between sex, age group, socio-economic status and weight status across different eating locations.
3. To examine the dietary quality of teenagers (13-18y) in Ireland and to identify any differences in dietary quality between sex, age group, socio-economic status and weight status.
4. To investigate the association between eating location and dietary quality in teenagers (13-18y) in Ireland and to identify any differences in dietary quality between sex, age group, socio-economic status and weight status across different eating locations.

Chapter 2

Methodology for the National Children's Food Survey II (2017-18) and the National Teens' Food Survey II (2019-20)

Methodology

Analyses for this PhD thesis were based on data from two nationally representative dietary surveys of school-aged children and teenagers in the Republic of Ireland: the National Children’s Food Survey II (NCFS II) of 5-12 year olds (2017-18) and the National Teens’ Food Survey II (NTFS II) of 13-18 year olds (2019-20), which were cross sectional surveys carried out by the Irish Universities Nutrition Alliance (IUNA) units at University College Cork, Munster Technological University, University College Dublin and Technological University Dublin. Both surveys were carried out using similar methodologies and a full detailed methodology for each survey is available at www.iuna.net with the methods relevant to this thesis outlined below.

Ethical approval

The NCFS II and the NTFS II were conducted in accordance with the guidelines laid down in the Declaration of Helsinki and ethical approval was obtained for both surveys from the Clinical Research Ethics Committee of the Cork Teaching Hospitals and the Human Ethics Research Committee of University College Dublin (Ref: NCFS II: ECM 4 (aa) 07/02/17, NTFS II: ECM 4 (II) 04/12/18 & ECM 3 (c) 15/04/19). Written informed consent was obtained from children, teenagers and their parents/guardians in both surveys.

Sampling and recruitment methodology

The NCFS II was carried out between April 2017 and May 2018 and included 600 children aged 5-12 years (300 boys and 300 girls) while the NTFS II was carried out between March 2019 and March 2020 and included 428 teenagers aged 13-18 years (212 boys and 216 girls). While the initial sample size for the NTFS II was intended to be 500 teenagers aged 13-18 years, due to Level 5 Covid-19 lockdown restrictions in March 2020, data collection ceased before the full sample could be surveyed. However, despite this, demographic analysis of the sample has shown that the final sample was relatively balanced compared to the national population data from Census 2016. For each survey, databases of primary and secondary schools (obtained from the Department of Education and Skills) (www.education.ie) was used to select schools to provide a demographically balanced sample with respect to urban/rural divide and socio-economic grouping. For the NCFS II, all schools in the primary schools database

(*n* 3124) were classified according to the size of the school; small (<200 pupils), medium (200-499 pupils) and large (>500 pupils). For the NTFS II, all schools in the secondary schools database (*n* 722) were classified according to the type of school; secondary (52.4%), vocational (34.3%) or comprehensive/community (13.3%). For both the NCFS II and the NTFS II, schools were further classified according to sex served (all males, all females or mixed), location (urban or rural) and whether they were disadvantaged or not disadvantaged. In Ireland, disadvantaged schools receive support through the DEIS (Delivering Equality of Opportunity in Schools) programme. In order to be included in this programme, schools must receive a Pobal HP deprivation index of -10 or below. This index measures the level of disadvantage or affluence in an area based on demographic growth, education levels, single parent rate, overcrowding, social class and unemployment. Additionally, this model now includes components to reflect the levels of educational disadvantage experienced by students who have self-identified as Traveller or Roma, students in direct provision centres and students who are experiencing homelessness (Department of Education, 2022). The list of all schools in Ireland with their classifications according to the above was obtained from the Department of Education. Schools within these categories were then randomly selected to participate so that in the final sample, the proportions of children and teenagers attending each of the categories of schools reflected that of the proportions according to the database.

For each survey, an introductory letter along with information about the survey was posted to the principal of each selected school. This was followed up by a phone call from the survey coordinator. If the principal verbally consented to the school’s participation in the survey, a suitable date and time to visit the school was arranged. Of the schools contacted, 80% agreed to take part in the NCFS II and 73% agreed to take part in the NTFS II. For both surveys, the school principal was provided with information packs (containing an introductory letter, an information brochure and reply slip). Students were randomly selected from the school roll and given these information packs to bring home to their parents/guardians. If the parents/guardians and the selected child/teenager were interested in finding out more about participating in the survey, they were asked to fill out their contact details on the reply slip and return it to the school. Children/teenagers who returned a reply slip were excluded from the survey if they were not within the required age range (NCFS II: 5-12 years,

NTFS II: 13-18 years), if they belonged to an age, gender or geographical location category for which the appropriate number of children/teenagers had already been recruited, or if another member of their household had already been recruited for participation in the survey. Non-responders were not contacted as only those consenting to taking part in the study or to obtaining more information about the study were permitted to be contacted by the research team. A trained nutritionist contacted the parents/guardians of all eligible children/teenagers who returned a reply slip and if they agreed to participate in the survey, a suitable time and date for a nutritionist to visit was arranged. The nutritionist then visited the home to explain the survey in more detail and to obtain consent from both parents/guardians and the child/teenager. The overall response rate of the surveys was 65% for the NCFS II and 57% for the NTFS II. Demographic analyses of both samples have shown them to be representative of children and teenagers in Ireland with respect to age-group, sex and geographical location when compared to Census 2016 data (Central Statistics Office, 2017b). However, the final sample in both surveys contained a higher proportion of children and teenagers of professional workers and a lower proportion of children and teenagers of semi-skilled and unskilled workers than the national population. Data in this thesis have been weighted to account for these differences except where social class was the variable of interest in analyses.

Dietary data collection

As weighed food diaries are considered the ‘gold standard’ of dietary assessment methods (Ortega et al., 2015, Thompson and Byers, 1994) this method was chosen to collect dietary data for this study. While other methods may also be suitable, such as 24 hour dietary recalls, which are frequently used in epidemiological studies, they are reliant on the participant’s memory and are prone to recall bias (Naska et al., 2017). Furthermore, this method was chosen for comparison with previous national dietary surveys in Ireland which used similar methodologies. A four day recording period was chosen as a longer recording period (traditionally seven consecutive days) has been associated with inaccurate reporting due to respondent fatigue (Ortega et al., 2015). For both surveys, food and beverage intake data were collected using a 4-day weighed food diary with at least one weekend day included. In order to account for seasonal variation, data collection was staggered. In both the NCFS II and the NTFS II, 56% of

data collection took place in winter (September – February) and 44% took place in the summer (March – August). Participants (and/or their caregivers) were provided with a food diary and a portable food scale and asked to record detailed information regarding the amount, type and brand of all foods, beverages and nutritional supplements consumed over the 4-day period, as well as the amount of any leftovers. The cooking methods used, the packaging size and type, and details of recipes were also recorded. Additionally, data were collected on the time of each eating or drinking occasion, the participant’s definition of each eating or drinking occasion (e.g., morning snack, lunch) and the location of preparation of the meal or snack (e.g., home, school, childminder, shop, fast food restaurant). Participants were also asked to keep all food/beverage/nutritional supplement packaging to provide further information such as brand details and nutritional information. If packaging was not provided/available, photographs of the packaging were taken by nutritionists at local shops/supermarkets/pharmacies. Nutritionists made three visits to the participant’s home over the survey period: an initial training visit to demonstrate how to complete the food diary and use the portable food scales, a second visit 24-36 hours into the recording period to review the diary and to clarify details regarding specific food descriptors and quantities, and a final visit one to two days after the recording period to check the recording from the final days and to collect the food diary.

Food quantification and coding

A quantification protocol established by the IUNA for the North/South Ireland Food Consumption Survey (NSIFCS) (Harrington et al., 2001) was adapted for the NCFS II and the NTFS II. In brief, a hierarchical approach to quantification was developed, where foods and beverages were quantified by specific methods. If it was not possible to quantify a food or beverage with a method on the first level of the hierarchy, a subsequent method was used. It is summarised as follows:

- 1) *Weighed (by the participant/manufacture’s weights)* – A portable food scales (Tanita KD400, Japan) was provided to each participant. Nutritionists provided detailed instructions (including a demonstration) on how to use the food scales. In the NCFSII, this method was used to quantify 76% of the foods and beverages consumed, with a further 11% of foods being quantified using manufacturer’s weights. In the NTFS II, this method was used to quantify 74%

of foods and beverages consumed, with a further 14% of foods being quantified using manufacturer’s weights. (Note: each participant and a parent/guardian were trained on how to use the food scales, as in some instances, it was more appropriate for a parent/guardian to weigh the food/meal (e.g., if they were preparing it). Information on who weighed the food was not recorded in the food diary in either the NCFS II or the NTFS II).

- 2) *Food atlas* – Age-appropriate photographic food atlases (Foster et al., 2010a, Foster et al., 2010b) were used to quantify 7% of the foods and beverages consumed in the NCFS II and 5% of the foods and beverages consumed in the NTFS II.
- 3) *Food portion sizes* – ‘The Irish Food Portion Sizes Database’ (Lyons and Giltinan, 2013) and ‘Food Portion Sizes’ (Ministry of Agriculture Fisheries and Food, 1997) were used to quantify 3% of the foods and beverages consumed in the NCFS II and 4% of the foods and beverages consumed in the NTFS II.
- 4) *Household measures* – Household measures (e.g., teaspoon, tablespoon, pint etc.) were used to quantify 1% of the foods and beverages consumed in the NCFS II and 2% of the foods and beverages consumed in the NTFS II.
- 5) *Estimated* – Food quantities were defined as estimated when the nutritionist made an estimate of the amount likely to have been consumed based on their knowledge of the participant’s eating habits as observed during the recording period. This quantification method was used to quantify $\leq 2\%$ of the foods and beverages consumed in the NCFS II and the NTFS II.

Estimation of food and nutrient intakes

For both surveys, each food, beverage and dietary supplement consumed during the recording period was assigned a unique food code based on its nutritional profile and brand information. All foods and beverages were then entered into the data entry system Nutritics[®]. A total of 2046 and 2029 food codes were included in the NCFS II and the NTFS II databases, respectively. These food and beverages were then categorised into food groups according to product type based on manufacturer’s information and based on previous classifications within IUNA dietary surveys (based

on UK McCance & Widdowson’s food composition tables) for consistency and comparability between studies (Appendix I and II).

The nutritional analysis software package Nutritics[®] was used to estimate nutrient intakes using data from McCance and Widdowson’s The Composition of Foods, seventh and sixth editions (for a small number of foods) (Food Standards Agency, 2015, Food Standards Agency, 2002).

During both surveys, modifications were made to the food composition database to include recipes of composite dishes, dietary supplements, fortified foods, new foods on the market and commonly consumed generic Irish foods. Additionally, the food composition databases were updated with values for total fat, saturated fat, monounsaturated fat, polyunsaturated fat, free sugars, dietary fibre, sodium and vitamin D, which have been detailed elsewhere (O'Connor et al., 2021, Kehoe et al., 2022). While the contribution of dietary supplements to nutrient intakes were included in the NCFS II and NTFS II databases, they were excluded from all analyses in this thesis and nutrient intakes were estimated from food sources only. These dietary supplements were excluded from all analyses in this thesis in order to assess dietary quality from food only to inform dietary strategies that can be applied to all members of the population (thus not relying on the use of dietary supplements at an individual level). Furthermore, excluding dietary supplements from these analyses avoids bias towards the home environment for micronutrient quality as this is where supplements are generally taken.

The mean daily intakes (MDI) of food groups, energy and each individual nutrient were calculated for each participant by obtaining the sum of the food weight (for food groups) and energy and nutrient content from each food consumed (for energy and nutrient intakes) over the recording period and dividing it by the number of recording days (four). Food and nutrient intakes in this thesis were presented as energy-adjusted intakes (% of energy for macronutrients and intakes per 10MJ for dietary fibre, salt, micronutrients and food groups) to remove energy as a confounding factor.

Socio-demographic and education data

For this thesis, social class and parental education were used as indicators of socio-economic status. In both the NCFS II and NTFS II, this information was collected via

the ‘Health & Lifestyle Questionnaire’ (Appendix III) which was completed by the parent(s)/guardian(s) of each participating child and teenager. This questionnaire contained detailed questions regarding the occupation and education level of the parent(s)/guardian(s) of the participating child/teenager.

The questions were based on questions used as part of the Irish Census, which allows for the comparison of NCFS II and NTFS II data to nationally representative data for these age-groups (Central Statistics Office, 2017a).

The information provided by the parent(s)/guardian(s) of the participating children and teenagers regarding their occupations were categorised by trained nutritionists according to the Census data (Central Statistics Office, 2017b) and aggregated into four social class categories, including: ‘professional workers’, ‘non-manual workers’, ‘skilled manual workers’ and ‘semi-skilled/unskilled workers’.

Information on education level was collected with the use of a multiple-choice question which provided nine possible answers, the last of which was open-ended. The first eight choices were then grouped into three education level categories as follows: ‘some primary (not complete)’, ‘primary or equivalent’ and ‘intermediate/junior/group certificate and equivalent’ formed ‘primary and intermediate’; ‘leaving certificate’ formed ‘secondary’ and ‘apprenticeship/trade certificate/FÁS training’, ‘diploma/certificate’, ‘primary degree/nursing qualification’ and ‘postgraduate/higher degree’ formed ‘tertiary’. If the participant chose to use the open-ended answer option, their answer was slotted into one of the above options where possible by a trained nutritionist. The education level and sociodemographic level of the participant was defined using that of the highest category from both parent(s)/guardian(s).

Anthropometric measurements

For both surveys, anthropometric measurements were obtained by a trained nutritionist in the participant’s home. Due to the nature of both surveys, these measurements typically took place in the afternoon/evening, after school. Height of the participants was measured to the nearest 0.1cm using a portable height measure (Seca, Birmingham, UK) with the participant’s head positioned in the Frankfurt Plane. Measurements were taken barefoot with the participant’s back to the backboard of the

height measure ensuring their feet, buttocks and occiput (back of skull) were touching the backboard. The participant’s weight was measured (in duplicate) to the nearest 0.1kg (for weight) using a Tanita body composition analyser BC-420MA (Tanita Ltd, GB). Participants were weighed after having voided, wearing light clothing and without shoes. Overweight and obesity were defined using the Body Mass Index (BMI) which was calculated as weight (kg) divided by height squared (m^2). The ‘LMS growth’ Microsoft Excel Add-in was used to establish BMI z-scores based on reference values for weight and height. SPSS© (SPSS Inc. Chicago, IL, USA) was used to convert z-scores to percentiles. BMI z-scores based on measured values for weight and height. The International Obesity Taskforce (IOTF) age and gender-specific extended BMI cut-offs were used to define weight status in these analyses (Cole et al., 2000, Cole and Lobstein, 2012). Participants classified as having thinness were excluded from any analyses involving weight status as they make up a very small proportion of the population (5.3% in both the NCFS II and the NTFS II).

Quality control

Both surveys included detailed quality control procedures to minimise error and ensure consistency throughout the collection and analysis of the data. Firstly, all nutritionists received comprehensive training on all SOPs which included role playing exercises where they were encouraged to establish a friendly approach to make each participant feel at ease during their home visits so that the most accurate data could be collected. It was stressed to participants that they should not try to change or ‘improve’ their diet during the recording period. At the end of the recording period, participants and their parents/guardians were asked whether the recorded food intake had been the same as usual, less than usual or more than usual and to explain why this might have been. They were also asked if there were any items consumed during the four-day recording period which had not yet been written down. If so, details on such items were then recorded by the nutritionist in the food diary.

To maintain consistency, each nutritionist was responsible for the collection, quantification, coding and data entry of their own participants’ food diaries in an attempt to maintain consistency and were provided with detailed guidelines regarding each task. Once the data entry was completed by the research nutritionist, all diaries were re-checked by the nutritionist themselves and a percentage of diaries were re-

checked by a different nutritionist. In the NCFS II, about 20% of diaries were randomly chosen to be re-checked. This was deemed sufficient as only a few anomalies were found. As the data entry phase of the NTFS II took place while all researchers were working remotely due to the Covid-19 restrictions it was decided for accuracy and best practice that 100% of diaries would be re-checked. The survey coordinator then exported all data into SPSS[®] where further quality control took place. All food codes and corresponding brand codes were compared to ensure no mismatches occurred and each variable exported was quality controlled for errors and outliers. Where outliers were found, these values were checked against the values recorded in the food diary. If the outlier value matched what had been recorded in the food diary, it was generally included in the data set. If the value seemed implausible, the survey coordinator discussed this with the researcher and if the value was definitely correct it was not changed, however if it was likely to be a recording error, a different quantification method was used as appropriate.

Under reporters

For both the NCFS II and the NTFS II, energy under reporters were identified by evaluating reported energy intake (as a ratio of energy intake to basal metabolic rate (BMR) (EI:BMR)) against presumed age-specific energy cut offs calculated on the basis of reported levels of physical activity (Goldberg et al., 1991, Black, 2000). This resulted in 19.5% of the study population being identified as under reporters in the NCFS II and 46% in the NTFS II. Energy under reporting was taken into account during certain analyses carried out by the IUNA (e.g., in estimating the prevalence of inadequate micronutrient intakes). It is possible for under-reporters to have a plausible energy intake and participants who may have been identified as under-reporters may actually be under-eaters, in cases of weight-loss dieting, thus only removing those with unpalatable energy intakes may introduce bias. (Drouillet-Pinard et al., 2016). Instead of excluding under reporters from the analysis in this thesis, nutrient and food group intakes were energy-adjusted.

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Chapter 3

**Dietary quality of school-aged children (5-12y) in Ireland and
differences in dietary quality between sex, age group, socio-
economic status and weight status**

Introduction

Adequate nutrition is particularly important during childhood as this is a crucial time for physical and cognitive development and for the development of healthy eating habits (Eilender, 2016). Additionally, childhood nutrition has an influence on the progression of diet related chronic diseases such as obesity and cardiovascular disease later in life as eating habits developed during the childhood years are often carried into adulthood (Liberali et al., 2020, Kaikkonen et al., 2014, Eilender, 2016). Monitoring dietary quality, which is often defined using nutrient and food markers based on food based dietary guidelines (FBDG), could be useful in informing strategies aimed at improving the diet of children to insure adequate growth and development (Royo-Bordonada et al., 2003).

A balanced diet that includes cereals, legumes, fruit, vegetables, eggs, milk, fish and meat should provide all necessary micronutrients needed for growth and development in school-aged children (Savarino et al., 2021). Moreover, macronutrient balance is important in order to prevent obesity, but also in order to support physical growth and development. Protein is vital for muscle development, fats allow for absorption of fat-soluble vitamins, while mono- and poly- unsaturated fatty acids support brain development (Savarino et al., 2021). In terms of the micronutrient requirements of school-aged children, calcium, phosphorus and vitamin D are essential for bone growth (European Food Safety Authority 2017), folate supports normal cell development and growth (Wagner, 2001) and iron is essential for red blood cell and new tissue formation and has also been associated with improved cognition in children (Savarino et al., 2021, Halterman et al., 2001).

Some evidence in the literature suggests that sex, age, socio-economic status and body mass index (BMI) are linked to dietary quality in school-aged children (Rasmussen et al., 2006, Novaković et al., 2014, Pérez-Escamilla et al., 2012). A review investigating the determinants of fruit and vegetable consumption has found that girls and younger children have higher intakes of fruit and vegetables than boys and older children (Rasmussen et al., 2006), however data from national nutrition surveys across Europe have found that there were generally no differences in the intakes of food groups such as ‘breads’, ‘breakfast cereals’, ‘potatoes’, ‘milk’, ‘meat & meat products’, ‘fruit & vegetables’ and ‘confectionery & snacks’ between boys and girls (Pedersen et al.,

2015, Van Rossum et al., 2020, Turkey Ministry of Health, 2014). It was found, however, that older children had higher intakes of ‘total meat’, while there were mixed findings regarding intakes of ‘fruit and vegetables’ between younger and older children. These studies have also found no differences in the intakes of nutrients such as saturated fat, monounsaturated fat (MUFA), polyunsaturated fat (PUFA), free sugars, dietary fibre, sodium, vitamin D, calcium and iron between boys and girls or between younger and older children (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Joffe et al., 2009, Hansen et al., 2015, Van Rossum et al., 2020, Bates et al., 2020, Turkey Ministry of Health, 2014). A systematic review on the socio-economic determinants of micronutrient intake in Europe using education, occupation and income as indicators of socio-economic status found that children with a higher socio-economic status have been found to be more likely to have better dietary quality (Novaković et al., 2014). However, conflicting evidence from other studies found no clear link between social class and dietary quality, with little evidence to show an association between socio-economic status and overall dietary quality scores (based on meeting FBDG for fruit and vegetable intakes) (Attorp et al., 2014, Mak et al., 2013, Martin et al., 2015). While studies have shown no differences in percent energy from macronutrient intakes between children classified as having a healthy BMI and those classified as having overweight and obesity, higher intakes of sugar-sweetened beverages and lower intakes of milk and fruit juice were noted in children classified as having overweight and obesity when compared to children classified as having a healthy BMI (Elliott et al., 2011, Golley et al., 2011, Grimes et al., 2013, Watowicz et al., 2015).

The recent NCFS II has collected detailed dietary data along with information on socio-economic status and weight status from a nationally representative sample of school-aged children across Ireland. This study aims to use these data to examine the dietary quality of school-aged children in Ireland and to identify any differences in dietary quality between sex, age group and categories of socio-economic status and weight status.

Methods

The analyses for this chapter are based on data from the NCFS II. A detailed survey methodology for the NCFS II including sampling, recruitment, data collection, food quantification, nutrient composition and estimation of food group and nutrient intakes is outlined in Chapter 2. The methods specific to this chapter are outlined below.

Defining dietary quality

In the context of this chapter, ‘dietary quality’ refers to the energy-adjusted intakes of pre-defined food groups and nutrients. The selection of food groups examined have been included in this definition on the premise that they best describe dietary quality based on current FBDG in Ireland, which recommend eating a variety of fruits and vegetables, choosing wholemeal bread, high-fibre breakfast cereals, low fat dairy products, lean meat and protein sources, using baking, boiling and steaming as cooking methods, rather than frying and drinking plenty of fluids, preferably water (Food Safety Authority of Ireland, 2019). This approach of using FBDG as a marker for dietary quality has also been used in many other studies (Rangelov et al., 2021, Royo-Bordonada et al., 2003, van Lee et al., 2012). The use of a scoring system (e.g., the Healthy Eating Index (HEI)) based on current dietary guidelines in order to define dietary quality is often seen in the literature (USDA, 2022, Jessri et al., 2017). The method used for the present study to define and examine dietary quality is tailored to children and teenagers in Ireland as it focuses on current Irish FBDG and nutrients which have been shown to be of concern to these particular age groups. This measure of dietary quality can be used alongside data on compliance with recommendations in order to inform healthy eating policies aimed at this cohort in Ireland.

The food groups examined in this study include intakes of:

- ‘White bread’ v ‘wholemeal & brown bread’
- ‘High-fibre RTEBC ($\geq 6\text{g}/100\text{g}$)’ v ‘low-fibre RTEBC ($< 6\text{g}/100\text{g}$)’
- ‘Porridge & hot oat cereals’
- ‘Boiled, baked & mashed potatoes’ v ‘chipped fried, roasted, processed & homemade potato products’
- ‘Whole milk’ v ‘reduced fat milks’

- ‘Fresh meat’ v ‘processed meat’ (products such as bacon, ham, burgers, sausages, meat pies and pastries and other meat products)
- ‘Total fruit & vegetables’
- ‘Total fruit’, including ‘discrete fruit’ and ‘fruit juices & smoothies’
- ‘Total vegetables’, including ‘discrete vegetables’ and ‘vegetable dishes’
- ‘Total confectionery & snacks’, including ‘biscuits, crackers, cakes, pastries, bun & desserts’, ‘chocolate, sweets, savoury snacks, sugars & preserves’ and ‘cereal bars’
- ‘Water consumed as a beverage’
- ‘Soft drinks (added sugar)’ v ‘soft drinks (no added sugar)’

This study also included intakes of the following nutrients in its definition of dietary quality: saturated fat, MUFA, PUFA, free sugars, dietary fibre, sodium, vitamin D, DFE, calcium and iron as intakes of these nutrients are generally not in line with recommendations, both in Ireland and across Europe (Kehoe et al., 2022, Rippin et al., 2019, Walton et al., 2021). Intakes of protein, total fat, carbohydrates and total sugars were also included in these analyses for completeness. As intakes of nutrients, particularly macronutrients, is correlated with energy intakes (Willett et al., 1997), removing energy as a confounder gives a more accurate picture of dietary quality, independent of energy intakes.

Defining socio-economic status

Socio-economic status has been found to have an effect on dietary quality in children in terms of food and nutrient intakes (Novaković et al., 2014, Rasmussen et al., 2006). Parental occupation, education and income are all examples of indicators of socio-economic status used in the literature. The present study used social class and parental education as indicators of socio-economic status as these are commonly used indicators of socio-economic status in the literature (Novaković et al., 2014). Details on how socio-economic and parental education data were collected are outlined in Chapter 2.

Anthropometric measurements

This study used BMI as a marker of weight status. There is evidence in the literature to suggest that BMI may have an impact on dietary quality, with studies showing differences in energy, nutrient and food group intakes between children classified as having a healthy BMI and children classified as having overweight and obesity (Elliott et al., 2011, Golley et al., 2011, Grimes et al., 2013, Watowicz et al., 2015). Details on how anthropometric measurements were carried out and how weight status was defined are outlined in Chapter 2.

Statistical Analysis

The mean, standard deviation, median and interquartile range was calculated for selected nutrients and foods groups using SPSS[®] Version 27.0 for Windows (SPSS Inc., Chicago, IL, USA). Differences in the MDI of energy and nutrients between sexes and age groups (5-8y & 9-12y) were calculated using independent sample t-tests regardless of normality (due to large sample size) (Fagerland, 2012). Differences in the MDI of energy and nutrients between social class and parental education groups were calculated using a Kruskal-Wallis test to determine overall differences in intakes between groups and post-hoc Mann-Whitney U Tests to identify where these differences occurred. Differences in food group intakes (e.g., ‘white bread’ vs. ‘wholemeal & brown bread’) in the total population were determined using Wilcoxon Signed Rank tests. The Bonferroni adjustment was used to minimise type 1 errors (as a result of multiple testing) by dividing the alpha level (0.05) by the number of comparisons, thus resulting in a significance value of $P < 0.001$.

Results

Mean daily intakes of energy and (energy-adjusted) nutrients

Table 1 presents the mean daily intake (MDI) of energy and (energy-adjusted) nutrients in the total population of school-aged children and split by sex. The MDI of total fat was 33.6%E which was in line with the DRV set by the UK Scientific Advisory Committee on Nutrition (SACN) for an average population intake of total fat of <35%E. The MDI of saturated fat was 14.0%E which is above the UK Department of Health (DOH) recommendation for an average population intake of less than 10%E from saturated fat. The MDI of MUFA was 13.8%E which is in line with the UK DOH recommendation for a minimum average population intake of 12%E. The MDI of PUFA was 5.6%E which is below the UK DOH recommendation for a minimum average population intake of 6%E. The MDI of carbohydrate was 50.0%E which meets the SACN recommendation for an average population intake of 50%E from carbohydrate. The MDI of free sugar was 10.1%E, which is above the SACN recommendation for an average population intake of no more than 5%E from free sugar.

When compared to girls, boys had a higher MDI of energy (1595kcal vs. 1400kcal, $P < .001$). There were no differences in the MDI of any nutrient examined between boys and girls.

Table 2 presents the MDI of energy and (energy-adjusted) nutrients split by age group. When compared to younger children (5-8y), older children (9-12y) had a higher MDI of energy (1611 kcal vs. 1384 kcal, $P < .001$). Younger children had a higher MDI of calcium than older children (1310mg/10MJ vs. 1187mg/10MJ, $P < .001$). There was no difference in the MDI of any other nutrient examined between older and younger children.

Table 3 presents the MDI of energy and (energy-adjusted) nutrients split by social class. There were no differences observed in the MDI of energy or nutrients across categories of social class with the exception of dietary fibre where children whose parents were professional workers had a higher MDI of dietary fibre than those whose parents were non-manual workers (23.3g/10MJ vs. 21.3g/10MJ, $P < .001$) or skilled manual workers (23.2g/10MJ vs. 20.4g/10MJ $P < .001$).

Table 4 presents the MDI of energy and (energy-adjusted) nutrients split by parental education level. There were no differences observed in the MDI of energy or nutrients across categories of parental education level with the exception of dietary fibre where children whose parents had tertiary education had a higher MDI of dietary fibre than those whose parents had primary education only (22.9g/10MJ vs. 19.6g/10MJ, $P < .001$).

Table 5 presents the MDI of energy and (energy-adjusted) nutrients split by BMI category. Children classified as having a healthy BMI had a higher MDI of saturated fat than children classified as having overweight and obesity (14.2%E vs. 13.1%E, $P < .001$) however both groups of children had an MDI of saturated fat higher than the SACN recommendation for an average population intake of <10%E from saturated fat. No other differences in nutrient intakes were observed between these two groups.

Mean daily intake of food groups

Table 6 presents the (energy-adjusted) MDI of food groups in the total population of school-aged children and split by sex. In the total population, the MDI of ‘white bread’ was higher than that of ‘wholemeal & brown bread’ (82g/10MJ vs. 43.2g/10MJ, $P < .001$), the MDI of ‘high-fibre ready-to-eat breakfast cereals (RTEBC)’ was higher than ‘low-fibre RTEBC’ (25.3g/10MJ vs. 19.0g/10MJ, $P < .001$), the MDI of ‘whole milk’ was higher than ‘reduced fat milk’ (201g/10MJ vs. 89.6g/10MJ, $P < .001$) with a very minimal intake of non-dairy alternatives and the MDI of ‘processed meat’ was higher than ‘fresh meat’ (62.2g/10MJ vs. 43.9g/10MJ, $P < .001$). No differences were noted between the MDI of ‘soft drinks (added sugar)’ when compared to ‘soft drinks (no added sugar)’ or between the MDI of ‘boiled, baked & mashed potatoes’ when compared to ‘chipped, fried, roasted, processed & homemade potato products’ in 5-12-year old children.

As can be seen in **table 6**, there were no differences in food group intakes between boys and girls.

Table 7 presents the (energy-adjusted) MDI of food groups split by age group. When compared to younger children (5-8y), older children (9-12y) had a higher MDI of ‘fresh meat’ (50.8g/10MJ vs. 37.1g/10MJ, $P < .001$) and ‘soft drinks (added sugar)’ (80.6g/10MJ vs. 42.0g/10MJ, $P < .001$) and a lower MDI of ‘discrete fruit’

(158g/10MJ vs. 197g/10MJ, $P < .001$). There were no other differences observed between these two groups.

Table 8 presents the (energy-adjusted) MDI of food groups split by social class. Children whose parents were professional workers had a higher MDI of ‘wholemeal & brown bread’ than those whose parents were skilled manual workers (48.3g/10MJ vs. 15.2g/10MJ, $P < .001$). Children whose parents were skilled manual workers had a higher MDI of ‘soft drinks (added sugar)’ than those whose parents were professional workers (135g/10MJ vs. 43.5g/10MJ, $P < .001$). No other differences in intakes of food groups were noted between these groups.

Table 9 presents the (energy-adjusted) MDI of food groups split by parental education level. Children whose parents had primary education only had a higher MDI of ‘white bread’ than children whose parents had tertiary education (120g/10MJ vs. 77.5g/10MJ, $P < .001$), while children whose parents had tertiary education had a higher MDI of ‘wholemeal & brown bread’ (47.0g/10MJ vs. 10.4g/10MJ, $P < .001$).

Table 10 presents the (energy-adjusted) MDI of food groups split by BMI category. No differences were noted in the MDI of these food groups between children classified as having a healthy BMI and those with overweight/obesity.

Table 1 Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in children aged 5-12 years (*n* 600) in the total population and by sex

	All (n=600)				Boys (n=300)				Girls (n=300)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
Energy (kcal)	1497	355	1466	(1253-1686)	1595	377	1561	(1328-1828)	1400*	303	1375	(1181-1582)
Energy (MJ)	6.3	1.5	6.2	(5.3-7.1)	6.7	1.6	6.6	(5.6-7.6)	5.9*	1.3	5.8	(5.0-6.7)
Protein (%E)	15.9	2.8	15.6	(14.0-17.4)	16.2	3	15.8	(14.1-17.9)	15.6	2.5	15.4	(13.9-17.2)
Total fat (%E)	33.6	5.0	33.3	(30.1-37.1)	33.5	4.9	33.4	(30.1-37.0)	33.7	5.1	33.2	(30.2-37.3)
Saturated fat (%E)	14.0	2.8	14.0	(12.2-15.9)	13.9	2.6	14	(12.2-15.9)	14.2	2.9	14.0	(12.3-15.9)
Monounsaturated fat (%E)	13.8	2.5	13.6	(12.0-15.4)	13.9	2.5	13.6	(12.1-15.4)	13.8	2.5	13.6	(11.9-15.3)
Polyunsaturated fat (%E)	5.6	1.3	5.5	(4.7-6.3)	5.6	1.3	5.5	(4.7-6.3)	5.6	1.3	5.5	(4.6-6.3)
Carbohydrate (%E)	50.0	5.4	50.1	(46.6-53.8)	49.8	5.5	49.8	(46.4-53.6)	50.2	5.3	50.3	(46.6-53.9)
Total sugars (%E)	18.8	4.9	18.6	(15.5-21.8)	18.7	4.9	18.6	(15.6-21.8)	18.9	4.8	18.7	(15.5-21.7)
Free sugars (%E)	10.1	4.5	9.6	(6.7-12.7)	9.8	4.5	9.4	(6.5-12.4)	10.3	4.5	9.7	(6.9-12.9)
Dietary fibre (g/10MJ)	22.6	5.8	22.1	(18.6-25.8)	22.6	5.8	22.1	(18.4-26.0)	22.6	5.8	22.0	(18.7-25.8)
Sodium (mg/10MJ)	2671	543	2634	(2285-3029)	2691	548	2653	(2299-3012)	2652	538	2624	(2259-3054)
Vitamin D (µg/10MJ)	5.4	4.0	4.4	(2.8-6.7)	5.4	4.2	4.3	(2.7-6.7)	5.4	3.7	4.5	(2.9-6.7)
DFE (µg/10MJ)	380	165	348	(275-449)	382	168	349	(276-463)	379	162	346	(274-444)
Calcium (mg/10MJ)	1249	360	1206	(1001-1444)	1278	360	1224	(1031-1465)	1219	358	1182	(965-1425)
Iron (mg/10MJ)	14.0	3.7	13.4	(11.3-16.1)	14.1	3.5	13.5	(11.5-16.2)	13.9	3.8	13.3	(11.1-16.0)

%E: percentage of total energy

DFE: Dietary Folate Equivalents

* Statistically different ($P < 0.001$) from that of boys within the rows via Independent Samples T Test and adjusted for multiple testing

Table 2 Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in children aged 5-12 years (*n* 600), by age group

	5-8 years (n=300)				9-12 years (n=300)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
Energy (kcal)	1384	286	1356	(1176-1561)	1611*	381	1595	(1351-1842)
Energy (MJ)	5.8	1.2	5.7	(5.0-6.5)	6.8*	1.6	6.7	(5.7-7.7)
Protein (%E)	15.8	2.6	15.6	(14.0-17.3)	16.1	3	15.6	(14.1-17.6)
Total fat (%E)	33.5	4.9	33.6	(30.0-36.9)	33.7	5.2	33.2	(30.3-37.4)
Saturated fat (%E)	14.3	2.7	14.3	(12.4-16.3)	13.8	2.8	13.8	(12.0-15.5)
Monounsaturated fat (%E)	13.6	2.4	13.6	(11.8-15.2)	14.1	2.5	13.6	(12.2-15.7)
Polyunsaturated fat (%E)	5.5	1.3	5.3	(4.5-6.3)	5.7	1.3	5.6	(4.8-6.3)
Carbohydrate (%E)	50.2	5.4	50.2	(46.6-53.9)	49.8	5.4	50	(46.6-53.3)
Total sugars (%E)	19.4	5.0	18.9	(16.0-22.6)	18.2	4.7	18.4	(15.2-21.0)
Free sugars (%E)	9.9	4.7	9.3	(6.5-12.3)	10.2	4.4	10	(6.9-12.9)
Dietary fibre (g/10MJ)	23.1	6.0	22.4	(19.2-26.1)	22	5.6	21.7	(18.2-25.7)
Sodium (mg/10MJ)	2640	531	2624	(2238-2976)	2702	553	2660	(2315-3064)
Vitamin D (µg/10MJ)	5.7	3.6	4.9	(3.3-6.9)	5.1	4.3	3.7	(2.4-6.4)
DFE (µg/10MJ)	394	172	360	(282-479)	367	156	340	(2682-422)
Calcium (mg/10MJ)	1310	375	1281	(1053-1512)	1187*	334	1141	(937-1388)
Iron (mg/10MJ)	14.1	3.8	13.4	(11.3-16.2)	13.9	3.5	13.4	(11.3-15.8)

%E: percentage of total energy

DFE: Dietary Folate Equivalents

* Statistically different ($P < 0.001$) from that of 5-8 year olds within the rows via Independent Samples T Test and adjusted for multiple testing

Table 3 Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in children aged 5-12 years (*n* 600), by social class group

	Professional workers (n=397)				Non-manual workers (n=102)				Skilled manual workers (n=54)				Semi-skilled/unskilled workers (n=43)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P12-P75)
Energy (kcal)	1485	332	1458	(1241-1672)	1553	414	1497	(1281-1796)	1542	417	1447	(1313-1830)	1435	317	1433	(1235-1605)
Energy (MJ)	6.2	1.4	6.1	(5.2-7.0)	6.5	1.7	6.3	(5.4-7.6)	6.5	1.7	6.1	(5.5-7.7)	6.0	1.3	6.0	(5.2-6.8)
Protein (%E)	16.0	2.9	15.6	(13.9-17.6)	15.6	2.6	15.6	(14.0-17.7)	15.5	2.5	15.3	(14.0-16.7)	16.1	2.5	16.1	(14.3-17.0)
Total fat (%E)	33.6	5.1	33.5	(30.1-37.0)	33.8	5.1	33.2	(30.2-37.5)	32.8	5.0	32.1	(29.1-37.1)	33.7	4.5	33.3	(31.1-37.0)
Saturated fat (%E)	14.2	2.8	14.1	(12.3-16.0)	14.0	2.9	14.0	(12.0-15.9)	13.5	2.4	13.3	(11.9-15.3)	13.6	2.6	13.7	(12.2-15.3)
Monounsaturated fat (%E)	13.7	2.5	13.6	(12.0-15.3)	14.0	2.6	13.7	(12.5-15.6)	13.7	2.5	13.4	(11.6-15.4)	14.3	2.2	14.0	(13.0-15.8)
Polyunsaturated fat (%E)	5.6	1.4	5.5	(4.7-6.3)	5.6	1.2	5.5	(4.7-6.4)	5.5	1.3	5.3	(4.5-6.1)	5.7	1.2	5.5	(4.8-6.3)
Carbohydrate (%E)	49.8	5.5	50.0	(46.6-53.7)	50.0	5.1	50.3	(46.3-53.1)	51.2	5.6	52.2	(46.7-55.1)	49.6	4.5	49.5	(46.4-52.5)
Total sugars (%E)	18.8	4.8	18.7	(15.4-21.8)	19.1	5.2	18.8	(16.0-22.4)	19.7	5.1	19.5	(16.7-23.1)	17.7	4.4	17.4	(14.6-20.3)
Free sugars (%E)	9.7	4.3	9.2	(6.5-12.2)	10.9	5.2	9.8	(6.9-14.0)	11.9	4.6	11.4	(9.4-13.8)	9.5	3.8	9.6	(6.4-12.0)
Dietary fibre (g/10MJ)	23.3	5.4	23.0 ^a	(19.5-26.5)	21.3	6.4	20.1 ^b	(16.8-24.9)	20.4	6.7	19.5 ^b	(15.2-23.0)	21.2	5.1	21.2 ^{ab}	(17.7-23.4)
Sodium (mg/10MJ)	2631	522	2594	(2254-2975)	2698	566	2692	(2211-3118)	2809	655	2785	(2393-3165)	2785	495	2756	(2434-3083)
Vitamin D (µg/10MJ)	5.5	4.1	4.4	(2.8-6.8)	5.3	3.8	4.6	(3.1-6.3)	5.2	3.6	4.1	(2.8-6.3)	5.6	3.4	5.1	(2.9-7.6)
Folate (DFE) (µg/10MJ)	385	158	357	(279-464)	378	200	325	(263-416)	365	146	337	(270-439)	366	141	363	(2512-423)
Calcium (mg/10MJ)	1262	377	1199	(1016-1462)	1235	333	1233	(986-1417)	1211	289	1184	(990-1419)	1210	348	1213	(906-1523)
Iron (mg/10MJ)	14.0	3.6	13.4	(11.3-15.8)	13.5	3.8	13.0	(10.9-15.7)	14.1	3.7	13.4	(11.4-16.2)	14.6	3.8	14.2	(12.2-17.4)

Excludes 4 missing values where information on social class was not obtained from participants

%E: percentage of total energy

DFE: Dietary Folate Equivalents

Statistical differences ($P < 0.01$) between social class groups are denoted by different superscript lowercase letters

Table 4 Mean daily intake of energy and nutrients (%E or /10MJ) in children aged 5-12 years (*n* 600), by parental education group

	Primary and intermediate (n=37)				Secondary (n=44)				Tertiary (n=516)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
Energy (kcal)	1452	322	1423	(1314-1640)	1571	355	1519	(1343-1777)	1494	358	1463	(1244-1694)
Energy (MJ)	6.1	1.4	6.0	(5.5-6.9)	6.6	1.5	6.4	(5.7-7.5)	6.3	1.5	6.2	(5.2-7.1)
Protein (%E)	15.7	2.6	15.3	(14.1-17.9)	15.2	2.4	15.4	(14.0-16.6)	16.0	2.9	15.7	(14.0-17.5)
Total fat (%E)	33.3	4.8	32.7	(29.1-38.3)	33.5	4.2	33.1	(31.0-35.6)	33.6	5.1	33.4	(30.0-37.0)
Saturated fat (%E)	13.5	2.4	13.8	(12.2-15.3)	13.6	2.5	13.4	(11.6-15.6)	14.1	2.8	14.1	(12.2-16.0)
Monounsaturated fat (%E)	14.1	2.3	13.8	(12.2-15.8)	14.1	2.4	13.6	(12.3-15.8)	13.8	2.5	13.6	(12.0-15.3)
Polyunsaturated fat (%E)	5.4	1.0	5.3	(4.7-6.1)	5.6	1.1	5.5	(4.6-6.4)	5.6	1.3	5.4	(4.7-6.3)
Carbohydrate (%E)	50.7	4.7	51.0	(46.7-54.6)	50.7	4.2	50.6	(48.1-53.9)	49.9	5.5	50.0	(46.5-53.7)
Total sugars (%E)	19.2	5.2	18.9	(14.9-23.1)	19.7	5.3	19.1	(16.6-21.9)	18.7	4.8	18.5	(15.5-21.7)
Free sugars (%E)	11.2	4.6	10.3	(8.5-13.4)	11.3	4.5	11.0	(7.7-13.2)	9.9	4.5	9.4	(6.6-12.6)
Dietary fibre (g/10MJ)	19.6	3.9	19.6 ^a	(17.2-21.8)	20.9	5.1	20.3 ^{ab}	(17.1-23.4)	22.9	5.8	22.7 ^b	(18.9-26.2)
Sodium (mg/10MJ)	2769	611	2767	(2268-3238)	2729	522	2699	(2355-3204)	2655	533	2614	(2257-3010)
Vitamin D (µg/10MJ)	5.3	3.5	4.7	(2.7-5.9)	4.9	3.0	4.1	(2.8-6.7)	5.4	4.1	4.4	(2.8-6.7)
DFE (µg/10MJ)	352	150	324	(229-444)	355	116	359	(291-387)	383	167	348	(276-459)
Calcium (mg/10MJ)	1233	362	1145	(911-1488)	1197	326	1174	(893-1468)	1253	362	1210	(1012-1439)
Iron (mg/10MJ)	13.3	3.6	12.5	(10.8-15.9)	13.9	2.8	13.5	(11.8-15.9)	14.0	3.7	13.4	(11.2-16.1)

Excludes 3 missing values where information on parental education was not obtained from participants

%E: percentage of total energy

DFE: Dietary Folate Equivalents

Statistical differences ($P < 0.01$) between education level groups are denoted by different superscript lowercase letters

Table 5 Mean daily intake of energy and nutrients (% E or /10MJ) from food sources only in children aged 5-12 years (*n* 600), by BMI classification

	Healthy weight (<i>n</i> =474)				Overweight/obese (<i>n</i> =89)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
Energy (kcal)	1508	354	1476	(1254-1692)	1453	366	1448	(1204-1686)
Energy (MJ)	6.3	1.5	6.2	(5.3-7.1)	6.1	1.5	6.1	(5.1-7.1)
Protein (%E)	15.8	2.7	15.6	(14.0-17.3)	16.7	3.5	16.5	(14.3-18.3)
Total fat (%E)	33.7	5.1	33.5	(30.1-37.1)	32.6	5.1	32.0	(29.0-36.1)
Saturated fat (%E)	14.2	2.8	14.1	(12.3-16.0)	13.1	2.7	13.1	(11.0-14.9)
Monounsaturated fat (%E)	13.8	2.5	13.6	(12.0-15.4)	13.6	2.5	13.2	(11.9-15.2)
Polyunsaturated fat (%E)	5.5	1.3	5.4	(4.7-6.3)	5.7	1.4	5.5	(4.7-6.3)
Carbohydrate (%E)	50.0	5.4	50.2	(46.6-53.9)	50.3	5.8	50.2	(46.3-54.3)
Total sugars (%E)	19.0	4.8	19.0	(15.7-22.0)	18.1	5.3	18.1	(14.4-21.3)
Free sugars (%E)	10.2	4.5	9.8	(7.0-12.7)	9.5	4.7	8.9	(5.9-11.8)
Dietary fibre (g/10MJ)	22.6	5.9	22.1	(18.5-25.7)	22.8	5.6	21.9	(19.0-26.2)
Sodium (mg/10MJ)	2671	544	2626	(2286-3032)	2772	547	2761	(2323-3114)
Vitamin D (µg/10MJ)	5.5	4.2	4.3	(2.8-6.6)	4.9	3.1	4.5	(2.5-6.7)
Folate (DFE) (µg/10MJ)	384	169	352	(275-459)	373	160	340	(266-459)
Calcium (mg/10MJ)	1261	370	1208	(1012-1463)	1204	319	1183	(938-1431)
Iron (mg/10MJ)	14.1	3.7	13.4	(11.3-16.1)	14.0	3.7	13.5	(11.3-16.4)

Excludes 37 participants where anthropometric measurements were not obtained from the participant (*n* 4), or where the participant's BMI indicated thinness (*n* 33). 'Overweight/obese' includes 64 participants classified as having overweight and 25 participants classified as having obesity.

%E: percentage of total energy

DFE: Dietary Folate Equivalents

* Statistically different ($P < 0.001$) from that of children classified as having a healthy BMI within the rows via Mann Whitney U Test and adjusted for multiple testing

Table 6 Mean daily intake of food groups (g/10MJ) in children aged 5-12 years (n 600) in the total population and by sex

	All (n=600)				Boys (n=300)				Girls (n=300)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
	g/10MJ				g/10MJ				g/10MJ			
Total Bread	136	65.2	129	(89.8-174)	140	70.8	134	(90.5-175)	132	58.9	127	(89.4-173)
<i>of which</i>												
White Bread	82.0	62.4	74.5	(33.6-119)	86.3	68.5	75.6	(33.2-123)	77.7	55.5	71	(34.4-114)
Wholemeal & brown bread	43.2†	56.9	20.5	(0.00-69.6)	44.1	58.7	21.6	(0.00-68.8)	42.4	55.1	20.1	(0.00-71.9)
Breakfast cereals	87.9	87.4	62.4	(31.1-113)	94.2	92.3	67.7	(33.7-119)	81.6	82	58.5	(26.9-107)
<i>of which</i>												
Ready-to-eat breakfast cereals	44.2	35.6	39.6	(15.8-66.2)	45.1	36.1	39.4	(16.3-67.9)	43.4	35.2	40	(15.2-64.3)
<i>high-fibre cereals (≥6g/100g)</i>	25.3	31.3	14.7	(0.00-39.7)	25.3	30.5	15.3	(0.00-39.3)	25.2	32.2	13.1	(0.00-40.6)
<i>low-fibre cereals (<6g/100g)</i>	19.0†	26.9	6.7	(0.00-31.2)	19.8	28.9	0.17	(0.00-31.4)	18.2	24.8	8.1	(0.00-30.3)
Porridge & hot oats cereals (made up)	43.6	85.6	0.00	(0.00-58.3)	49.1	93.5	0.00	(0.00-61.9)	38.2	76.7	0.00	(0.00-52.1)
Potatoes & potato products	96.0	73.1	83.9	(41.5501-140)	98.4	72.5	87.2	(42.4-142)	93.6	73.7	81.4	(40.1-138)
<i>of which</i>												
Boiled, baked & mashed potatoes	50.0	57.4	36.6	(0.00-81.3)	51.1	58.9	39.9	(0.00-77.4)	48.8	55.9	33.0	(0.00-82.1)
Chipped, fried, roasted, processed & homemade potato products	46.0	51.7	33.4	(0.00-64.4)	47.2	50.7	36.9	(0.00-68.1)	44.8	52.8	31.6	(0.00-63.5)
Total Milk	292	228	253	(125-429)	313	221	276	(153-452)	271	233	221	(94.8-407)
<i>of which</i>												
Whole milk	201	228	147	(0.00-323)	217	225	173	(0.00-343)	186	229	98.1	(0.00-288)
Reduced fat milk	86.9†	174	0.00	(0.00-96.4)	92.9	179	0.00	(0.00-125)	80.8	169	0.00	(0.00-83.8)
Non-dairy alternatives	3.8	28.5	0.00	(0.00-0.00)	2.9	19.7	0.00	(0.00-0.00)	4.7	35.2	0.00	(0.00-0.00)
Total meat	181	101	171	(113-231)	188	108	172	(113-242)	174	93.3	169	(110-220)
<i>of which</i>												
Meat dishes	74.8	91.3	49.4	(0.00-117)	76.9	98.1	45.8	(0.00-123)	72.8	84.0	50.6	(0.00-110)
Fresh meat	43.9	47.5	33.0	(0.00-66.2)	47.6	51.0	37.1	(9.0-69.3)	40.3	43.5	29.1	(0.00-63.0)
Processed meat	62.2†	49.1	53.6	(23.7-92.0)	63.1	47.6	54.7	(26.1-89.6)	61.2	50.6	50.8	(22.9-94.3)
Total fruit and vegetables	336	212	305	(189-447)	327	217	286	(180-438)	345	206	311	(207-457)
Total Fruit	256	193	222	(119-341)	250	199	212	(116-334)	262	188	235	(125-348)
<i>of which</i>												
Discrete fruit	178	138	150	(78.2-245)	175	140	141	(75.4-246)	181	136	158	(82.8-242)
Fruit juices & smoothies	78.8	138	0.00	(0.00-124)	75.8	144	0.00	(0.00-113)	81.9	132	0.00	(0.00-140)
Total vegetables	79.8	79.6	60.6	(23.3-113)	76.6	75.1	59.6	(21.1-112)	82.9	83.9	61.6	(24.2-116)
<i>of which</i>												
Discrete vegetables	70.6	65.8	54.9	(20.1-104)	68.1	62.1	51.4	(17.8-102)	73.1	69.4	55.7	(22.4-106)
Vegetable dishes	9.2	35.9	0.00	(0.00-0.00)	8.5	36.8	0.00	(0.00-0.00)	9.8	35.1	0.00	(0.00-0.00)
Total confectionery/snacks	121	66.5	108	(72.9-162)	116	67.3	105	(68.2-151)	125	65.5	115	(76.1-167)

<i>of which</i>												
Biscuits, crackers, cakes, pastries, buns & desserts	71.3	54.6	62.5	(31.4-98.1)	68.3	56.0	55.1	(28.6-95.5)	74.3	53.1	66.8	(34.9-103)
Chocolate, sweets, savoury snacks, sugars & preserves	45.8	37.9	38.9	(18.7-61.8)	44.9	35.9	38.2	(18.9-61.2)	46.7	39.7	39.2	(17.8-63.2)
Cereal bars	3.5	10.3	0.00	(0.00-0.00)	2.7	9.9	0.00	(0.00-0.00)	4.3	10.6	0	(0.00-0.00)
Water consumed as a beverage	872	493	798	(532-1104)	886	516	810	(531-1119)	857	470	790	(5341-1091)
Soft drinks (added sugar)	61.3	117	0.00	(0-87.5)	63.6	108	0.00	(0.00-101)	59.0	125	0.00	(0.00-74.9)
Soft Drinks (no added sugar)	45.5	97.9	0.00	(0-52.5)	54.8	109	0.00	(0.00-64.0)	36.2	84.5	0.00	(0.00-30.6)

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products;
†Statistically different from that of previous value in the same column via independent T Test and adjusted for multiple testing
No statistical differences (P<0.001) in intakes were noted between boys and girls

Table 7 Mean daily intake of food groups (g/10MJ) in children aged 5-12 years (n 600), by age group

	5-8 years (n=300)				9-12 years (n=300)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
	g/10MJ				g/10MJ			
Total Bread	136	63.6	132	(90.3-176)	136	66.8	127	(89.3-171)
of which								
White Bread	76.5	61.5	66.2	(28.5-113)	87.4	63.1	80.0	(41.0-122)
Wholemeal & brown bread	46.4	55.0	27.0	(0.00-74.0)	40.0	58.6	6.1	(0.00-65.6)
Breakfast cereals	98.0	96.4	71.6	(33.8-121)	77.8	76.2	55.4	(26.5-105)
of which								
Ready-to-eat breakfast cereals	43.3	34.3	38.2	(166-65.6)	45.2	36.9	41.4	(15.2-66.6)
<i>high-fibre cereals ($\geq 6\text{g}/100\text{g}$)</i>	26.1	31.6	16.2	(0.00-39.6)	24.5	31.0	13.9	(0.00-39.7)
<i>low-fibre cereals ($< 6\text{g}/100\text{g}$)</i>	17.2	24.8	6.9	(0.00-28.9)	20.7	28.8	6.5	(0.00-36.4)
Porridge & hot oats cereals (made up)	54.7	96.8	0.00	(0.00-80.8)	32.6	71.1	0.00	(0.00-0.00)
Potatoes & potato products	95.8	70.8	84.2	(42.9-133)	96.2	75.3	83.6	(40.9-148)
of which								
Boiled, baked & mashed potatoes	51.4	57.9	36.5	(0.00-82.9)	48.5	57	37.4	(0.00-76.6)
Chipped, fried, roasted, processed & homemade potato products	44.4	51.3	30.1	(0.00-63.6)	47.7	52.2	37.4	(0.00-67.3)
Total Milk	304	231	255	(137-468)	280	225	248	(109-411)
of which								
Whole milk	223	241	174	(0.00-345)	180	212	109	(0.00-288)
Reduced fat milk	76.4	158	0.00	(0.00-63.3)	97.4	189	0.00	(0.00-122)
Non-dairy alternatives	4.7	28.4	0.00	(0.00-0.00)	2.9	28.7	0.00	(0.00-0.00)
Total meat	169	96.8	160	(105-223)	192	104	176	(118-247)
of which								
Meat dishes	71.3	87.9	53.7	(0.00-113)	78.3	94.6	43.9	(0.00-127)
Fresh meat	37.1	39.8	28.8	(0.00-59.9)	50.8*	53.3	37.1	(12.7-72.3)
Processed meat	60.9	45.9	51.2	(24.6-92.5)	63.4	52.1	54.7	(22.7-90.7)
Total fruit and vegetables	355	226	309	(208-455)	317	194	293	(174-435)
Total Fruit	276	207	238	(134-360)	237	176	207	(109-338)
of which								
Discrete fruit	197	147	165	(93.5-261)	158*	125	136	(65.3-229)
Fruit juices & smoothies	78.9	151	0.00	(0.00-123)	78.8	124	0.00	(0.00-124)
Total vegetables	79.6	72.9	61.7	(27.4-111)	79.9	85.9	55.5	(17.3-118)
of which								
Discrete vegetables	71.4	61.3	58.6	(25.3-103)	69.8	70.2	50.5	(16.1-105)
Vegetable dishes	8.2	31.9	0.00	(0.00-0.00)	10.1	39.6	0.00	(0.00-0.00)
Total confectionery/snacks	124	69.6	114	(72.1-167)	117	63.1	107	(73.9-150)
of which								

Biscuits, crackers, cakes, pastries, buns & desserts	77.0	57.3	66.9	(33.0-107)	65.6	51.3	56.7	(29.9-91.3)
Chocolate, sweets, savoury snacks, sugars & preserves	44.2	39.1	37.6	(15.8-57.3)	47.3	36.6	40.8	(21.7-65.3)
Cereal bars	3	8.5	0.00	(0.00-0.00)	4.1	11.9	0.00	(0.00-0.00)
Water consumed as a beverage	830	513	737	(500-1044)	914	470	883	(570-1156)
Soft drinks (added sugar)	42.0	86.2	0.00	(0.00-50.7)	80.6*	138	0.00	(0.00-130)
Soft drinks (no added sugar)	56.2	115	7.5	(7.5-64.1)	34.9	75.3	0.00	(0.00-32.6)

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

* Statistically different ($P < 0.001$) from that of 5-8year olds within the rows via Independent Samples T Test and adjusted for multiple testing

Table 8 Mean daily intake of food groups (g/10MJ) in children aged 5-12 years (n 600), by social class

	Professional workers (n=397)				Non-manual workers (n=102)				Skilled manual workers (n=54)				Semi-skilled/unskilled workers (n=43)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
	g/10 MJ				g/10 MJ				g/10 MJ				g/10 MJ			
Total Bread	137	63.1	130	(89.8-175)	134	76.2	119	(85.2-170)	132	65.5	135	(84.4-170)	137	53.8	136	(104-171)
<i>of which</i>																
White Bread	77	61.9	69.6	(29.5-112)	82.4	60.6	67.3	(41.8-124)	102	64.0	93.1	(63.5-136)	94.7	61.0	93.5	(38.1-142)
Wholemeal & brown bread	48.3	55.7	33.8 ^a	(0.00-78.7)	42.0	68.9	0.00 ^{ab}	(0.00-52.7)	15.2	36.0	0.00 ^b	(0.00-20.4)	36.7	48.4	0.00 ^{ab}	(0.00-82.3)
Breakfast cereals	93.5	95.0	64	(32.2-116)	84.0	75.5	70.1	(26.5-119)	58.9	46.0	54.4	(27.8-73.4)	85.5	75.5	65.7	(40.9-110)
<i>of which</i>																
Ready-to-eat breakfast cereals	42.8	34.5	38.8	(14.7-64.2)	45.4	40.7	35.0	(16.0-69.2)	46.9	33.1	41.3	(16.8-64.7)	51.4	34.4	44.1	(24.0-75.0)
<i>high-fibre cereals</i>																
($\geq 6\text{g}/100\text{g}$)	26.2	30.9	16.1	(0.00-40.7)	23.1	33.2	5.7	(0.00-39.2)	23.8	27.7	15.0	(0.00-38.1)	23.2	32.7	0.00	(0.00-42.0)
<i>low-fibre cereals</i>																
($< 6\text{g}/100\text{g}$)	16.7	25	0	(0.00-29.1)	22.3	31.1	10.7	(0.00-35.0)	23.1	28.7	16.2	(0.00-36.1)	28.2	28.6	24.0	(0.00-43.3)
Porridge & hot oats cereals (made up)	50.7	93.4	0	(0.00-68.5)	38.7	75.2	0.00	(0.00-62.7)	12.0	38.1	0.00	(0.00-0.00)	34.1	68.4	0.00	(0.00-65.7)
Potatoes & potato products	95.6	74.4	82.2	(41.2-138)	94.9	62.9	90.3	(43.6-131)	98.7	67.0	84.8	(46.3-149)	91.1	82.7	61.7	(26.0-160)
<i>of which</i>																
Boiled, baked & mashed potatoes	48.6	56.5	35.7	(0.00-73.4)	50.0	58.1	34.2	(0.00-88.4)	59.7	64.3	49.1	(0.00-84.4)	50.1	57.3	24.1	(0.00-87.9)
Chipped, fried, roasted, processed & homemade potato products	47.0	52.5	35.9	(0.00-67.3)	44.9	45.9	32.3	(7.6-64.1)	38.9	34.2	32.8	(0.00-63.1)	41.0	55.3	26.0	(0.00-58.7)
Total Milk	294	234	250	(130-432)	309	235	277	(131-462)	260	207	226	(87.8-398)	279	183	246	(126-449)
<i>of which</i>																
Whole milk	192	228	134	(0.00-310)	232	246	170	(0.00-365)	207	217	159	(0.00-366)	214	201	162	(0.00-380)
Reduced fat milk	98.9	189.1	0.00	(0.00-121)	71.1	155	0.00	(0.00-3.4)	45.6	109	0.00	(0.00-15.6)	62.2	122	0.00	(0.00-97.0)
Non-dairy alternatives	3.0	24.1	0.00	(0.00-0.00)	5.4	41.9	0.00	(0.00-0.00)	7.6	35.2	0.00	(0.00-0.00)	2.6	17.0	0.00	(0.00-0.00)
Total meat	175	95.7	168	(104-227)	178	86.9	170	(116-229)	199	137	178	(121-243)	223	119	191	(131-258)
<i>of which</i>																
Meat dishes	75.9	83.3	59.0	(0.00-119)	61.2	74.1	29.6	(0.00-119)	78.1	142	32.3	(0.00-107)	99.0	115	66.9	(0.00-127)
Fresh meat	43.1	49.1	31.6	(0.00-64.0)	44.2	45.2	35.3	(0.00-70.0)	51.1	45.4	42.2	(17.8-75.8)	43.9	41.6	37.4	(0.00-71.5)
Processed meat	56.2	43.8	49.2	(20.6-82.0)	72.4	58.7	58.0	(29.3-106)	70.1	57.8	57.3	(24.2-109)	80.3	50.1	71.9	(41.9-119)
Total fruit and vegetables	349	206	313	(206-467)	316	235	285	(171-427)	310	212	308	(155-424)	301	207	262	(163-367)
Total Fruit	265	186	234	(133-348)	242	227	192	(108-313)	241	206	210	(83.2-371)	230	166	193	(95.7-319)
<i>of which</i>																

Discrete fruit	186	141	155	(86.7-251)	146	109	135	(68.0-222)	170	164	125	(45.4-249)	182	135	162	(85.4-250)
Fruit juices & smoothies	79.1	128	0	(0.00-132)	95.6	198	0.00	(0.00-122)	70.4	102	3.0	(0.00-111)	48.1	82.3	0.00	(0.00-92.7)
Total vegetables	84.0	81.3	61.8	(27.0-122)	74.3	73.8	60.1	(22.5-97.7)	69.6	80.9	49.3	(10.5-100)	71.0	76.8	43.6	(13.1-113)
<i>of which</i>																
Discrete vegetables	74.2	67.5	56.1	(23.9-111)	66.0	60.7	53.3	(22.1-91.6)	63.7	71.4	42.1	(7.9-100)	61.6	54.8	43.6	(13.1-104)
Vegetable dishes	9.9	37.6	0.00	(0.00-0.00)	8.4	36.1	0.00	(0.00-0.00)	5.9	23.1	0.00	(0.00-0.00)	9.4	35.2	0.00	(0.00-0.00)
Total confectionery/snacks	121	65.3	112	(74.1-161)	122	69.8	113	(74.8-175)	127	74.1	108	(76.0-170)	101	52.1	90.3	(55.6-141)
<i>of which</i>																
Biscuits, crackers, cakes, pastries, buns & desserts	73.3	53.2	65.4	(34.9-104)	71.7	56.5	65	(26.8-98.6)	71.3	65.7	60.8	(35.0-89.3)	48.3	34.6	41.5	(22.4-64.9)
Chocolate, sweets, savoury snacks, sugars & preserves	44.8	38	38	(17.9-59.2)	44.0	34.8	36.3	(16.5-61.9)	54	43.3	47.7	(23.9-72.0)	49.9	37.4	38.3	(23.5-77.2)
Cereal bars	3.1	9.1	0.00	(0.00-0.00)	6.6	16.1	0.00	(0.00-8.9)	1.9	5.4	0.00	(0.00-0.00)	2.2	5.8	0.00	(0.00-0.00)
Water consumed as a beverage	875	490	836	(542-1112)	859	490	778	(528-1116)	820	538	693	(424-1060)	940	475	857	(700-1036)
Soft drinks (added sugar)	43.5	84	0.00 ^a	(0.00-64.5)	91.5	145	0.00 ^{ab}	(0.00-143)	135	212	66.7 ^b	(66.7-222)	59.2	80.7	0.00 ^{ab}	(0.00-119)
Soft drinks (no added sugar)	38.6	77.2	0.00	(0.00-43.6)	56.7	110	0.00	(0.00-72.5)	37.1	66.0	0.00	(0.00-47.7)	96.2	206	16.7	(16.7-103)

Excludes 4 missing values where information on social class was not obtained from participants

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

Statistical differences (P < 0.001) between social class groups are denoted by different superscript lowercase letters

Table 9 Mean daily intake of food groups (g/10MJ) in children aged 5-12 years (n 600), by parental education level

	Primary and intermediate (n=37)				Secondary (n=44)				Tertiary (n=516)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
	g/10 MJ				g/10 MJ				g/10 MJ			
Total Bread	136	62.5	130	(94.3-172)	142	62.7	135	(108-175)	136	65.8	129	(87.6-174)
<i>of which</i>												
White Bread	120	73.2	124 ^a	(64.2-159)	102	69.2	94.0 ^{ab}	(43.6-128)	77.5	60.0	69.6 ^b	(31.1-113)
Wholemeal & brown bread	10.4	26.2	0.00 ^a	(0.00-0.00)	29.5	45.6	0.00 ^{ab}	(0.00-46.1)	47.0	58.5	25.1 ^b	(0.00-75.0)
Breakfast cereals	48.9	43.3	48.0	(8.1-83.1)	72.6	56.5	54.3	(33.2-109)	92.0	91.3	66.1	(31.7-116)
<i>of which</i>												
Ready-to-eat breakfast cereals	37.9	36.7	34.5	(1.5-54.9)	43.3	29.0	37.4	(29.0-56.6)	44.6	36.0	39.8	(15.6-67.4)
<i>high-fibre cereals (≥6g/100g)</i>	14.4	28.0	0.00	(0.00-15.9)	19.6	25.4	13.6	(0.00-30.0)	26.3	31.6	15.2	(0-41.2852)
<i>low-fibre cereals (<6g/100g)</i>	23.4	31.0	11.0	(0.00-42.5)	23.7	28.6	16.2	(0.00-37.9)	18.2	26.4	0.53	(0-29.4643)
Porridge & hot oats cereals (made up)	11.0	33.7	0.00	(0.00-0.00)	29.2	54.1	0.00	(0.00-60.9)	47.5	89.9	0.00	(0.00-64.6)
Potatoes & potato products	112	91.9	96.8	(41.8-169)	113	81.2	101.3	(35.8-167)	93.5	70.8	82.5	(41.5-134)
<i>of which</i>												
Boiled, baked & mashed potatoes	62.1	70.8	40.2	(0.00-102)	47.3	57.1	26.8	(0.00-83.3)	49.2	56.5	36.2	(0.00-76.9)
Chipped, fried, roasted, processed & homemade potato products	49.7	53.4	41.5	(9.8-63.8)	65.4	68.3	49.8	(26.6-73.7)	44.2	49.8	31.9	(0.00-64.3)
Total Milk	277	202	260	(116-420)	284	190	253	(138-446)	293	233	251	(120-430)
<i>of which</i>												
Whole milk	209	199	186	(46.7-290)	242	205	216	(46.6-365)	197	231	135	(0.00-325)
Reduced fat milk	67.5	130	0.00	(0.00-89.2)	39.1	120	0.00	(0.00-0.00)	91.9	180	0.00	(0.00-116)
Non-dairy alternatives	0.00	0.00	0.00	(0.00-0.00)	3.1	14.6	0.00	(0.00-0.00)	4.2	30.4	0.00	(0.00-0.00)
Total meat	222	135	189	(114-303)	175	60.6	179	(135-209)	178	100	168	(109-232)
<i>of which</i>												
Meat dishes	87.6	127.6	0.00	(0.00-122)	51.9	53.3	45.4	(0.00-88.6)	75.7	90.2	50.7	(0.00-124)
Fresh meat	50.0	43.5	43.2	(0.00-79.3)	45.7	40.2	34.0	(18.3-71.1)	43.6	48.4	32.3	(0.00-64.4)
Processed meat	84.0	58.3	80.1	(41.1-126)	77.8	47.7	80.1	(41.4-118)	58.7	47.2	50.6	(21.8-85.2)
Total fruit and vegetables	286	189	229	(153-429)	343	231	307	(167-465)	340	212	307	(192-448)
Total Fruit	232	181	184	(83.5-381)	269	206	241	(121-361)	258	194	225	(121-339)
<i>of which</i>												
Discrete fruit	158	156	98.8	(38.0-254)	167	116	152	(82.2-223)	180	139	151	(80.7-247)
Fruit juices & smoothies	73.6	113	0.00	(0.00-124)	102	179	11.8	(0.00-159)	77.6	136	0.00	(0.00-123)
Total vegetables	54.2	56.1	37.6	(3.3-81.0)	73.6	65.9	61.5	(25.8-111)	82.4	81.9	61.4	(24.9-118)
<i>of which</i>												
Discrete vegetables	53.1	54.2	37.6	(3.3-81.0)	70.6	63.3	54.0	(25.8-104)	72.1	66.8	55.5	(21.0-107)
Vegetable dishes	1.1	4.6	0.00	(0.00-0.00)	3.1	12.6	0.00	(0.00-0.00)	10.3	38.4	0.00	(0.00-0.00)
Total confectionery/snacks	120	62.2	121	(57.9-177)	118	69.3	103	(63.1-165)	121	66.8	108	(75.6-162)
<i>of which</i>												

Biscuits, crackers, cakes, pastries, buns & desserts	64.0	46.7	62.9	(20.4-105)	71.7	60.8	56.4	(26.7-95.7)	72.0	54.7	63.6	(33.1-100)
Chocolate, sweets, savoury snacks, sugars & preserves	52.5	39.1	42.6	(22.2-76.8)	44.0	32.2	36.3	(14.3-63.8)	45.4	38.3	38.6	(18.5-61.1)
Cereal bars	3.2	8.5	0.00	(0.00-0.00)	2.5	6.0	0.00	(0.00-0.00)	3.6	10.7	0.00	(0.00-0.00)
Water consumed as a beverage	773	416	772	(509-1031)	936	521	855	(521-1064)	875	497	800	(541-1114)
Soft drinks (added sugar)	102	139	45.3	(0.00-176)	87.7	108	55.8	(0.00-153.6)	56.2	115	0.00	(0.00-75.6)
Soft drinks (no added sugar)	69.5	126	4.9	(0.00-64.2)	85.1	195	8.4	(0.00-82.2)	40.6	81.5	0.00	(0.00-48.4)

Excludes 3 missing values where information on parental education was not obtained from participants

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

Statistical differences ($P < 0.001$) between education level groups are denoted by different superscript lowercase letters

Table 10 Mean daily intake of food groups (g/10MJ) in children aged 5-12 years (n 600), by BMI classification

	Healthy weight (n=474)				Overweight/obese (n=89)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
	g/10MJ				g/10MJ			
Total Bread	133	63.3	124	(87.4-169)	150	75.3	141	(99.7-189)
<i>of which</i>								
White Bread	80.0	62.6	70.2	(32.2-117)	91.2	62.5	89.0	(43.2-127)
Wholemeal & brown bread	42.4	55.6	21.4	(0.00-66.8)	48.2	67.0	20.2	(0.00-81.4)
Breakfast cereals	91.7	90.7	65.9	(32.9-116)	67.3	71.8	48.8	(17.3-92.4)
<i>of which</i>								
Ready-to-eat breakfast cereals	45.3	36.6	40.7	(16.4-67.3)	38.4	31.0	36.0	(12.2-59.8)
<i>high-fibre cereals (≥6g/100g)</i>	26.2	32.2	15.2	(0.00-40.6)	19.2	26.0	10.1	(0.00-29.5)
<i>low-fibre cereals (<6g/100g)</i>	19.1	27.6	6.7	(0.00-31.0)	19.1	24.3	6.9	(0.00-39.3)
Porridge & hot oats cereals (made up)	46.4	89.6	0.00	(0.00-60.9)	29.0	64.9	0.00	(0.00-19.6)
Potatoes & potato products	93.2	69.8	82.8	(41.0-130)	108	89.3	84.6	(37.4-167)
<i>of which</i>								
Boiled, baked & mashed potatoes	48.9	57.4	34.0	(0.00-78.8)	57.2	63.6	47.2	(0.00-92.0)
Chipped, fried, roasted, processed & homemade potato products	44.2	47.6	32.4	(0.00-64.2)	50.8	63.4	33.6	(0.00-67.5)
Total Milk	302	230	263	(133-446)	241	211	198	(92.5-337)
<i>of which</i>								
Whole milk	211	231	162	(0.00-335)	133	181	50.8	(0.00-230)
Reduced fat milk	86.7	174	0.00	(0.00-84.8)	104	195	0.00	(0.00-134)
Non-dairy alternatives	4.0	30.2	0.00	(0.00-0.00)	4.5	25.3	0.00	(0.00-0.00)
Total meat	179	99.4	170	(113-227)	200	113	191	(128-280)
<i>of which</i>								
Meat dishes	76.3	91.6	53.6	(0.00-121)	76.4	98.0	46.9	(0.00-114)
Fresh meat	41.8	42.6	32.0	(0.00-64.4)	53.3	69.3	37.0	(0.00-78.6)
Processed meat	61.3	46.8	53.4	(25.7-89.8)	70.4	61.5	60.1	(19.5-105)
Total fruit and vegetables	335	215	298	(186-436)	350	203	327	(200-486)
Total Fruit	256	196	221	(1195-340)	272	196	256	(125-384)
<i>of which</i>								
Discrete fruit	177	139	149	(77.5-245)	183	136	156	(80.3-257)
Fruit juices & smoothies	79.0	140	0.00	(0.00-125)	89.3	147	0.00	(0.00-124)
Total vegetables	78.6	77.6	60.4	(23.0-112)	77.9	79.0	56.1	(14.4-118)
<i>of which</i>								
Discrete vegetables	69.7	64.8	54.2	(20.2-103)	69.6	69.9	48.9	(12.2-108)
Vegetable dishes	8.9	32.5	0.00	(0.00-0.00)	8.3	34.7	0.00	(0.00-0.00)
Total confectionery/snacks	122	64.3	114	(77.1-162)	108	74.3	93.4	(59.2-145)

of which

Biscuits, crackers, cakes, pastries, buns & desserts	72.4	53.2	65.1	(34.5-103)	61.7	61.0	43.4	(17.1-83.3)
Chocolate, sweets, savoury snacks, sugars & preserves	46.5	37.4	40.4	(18.8-62.0)	42.0	38.9	34.5	(17.9-58.8)
Cereal bars	3.3	9.6	0.00	(0.00-0.00)	4.6	14.2	0.00	(0.00-0.00)
Water consumed as a beverage	855	490	795	(516-1087)	963	538	845	(616-1137)
Soft drinks (added sugar and)	57.6	102	0.00	(0.00-81.2)	87.3	184	0.00	(0.00-106)
Soft drinks (no added sugar)	47.5	102	0.00	(0.00-57.5)	33.3	78.8	0.00	(0.00-36.9)

Excludes 37 participants where anthropometric measurements were not obtained from the participant (*n* 4), or where the participant's BMI indicates thinness (*n* 33). 'Overweight/obese'

includes 64 participants classified as having overweight and 25 participants classified as having obesity

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

No statistical differences ($P < 0.001$) were noted between children classified as having a healthy BMI (18.5-24.9 kg/m²) and those classified as having overweight and obesity (>25.0 kg/m²) for intakes of selected food groups

Discussion

The aim of this chapter was to examine the dietary quality of school-aged children in Ireland and to identify any differences in dietary quality between sex, age group, socio-economic status and weight status. The findings of this study will help to inform strategies to improve the diets of school-aged children. Current FBDG in Ireland recommend choosing wholemeal breads, high-fibre breakfast cereals, reduced fat milk and dairy products, lean meat and protein sources and using baking, boiling, stewing and steaming rather than frying (Food Safety Authority of Ireland, 2019). The present study has found that the overall quality of the diet in school aged children needs to be improved as higher intakes of ‘white bread’ were noted compared to ‘wholemeal & brown bread’, ‘whole milk’ compared to ‘reduced fat milk’ and ‘processed meat’ compared to ‘fresh meat’. Both ‘boiled, baked and mashed potatoes’ and ‘chipped, fried, roasted, processed & homemade potato products’ were consumed in similar amounts and ‘soft drinks (added sugar)’, and ‘soft drinks (no added sugar)’ were also consumed in similar amounts to each other. Intakes of ‘high-fibre RTEBC’ were higher than ‘low-fibre RTEBC’ which was a positive finding but overall, the current intakes of food groups among school-aged children in Ireland are not in line with dietary guidelines. There were very few differences in the nutrient and food group intakes across sex, age group, socio-economic status and weight status.

Overall dietary quality and differences between sexes and age groups

Adequate nutrient intakes, particularly for protein, healthy fats, calcium, vitamin D folate and iron are essential for the development of the musculoskeletal system, cell development and growth and cognition in school-aged children (Savarino et al., 2021, European Food Safety Authority 2017, Wagner, 2001, Halterman et al., 2001).

Findings from the NCFS II show that staple foods for children in Ireland included breads, potatoes, milks, meats, fruits, vegetables and breakfast cereals, with practically all children consuming these foods. However, when looking at the breakdown of how these food groups were consumed, food intakes were not in line with current recommendations. Intakes of fruit and vegetables were low at approximately three servings per day, which is well below the recommended 5-7-a-day, 54% of children consumed wholemeal/brown bread, 59% of children consumed high-fibre ready-to-eat cereals and milk was consumed mostly as whole milk (70%) and only 28% as

reduced fat milk (Irish Universities Nutrition Alliance, 2019). In terms of micronutrient intakes, significant proportions of children had inadequate intakes of vitamin D (94%), calcium (37%), iron (20%) and DFE (13%) (Kehoe et al., 2022).

The present study has found that the overall dietary quality of school-aged children in Ireland is unfavourable as dietary patterns show higher intakes of ‘white bread’ compared to ‘wholemeal & brown bread’ (82g/10MJ vs. 43.2g/10MJ, $P < .001$), ‘whole milk’ compared to ‘reduced fat milk’ (201g/10MJ vs. 86.9g/10MJ, $P < .001$) and ‘processed meat’ compared to ‘fresh meat’ (62.2g/10MJ vs. 43.9g/10MJ, $P < .001$) leading to lower intakes of dietary fibre and higher intakes of saturated fat and salt than recommended. Intakes of ‘boiled, baked and mashed potatoes’ were similar to that of ‘chipped, fried, roasted, processed & homemade potato products’ and intakes of ‘soft drinks (added sugar)’ were similar to the ‘soft drinks (no added sugar)’ variety. Interestingly, intakes of ‘high-fibre RTEBC’ were higher than that of ‘low-fibre RTEBC’ (25.3g/10MJ vs. 19.0g/10MJ, $P < .001$) which may be partially attributed to the fact that ‘wheat biscuit’ type cereal (such as Weetabix) were among the most commonly consumed RTEBC and also that over half of the RTEBC consumed had a dietary fibre content of 6g/100g or higher.

FBDG and nutrient recommendations for children aged 5-12 years in Ireland are not differentiated by sex or age group, but rather by activity levels. The notable exceptions to this are for dietary fibre (recommendation is age dependent: age+5g/d), for ‘milk, yogurt and cheese’ (recommendation is 3 servings/day for younger children (5-8y) and 5 servings/day for older children (9-12y)) and for ‘wholemeal cereals and breads, potatoes and rice’ (recommendation is higher for boys (3-5 servings/day) than for girls (3-4 servings/day)) (Food Safety Authority of Ireland, 2011, Food Safety Authority of Ireland, 2019). This study found that boys had a higher MDI of energy than girls (6.7MJ vs. 5.9MJ $P < .001$), however, overall, there were no differences in dietary quality between sexes with no differences in the MDI of any of the nutrients or food groups examined. This is reflected in findings from other surveys across Europe where boys had higher intakes of energy than girls, but there were no differences in the intakes of MUFA, PUFA, free sugar, fibre, sodium, folate, vitamin D, calcium and iron between boys and girls (based on crude calculations of energy-adjusted intakes from data provided) (Elmadfa et al., 2012, Hansen et al., 2015, Pedersen et al., 2015, Van Rossum et al., 2020, Tornaritis et al., 2014, UK Department of Health, 2020,

Turkey Ministry of Health, 2014, Ruiz et al., 2017). There were also no differences in the intakes of food groups between boys and girls, with the exception of Turkey, where compared to girls, boys had a higher MDI of ‘total meat’ (61.2-70.1g/10J vs. 37.6-57.9g/10MJ) and a lower MDI of ‘total fruit and vegetables’ (449-599g/10MJ vs. 555-629g/10MJ) (Pedersen et al., 2015, Van Rossum et al., 2020, Turkey Ministry of Health, 2014).

The available literature suggests that when compared to younger children (6-9y), older children (9-13.9y) generally had higher intakes of energy (7.0-9.2MJ/day vs. 6.3-8.0MJ/day), however, there were no differences in the intakes of saturated fat, MUFA, PUFA, free sugar, dietary fibre, sodium, folate, vitamin D, calcium or iron between age groups (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Turkey Ministry of Health, 2014). The present study is somewhat in keeping with these findings and found that although older children (9-12y) had a higher MDI of energy than younger children (5-8y) (6.8MJ/day vs. 5.8MJ/day, $P < .001$), there were no differences in the intakes of most nutrients. The quality of the diet of younger children was slightly better than that of older children based on their higher intakes of calcium (1310mg/10MJ vs. 1187mg/10MJ, $P < .001$) and ‘discrete fruit’ (197g/10MJ vs. 158g/10MJ, $P < .001$) and lower intakes of ‘soft drinks (added sugar)’ (42.0g/10MJ vs. 80.6g/10MJ, $P < .001$). Younger children did, however, also have a lower MDI of ‘fresh meat’ than older children (37.1g/10MJ vs. 50.8g/10MJ, $P < .001$). Interestingly, when parents were asked about their perceived barriers to providing a healthy diet for their children as part of the NCFS II, a higher proportion of parents of younger children (75%) reported that they found it difficult to provide a healthy diet compared with parents of older children (65%). The main barriers perceived by parents to providing a healthy diet were the child’s likes/dislikes, convenience, other people minding the child and food advertising. These did not differ between older and younger children. These barriers to healthy eating in this age group should be considered by policy makers when implementing any healthy eating initiatives aimed at school-aged children (Irish Universities Nutrition Alliance, 2019). The findings of the present study are similar to those from Belgium and Turkey, where older children (9-13y) had a higher MDI of ‘total meat’ than younger children (6-9y) (57.9-132g/10MJ vs. 37.6-126g/10MJ). Intakes of ‘total fruit’ were higher in younger children in Belgium (173g/10MJ vs. 130g/10MJ) compared to older children, while intakes of ‘total fruit

and vegetables’ were higher in older children than in younger children in Turkey (599-629g/10MJ vs. 449-555g/10MJ) (De Ridder et al., 2016, Turkey Ministry of Health, 2014). In contrast to the findings of the present study, findings from Belgium show that younger children had a higher MDI of ‘total milk’ than older children (358g/10MJ vs. 266g/10MJ) (De Ridder et al., 2016).

Socio-economic status

A systematic review looking at determinants of micronutrient intakes in Europe found that micronutrient intakes were lower in children with a lower socio-economic status (including parental occupation, income and education) (Novaković et al., 2014), however the present study found no clear link between dietary quality and social class. There were no differences in energy intakes across the four social class groups examined. With the exception of dietary fibre, where children whose parents were professional workers had higher intakes compared to those whose parents were non-manual workers (23.3g/10MJ vs. 21.3g/10MJ, $P < .001$) and skilled manual workers (23.3g/10MJ vs. 20.4g/10MJ, $P < .001$), but similar intakes to those whose parents were semi-skilled/unskilled workers, there were no other differences in nutrient intakes between the four social class groups. There were some differences in the MDI of food groups of children belonging to the four social class groups, however, these differences did not show a clear pattern. When compared to children of skilled manual workers, children of professional workers had a higher MDI of ‘wholemeal & brown bread’ (48.3g/10MJ vs. 15.2g/10MJ, $P < .001$) and a lower MDI of ‘soft drinks (added sugar)’ (43.7g/10MJ vs. 135g/10MJ, $P < .001$), however, both were similar to non-manual workers and semi-skilled/unskilled workers. This shows no clear gradient in food groups intakes and social class, however, the differences in intakes of ‘wholemeal & brown bread’ across social class groups could account for the differences in dietary fibre intakes. While a clear link between micronutrient intakes and socio-economic status has been established in the literature (Novaković et al., 2014), there are conflicting findings regarding the link between social class and overall dietary quality. The findings of the present study are consistent with some findings from the literature, where no clear link between social class and dietary quality was found in children aged 1.5-17 years in Canada and in children of Mexican origin in the USA, where socio-economic status was not found to have an influence on fruit and vegetable intakes or

dietary quality scores (Mak et al., 2013, Martin et al., 2015). In contrast to the findings of the present study and notwithstanding differences in choice of indicators of socio-economic status (e.g. parental occupation, income and education), two systematic reviews did, however, establish that dietary quality follows a socio-economic gradient, where a higher socio-economic status is associated with a higher intakes of most vitamins and minerals and fibre, albeit, the association between socio-economic status and the macronutrient composition of the diet was found to be either inconsistent or insignificant, however, these reviews did not exclusively include studies that reported energy-adjusted dietary intakes and they included studies which used less reliable dietary intake data collection methods, such as food frequency questionnaires (Novaković et al., 2014, Darmon and Drewnowski, 2008).

Available studies suggest that parental education may have a higher impact on dietary quality than other indicators of socio-economic status such as household income, with higher parental education being associated with higher dietary quality (Olstad et al., 2021, Golley et al., 2011). This study found no difference in the MDI of energy among the three education level groups examined. Children whose parents had tertiary education had a higher MDI of dietary fibre than those whose parents had primary education only (22.9g/10MJ vs. 19.6g/10MJ, $P < .001$). There were no differences in the MDI of all other nutrients examined across all education levels. The differences in dietary fibre intakes across parental education levels, could be explained by the differences in the type of bread consumed. Children whose parents had tertiary education had a higher MDI of ‘wholemeal & brown bread’ (47.0g/10MJ vs. 10.4g/10MJ, $P < .001$) and a lower MDI of ‘white bread’ (77.5g/10MJ vs. 120g/10MJ, $P < .001$) than children whose parents had primary education only. This is somewhat in agreement with the literature, which found no association between higher parental education and adherence to dietary guidelines for fat (total fat, saturated fat, MUFA and PUFA), dietary fibre, vitamins A, C and B2, calcium, magnesium, phosphorus and sodium, however, higher parental education was associated with adherence to dietary guidelines for iron, as well as vitamins B1 and B6 (Tornaritis et al., 2014). Additionally, higher parental education was associated with higher dietary quality scores which were based on adherence to dietary guidelines for fruit and vegetables, grains, dairy, protein foods, fatty acids, sodium and added sugar (Olstad et al., 2021, Golley et al., 2011).

Findings from the literature suggest that misreporting rates are higher among children with a lower socio-economic status (Rangan et al., 2011, Murakami and Livingstone, 2016). The present study population contains a higher proportion of children with a higher social class and less children with a lower social class than the national average and thus in order to obtain an accurate depiction of the dietary intakes and barriers to healthy eating of children with a lower socio-economic status in Ireland, there is a need for dietary surveillance targeting this specific population subgroup.

Weight status

Findings from the NCFS II have shown that 16% of school-aged children in Ireland have overweight or obesity (O'Donnell et al., 2020). A systematic review examining the link between energy density and adiposity has found moderately strong evidence to suggest that there is a positive association between dietary energy density and increased adiposity in children and adolescents (Pérez-Escamilla et al., 2012). However, this study found no differences in the intakes of energy or nutrients among children classified as having a healthy BMI and children classified as having overweight and obesity, with the exception of saturated fat intake, where children classified as having a healthy BMI had a higher MDI of saturated fat than children classified as having overweight and obesity (14.2%E vs. 13.1%E, $P < .001$). This is not explained by differences in food intake patterns as this study found no differences in the MDI of food groups between children classified as having a healthy BMI and those with overweight/obesity. In agreement with the findings of this study, findings from New Zealand showed that there were no differences in the MDI of macronutrients between children with overweight/obesity and the general population, however, this study has also reported issues with dietary data collection which may have affected the results (Anderson et al., 2016). Finding from two separate studies in Australia showed that children with a higher BMI z-score had higher energy intakes, but no correlations between BMI z-scores and the MDI of macronutrients between children classified as having a healthy BMI and those with overweight/obesity and weak positive associations between dietary quality scores and BMI z-scores (i.e., those with a higher BMI z-score had a better dietary quality score) (Elliott et al., 2011, Golley et al., 2011). Findings from Portugal show an inverse relationship between calcium intakes from food sources and BMI in girls and not in boys (Moreira et al., 2005). As this study found no differences in the dietary quality of boys and girls in

school-aged children in Ireland, it is unlikely that the overall quality of the diet would be influenced greatly by sex when examining the link between dietary quality, BMI and sex. Although the literature suggests that children with overweight/obesity may have higher intakes of certain food groups such sugar-sweetened beverages and lower intakes of milk and fruit juice, this study found no differences in the intakes of any of the selected food groups between children classified as having a healthy BMI and those with overweight/obesity (Grimes et al., 2013, Watowicz et al., 2015). Studies have reported that children classified as having overweight/obesity are more likely to be under-reporters (LioRET et al., 2011, Forrestal, 2011, Rangan et al., 2011). And so it is possible that the lack of differences in dietary quality between children classified as having a healthy BMI and those with overweight/obesity could be due to the higher number of children with overweight ($n = 64$) compared to those with obesity ($n = 25$) included in this study population, resulting in a higher number of participants which are closer to having a healthy BMI.

Strengths and limitations

The strengths of this study include the nationally representative sample of school-aged children included in the NCFS II and the detailed dietary intake data collected at brand level using a 4-day weighed food diary. Another key strength of this study is that the anthropometric measurements used to calculate BMI were taken by a trained research nutritionist in the participant's home rather than the use of self-reported measurements. Limitations of this study includes the smaller proportion of children with a lower social class and a larger proportion of children with a higher social class compared to the Irish population, however, as dietary quality was found to be poor across all demographic characteristics, this does not affect the recommendations made for future healthy eating policies.

Conclusion

In summary, the overall dietary quality among school-aged children in Ireland was found to be unfavourable and only slight differences were seen across sex, age groups, socio-economic status and weight status. Initiatives aimed at improving the dietary quality of children in Ireland – such as taxation of sugar-sweetened beverages and primary school curriculum linked healthy eating campaigns such as ‘Food Dudes’ – have been previously introduced, however, the long term benefits of these initiatives still need to be assessed. There is a need for more policies aimed at improving the dietary quality of children in Ireland, irrespective of sex, age group, socio-economic status and weight status. Examples of these include aggressive food marketing practices, enhanced nutrition education in schools and the improvement of the food supply (reformulation and fortification of staple foods).

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Chapter 4

The association between eating location and dietary quality in school-aged children (5-12y) in Ireland

Introduction

There are currently 340 million children and teenagers living with overweight and obesity worldwide, with 16% of school-aged children (5-12y) in Ireland being classified as having overweight and obesity, according to findings from the recent National Children's Food Survey II (NCFS II) (World Health Organization, 2021, O'Donnell et al., 2020). Moreover, childhood nutrition has been shown to have an influence on diet related diseases such as obesity and cardiovascular disease later in life as eating habits developed during the childhood years are often carried into adulthood (Liberali et al., 2020, Kaikkonen et al., 2014, Eilander, 2016). The National Obesity Policy and Action Plan 'A Healthy Weight for Ireland' has identified the eating environment as an influential factor on a child's eating habits (Healthy Ireland, 2016).

Evidence from the literature has shown that a global increase in the consumption of meals 'outside of the home' across all population groups, including children, is associated with poorer dietary quality (Janssen et al., 2018, Lachat et al., 2012). Findings from the UK National Diet and Nutrition Survey (NDNS) (2008-2014) show that in children aged 4-10 years, approximately a third of eating occasions took place 'outside of the home', mainly at 'school', with small proportions of eating occasions taking place at 'leisure places', 'food outlets' and 'on the go' (Ziauddeen et al., 2018). Findings from Canada show that just under 20% of children consumed food from 'fast food/takeaways' and just over 20% consumed food from 'other out of home locations' (Nishi et al., 2018).

Some demographic characteristics such as sex, age group and socio-economic status may have an influence on the consumption of foods from 'outside of the home' and the food environment (including frequent consumption of 'takeaway' meals) has been shown to potentially have an impact on weight status, however these associations were found to be mixed and inconsistent (Janssen et al., 2018, Adams et al., 2015).

The previous chapter of this thesis has identified that overall, the dietary quality of school-aged children (5-12y) in Ireland was unfavourable. Food choices were not conducive with food based dietary guidelines (FBDG) with higher intakes of 'white bread' being consumed compared to 'wholemeal & brown bread', 'whole milk' compared to 'reduced fat milk' and 'processed meat' compared to 'fresh meat' were

identified. It has also been shown that this population group have low intakes of ‘fruit and vegetables’, while ‘top shelf foods’ contributed to almost a fifth of energy intakes (18%) and the majority of children (67%) consumed ‘soft drinks (with and without added sugar)’. (Irish Universities Nutrition Alliance, 2019). These food choices have resulted in intakes of saturated fat, free sugars and salt which are higher than recommended and intakes of dietary fibre, vitamin D, calcium, iron and folate which are lower than recommended (Kehoe et al., 2022).

Findings from the previous National Children’s Food Survey (NCFS) of children aged 5-12 years in Ireland (2003-04) showed that while over three quarters of children (77%) consumed food from ‘outside of the home’, on average, only 9% of energy came from foods consumed from ‘outside of the home’ (Burke et al., 2007). Furthermore, older children had higher energy intakes from food consumed from ‘outside of the home’, particularly from ‘takeaways’ and ‘shops’ compared to younger children. Additionally, the dietary quality of food consumed from ‘outside of the home’ was found to be poorer than that from ‘home’ in terms of total fat, dietary fibre, calcium, iron, folate and vitamin C (Burke et al., 2007).

The aim of this chapter was to use more recent data from the NCFS II (2017-18) to investigate the association between eating location and dietary quality in school-aged children (5-12y) in Ireland and to identify any differences in dietary quality between sex, age groups, socio-economic status and weight status across different eating locations. A secondary aim of this chapter was to compare these findings to findings from the previous NCFS (2003-04).

Methods

The analyses for this chapter are based on data from the NCFS II. A detailed survey methodology for the NCFS II including sampling, recruitment, data collection, food quantification and nutrient composition is outlined in Chapter 2 and methodology related to dietary quality is outlined in Chapter 3. The methods specific to this chapter are outlined below.

Defining eating location

Chapter 1 has identified that eating location can be defined as the location where a meal was prepared or the location where the meal was consumed. In the context of these analyses, eating location was defined as the location where the food was prepared, irrespective of where it was consumed, which is consistent with the definition previously used in the NCFS (Burke et al., 2007). This information was provided by the participants in the food diary for each individual eating occasion (any instance when any food or beverages were consumed) in response to an open-ended question ‘where was this meal prepared?’. The data provided for this question was then coded into 14 categories by the nutritionist and further categorised and subcategorised for these analyses as described in **Table 1**. The two main categories were ‘home’ and ‘outside the home’ and it is important to note that in the context of the definition used that foods purchased in a takeaway and consumed at home were coded as ‘outside the home’ whereas lunch prepared at home and brought to/consumed at school was coded as ‘home’. ‘Home’ was then further disaggregated into ‘participant’s own home’ and ‘other homes’ and ‘outside of the home’ was further disaggregated into ‘restaurant & coffee shops’, ‘fast-food/takeaways’, ‘shops’, ‘school’ and ‘other’ locations. The eating location ‘shops’ refers to when the participant purchased and consumed food from a local shop rather than the weekly shop purchased for home use.

Table 1 Eating locations categories and subcategories

Location	Location subcategories	Location coding (entered by nutritionist)
Home	Participant's own home	Home
	Other homes	Friend's home Relative/family home Child minder's home
	Restaurants & coffee shops	Restaurant/hotel/public house Coffee shop/sandwich bar/delicatessen
	Fast food/takeaways	Fast food chain Takeaway (ethnic) Takeaway (non-ethnic)
Outside of the home	Shops	Shop bought
	School	School After school centre/homework club
	Other locations	Cinema Social function

Defining dietary quality

In the context of this chapter, ‘dietary quality’ refers to the energy-adjusted intakes of pre-defined food groups and nutrients. The food groups included in this definition include:

- ‘White bread’ v ‘wholemeal & brown bread’
- ‘High-fibre (RTEBC) ($\geq 6\text{g}/100\text{g}$)’ v ‘low-fibre RTEBC ($< 6\text{g}/100\text{g}$)’
- ‘Porridge & hot oat cereals’
- ‘Boiled, baked & mashed potatoes’ v ‘chipped fried, roasted, processed & homemade potato products’
- ‘Whole milk’ v ‘reduced fat milks’
- ‘Fresh meat’ v ‘processed meat’ (products such as bacon, ham, burgers, sausages, meat pies and pastries and other meat products)
- ‘Total fruit & vegetables’
- ‘Total fruit’, including ‘discrete fruit’ and ‘fruit juices & smoothies’
- ‘Total vegetables’, including ‘discrete vegetables’ and ‘vegetable dishes’
- ‘Total confectionery & snacks’, including ‘biscuits, crackers, cakes, pastries, bun & desserts’, ‘chocolate, sweets, savoury snacks, sugars & preserves’ and ‘cereal bars’

- ‘Water consumed as a beverage’
- ‘Soft drinks (added sugar)’ v ‘soft drinks (no added sugar)’

This study also included intakes of the following nutrients in its definition of dietary quality: saturated fat, mono-unsaturated fat (MUFA), poly-unsaturated fat (PUFA), free sugars, dietary fibre, sodium, vitamin D, dietary folate equivalents (DFE), calcium and iron. The rationale behind the selection of these food groups and nutrients is described in detail in Chapter 3.

Defining socio-economic status and weight status

Data on socio-economic status was collected as part of the ‘health and lifestyle questionnaire’ which was completed by the parent(s)/guardian(s) of each participant as part of the NCFS II. Details on how this data was used to define socio-economic status and parental education level are outlined in Chapter 2.

Anthropometric measurements were obtained in the home of the participant by a trained nutritionist. In this study, BMI was used as a marker of weight status. Details on how anthropometric measurements were carried out and how weight status was defined are outlined in Chapter 2.

Data analysis

Data analysis was carried out using SPSS[®] Version 27.0 for Windows (SPSS Inc., Chicago, IL, USA). As the final sample of the NCFS II contained a higher proportion of children of professional workers and a lower proportion of children of semi-skilled and unskilled workers than the national population, a weighting variable was applied when analysing the % contribution to energy intakes in the total population and in consumers only (Table 2). This weighting variable was applied in this analysis as social class was not a variable of interest and was not applied in any other analysis in this chapter. For the present study, data analysis was carried out for those who were consumers of food at a given location, except where stated (as total population). Consumers were defined as those who consumed food at a given location at least once during the four-day recording period. Means and standard deviations, medians and interquartile ranges (IQR) were calculated across different locations for eating occasions over the recording period. The percentage contribution of each location to

mean daily intake (MDI) of energy was calculated for the total population and by consumers at each location. The percentage contribution of each location to MDI of energy was calculated for consumers at that location only was also split by sex, age group, BMI classification, and indicators of socio-economic status (social class and parental education) to see if there were differences across demographic groups. The MDI of energy and energy-adjusted nutrients and food groups was also calculated from each eating location for consumers at each location and by sex, age group, BMI classification, and indicators of socio-economic status.

Statistical analysis

Differences in the contribution (%) of energy at each location to total energy intake in the total population between sexes, age groups and BMI classification in the total population were calculated using Mann-Whitney U Tests. Differences in the contribution (%) of energy at each location to total energy intake in the total population between social class and parental education groups were calculated using a Kruskal-Wallis test to determine overall differences in intakes between groups and post-hoc Mann-Whitney U Tests to identify where these differences occurred.

Differences in the MDI of energy, nutrients and food groups between ‘home’ and ‘outside of the home’ and between ‘participant’s own home’ and ‘other homes’ were calculated using Mann-Whitney U Tests. Differences in the MDI of energy nutrients and foods between multiple locations (e.g., ‘restaurants & coffee shops’, ‘shops’, ‘fast food/takeaways’ and ‘school’) were calculated using Kruskal-Wallis tests to determine overall differences and post-hoc Mann-Whitney U Tests to identify where these differences occurred. The Bonferroni adjustment was used to minimise type 1 errors (as a result of multiple testing) by dividing the alpha level (0.05) by the number of comparisons, thus resulting in a significance value of $P < 0.001$.

Results

Eating location characteristics: percentage of consumers, mean number of eating occasions and contribution to energy intake

Table 2 presents the proportion (%) of children who consumed food that was prepared at ‘home’ and ‘outside of the home’, the number of eating occasions in each location and the percentage contribution of energy from foods consumed ‘at home’ and ‘outside the home’ to total MDI of energy .

During the recording period, all children (100%) consumed food that was prepared at ‘home’ (‘participant’s own home’: 100%, ‘other homes’: 39%) and 73% of children consumed food that was prepared ‘outside of the home’ with 33% of participants consuming food from ‘restaurants & coffee shops’ , 28% consuming food from ‘shops’ 23% consuming food from ‘fast food/takeaways’, 20% consuming food from ‘school’ and 12% consuming food from ‘other locations’. Overall, 91% of eating occasions took place at ‘home’ (‘participant’s own home’: 86%, ‘other homes’: 5%). Nine percent of eating occasions took place ‘outside of the home’ (‘school’: 3%, ‘restaurants & coffee shops’: 2%, ‘shops’: 2%, ‘fast food/takeaways’: 1% and ‘other locations’: <1%).

In the total population, food consumed from ‘home’ contributed 88% to the MDI of total energy intake (‘participant’s own home’: 84%, ‘other homes’: 4%) and food consumed from ‘outside of the home’ contributed 12% to the MDI of total energy intake (‘restaurants & coffee shops’: 4%, ‘fast food/takeaways’: 3% ‘school’: 2%, ‘shops’: 2%, ‘other locations’: <1%).

In consumers only, for each location, food consumed from at ‘home’ contributed 88% to the MDI of total energy intake (‘participant’s own home’: 84%, ‘other homes’: 12%) and food consumed from ‘outside of the home’ contributed 16% to the MDI of total energy intake (‘restaurants & coffee shops’: 11%, ‘fast food/takeaways’: 13%, ‘shops’: 7%, ‘school’: 10% and ‘other locations’: 8%).

Table 3 presents the contribution (%) of food consumed from each eating location to the MDI of total energy split by sex, age group and BMI classification. Overall, the percent energy from food consumed from ‘home’ was higher than that from food consumed from ‘outside of the home’. There were no differences observed in the

percent energy from each eating location between sexes, age groups or BMI classifications, with the exception of percent energy from ‘other homes’, where a higher percent energy was seen in younger children (5-8y) when compared to older children (9-12y) (6% vs. 3%, $P < .001$).

Table 4 presents the contribution (%) of food consumed from each eating location to the MDI of total energy in the total population and split by indicators of socio-economic status (social class and parental education). There were no differences in the contribution (%) of food consumed from each eating location to energy intake between social class groups or between parental education levels, with the exception of ‘fast food/takeaways’ where a higher contribution to the MDI of energy from ‘fast food/takeaways’ was seen in children of parents with primary education only when compared to children of parents with tertiary education (8%E vs. 3%E, $P < .001$).

Mean daily intake of energy and nutrients by eating location

Table 5a presents the MDI of energy and (energy-adjusted) nutrients from food consumed from ‘home’ and ‘outside of the home’ **in consumers at each eating location**. The MDI of energy was higher from food consumed from ‘home’ compared to food consumed from ‘outside of the home’ (1324 kcal vs. 237 kcal, $P < .001$) as was the MDI of dietary fibre (23.4g/10MJ vs. 14.9g/10MJ, $P < .001$), sodium (2672mg/10MJ vs. 2494mg/10MJ), vitamin D (5.9µg/10MJ vs. 0.48µg/10MJ, $P < .001$), folate (408mg/10MJ vs. 45.0mg/10MJ, $P < .001$), calcium (1293mg/10MJ vs. 229mg/10MJ, $P < .001$) and iron (14.7mg/10MJ vs. 2.2mg/10MJ, $P < .001$). The MDI of the following nutrients were lower from food consumed from ‘home’ compared to food consumed from ‘outside of the home’: total fat (33.2%E vs. 36.0%E, $P < .001$), MUFA (13.6%E vs. 15.8%E, $P < .001$) and free sugars (9.5%E vs. 16.9%E, $P < .001$). There were no differences in the MDI of saturated fat, PUFA, carbohydrate and total sugars between food consumed from ‘home’ and that from ‘outside of the home’.

Table 5b presents the MDI of energy and (energy-adjusted) nutrients at the ‘participant’s own home’ and at ‘other homes’ **in consumers at each eating location**. The MDI of energy, was higher from food consumed from the ‘participant’s own home’ compared to food consumed from ‘other homes’(1258 kcal vs. 182 kcal $P < .001$) as was the MDI of protein (16.2%E vs. 14.9%E, $P < .001$), PUFA (5.5%E vs.

5.4%E, $P < .001$), dietary fibre (22.3g/10MJ vs. 20.4g/10MJ, $P < .001$), vitamin D (6.0µg/10MJ vs. 4.5µg/10MJ, $P < .001$), folate (417µg/10MJ vs. 284µg/10MJ), calcium (1311mg/10MJ vs. 946mg/10MJ, $P < .001$) and iron (14.9mg/10MJ vs. 12.mg/10MJ, $P < .001$). The MDI of the following nutrients was lower from food consumed in the ‘participant’s own home’ compared to food consumed from ‘other homes’: total fat (33.1%E vs. 34.7%E, $P < .001$) and MUFA (13.5%E vs. 14.7%E, $P < .001$). There were no differences in the MDI of saturated fat, carbohydrate, total sugars, free sugars or sodium between food consumed from the ‘participant’s own home’ and that from ‘other homes’.

Table 5c presents the MDI of energy and (energy-adjusted) nutrients at four ‘out of home’ locations in **in consumers at each eating location**. Overall, there were no clear differences in energy and nutrient intakes across the different ‘out of home’ locations. The MDI of energy, protein, sodium, vitamin D and folate were lower from food consumed from ‘shops’ when compared to all other ‘out of home’ locations. The MDI of saturated fat was lower from food consumed from ‘school’ than at ‘restaurants & coffee shops’ and ‘shops’. The MDI of total fat and MUFA was lower from food consumed from ‘school’ compared to all other ‘out of home’ locations. The MDI of PUFA was higher from food consumed from ‘restaurants & coffee shops’ and ‘fast food/takeaways’ than from ‘shops’ and ‘school’. The MDI of carbohydrate was higher from food consumed from ‘school’ than at ‘restaurants & coffee shops’ and ‘fast food/takeaways’. The MDI of total sugars and free sugars was higher from food consumed from ‘shops’ compared to all other ‘out of home’ locations. The MDI of dietary fibre, calcium and iron were higher from food consumed from ‘school’ compared to all other ‘out of home’ locations.

Mean daily intake of food groups by eating location

Table 6a presents the energy-adjusted MDI of selected food groups at ‘home’ and ‘outside of the home’ in **in consumers at each eating locations**. The MDI of most food groups was higher from food consumed from ‘home’ than ‘outside of the home’, with the exception of the following food groups, where the MDI from food consumed from ‘outside of the home’ was higher than food consumed from ‘home’: ‘chipped, fried, roasted, processed & homemade potato products’ (95.4g/10MJ vs. 37.6g/10MJ, $P < .001$), ‘processed meat’(86.9g/10MJ vs. 56.7g/10MJ, $P < .001$), ‘biscuits, crackers,

cakes, pastries, buns & desserts’ (88.2g/10MJ vs. 69.3g/10MJ, $P < .001$), ‘water as a beverage’ (903g/10MJ vs. 891g/10MJ, $P < .001$), ‘soft drinks (with added sugar)’ (239g/10MJ vs. 40.7g/10MJ, $P < .001$) and ‘soft drinks (no added sugar)’ (91.0g/10MJ vs. 43.7g/10MJ, $P < .001$). There were no differences in the MDI of ‘chocolate, sweets, savoury snacks, sugars & preserves’ from food consumed from ‘home’ compared to food consumed from ‘outside of the home’.

Table 6b presents the energy-adjusted MDI of selected food groups at the ‘participant’s own home’ and in ‘other homes’ **in consumers at each eating locations**. The MDI of most foods was higher from food consumed from ‘participant’s own home’ with the exception of the following food groups, where the MDI was higher from food consumed from ‘other homes’ than that from food consumed from the ‘participant’s own home’: ‘potatoes and potato products’ (152g/10MJ vs. 88.4g/10MJ, $P < .001$), ‘boiled, baked & mashed potatoes’ (106g/10MJ vs. 51.3g/10MJ, $P < .001$), ‘chipped, fried, roasted processed & homemade potato products’ (45.2g/10MJ vs. 37.1g/10MJ $P < .001$), ‘total meat’ (197g/10MJ vs. 180g/10MJ, $P < .001$), ‘processed meat’ (71.5g/10MJ vs. 55.6g/10MJ, $P < .001$), ‘total vegetables’ (102g/10MJ vs. 85.9g/10MJ, $P < .001$), ‘discrete vegetables’(90.8g/10MJ vs. 76.2g/10MJ, $P < .001$), ‘total confectionery/snacks’ (183g/10MJ vs. 112g/10MJ, $P < .001$), ‘biscuits, crackers, cakes, pastries, buns & desserts’ (99.2g/10MJ vs. 67.6g/10MJ, $P < .001$), ‘chocolate, sweets, savoury snacks, sugars & preserves’ (80.5g/10MJ vs. 38.9g/10MJ, $P < .001$) and ‘soft drinks (no added sugar)’ (86.6g/10MJ vs. 42.2g/10MJ, $P < .001$). There were no differences in the MDI of ‘non-dairy milk alternatives’, ‘vegetable dishes’, and ‘soft drinks (added sugar)’ between food consumed from the ‘participant’s own home’ and food consumed from ‘other homes’.

Table 6c presents the energy-adjusted MDI of selected food groups at each ‘out of home’ eating location: ‘restaurants & coffee shops’, ‘fast food/takeaways’, ‘shops’ and ‘school’ **in consumers at each eating locations**. The MDI of ‘total bread’ and ‘white bread’ was higher from food consumed from ‘school’ than all other locations, while the MDI of ‘wholemeal & brown bread’ was higher from food consumed from ‘school’ than from ‘shops’ and ‘fast food/takeaways’. The MDI of ‘potatoes & potato products’ and ‘chipped, fried, roasted, processed & homemade potato products’ was higher from food consumed from ‘fast food/takeaways’ compared to all other

locations. The MDI of ‘boiled, baked & mashed potatoes’ was higher from food consumed from ‘restaurants & coffee shops’ compared to ‘shops’ and ‘fast food/takeaways’. The MDI of ‘total milk’ and ‘whole milk’ was higher from food consumed from ‘school’ than from ‘restaurants & coffee shops’ and ‘shops’. The MDI of ‘total meat’ and ‘processed meat’ was lower from food consumed from ‘shops’ compared to all other ‘out of home’ locations. The MDI of ‘total fruit & vegetables’, ‘total fruit’ and ‘discrete fruit’ was highest from food consumed from ‘school’ compared to all other ‘out of home’ locations. The MDI of ‘fruit juices & smoothies’ was higher from food consumed from ‘restaurants & coffee shops’ than from ‘school’. The MDI of ‘total vegetables’ and ‘discrete vegetables’ was lower from food consumed from ‘shops’ compared to all other ‘out of home’ locations. The MDI of ‘total confectionery/snacks’ was higher from food consumed from ‘shops’ and lower from ‘fast food/takeaways’ compared to all other ‘out of home’ locations. The MDI of ‘biscuits, crackers, cakes, pastries, buns & desserts’ and ‘chocolate, sweets, savoury snacks, sugars & preserves’ was higher from food consumed from ‘shops’ compared to all other ‘out of home’ locations. The MDI of ‘water consumed as a beverage’ was higher, while the MDI of ‘soft drink (added sugar)’ was lower from food consumed from ‘school’ compared to all other ‘out of home’ locations. The MDI of ‘soft drinks (no added sugar)’ was higher from food consumed from ‘restaurants & coffee shops’ and ‘fast food/takeaways’ than at ‘shops’.

There were no differences in the MDI of ‘breakfast cereals’, ‘reduced fat milk’, ‘non-dairy alternatives’, ‘meat dishes’, ‘fresh meat’, ‘vegetable dishes’ and ‘cereal bars’ between the different ‘out of home’ locations.

These results are summarised in **table 7**.

Table 2 Proportion of consumers, number of eating occasions over the four-day diary period (mean, SD), and the percentage contribution to mean daily energy intake, by eating location*

	<i>n</i>	% Consumers	Number of eating occasions over the 4 days		% Eating occasions	% Eating occasions outside of the home	% Contribution to energy			
			Mean	(SD)			Total population Mean	(SD)	Consumers only Mean	(SD)
All Homes	600	100	17.5	(4.2)	91.0	-	88.2	(11.4)	88.2	(11.4)
<i>Of which</i>										
Participant's own home	600	100	16.6	(4.2)	86.4	-	83.8	(13.5)	83.8	(13.5)
Other homes	234	39.0	2.2	(1.8)	4.6	-	4.4	(8.2)	12.1	(9.0)
Outside of the home	440	73.3	2.4	(1.8)	9.1	-	11.8	(11.4)	16.1	(10.7)
<i>Of which</i>										
Restaurants & coffee shops	195	32.5	1.3	(0.6)	2.2	24.3	3.5	(6.8)	11.2	(7.4)
Shops	166	27.7	1.4	(0.9)	2.0	22.5	1.9	(3.9)	7.0	(4.9)
Fast food/takeaways	138	23.0	1.2	(0.4)	1.4	15.5	3.2	(6.5)	13.2	(6.9)
School	120	20.0	2.7	(1.8)	2.8	30.3	2.2	(5.0)	10.4	(6.7)
Other locations	72.0	12.0	1.1	(0.4)	0.7	7.6	0.9	(3.2)	8.4	(5.5)

*Eating location is defined as the location where the meal was prepared, irrespective of where it was consumed

% Contribution to energy has been weighted for social class in order to account for discrepancies between the social class of the NCFS II population and the national population

Table 3 Percent contribution of food consumed from each eating location to mean daily energy intake, split by sex, age group and BMI classification

	Sex				Age group				BMI			
	Boys (n=300)		Girls (n=300)		5-8y (n=300)		9-12y (n=300)		Healthy weight (n=474)		Overweight/obese (n=89)	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
	%E											
All Homes	89	(10.9)	88.1	(12.0)	88.8	(11.2)	87.7	(11.7)	88.7	(11.4)	86.8	(12.5)
<i>Of which</i>												
Participant's own home	84.5	(13.1)	83.0	(13.9)	82.8	(14.1)	84.7	(12.9)	84	(13.3)	81.6	(15.5)
Other homes	4.5	(8.3)	5.1	(8.1)	6.0	(9.6)	3.0*	(6.1)	4.7	(8.2)	5.2	(8.3)
Outside of the home	11.0	(10.9)	11.9	(12.0)	11.2	(11.2)	12.3	(11.7)	11.3	(11.4)	13.2	(12.5)
<i>Of which</i>												
Restaurants & coffee shops	3.4	(6.8)	3.9	(6.7)	3.5	(6.7)	3.6	(6.9)	3.7	(6.8)	3.5	(6.7)
Shops	1.8	(4.0)	1.9	(3.9)	1.6	(3.5)	2.2	(4.3)	1.9	(4.0)	1.7	(4.1)
Fast food/takeaways	2.6	(5.8)	3.4	(7.0)	2.9	(5.6)	3.6	(7.1)	2.7	(6.0)	5.0	(8.5)
School	2.3	(5.1)	1.7	(4.8)	2.2	(4.9)	2.2	(5.1)	1.9	(4.8)	2.6	(6.4)
Other locations	0.9	(3.2)	1.0	(3.2)	1.0	(3.5)	0.7	(2.9)	1.1	(3.4)	0.3	(1.4)

Excludes 37 participants where anthropometric measurements were not obtained from the participant (*n* 4) or where the participant's BMI indicated thinness (*n* 33).

'Overweight/obese' includes 64 participants classified as having overweight and 25 participants classified as having obesity.

%E percent energy

*Statistically different ($P < 0.001$) from that of 5-8 year olds within the rows via Independent Samples T Test and adjusted for multiple testing, no statistical differences were noted between sexes or BMI classifications

Table 4 Percent contribution of food consumed from each eating location to mean daily energy intake, split by indicators of socio-economic status (social class and parental education)

	Social class								Parental education					
	Professional workers (n=397)		Non-manual workers (n=102)		Skilled manual workers (n=54)		Semi-skilled/unskilled workers (n=43)		Primary/intermediate (n=37)		Secondary (n=44)		Tertiary (n=516)	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
	%E													
All Homes	89.5	(10.7)	87.5	(12.2)	86.5	(12.9)	85.7	(13.1)	82.7	(13.4)	86.8	(12.5)	89.1	(11.1)
<i>Of which</i>														
Participant's own home	84.1	(12.8)	82.9	(14.8)	84.2	(16.0)	82.5	(13.8)	78.3	(15.1)	84.4	(14.3)	84.1	(13.3)
Other homes	5.4	(8.6)	4.7	(8.4)	2.3	(6.6)	3.3	(5.2)	4.4	(8.3)	2.5	(5.1)	5.0	(8.4)
Outside of the home	10.5	(10.7)	12.5	(12.2)	13.5	(12.9)	14.3	(13.1)	17.3	(13.4)	13.2	(12.5)	10.9	(11.1)
<i>Of which</i>														
Restaurants & coffee shops	3.7	(6.8)	4.0	(6.9)	3.8	(7.1)	3.0	(6.0)	3.2	(5.5)	4.0	(7.0)	3.7	(6.9)
Shops	1.7	(3.5)	1.7	(4.1)	2.1	(4.7)	3.0	(6.2)	2.2	(5.5)	1.5	(4.4)	1.8	(3.7)
Fast food/takeaways	2.4	(5.7)	4.2	(7.5)	3.5	(7.0)	4.8	(8.4)	8.0 ^a	(9.2)	4.8 ^{ab}	(8.5)	2.5 ^b	(5.8)
School	1.6	(4.2)	2.1	(5.0)	3.2	(6.3)	3.1	(6.6)	3.4	(6.9)	2.5	(6.1)	1.8	(4.7)
Other locations	1.1	(3.5)	0.5	(2.1)	0.9	(2.9)	0.5	(2.2)	0.6	(2.1)	0.3	(1.5)	1.0	(3.4)

%E Percent energy
Statistical differences (P < 0.001) between parental education levels are denoted by different superscript lowercase letters, no statistical differences were noted between social class groups

Table 5a Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in children aged 5-12 years (*n* 600) at home and outside of the home, in consumers at that location only

	Home (<i>n</i> =600)				Outside of the home (<i>n</i> =440)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR
Energy (kcal)	1324	352	1295	(1095-1521)	237	170	191*	(119-328)
Energy (MJ)	5.6	1.5	5.5	(4.6-6.4)	1.0	0.72	0.80*	(0.50-1.4)
Protein (%E)	16.3	3.1	16.0	(14.2-17.8)	12.1	5.9	12.0*	(7.8-15.3)
Total fat (%E)	33.2	5.4	33.1	(29.4-36.8)	36.0	10.7	36.5*	(30.4-42.7)
Saturated fat (%E)	14.1	3.0	14.0	(12.0-16.1)	14.1	6.6	13.5	(9.7-18.0)
Monounsaturated fat (%E)	13.6	2.6	13.4	(11.7-15.2)	15.8	5.9	15.5*	(12.3-18.9)
Polyunsaturated fat (%E)	5.5	1.4	5.3	(4.4-6.2)	6.0	3.2	5.5	(3.8-7.8)
Carbohydrate (%E)	49.9	5.8	50.1	(46.2-53.9)	50.9	12.3	50.5	(44.3-57.7)
Total sugars (%E)	18.7	5.3	18.2	(15.1-21.8)	22.5	15.9	19.7	(11.5-29.9)
Free sugars (%E)	9.5	4.7	8.9	(6.1-12.1)	16.9	15.3	14.1*	(5.7-24.3)
Dietary fibre (g/10MJ)	23.4	6.3	23.0	(19.2-27.0)	14.9	9.7	14.2*	(8.6-19.8)
Sodium (mg/10MJ)	2672	579	2651	(2238-3048)	2494	1526	2404*	(1610-3233)
Vitamin D (µg/10MJ)	5.9	4.6	4.7	(2.9-7.5)	0.48	0.67	0.29*	(0.08-0.63)
Folate (DFE) (µg/10MJ)	408	191	371	(285-483)	45.0	31.3	41.3*	(24.0-59.8)
Calcium (mg/10MJ)	1293	392	1242	(1018-1509)	229	157	190*	(113-311)
Iron (mg/10MJ)	14.7	4.2	13.9	(11.7-16.9)	2.2	1.1	2.1*	(1.6-2.7)

%E: Percentage energy

DFE: Dietary folate equivalents

Statistically different ($P < 0.001$) from that at home within the rows via Mann-Whitney U Test and adjusted for multiple testing

Table 5b Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in children aged 5-12 years (*n* 600) at the participant's own home and at other homes, in consumers at that location only

	Participant's Own Home (n=600)				Other Homes (n=234)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR
Energy (kcal)	1258	371	1228	(1014-1461)	182	144	153*	(74.7-238)
Energy (MJ)	5.3	1.6	5.2	(4.3-6.2)	0.76	0.61	0.64*	(0.32-1.0)
Protein (%E)	16.2	3.1	16.0	(14.3-17.9)	14.9	7.8	14.3*	(9.4-19.4)
Total fat (%E)	33.1	5.5	32.8	(29.5-36.8)	34.7	12.6	36.5*	(27.7-42.5)
Saturated fat (%E)	14.0	3.1	13.9	(11.8-15.9)	14.5	6.9	15.0	(9.5-17.8)
Monounsaturated fat (%E)	13.5	2.6	13.4	(11.7-15.1)	14.7	7.1	14.7*	(10.8-17.9)
Polyunsaturated fat (%E)	5.5	1.4	5.3	(4.4-6.2)	5.4	3.3	4.7*	(3.2-6.8)
Carbohydrate (%E)	50.1	5.8	50.3	(46.4-54.2)	50.0	13.6	48.4	(42.1-56.5)
Total sugars (%E)	18.7	5.5	18.2	(15.1-22.1)	20.0	14.3	17.9	(10.8-25.5)
Free sugars (%E)	9.5	5.0	9.0	(5.9-12.2)	13.4	13.0	10.5	(3.5-19.2)
Dietary fibre (g/10MJ)	23.3	6.6	22.7	(18.7-26.7)	20.4	13.2	18.2*	(12.2-24.7)
Sodium (mg/10MJ)	2697	611	2657	(2266-3072)	2615	1541	2458	(1704-3237)
Vitamin D (µg/10MJ)	6.0	4.7	4.9	(2.8-7.6)	4.5	7.8	2.0*	(0.59-4.9)
Folate (DFE) (µg/10MJ)	417	199	376	(284-496)	284	340	209*	(123-316)
Calcium (mg/10MJ)	1311	411	1259	(1022-1537)	946	632	758*	(482-1377)
Iron (mg/10MJ)	14.9	4.4	14.0	(11.8-17.2)	12.1	8.3	10.4*	(7.8-13.8)

%E: Percentage energy

DFE: Dietary folate equivalents

*Statistically different ($P < 0.001$) from that at participant's own home within the rows via Mann-Whitney U Test and adjusted for multiple testing

Table 5c Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in children aged 5-12 years (*n* 600) at out of home locations: restaurants & coffee shops, fast food/takeaways, shops and school, in consumers at that location only

	Restaurants & coffee shops (n=195)				Shops (n=166)				Fast food/takeaways (n=138)				School (n=120)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR	Mean	SD	Median	IQR	Mean	SD	Median	IQR
Energy (kcal)	171	117	146 ^{ac}	(81.1-217)	103	80.6	86.1 ^b	(44.0-135)	201	114	171 ^a	(119-242)	144	100	126 ^c	(65.3-209)
Energy (MJ)	0.72	0.49	0.61 ^{ac}	(0.34-0.91)	0.43	0.34	0.36 ^b	(0.19-0.57)	0.85	0.48	0.71 ^a	(0.50-1.0)	0.61	0.42	0.53 ^c	(0.27-0.88)
Protein (%E)	13.3	6.2	13.1 ^a	(9.0-16.0)	8.1	5.7	6.3 ^b	(4.6-9.4)	15.4	5.7	14.7 ^c	(11.5-19.6)	13.8	6.6	14.3 ^{ac}	(9.3-17.2)
Total fat (%E)	38.3	10.3	38.3 ^a	(33.1-43.8)	37.2	15.3	40.1 ^a	(29.7-47.5)	37.2	7.9	36.4 ^a	(31.7-42.0)	27.5	12.2	27.2 ^b	(20.7-34.8)
Saturated fat (%E)	14.5	6.8	14.6 ^{ab}	(9.5-18.8)	16.4	9.8	16.7 ^b	(8.5-24.2)	12.7	5.3	12.5 ^{ac}	(8.5-14.9)	11.5	6.9	10.3 ^c	(6.3-16.4)
Monounsaturated fat (%E)	16.7	6.6	15.6 ^a	(12.9-19.4)	16.1	8.6	15.7 ^a	(11.4-20.3)	17.2	4.8	16.6 ^a	(13.9-19.9)	11.0	5.5	10.5 ^b	(7.7-14.2)
Polyunsaturated fat (%E)	6.9	4.0	6.3 ^a	(4.2-9.1)	4.6	3.2	4.0 ^b	(2.2-6.3)	6.9	2.9	6.6 ^a	(5.0-8.7)	4.9	2.6	4.6 ^b	(3.6-5.6)
Carbohydrate (%E)	48.2	11.4	47.6 ^{ab}	(42.1-54.0)	53.7	16.2	50.9 ^{bc}	(43.0-60.6)	47.3	9.6	48.4 ^{ab}	(42.8-53.3)	56.8	14.7	58.3 ^c	(49.8-65.0)
Total sugars (%E)	22.2	16.1	19.6 ^a	(10.6-32.2)	32.2	21.9	30.2 ^b	(16.3-43.4)	13.0	10.3	10.9 ^c	(3.8-19.5)	19.8	15.4	17.7 ^a	(9.3-26.0)
Free sugars (%E)	17.3	15.1	15.1 ^a	(6.6-25.1)	25.7	21.2	24.5 ^b	(8.9-37.5)	10.1	10.0	8.0 ^c	(1.5-16.1)	7.8	12.3	3.3 ^c	(0.35-9.1)
Dietary fibre (g/10MJ)	13.2	9.5	12.9 ^{ab}	(6.1-18.2)	13.0	12.4	10.6 ^b	(5.5-17.1)	15.2	8.9	15.5 ^a	(9.2-20.3)	23.7	21.6	21.7 ^c	(16.4-26.7)
Sodium (mg/10MJ)	2549	1853	2283 ^a	(1487-3280)	1928	1517	1676 ^b	(760-2762)	2872	1280	2740 ^{ac}	(2190-3661)	3011	1466	3142 ^c	(2204-3913)
Vitamin D (µg/10MJ)	2.3	4.4	1.4 ^a	(0.51-2.8)	1.9	6.9	0.00 ^b	(0.00-1.4)	2.1	2.3	1.3 ^a	(0.40-3.0)	2.7	4.4	1.2 ^a	(0.41-2.1)
Folate (DFE) (µg/10MJ)	198	126	170 ^a	(104-273)	127	136	82.1 ^b	(41.5-191)	195	113	184 ^a	(106-264)	297	849	207 ^a	(160-278)
Calcium (mg/10MJ)	913	682	694 ^a	(414-1278)	814	731	629 ^a	(365-1041)	930	658	737 ^a	(318-1435)	1276	953	1132 ^b	(677-1660)
Iron (mg/10MJ)	9.0	4.7	8.3 ^a	(6.4-10.6)	8.2	8.5	7.1 ^b	(4.6-9.7)	8.8	3.6	8.5 ^{ab}	(6.0-11.0)	11.5	12.7	10.8 ^c	(8.0-13.0)

%E: Percentage of total energy

DFE: Dietary folate equivalent

Statistical differences ($P < 0.01$) between eating locations are denoted by different superscript lowercase letters

Table 6a Mean daily intake of food groups (g/10MJ) in children aged 5-12 years (n 600) at home and outside of home, in consumers at that location only

	Home (n=600)				Outside of the home (n=440)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR
	g/10MJ				g/10MJ			
Total Bread	138	72.3	133	(88.0-183)	95.5	148	0.00*	(0.00-175)
<i>of which</i>								
White Bread	81.2	69.3	70.3	(26.0-120)	74.9	133	0.00*	(0.00-114)
Wholemeal & brown bread	46.2	61.8	18.7	(0.00-75.6)	9.5	46.7	0.00*	(0.00-0.00)
Breakfast cereals	99.3	98.2	70.7	(35.0-129)	6.5	106	0.00*	(0.00-0.00)
<i>of which</i>								
Ready-to-eat breakfast cereals	99.3	98.2	70.7	(35.0-129)	1.3	11.2	0.00*	(0.00-0.00)
<i>high-fibre cereals (≥6g/100g)</i>	28.5	35.7	16.1	(0.00-45.1)	0.51	5.1	0.00*	(0.00-0.00)
<i>low-fibre cereals (<6g/100g)</i>	21.9	32.1	7.1	(0.00-36.5)	0.74	9.3	0.00*	(0.00-0.00)
Porridge & hot oats cereals (made up)	48.9	95.8	0.00	(0.00-61.9)	5.3	105	0.00*	(0.00-0.00)
Potatoes & potato products	92.2	76.7	79.4	(35.8-134)	111	181	0.00*	(0.00-179)
<i>of which</i>								
Boiled, baked & mashed potatoes	54.5	63.3	40.2	(0.00-88.5)	15.8	94.6	0.00*	(0.00-0.00)
Chipped, fried, roasted, processed & homemade potato products	37.6	51.3	22.0	(0.00-58.2)	95.4	157	0.00*	(0.00-155)
Total Milk	322	255	272	(133-477)	82.8	276	0.00*	(0.00-0.00)
<i>of which</i>								
Whole milk	219	253	153	(0.00-355)	76.8	269	0.00*	(0.00-0.00)
Reduced fat milk	98.7	200	0.00	(0.00-109)	6.0	70.0	0.00*	(0.00-0.00)
Non-dairy alternatives	4.3	32.1	0.00	(0.00-0.00)	0.00	0.00	0.00*	(0.00-0.00)
Total meat	182	109	172	(108-238)	153	227	66.9*	(0.00-231)
<i>of which</i>								
Meat dishes	79.2	99.2	46.9	(0.00-130)	40.7	177	0.00*	(0.00-0.00)
Fresh meat	370	414	281	(0.00-546)	19.2	76.2	0.00*	(0.00-0.00)
Processed meat	56.7	48.7	46.5	(20.5-83.6)	86.9	141	0.00*	(0.00-146)
Total fruit and vegetables	357	234	315	(198-474)	217	631	0.00*	(0.00-246)
Total Fruit	271	215	235	(123-369)	188	624	0.00*	(0.00-159)
<i>of which</i>								
Discrete fruit	188	153	165	(71.7-257)	113	497	0.00*	(0.00-0.00)
Fruit juices & smoothies	82.6	150	0.00	(0.00-124)	74.2	381	0.00*	(0.00-0.00)
Total vegetables	86.5	88.6	65.7	(24.0-122)	29.9	109	0.00*	(0.00-0.00)
<i>of which</i>								
Discrete vegetables	76.3	72.8	59.5	(20.7-113)	26.4	106	0.00*	(0.00-0.00)
Vegetable dishes	10.2	41.3	0.00	(0.00-0.00)	3.5	29.0	0.00*	(0.00-0.00)
Total confectionery/snacks	115	67.9	104	(64.0-155)	91.6	146	0.00*	(0.00-144)

of which

Biscuits, crackers, cakes, pastries, buns & desserts	69.3	57.6	56.2	(27.0-97.4)	88.2	144	0.00*	(0.00-142)
Chocolate, sweets, savoury snacks, sugars & preserves	41.3	35.2	32.6	(14.7-59.2)	118	437	11.1*	(0.00-134)
Cereal bars	4.0	11.5	0.00	(0.00-0.00)	0.52	11.1	0.00	(0.00-0.00)
Water as a beverage	891	525	824	(536-1141)	903	2009	386*	(0.00-1166)
Soft drinks (added sugar)	40.7	116	0.00	(0.00-0.00)	239	598	0.00*	(0.00-272)
Soft drinks (no added sugar)	43.7	132	0.00	(0.00-42.5)	91.0	302	0.00*	(0.00-0.00)

%E: percentage energy

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

*Statistically different ($P < 0.001$) from that at home within the rows via Mann-Whitney U Test and adjusted for multiple testing

Table 6b Mean daily intake of food groups (g/10MJ) in children aged 5-12 years (*n* 600) at the participant's own home and at other homes, in consumers at that location only

	Participant's Own Home (n=600)				Other Homes (n=234)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR
	g/10MJ				g/10MJ			
Total Bread	141	74.6	133	(89.5-185)	88.3	154	0.00*	(0.00-145)
<i>of which</i>								
White Bread	82.5	70.9	70.7	(26.5-121)	52.2	119	0.00*	(0.00-4.6)
Wholemeal & brown bread	47.8	64.5	20.6	(0.00-75.6)	26.1	104	0.00*	(0.00-0.00)
Breakfast cereals*	104	105	71.6	(36.2-138)	30.9	94.7	0.00*	(0.00-0.00)
<i>of which</i>								
Ready-to-eat breakfast cereals	52.2	43.4	45.6	(18.1-73.7)	25.3	85.9	0.00*	(0.00-0.00)
<i>high-fibre cereals (≥6g/100g)</i>	29.6	37.0	16.6	(0.00-46.8)	11.1	58.7	0.00*	(0.00-0.00)
<i>low-fibre cereals (<6g/100g)</i>	22.6	33.4	0.60	(0.00-37.5)	14.2	64.9	0.00*	(0.00-0.00)
Porridge & hot oats cereals (made up)	51.9	103	0.00	(0.00-67.2)	5.6	43.2	0.00*	(0.00-0.00)
Potatoes & potato products	88.4	77.3	73.3	(32.1-132)	152	290	0.00*	(0.00-203)
<i>of which</i>								
Boiled, baked & mashed potatoes	51.3	61.9	35.5	(0.00-83.5)	106	274	0.00*	(0.00-0.00)
Chipped, fried, roasted, processed & homemade potato products	37.1	52.7	16.9	(0.00-57.1)	45.2	122	0.00*	(0.00-0.00)
Total Milk	329	260	276	(132-486)	219	419	0.00*	(0.00-254)
<i>of which</i>								
Whole milk	223	258	151	(0.00-361)	144	329	0.00*	(0.00-0.00)
Reduced fat milk	102	207	0.00	(0.00-109)	61.2	247	0.00*	(0.00-0.00)
Non-dairy alternatives	4.3	32.4	0.00	(0.00-0.00)	13.8	159	0.00	(0.00-0.00)
Total meat	180	111	165	(106-237)	197	289	95.6*	(0.00-285)
<i>of which</i>								
Meat dishes	79.3	102	45.0	(0.00-131)	74.8	253	0.00*	(0.00-0.00)
Fresh meat	45.2	51.2	33.5	(0.00-66.9)	26.6	98.6	0.00*	(0.00-0.00)
Processed meat	55.6	50.1	45.0	(18.1-82.9)	71.5	137	0.00*	(0.00-95.1)
Total fruit and vegetables	364	238	325	(196-485)	261	573	0.00*	(0.00-339)
Total Fruit	278	218	242	(124-385)	159	530	0.00*	(0.00-0.00)
<i>of which</i>								
Discrete fruit	195	160	166	(71.9-274)	106	458	0.00*	(0.00-0.00)
Fruit juices and smoothies	82.9	152	0.00	(0.00-130)	53.3	241	0.00*	(0.00-0.00)
Total vegetables	85.9	90.3	64.1	(22.5-119)	102	250	0.00*	(0.00-77.1)
<i>of which</i>								
Discrete vegetables	76.2	74.6	58.3	(18.5-113)	90.8	242	0.00*	(0.00-66.2)
Vegetable dishes	9.7	41.3	0.00	(0.00-0.00)	10.9	66.3	0.00	(0.00-0.00)
Total confectionery/snacks	112	69.6	99.8	(62.0-154)	183	278	112*	(0.00-258)
<i>of which</i>								

Biscuits, crackers, cakes, pastries, buns & desserts	67.6	58.9	53.7	(24.2-96.1)	99.2	166	0.00*	(0.00-157)
Chocolate, sweets, savoury snacks, sugars & preserves	38.9	35.5	30.3	(12.7-57.1)	80.5	240	0.00*	(0.00-86.0)
Cereal bars	4.1	11.9	0.00	(0.00-0.00)	2.8	23.5	0.00*	(0.00-0.00)
Water as a beverage	905	530	832	(549-1164)	624	1030	114*	(0.00-887)
Soft drinks (added sugar)	36.8	114	0.00	(0.00-0.00)	102	330	0.00	(0.00-0.00)
Soft drinks (no added sugar)	42.2	131	0.00	(0.00-38.8)	86.6	511	0.00*	(0.00-0.00)

%E: percentage energy

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

*Statistically different ($P < 0.001$) from that at participant's own home within the rows via Mann-Whitney U Test and adjusted for multiple testing

Table 6c Mean daily intake of food groups (g/10MJ) in children aged 5–12 years (*n* 600) at out of home locations: restaurants & coffee shops, fast food/takeaways, shops and school, in consumers at that location only

	Restaurants & coffee shops (n=195)				Shops(n=166)				Fast food/takeaways (n=138)				School (n=120)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR	Mean	SD	Median	IQR	Mean	SD	Median	IQR
	g/10MJ				g/10MJ				g/10MJ				g/10MJ			
Total Bread	64.6	132	0.00 ^a	(0.00-86.2)	46.3	132	0.00 ^a	(0.00-0.00)	52.2	106	0.00 ^a	(0.00-15.0)	333	255	365 ^b	(0.00-518)
<i>of which</i>																
White Bread	42.8	112	0.00 ^a	(0.00-0.00)	42.3	127	0.00 ^a	(0.00-0.00)	44.0	96.9	0.00 ^a	(0.00-0.00)	284	259	295 ^b	(0.00-463)
Wholemeal & brown bread	8.8	56.9	0.00 ^{ab}	(0.00-0.00)	0.88	11.3	0.00 ^a	(0.00-0.00)	1.8	16.0	0.00 ^a	(0.00-0.00)	31.4	87.7	0.00 ^b	(0.00-0.00)
Breakfast cereals	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	23.1	203	0.00	(0.00-0.00)
<i>of which</i>																
Ready-to-eat breakfast cereals	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	2.7	13.8	0.00	(0.00-0.00)
<i>high-fibre cereals (≥6g/100g)</i>	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	2.3	11.4	0.00	(0.00-0.00)
<i>low-fibre cereals (<6g/100g)</i>	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.36	3.9	0.00	(0.00-0.00)
Porridge & hot oats cereals (made up)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	20.4	203	0.00	(0.00-0.00)
Potatoes & potato products	158	258	0.00 ^a	(0.00-244)	4.0	36.7	0.00 ^b	(0.00-0.00)	237	248	215 ^c	(0.00-379)	11.2	60.3	0.00 ^b	(0.00-0.00)
<i>of which</i>																
Boiled, baked & mashed potatoes	58.7	215	0.00 ^a	(0.00-0.00)	0.00	0.00	0.00 ^b	(0.00-0.00)	0.00	0.00	0.00 ^b	(0.00-0.00)	2.9	22	0.00 ^{ab}	(0.00-0.00)
Chipped, fried, roasted, processed & homemade potato products	98.8	155	0.00 ^a	(0.00-172)	4.0	36.7	0.00 ^{bc}	(0.00-0.00)	237	248	215 ^b	(0.00-379)	8.3	56.5	0.00 ^c	(0.00-0.00)
Total Milk	31.1	173	0.00 ^a	(0.00-0.00)	63.8	315	0.00 ^a	(0.00-0.00)	67.8	253	0.00 ^{ab}	(0.00-0.00)	165	379	0.00 ^b	(0.00-0.00)
<i>of which</i>																
Whole milk	22.0	131	0.00 ^a	(0.00-0.00)	63.8	315	0.00 ^a	(0.00-0.00)	57.4	243	0.00 ^{ab}	(0.00-0.00)	165	379	0.00 ^b	(0.00-0.00)
Reduced fat milk	9.1	114	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	10.4	76.5	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)
Non-dairy alternatives	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)
Total meat	175	239	60.9 ^{ac}	(0.00-280)	78.9	226	0.00 ^b	(0.00-0.00)	235	237	188 ^a	(0.00-362)	120	213	55.6 ^c	(0.00-183)
<i>of which</i>																
Meat dishes	48.1	182	0.00	(0.00-0.00)	31.6	187	0.00	(0.00-0.00)	37.4	154	0.00	(0.00-0.00)	33.1	186	0.00	(0.00-0.00)
Fresh meat	31.3	114	0.00	(0.00-0.00)	14.2	70.4	0.00	(0.00-0.00)	43.5	136	0.00	(0.00-0.00)	11.1	75.9	0.00	(0.00-0.00)

Biscuits, crackers, cakes, pastries, buns & desserts	92.8	153.3	0.00 ^a	(0.00-158)	134	219	0.00 ^a	(0.00-201)	11.7	53.8	0.00 ^b	(0.00-0.00)	102	153	38.9 ^a	(0.00-150)
Chocolate, sweets, savoury snacks, sugars & preserves	52.7	119.5	0.00 ^a	(0.00-42.1)	324	939	177 ^b	(0.00-461)	17.6	53.3	0.00 ^c	(0.00-0.00)	54.9	138	0.00 ^{ac}	(0.00-7.6)
Cereal bars	1.2	16.7	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)
Water as a beverage	675	1166	0.00 ^a	(0.00-956)	1204	3787	0.00 ^a	(0.00-842)	393	736	0.00 ^a	(0.00-545)	1761	1818	1375 ^b	(0.00-2812)
Soft drinks (added sugar)	242	633	0.00 ^a	(0.00-0.00)	254	769	0.00 ^a	(0.00-0.00)	315	509	0.00 ^a	(0.00-608)	13.2	102	0.00 ^b	(0.00-0.00)
Soft drinks (no added sugar)	147	517	0.00 ^a	(0.00-0.00)	78.2	688	0.00 ^b	(0.00-0.00)	117	356	0.00 ^a	(0.00-0.00)	72.7	461	0.00 ^{ab}	(0.00-0.00)

%E: percentage energy

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

Statistical differences (P < 0.001) between eating locations are denoted by different superscript lowercase letters

Table 7: Differences in food group intakes across the four 'out of home' locations

	Restaurants & coffee shops	Shops	Fast food/takeaways	School
Total Bread				↑
<i>of which</i>				
White Bread				↑
Wholemeal & brown bread				↑*
Breakfast cereals				
<i>of which</i>				
Ready-to-eat breakfast cereals		No differences noted		
<i>high-fibre cereals (≥6g/100g)</i>				
<i>low-fibre cereals (<6g/100g)</i>				
Porridge & hot oats cereals (made up)				
Potatoes & potato products			↑	
<i>of which</i>				
Boiled, baked & mashed potatoes	↑**			
Chipped, fried, roasted, processed & homemade potato products			↑	
Total Milk				↑***
<i>of which</i>				
Whole milk				↑***
Reduced fat milk		No differences noted		
Non-dairy alternatives				
Total meat		↓		
<i>of which</i>				
Meat dishes		No differences noted		
Fresh meat				
Processed meat		↓		
Total fruit and vegetables				↑
Total Fruit				↑
<i>of which</i>				
Discrete fruit				↑
Fruit juices & smoothies				
Total vegetables		↓		

of which

Discrete vegetables

↓

Vegetable dishes

No differences noted

Total confectionery/snacks

↑

↓

of which

Biscuits, crackers, cakes, pastries, buns & desserts

↑

Chocolate, sweets, savoury snacks, sugars & preserves

↑

Cereal bars

No differences noted

Water as a beverage

↑

Soft drinks (added sugar)

↓

Soft drinks (no added sugar)

↑****

↑ higher than from all other location ($P < .001$); ↓ lower than from all other locations ($P < .001$)

↑* higher from 'school' than from 'shops' and 'fast food/takeaways' ($P < .001$); ↑** higher from 'restaurants & coffee shops' than from 'shops' and 'fast food & takeaways' ($P < .001$); ↑*** higher from 'school' than from 'restaurants & coffee shops' and 'shops' ($P < .001$); ↑**** higher from 'restaurants & coffee shops' than from 'fast food & takeaways' and 'shops' ($P < .001$)

Discussion

The aim of this chapter was to investigate the association between eating location and dietary quality in school-aged children (5-12y) in Ireland. The main finding of this study was that 91% of all eating occasions took place in the ‘home’ location (with 86% taking place at the ‘participant’s own home’). Whilst almost three-quarters of children (73%), consumed food from ‘outside of the home’ these locations (primarily including ‘school’, ‘restaurants & coffee shops’ and ‘fast food/takeaways’) accounted for only 9% of all eating occasions. In line with these findings, on average, 88% of overall energy intake came from the ‘home’ location and 12% from ‘outside of the home’. There were very few differences observed in these eating patterns between sexes, age groups and categories of weight status and socio-economic status. Exceptions to this were that younger children (5-8y) had a higher percentage of energy from food consumed from ‘other homes’ than older children (9-12y) and those with parents of primary/intermediate education only, had a higher percentage of energy from food consumed from ‘fast food/takeaways’ than those with tertiary education.

When comparing the dietary quality of food consumed from the ‘participant’s own home’ compared to ‘other homes’ and ‘outside of the home’, food consumed from ‘home’ was of better dietary quality for protein, total fat, dietary fibre, vitamin D, folate, calcium and iron and PUFA (when comparing ‘participant’s own home’ and ‘other homes’ only) and free sugars (when comparing ‘home’ to ‘outside of the home’ only). It was of poorer quality, however, for MUFA and for sodium (when comparing ‘participant’s own home’ to ‘outside of the home’ only). These differences can be explained by the differences in the foods consumed from these locations. When compared to food consumed from ‘outside the home’ and ‘other homes’, food consumed from ‘home’ and ‘participant’s own home’ included higher intakes of ‘wholemeal & brown bread’, ‘high-fibre RTEBC’, ‘porridge & hot oats cereals’, ‘boiled, baked & mashed potatoes’ (when comparing ‘home’ to ‘outside of the home’ only), ‘reduced fat milk’, ‘meat dishes’, ‘fresh meat’ and ‘total fruit and vegetables’ and lower intakes of ‘chipped, fried, roasted, processed & homemade potato products’, ‘processed meat’, ‘biscuits, crackers, cakes, pastries, buns & desserts’, ‘chocolate, sweets, savoury snacks, sugars & preserves’ and ‘soft drinks’ (both with and without added sugar). These findings are discussed below in the context of the literature and

changes since the previous survey of school-aged children in Ireland, the NCFS (2003-04).

Eating location characteristics

The National Obesity Policy and Action Plan ‘A Healthy Weight for Ireland’ has identified the eating environment as an influential factor on a child’s eating habits (Healthy Ireland, 2016) and a global increase in the consumption of meals ‘outside of the home’ has been associated with poorer dietary quality (Janssen et al., 2018, Lachat et al., 2012). The findings of this study are similar to those from the previous NCFS of school-aged-children in Ireland carried out in 2003-2004 which reported that 89% of eating occasions were from the ‘participant’s own home’ and 5% were from ‘other homes’ and on average, 91% of energy intake came from ‘home’. In keeping with our study also, 77% of children consumed food from ‘outside of the home’, however, only 6% of eating occasions were ‘outside of the home’ accounting for 9% of energy intake. This highlights that there is no real change in where children are eating over this time period (Burke et al., 2007). The findings of this study are also generally in keeping with other studies where the ‘home’ location has been reported as where most eating occasions take place for children. A large nationally representative study in Canada has shown that over 90% of children (2-12y) consumed food from ‘home’ with less than 20% of children consuming food from ‘fast food/takeaways’ and just over 20% consuming food from other locations (Nishi et al., 2018). In comparison to our study, this Canadian study reported a much lower contribution to energy intake from ‘home’ (54-62% in children and teenagers), with 16-26% coming from ‘fast food/takeaways’ (Nishi et al., 2018). Similarly, a large nationally representative study in the US has shown that the ‘home’ location (which included ‘home’ and ‘store bought’) contributed 68% of daily energy intake for 7-12 year olds (Poti and Popkin, 2011).

In the current study, food from ‘out of home’ locations contributed on average 12% of energy intake (16% in consumers). The biggest contributors to this were ‘fast food/takeaways’, ‘restaurants & coffee shops’ and ‘school’, which contributed 13%, 11% and 10% of energy intake, respectively in consumers at each eating location. In the previous NCFS (2003-04), food consumed from ‘out of home’ locations contributed on average 9% of energy intake (11% in consumers). Considering the increasing number of restaurants and takeaways in Ireland in the last five years (1.4%

per year), an increase in the amount of energy consumed outside of the home since the previous NCFS was expected (IBISWorld, 2022). This increase whilst small, is consistent with an increase in energy intake from ‘outside of the home’ reported in a nationally representative sample of children aged 7-12 years in the US, where the contribution of energy from ‘outside of the home’ increased from 27% to 35% over a 29 year period (1977/78-2003/4), however, more recent data is needed in order to make a more accurate comparison (Poti and Popkin, 2011). Furthermore, a study carried out in the UK has identified a shift in the reasons for eating out when comparing data from 1995 to 2015 and concluded that eating out has become more normalised as is no longer only associated with special occasions (Paddock et al., 2017). These societal changes, together with the fact that food consumed ‘outside of the home’ has been associated with poorer dietary quality (Poti et al., 2014, Young et al., 2019) show that ‘out of home’ eating must be closely monitored in order to deliver healthy eating policies for this age group.

Eating location characteristics by demographics

A recent review of the literature examining the influence of demographic characteristics on consumption of food from ‘outside of the home’ has shown mixed findings regarding differences between sex, age group and socio-economic status, however, many of the studies available were carried out in adults only (Janssen et al., 2018). The present study found very few associations between eating location and demographic characteristics. Exceptions to this were that younger children (5-12y) had a higher percentage of energy from food consumed from ‘other homes’ than older children (9-12y) (6.0%E vs. 3.0%E, $P < .001$) which highlights that caregivers and other adults involved in the lives of younger children need to be considered by policymakers when addressing the dietary intake issues of school-aged children. Additionally, children of parents with primary/intermediate education only had a higher percentage of energy from food consumed from ‘fast food/takeaways’ than children of parents with tertiary education’ (8.0%E vs. 2.5 %E, $P < .001$). Data from the UK shows that there is strong evidence linking the availability of fast food outlets and increasing level of area deprivation (Public Health England, 2018). This link should be examined in the context of Irish data in order to further assess the link between indicators of socio-economic status and fast food consumption.

In contrast to the results of our study, findings from the previous NCFS (2003-04) showed that older children had higher energy intakes from food consumed from ‘outside of the home’, particularly from ‘takeaways’ and ‘shops’ compared to younger children, however the study based on the NCFS has not examined energy intakes ‘outside of the home’ by any other demographic characteristics (Burke et al., 2007). In keeping with the findings of our study, data from the National Diet and Nutrition Survey (NDNS) (2008-2012) in the UK in children aged 0-18 years, has shown there were no differences in the frequency of eating take-away meals at home in children when split by sex or age group (5-9y vs. 10-14y) (Adams et al., 2015). A lower occupational socio-economic status was, however, associated with more frequent consumption of ‘take-away’ meals, but no difference was observed between categories of parental education (Adams et al., 2015).

Dietary quality by eating location

It has previously been identified that one of the perceived burdens that parents face when trying to promote a healthy relationship with food for their children is the other adults involved in their child’s life (through childcare, playdates and grandparents) undoing the dietary habits instilled in their own home by offering an excess of ‘treat foods’ (SafeFood, 2022). This is in keeping with the findings of the present study, which has found that the dietary quality of the foods consumed from the ‘participant’s own home’ was of better quality than that at ‘other homes’. This is also consistent with findings from the previous NCFS, where nutrient intakes were more favourable from the ‘participant’s own home’ than from ‘other homes’ in terms of intakes of protein, calcium, iron, folate and vitamin C (Burke *et al.*, 2007).

The findings of the present study show that for the most part with the exception of one or two nutrients that food consumed from ‘home’ was of better dietary quality than that consumed from ‘outside of the home’, which corroborates with findings from a systematic review which examined the association between eating out of home and dietary intake (Lachat et al., 2012). This is in keeping with findings from the previous NCFS where food consumed from ‘home’ was of better dietary quality than food consumed from ‘outside of the home’ for protein, total fat, dietary fibre, calcium, iron, folate and vitamin C (Burke et al., 2007). Findings from the National Health and Examination Survey (NHANES) in the US also showed that, in children aged 2-17

years, dietary quality of food consumed from ‘home’ is more favourable in terms of intakes of saturated fat, added sugar, dietary fibre and iron when compared to ‘outside of the home’, however, intakes of sodium were found to be similar at ‘home’ and ‘outside of the home’ (Guthrie et al., 2002).

With regard to food group intakes, this study has shown that food choices are more consistent with current FBDG when prepared at ‘home’ than ‘outside of the home’ (Food Safety Authority of Ireland, 2019). In keeping with the results of the present study, findings from the National Diet and Nutrition Survey (NDNS) (2008-2014) in the UK shows that dietary quality was lower when food was consumed ‘outside of the home’ than at ‘home’ in terms of higher intakes of discretionary foods/non-core foods. Meals consumed ‘outside of the home’ were higher in ‘non-core foods’ such as ‘red and processed meat’, ‘sugar-sweetened beverages’, ‘non-milk extrinsic sugars’ (Ziauddeen et al., 2018).

While it has previously been established that dietary quality from food ‘outside of the home’ is not as favourable as at home, dietary quality from different ‘out of home’ locations can vary with ‘school’ generally being associated with higher dietary quality and more similar to ‘at home, while ‘fast food/takeaways’ are generally associated with poorer dietary quality than other ‘out of home’ locations based on data from NHANES in the US (Drewnowski and Rehm, 2013; Poti *et al.*, 2014). The present study has found that the dietary quality of food from ‘school’ to be better than other ‘out of home’ locations, particularly in terms of saturated fat, dietary fibre, free sugars, iron and calcium. In terms of food group intakes, food consumed from ‘school’ included higher intakes of ‘wholemeal & brown bread’, ‘total milk’, ‘total fruit & vegetables’, ‘total fruit’ and ‘water consumed as a beverage’ and lower intakes of ‘chipped, fried, roasted, processed & homemade potato products’ and ‘soft drinks (added sugar)’ when compared to the other ‘out of home’ locations. These findings are consistent with findings from the US NHANES suggest that of all ‘out of home’ locations, meals consumed from ‘school’ were of higher dietary quality than any other location in terms of empty calories and sugar consumption, (Poti *et al.*, 2014). This outcome has likely occurred in the present study as the school lunches which are provided to children in primary schools, are provided by a government initiative. These lunches closely follow current FBDG, particularly for ‘wholemeal/wholegrain cereal or bread’, ‘fruit and vegetables’ and ‘milk’, which partially explains the higher

intakes of these food groups at school, when compared to other ‘out of home’ locations (Department of Social Protection, 2019). However, it is worth noting that these school lunches are only provided to disadvantaged schools which serve approximately 20% of the overall school population in Ireland (Department of Education, 2022). Moreover, given that the present study does not differentiate between food prepared and consumed at home and food prepared at home and consumed elsewhere, the dietary quality of school lunches needs to be further examined, taking into account the preparation location of school lunches as well as any lunchbox policies imposed by individual schools.

A recent study which examined the nutritional value of children’s meals in chain restaurants in the UK and Ireland has found that the foods offered do not contribute positively to children’s diets and despite a large variety of choice on these menus, it is still potentially difficult for parents to select a meal which complies with calorie recommendations for children, with healthy options not being readily available. Sales tactics such as ‘meal deals’ further add to this issue by contributing to the calorie content of meals while seeming economically attractive to parents (Young et al., 2019). In the present study the two main types of ‘out of home’ food service establishments where children obtained food from were ‘restaurants & coffee shops’ and ‘fast food/takeaways’. Overall, the dietary quality of the food consumed from ‘restaurants & coffee shops’ was similar to that at ‘fast food/takeaways’, with few differences observed at these locations. The exceptions to this were protein, where intakes were higher for food consumed from ‘fast food/takeaways’ than at ‘restaurants & coffee shops’ (15.4%E vs. 13.3%E, $P < .001$) and ‘total and free sugars’ where intakes were higher for food consumed from ‘restaurants & coffee shops’ than ‘fast food/takeaways’ (22.2%E vs. 13.0%E, $P < .001$; 17.3%E vs. 10.1%E, $P < .001$). Food consumed from ‘fast food/takeaways’ included higher intakes of ‘chipped, fried, roasted, processed & homemade potato products’ (237g/10MJ vs. 98.8g/10MJ, $P < .001$), while food consumed from ‘restaurants & coffee shops’ included higher intakes of ‘boiled, baked & mashed potatoes’ (58.7g/10MJ vs. 0.00g/10MJ, $P < .001$), ‘total confectionery/snacks’ (147g/10MJ vs. 29.3g/10MJ, $P < .001$), ‘biscuits, crackers, cakes, pastries, buns & desserts’ (92.8g/10MJ vs. 11.7g/10MJ, $P < .001$) and ‘chocolate, sweets, savoury snacks, sugars & preserves’ (52.7g/10MJ vs. 17.6g/10MJ, $P < .001$) than at ‘fast food/takeaways’. Findings from the previous NCFS showed no

differences in energy intake between ‘restaurants’ and ‘takeaways’ however the intake of sugars, dietary fibre and calcium were higher for food consumed from ‘restaurants’ takeaways’. Intakes of ‘meat products’ and ‘soups sauces and miscellaneous’ were higher at ‘restaurants’ than at ‘takeaways’ (Burke *et al.*, 2007). In keeping findings from the present study as well as previous findings in Irish children, findings from the USA showed that ‘full-service’ restaurants (restaurants with waiter/waitress, bar/tavern/lounge) were associated with higher intakes of sugar than ‘fast food/takeaways’, however, in contrast to our findings, this study also found that ‘full serve’ restaurants were also associated with higher intakes of protein than ‘fast-food’ restaurants, as well as higher intakes of sugar and sodium, which was not found in the present study (Powell and Nguyen, 2013). This indicates that menu choices offered to children at both types of restaurants are similar and any policies introduced to improve the nutritional quality of these menus should target both types of restaurants.

Strengths and limitations

The key strengths of this study are the nationally representative sample of children aged 5-12 years in Ireland included in the NCFS II and the detailed dietary intake information collected through a 4-day weighed food diary with detailed information on the eating location at meal level. Another important strength of this study includes the detailed food composition data, in particular the brand-level information provided from the food packaging and food outlets during the survey. Limitations of this study includes the smaller proportion of children with a lower social class and a larger proportion of children with a higher social class compared to the Irish population. This was mitigated by weighting the data in analysis where social class was not a variable of interest.

Conclusion

In summary, the main finding of this study was that food and nutrient intakes in school-aged children in Ireland is driven by food consumed from ‘home’, particularly the ‘participant’s own home’ where the majority of eating occasions took place, contributing a large proportion of energy intakes. While the majority of children consumed food/beverages ‘outside of the home’, this only accounted for a small proportion of eating occasions and energy intakes. There were very few differences

observed in these eating patterns between sexes, age groups, BMI classifications or socio-economic status indicating that any policies aimed at improving the diets of school-aged children should be mostly focused on the food prepared in the home environment. These policies could include aggressive marketing practices such as restricting supermarket promotions or introducing a watershed on TV advertising of unhealthy food, which has been introduced in in other European countries (European Public Health Alliance, 2019).

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Chapter 5

Dietary quality of teenagers (13-18y) in Ireland and differences in dietary quality between sex, age group, socio-economic status and weight status

Introduction

The transformative growth and development which occurs during the teenage years vastly influences the health of an individual later in life, particularly in terms of musculoskeletal growth, cardiorespiratory fitness, neurodevelopment and immunity (Norris et al., 2022). The teenage years are a unique life stage differentiated from childhood by the increase in independence when it comes to food choice (Neufeld et al., 2022). Teenagers are affected by nutritional issues such as micronutrient deficiency, food insecurity and increasing rates of overweight and obesity (Norris et al., 2022). Investigating the dietary quality of teenagers can help to inform targeted strategies aimed at tackling these nutritional issues.

The teenage years are a transformative life phase, with growth and maturation of all organs and physiological systems as well as remodelling of the skeleton and increase in bone mass of up to 40% (Norris et al., 2022). Teenagers have higher protein requirements in for protein compared to children in order to support the increase in muscle mass, erythrocytes and myoglobin and to support hormonal changes (Savarino et al., 2021). Micronutrient requirements are also higher in this age group, in order to support this period of rapid growth and development. Adequate calcium and vitamin D are important to support bone development, while adequate iron intakes are vital in preventing iron deficiency anaemia and for the formation of red blood cells as well as preventing depletion of iron stores during menstruation in teenage girls (Savarino et al., 2021, Moschonis et al., 2013, European Food Safety Authority 2017).

There is evidence in the literature to suggest that sex, age, socio-economic status and weight status are linked to dietary quality in teenagers (Rasmussen et al., 2006, Novaković et al., 2014, Pérez-Escamilla et al., 2012). A recent review investigating the determinants of fruit and vegetable consumption globally has found that teenage boys had lower intakes of fruit and vegetables compared to girls, particularly in European countries. Additionally, this review has identified a possible negative association between increasing age and fruit and vegetable intakes in children and teenagers (Rasmussen et al., 2006). Data from European surveys show that boys generally had higher intakes of ‘bread’ and ‘meat’ and lower intakes of ‘fruit and vegetables’ ‘when compared to girls, however, older teenagers have been identified to have higher intakes of ‘bread’ and ‘fruit and vegetables’ and lower intakes of ‘meat’

than younger teenagers (Elmadfa et al., 2012, Pedersen et al., 2015, Turkey Ministry of Health, 2014). These studies have also found that although boys and older teenagers generally had higher intakes of energy than girls and younger teenagers, there were only minor differences in the intakes of protein, total fat, saturated fat, monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), carbohydrate, total sugars, free sugars, dietary fibre, sodium, vitamin A, vitamin D, riboflavin, vitamin B6, folate, vitamin C, calcium and iron between boys and girls or younger and older teenagers (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Joffe et al., 2009, Lopes et al., 2017, Royo-Bordonada et al., 2003, Van Rossum et al., 2020, Bates et al., 2020, Turkey Ministry of Health, 2014). These differences could be explained by the different eating behaviour styles in these population subgroups as it has been reported that girls and younger teenagers tend to be more emotional and restrained eaters than boys and younger teenagers (Daly et al., 2021).

Reviews of the literature have determined that teenagers with a lower socio-economic status had poorer dietary quality than those with a higher socio-economic status in terms of intakes of ‘fruit and vegetables’ and ‘soft drinks’, as well as fat and refined sugar (Hanson and Chen, 2007, Rasmussen et al., 2006, Darmon and Drewnowski, 2008). These findings are consistent with data from more recent studies carried out in Europe which have concluded that teenagers in a higher socio-economic group generally have better dietary quality than teenagers in a lower socio-economic group in terms of intakes of ‘fruit and vegetables’, ‘processed meat’ and ‘sugar-sweetened beverages (SSB)’ as well as fat and added sugar (Drouillet-Pinard et al., 2017, Vilela et al., 2020, Moraeus et al., 2020). The link between BMI and dietary quality is unclear as there are conflicting findings across different studies (Moraeus et al., 2020, Hassapidou et al., 2006, Elliott et al., 2011, Golley et al., 2011, Wong and Louie, 2018). Teenagers classified as having overweight and obesity have been found to have less favourable dietary quality in terms of dietary quality scores and intakes of ‘fruits, vegetables and legumes’, and processed snack foods such as ‘pizza’, ‘sausages’ and ‘potato chips’ as well as lower intakes of macronutrients, fibre and micronutrients according to data from Sweden and Greece (Moraeus et al., 2020, Hassapidou et al., 2006). However, findings from Australia and New Zealand show little to no association between BMI z-scores and intakes of protein, carbohydrate, sugars and fat

in teenagers (Elliott et al., 2011, Golley et al., 2011, Wong and Louie, 2018). It is important to note that data collection from study participants categorised as having overweight/obesity is subject to misreporting and this may account for some of the inconsistencies observed in the literature (Lioret et al., 2011, Forrestal, 2011, Rangan et al., 2011).

The recent NTFS II has collected detailed dietary data along with information on socio-economic status and weight status from a nationally representative sample of teenagers across Ireland. This study aims to use these data to examine the dietary quality of teenagers in Ireland and to identify any differences in dietary quality between sex, age group, socio-economic status and weight status.

Methods

The analyses for this chapter are based on data from the NTFS II. A detailed survey methodology for the NTFS II including sampling, recruitment, data collection, food quantification and nutrient composition is outlined in Chapter 2. The methods specific to this chapter are outlined below.

Defining dietary quality

In the context of this chapter, ‘dietary quality’ refers to the energy-adjusted intakes of pre-defined food groups and nutrients. The selection of food groups examined have been included in this definition on the premise that they best describe dietary quality based on current food based dietary guidelines (FBDG) in Ireland, which recommend eating a variety of fruits and vegetables, choosing wholemeal, high-fibre bread and breakfast cereals, low fat dairy products, lean meat and protein sources, using baking, boiling and steaming as cooking methods, rather than frying and drinking plenty of fluids, preferably water (Food Safety Authority of Ireland, 2019). This approach of using FBDG as a marker for dietary quality has also been used in many other studies (Olza et al., 2019, Moraeus et al., 2020, USDA, 2022).

The food groups examined in this study include intakes of:

- ‘White bread’ v ‘wholemeal & brown bread’
- ‘High-fibre RTEBC (≥ 6 g of fibre/100g)’ v ‘low-fibre RTEBC (< 6 g of fibre/100g)’
- ‘Porridge & hot oat cereals’
- ‘Boiled, baked & mashed potatoes’ v ‘chipped fried, roasted, processed & homemade potato products’
- ‘Whole milk’ v ‘reduced fat milks’
- ‘Fresh meat’ v ‘processed meat’ (products such as bacon, ham, burgers, sausages, meat pies and pastries and other meat products)
- ‘Total fruit & vegetables’
- ‘Total fruit’, including ‘discrete fruit’ and ‘fruit juices & smoothies’
- ‘Total vegetables’, including ‘discrete vegetables’ and ‘vegetable dishes’

- ‘Total confectionery & snacks’, including ‘biscuits, crackers, cakes, pastries, bun & desserts’, ‘chocolate, sweets, savoury snacks, sugars & preserves’ and ‘cereal bars’
- ‘Water consumed as a beverage’
- ‘Soft drinks (added sugar)’ v ‘soft drinks (no added sugar)’
- ‘Energy drinks’

This study also included intakes of the following nutrients in its definition of dietary quality: saturated fat, MUFA, PUFA, free sugars, dietary fibre, sodium, vitamin A, vitamin D, riboflavin, vitamin B6, dietary folate equivalents (DFE), vitamin C, calcium and iron as intakes of these nutrients are generally not in line with recommendations for teenagers both in Ireland and across Europe (Rippin et al., 2019, Aljaraedah et al., 2019, Walton et al., 2021, Irish Universities Nutrition Alliance, 2021). Intakes of protein, total fat, carbohydrates and total sugar were also included in these analyses for completeness. As intakes of nutrients, particularly macronutrients are correlated with energy intakes (Willett et al., 1997), removing energy as a confounder gives a more accurate picture of dietary quality, independent of energy intakes.

Defining socio-economic status

Socio-economic status has been associated with dietary quality in teenagers in terms of nutrient and food group intakes (Hanson and Chen, 2007, Rasmussen et al., 2006, Novaković et al., 2014). The present study used social class and parental education as indicators of socio-economic status as these are commonly used indicators in the literature (Novaković et al., 2014). Details on how socio-economic and parental education data were collected are outlined in Chapter 2.

Anthropometric measurements

This study used BMI as a marker of weight status. Evidence from the literature suggests that BMI may have an impact on dietary quality in children and teenagers, with studies showing differences in energy, nutrient and food group intakes between children and teenagers classified as having a healthy BMI and those with overweight/obesity (Golley et al., 2011, Elliott et al., 2011). Details on how anthropometric measurements were carried out and how weight status was defined are outlined in Chapter 2.

Statistical Analysis

The mean, standard deviation, median and interquartile range was calculated for selected nutrients and foods groups using SPSS[®] Version 27.0 for Windows (SPSS Inc., Chicago, IL, USA). Differences in the MDI of energy and nutrients between sexes and age groups (13-15y & 16-18y) were calculated using independent sample t-tests regardless of normality (due to large sample size) (Fagerland, 2012). Differences in the MDI of energy and nutrients between social class and parental education groups were assessed using a Kruskal-Wallis test to determine overall differences in intakes between groups and post-hoc Mann-Whitney U Tests to identify where these differences occurred. Differences in food group intakes (e.g., ‘white bread’ vs. ‘wholemeal & brown bread’) were determined using Wilcoxon Signed Rank tests. The Bonferroni adjustment was used to minimise type 1 errors (as a result of multiple testing) by dividing the alpha level (0.05) by the number of comparisons, thus resulting in a significance value of $P < 0.001$.

Results

Mean daily intakes of energy and (energy-adjusted) nutrients

Table 1 presents the MDI of energy and (energy-adjusted) nutrients in the total population of teenagers and split by sex. The MDI of total fat was 34.9% E which is in line with the DRV set by the UK Scientific Advisory Committee on Nutrition (SACN) for an average population intake of total fat of <35%E. The MDI of saturated fat was 14.2%E which is above the UK Department of Health (DOH) recommendation for an average population intake of less than 10%E from saturated fat. The MDI of MUFA was 14.4%E which is in line with the UK DOH recommendation for a minimum average population intake of 12%E. The MDI of PUFA was 6.1%E which is in line with the UK DOH recommendation for a minimum average population intake of 6%E. The MDI of carbohydrate was 47.7%E which is below the SACN recommendation for an average population intake of 50%E from carbohydrate. The MDI of free sugars was 8.4%E, which is above the SACN recommendation for an average population intake of no more than 5%E from free sugar.

When compared to girls, boys had a higher MDI of energy (2095kcal vs. 1549kcal, $P < .001$), riboflavin (2.3mg/10MJ vs. 2.0mg/10MJ, $P < .001$) and calcium (1123mg/10MJ vs. 992mg/10MJ, $P < .001$) and a lower MDI of PUFA (5.7%E vs. 6.5%E, $P < .001$). There were no differences in the MDI of any other nutrient examined between boys and girls.

Tables 2-5 presents the MDI of energy and (energy adjusted) nutrients split by age group, social class, parental education and BMI classification. There were no differences in the MDI of energy or nutrients between younger (13-15y) and older (16-18y) teenagers, across social class categories, parental education levels or by BMI classification.

Mean daily intake of food groups

Table 6 presents the (energy-adjusted) MDI of selected food groups in the total population of teenagers and split by sex. In the total population, the MDI of ‘white bread’ was higher than the MDI of ‘wholemeal & brown bread’ (77.3g/10MJ vs. 25.1g/10MJ, $P < .001$). The MDI of ‘whole milk’ was higher than the MDI of ‘reduced fat milk’ (135g/10MJ vs. 75.6g/10MJ, $P < .001$) with a very minimal MDI of ‘non-

dairy alternatives' (7.8g/10MJ). The MDI of 'processed meat' was higher than the MDI of 'fresh meat' (78.7g/10MJ vs. 57.6g/10MJ, $P < .001$) and the MDI of 'soft drinks (added sugar)' was higher than the MDI of 'soft drinks (no added sugar)' (96.8g/10MJ vs. 58.6g/10MJ, $P < .001$). No differences were noted between the MDI of 'high-fibre ready-to-eat breakfast cereals (RTEBC)' and 'low-fibre RTEBC' or between the MDI of 'boiled, baked & mashed potatoes' and 'chipped, fried, roasted, processed & homemade potato products' in 13–18-year-old teenagers.

As can be seen in **Table 6**, when compared to girls, boys had a higher MDI of 'white bread' (87.9g/10MJ vs. 66.8g/10MJ, $P < .001$) and 'total milk' (263g/10MJ vs. 175g/10MJ, $P < .001$) and a lower MDI of 'total vegetables' (64.4g/10MJ vs. 95.8g/10MJ, $P < .001$). There were no other differences in the intakes of food groups between boys and girls.

Table 7-10 presents the (energy-adjusted) MDI of food groups split by age group, social class, parental education and BMI classification, respectively. There were no differences in the MDI of food groups between younger (13-15y) and older (16-18y) teenagers, across social class categories, parental education levels or by BMI classification.

Table 1 Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in teenagers aged 13-18 years (*n* 428) in the total population and by sex

	All (n=428)				Boys (n=212)				Girls (n=216)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
Energy (kcal)	1819	598	1722	(1442-2201)	2095	607	2045	(1636-2463)	1549*	449	1569	(1231-1780)
Energy (MJ)	7.7	2.5	7.2	(6.1-9.2)	8.8	2.6	8.6	(6.9-10.3)	6.5*	1.9	6.6	(5.2-7.5)
Protein (%E)	16.5	3.6	16.1	(14.3-18.4)	16.9	3.7	16.4	(14.6-18.8)	16.1	3.4	15.9	(14.1-17.6)
Total fat (%E)	34.9	5.5	34.9	(31.1-38.5)	34.2	5.2	34.3	(30.3-37.7)	35.7	5.6	35.7	(31.6-38.9)
Saturated fat (%E)	14.2	3.2	14.0	(11.6-16.5)	14.3	3.3	14.3	(11.7-16.4)	14.1	3.2	14.0	(11.5-16.7)
Monounsaturated fat (%E)	14.4	2.9	14.3	(12.4-16.0)	14.0	2.7	13.9	(12.1-15.5)	14.9	3.1	14.8	(12.6-16.5)
Polyunsaturated fat (%E)	6.1	1.7	5.9	(5.0-7.0)	5.7	1.5	5.5	(4.7-6.6)	6.5*	1.8	6.2	(5.3-7.5)
Carbohydrate (%E)	47.7	5.8	47.9	(44.3-51.4)	48.0	5.6	48.1	(44.5-51.6)	47.4	5.9	47.6	(44.0-50.9)
Total sugars (%E)	15.7	4.9	15.3	(12.3-18.7)	15.7	4.8	15.1	(12.4-18.5)	15.6	5.0	15.6	(12.2-18.8)
Free sugars (%E)	8.4	4.5	7.9	(5.0-11.5)	8.4	4.5	7.8	(4.8-11.7)	8.4	4.4	7.9	(5.1-11.3)
Dietary fibre (g/10MJ)	22.8	5.7	22.0	(18.5-25.9)	22.0	5.2	21.8	(18.2-25.1)	23.5	6.1	22.6	(19.2-27.2)
Sodium (mg/10MJ)	2763	680	2678	(2308-3126)	2753	641	2661	(2311-3143)	2774	718	2698	(2308-3123)
Vitamin A (ug/10MJ)	808	556	688	(435-1032)	796	598	677	(421-1029)	820	513	699	(453-1072)
Vitamin D (µg/10MJ)	4.2	3.3	3.3	(1.9-5.2)	4.3	3.3	3.3	(2.0-5.4)	4.1	3.4	3.2	(1.9-5.1)
Riboflavin (mg/10MJ)	2.2	0.9	2.0	(1.5-2.7)	2.3	1.0	2.1	(1.6-3.0)	2.0*	0.8	1.9	(1.5-2.4)
Vitamin B6 (mg/10MJ)	2.3	0.9	2.1	(1.7-2.6)	2.4	1.1	2.2	(1.7-2.7)	2.2	0.8	2.1	(1.8-2.6)
DFE (µg/10MJ)	360	187	311	(235-442)	372	202	319	(236-457)	348.8	172.0	301.2	(234-421)
Vitamin C (mg/10MJ)	85.0	60.8	72.0	(43.0-113)	78.9	53.3	64.9	(37.6-107)	90.9	67.0	75.1	(45.0-122)
Calcium (mg/10MJ)	1057	325	1007	(837-1226)	1123	342	1076	(886-1364)	992*	293	961	(801-1129)
Iron (mg/10MJ)	14.3	4.6	13.6	(11.0-16.5)	14.7	5.0	13.9	(11.3-17.1)	13.8	4.1	13.2	(10.9-16.1)

%E: percentage of total energy

DFE: Dietary Folate Equivalents

* Statistically different ($P < 0.001$) from that of boys within the rows via Independent Samples T Test and adjusted for multiple testing

Table 2 Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in teenagers aged 13-18 years (*n* 428), by age group

	13-15y (n=236)				16-18y (n=192)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
Energy (kcal)	1762	577	1683	(1378-2162)	1890	618	1765	(1517-2247)
Energy (MJ)	7.4	2.4	7.1	(5.8-9.1)	8.0	2.6	7.4	(6.4-9.4)
Protein (%E)	16.1	3.0	15.9	(14.3-17.9)	17.0	4.1	16.4	(14.4-18.8)
Total fat (%E)	35.3	5.4	35.2	(31.7-38.9)	34.5	5.6	34.7	(30.7-38.3)
Saturated fat (%E)	14.6	3.3	14.5	(12.0-17.1)	13.7	3.1	13.7	(11.3-16.0)
Monounsaturated fat (%E)	14.5	3.0	14.4	(12.4-16.0)	14.3	2.8	14.0	(12.5-16.0)
Polyunsaturated fat (%E)	6.0	1.5	5.8	(4.9-6.9)	6.2	1.9	5.9	(5.0-7.4)
Carbohydrate (%E)	47.9	5.4	48.0	(44.8-51.6)	47.4	6.2	47.8	(44.0-51.3)
Total sugars (%E)	16.1	4.7	15.8	(12.7-18.9)	15.1	5.1	15.0	(11.5-18.6)
Free sugars (%E)	8.7	4.3	8.2	(5.6-11.6)	8.0	4.6	7.3	(4.2-10.9)
Dietary fibre (g/10MJ)	22.5	5.2	21.9	(18.8-25.7)	23.1	6.3	22.3	(18.4-26.2)
Sodium (mg/10MJ)	2748	628	2662	(2320-3111)	2782	741	2704	(2268-3145)
Vitamin A (ug/10MJ)	803	531	673	(434-1037)	814	587	697	(436-1030)
Vitamin D (µg/10MJ)	3.9	2.9	3.2	(1.8-4.9)	4.6	3.8	3.6	(2.1-5.8)
Riboflavin (mg/10MJ)	2.1	0.84	2.0	(1.5-2.7)	2.2	1.0	1.9	(1.5-2.7)
Vitamin B6 (mg/10MJ)	2.2	0.75	2.1	(1.7-2.6)	2.4	1.1	2.2	(1.8-2.7)
DFE (µg/10MJ)	354.9	176.1	304.3	(228-445)	367.2	200.6	315.5	(240-438)
Vitamin C (mg/10MJ)	87.6	62.7	75.3	(42.3-116)	81.8	58.3	65.5	(44.0-109)
Calcium (mg/10MJ)	1064	318	1009	(850-1222)	1048	333	996	(825-1231)
Iron (mg/10MJ)	13.7	4.0	13.2	(10.8-16.0)	15.0	5.1	14.4	(11.6-17.4)

%E: percentage of total energy

DFE: Dietary Folate Equivalents

No statistical differences ($P < 0.001$) in intakes were noted between younger teenagers (13-15y) and older teenagers (16-18y)

Table 3 Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in teenagers aged 13-18 years (n 428), by social class group

	Professional workers (n=242)				Non-manual workers (n=75)				Skilled manual workers (n=63)				Semi-skilled/unskilled workers (n=39)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P12-P75)
Energy (kcal)	1830	578	1728	(1457-2214)	1797	691	1689	(1211-2153)	1840	560	1754	(1436-2287)	1773	627	1743	(1444-2105)
Energy (MJ)	7.7	2.4	7.3	(6.1-9.3)	7.6	2.9	7.1	(5.1-9.1)	7.7	2.3	7.4	(6.0-9.6)	7.5	2.6	7.3	(6.1-8.9)
Protein (%E)	16.7	3.8	16.2	(14.5-18.5)	16.1	2.8	16.0	(13.7-18.5)	16.6	4.2	16.2	(14.3-18.5)	16.1	2.8	15.5	(14.4-17.5)
Total fat (%E)	34.6	5.5	34.7	(30.5-38.4)	36.1	5.8	36.1	(33.0-39.2)	34.7	5.3	35.2	(30.5-38.9)	35.0	5.2	34.9	(32.2-37.8)
Saturated fat (%E)	14.2	3.3	14.2	(11.6-16.4)	14.6	2.8	14.5	(12.4-16.8)	14.2	3.2	14.0	(11.7-16.5)	14.0	3.5	13.6	(11.2-16.7)
Monounsaturated fat (%E)	14.2	2.7	14.0	(12.2-15.9)	15.1	3.8	14.8	(12.8-16.8)	14.4	2.6	14.2	(12.2-16.3)	14.5	2.8	14.6	(12.8-15.9)
Polyunsaturated fat (%E)	6.1	1.7	5.8	(4.9-7.0)	6.1	1.8	5.9	(5.1-7.2)	6.0	1.5	5.8	(4.8-6.8)	6.3	1.6	5.9	(5.0-7.7)
Carbohydrate (%E)	47.8	6.0	48.2	(44.0-51.6)	46.9	5.5	46.9	(44.0-50.2)	47.7	5.6	47.6	(44.4-52.1)	47.9	5.6	47.8	(45.2-51.0)
Total sugars (%E)	15.7	5.0	15.6	(12.3-18.8)	15.5	4.6	15.5	(12.4-18.2)	15.6	5.0	14.9	(12.1-19.0)	15.4	4.9	15.2	(12.7-18.6)
Free sugars (%E)	8.1	4.4	7.5	(4.8-11.0)	8.7	4.4	8.3	(5.0-11.9)	8.7	4.7	7.9	(5.0-12.2)	8.5	4.5	8.3	(4.3-12.0)
Dietary fibre (g/10MJ)	23.2	5.7	22.4	(19.2-26.3)	21.6	5.8	21.5	(17.1-25.5)	22.8	5.4	22.4	(19.1-25.3)	22.7	6.0	21.9	(17.0-27.3)
Sodium (mg/10MJ)	2803	730	2695	(2303-3143)	2706	622	2651	(2341-3106)	2734	595	2761	(2328-3097)	2664	597	2621	(2263-3036)
Total vitamin A (ug/10MJ)	829	535	705	(453-1043)	781	728	589	(351-1039)	722	433	601	(463-865)	931	508	916	(489-1305)
Vitamin D (µg/10MJ)	4.6	3.6	3.7	(2.3-5.8)	4.1	3.5	2.9	(1.8-5.4)	3.3	2.1	2.9	(1.9-4.0)	3.8	3.0	2.8	(1.8-4.3)
Riboflavin (mg/10MJ)	2.2	0.9	2.0	(1.5-2.7)	2.2	1.0	2.1	(1.5-2.8)	2.0	0.7	1.8	(1.5-2.4)	2.0	0.9	1.8	(1.3-2.7)
Vitamin B6 (mg/10MJ)	2.3	0.9	2.2	(1.8-2.7)	2.4	1.3	2.1	(1.7-2.6)	2.1	0.7	2.1	(1.7-2.5)	2.2	0.7	2.1	(1.7-2.6)
DFE (µg/10MJ)	381	201	325	(251-476)	345	189	283	(228-413)	324	156	291	(219-38.0)	336	140	337	(225-449)
Vitamin C (mg/10MJ)	88.6	59.7	75.7	(44.5-123)	77.4	57.0	65.3	(34.8-104)	76.4	58.0	62.8	(42.6-104)	90.6	76.6	54.5	(45.2-113)
Calcium (mg/10MJ)	1076	315	1038	(874-1246)	1065	334	1019	(812-1289)	1004	315	951	(756-1143)	1046	374	953	(809-1194)
Iron (mg/10MJ)	14.6	4.8	14.0	(11.3-17.1)	14.0	4.6	13.1	(10.8-15.7)	14.2	3.9	13.5	(10.8-16.4)	13.3	4.1	12.5	(10.6-16.1)

Excludes 9 missing values where information on social class was not obtained from participants

%E: percentage of total energy

DFE: Dietary Folate Equivalents

No statistical differences (P<0.001) in intakes were noted between teenagers belonging to the four social class groups

Table 4 Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in teenagers aged 13-18 years (*n* 428), by parental education group

	Primary/intermediate (n=31)				Secondary (n=51)				Tertiary (n=344)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
Energy (kcal)	1737	685	1667	(1267-2004)	1719	613	1612	(1278-2152)	1838	586	1740	(1456-2219)
Energy (MJ)	7.3	2.9	7.0	(5.3-8.4)	7.2	2.6	6.8	(5.4-9.1)	7.7	2.5	7.3	(6.1-9.4)
Protein (%E)	15.9	3.7	15.6	(13.0-18.3)	17.1	4.4	16.3	(14.8-18.5)	16.5	3.4	16.1	(14.3-18.4)
Total fat (%E)	35.4	6.4	35.5	(30.5-38.7)	35.0	5.0	35.6	(31.6-38.2)	34.9	5.5	34.9	(31.0-38.5)
Saturated fat (%E)	13.2	3.2	12.7	(11.0-16.2)	14.6	3.3	14.3	(12.1-17.1)	14.2	3.2	14.2	(11.7-16.4)
Monounsaturated fat (%E)	15.3	4.0	14.8	(12.7-16.9)	14.4	2.6	14.4	(12.5-16.3)	14.4	2.9	14.2	(12.4-15.9)
Polyunsaturated fat (%E)	6.7	1.8	6.4	(5.4-8.2)	5.8	1.8	5.4	(4.5-6.8)	6.1	1.6	5.9	(5.0-7.0)
Carbohydrate (%E)	47.5	6.6	47.0	(43.7-51.2)	46.8	5.0	46.7	(44.0-50.2)	47.8	5.8	48.0	(44.4-51.6)
Total sugars (%E)	16.3	5.4	15.3	(12.8-20.1)	15.5	5.3	15.7	(12.7-18.2)	15.6	4.8	15.3	(12.2-18.7)
Free sugars (%E)	9.5	4.4	9.7	(7.2-13.2)	8.9	4.9	8.6	(5.7-12.0)	8.2	4.4	7.6	(4.9-11.0)
Dietary fibre (g/10MJ)	21.4	6.2	19.9	(17.0-24.2)	21.7	5.3	20.9	(17.7-25.3)	23.0	5.7	22.4	(19.0-26.1)
Sodium (mg/10MJ)	2927	674	2925	(2415-3229)	2829	783	2846	(2304-3135)	2737	664	2650	(2298-3112)
Vitamin A (ug/10MJ)	693	441	603	(351-979)	712	426	618	(349-970)	830	580	693	(444-1051)
Vitamin D (µg/10MJ)	2.8	1.5	2.6	(1.6-3.7)	3.4	2.5	2.8	(1.8-4.5)	4.4	3.5	3.4	(2.1-5.6)
Riboflavin (mg/10MJ)	2.2	1.2	1.9	(1.3-2.9)	2.1	0.9	2.1	(1.3-2.7)	2.2	0.9	2.0	(1.5-2.6)
Vitamin B6 (mg/10MJ)	2.6	1.3	2.5	(1.6-2.7)	2.5	1.4	2.2	(1.9-2.6)	2.2	0.8	2.1	(1.7-2.6)
DFE (µg/10MJ)	296	133	258	(188-386)	348	174	297	(238-425)	368	193	318	(238-457)
Vitamin C (mg/10MJ)	69.6	61.2	48.2	(23.3-96.9)	93.5	81.6	69.4	(44.5-110)	85.2	57.2	74.6	(43.8-114)
Calcium (mg/10MJ)	989	410	896	(652-1202)	1078	339	1069	(823-1289)	1059	315	999	(850-1226)
Iron (mg/10MJ)	12.3	3.6	12.3	(9.5-15.5)	14.1	4.6	13.0	(10.9-17.0)	14.5	4.6	13.9	(11.2-16.9)

Excludes 2 missing values where information on parental education was not obtained from participants

%E: percentage of total energy

DFE: Dietary Folate Equivalents

No statistical differences ($P < 0.001$) in intakes were noted between parental education groups

Table 5 Mean daily intake of energy and nutrients (% E or /10MJ) from food sources only in teenagers aged 13-18 years (*n* 428), by BMI classification

	Healthy weight (<i>n</i> =310)				Overweight/ obese (<i>n</i> =92)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
Energy (kcal)	1829	588	1728	(1458-2189)	1794	652	1666	(1374-2242)
Energy (MJ)	7.7	2.5	7.3	(6.1-9.2)	7.5	2.7	7.0	(5.8-9.4)
Protein (%E)	16.4	3.3	16.2	(14.2-18.1)	16.7	4.5	16.1	(14.4-18.9)
Total fat (%E)	35.0	5.4	35.0	(31.7-38.5)	35.0	5.9	35.3	(30.4-38.7)
Saturated fat (%E)	14.4	3.3	14.3	(11.8-16.7)	13.7	3.2	13.5	(11.5-15.9)
Monounsaturated fat (%E)	14.4	2.8	14.4	(12.5-16.0)	14.7	3.3	14.4	(12.4-16.7)
Polyunsaturated fat (%E)	6.1	1.6	5.8	(4.9-7.0)	6.4	2.0	6.1	(4.9-7.8)
Carbohydrate (%E)	47.7	5.8	47.9	(44.3-51.4)	47.5	6.2	47.1	(44.0-53.2)
Total sugars (%E)	15.5	4.8	15.3	(12.4-18.4)	16.2	5.1	15.8	(12.0-19.7)
Free sugars (%E)	8.3	4.4	7.8	(5.0-11.0)	8.9	4.6	8.1	(5.0-12.4)
Dietary fibre (g/10MJ)	22.8	5.7	22.1	(18.8-26.1)	22.0	5.5	21.6	(18.0-25.3)
Sodium (mg/10MJ)	2764	686	2678	(2311-3111)	2800	683	2737	(2355-3224)
Vitamin A (ug/10MJ)	822	593	665	(428-1079)	744	447	685	(432-949)
Vitamin D (µg/10MJ)	4.1	3.2	3.3	(1.9-5.4)	4.2	3.4	3.2	(2.2-5.0)
Riboflavin (mg/10MJ)	2.1	0.9	2.0	(1.5-2.7)	2.2	1.0	2.1	(1.4-2.7)
Vitamin B6 (mg/10MJ)	2.3	1.0	2.1	(1.7-2.6)	2.4	0.8	2.2	(1.8-2.7)
DFE (µg/10MJ)	356	185	311	(233-425)	371	189	312	(237-498)
Vitamin C (mg/10MJ)	84.0	60.3	69.5	(41.6-111)	87.8	60.5	73.2	(43.9-123)
Calcium (mg/10MJ)	1048	303	1008	(833-1203)	1069	358	975	(854-1254)
Iron (mg/10MJ)	14.4	4.6	13.9	(11.2-16.6)	13.9	4.6	12.6	(10.5-16.3)

Excludes 26 participants where anthropometric measurements were not obtained (*n* 3) from the participant, or where the participant's BMI indicated thinness (*n* 23) .

'Overweight/obese' includes 64 participants classified as having overweight and 28 participants classified as having obesity.

%E: percentage of total energy

DFE: Dietary Folate Equivalents

No statistical differences ($P < 0.001$) in intakes were noted between teenagers with a healthy BMI (18.5-24.9 kg/m²) and those classified as having overweight and obesity (>25.0 kg/m²)

Table 6 Mean daily intake of food groups (g/10MJ) in teenagers aged 13-18 years (*n* 428) in the total population and by sex

	All (n=428)				Boys (n=212)				Girls (n=216)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
	g/10MJ				g/10MJ				g/10MJ			
Total Bread	114	67.4	104	(67.5-157)	121	68.4	108	(68.6-168)	108	65.9	103	(62.3-141)
<i>of which</i>												
White Bread	77.3	63.7	66.9	(27.2-113)	87.9	67.0	78.6	(34.8-130)	66.8*	58.6	55.9	(21.0-100)
Wholemeal & brown bread	25.1†	39.4	0.00	(0.00-41.3)	21.7	35.4	0.00	(0.00-31.3)	28.5	42.8	0.00	(0.00-47.1)
Breakfast cereals	63.8	77.4	42.2	(0.00-92.9)	72.6	84.8	49.6	(14.3-99.2)	55.2	68.4	39.5	(0.00-83.0)
<i>of which</i>												
Ready-to-eat breakfast cereals	39.2	41.9	29.1	(0.00-61.6)	43.9	44.1	32.4	(0.00-69.2)	34.6	39.2	23.6	(0.00-53.1)
<i>high-fibre cereals (≥6g/100g)</i>	22.0	33.4	0.00	(0.00-37.6)	26.0	37.0	0.00	(0.00-45.2)	18.1	29.0	0.00	(0.00-29.6)
<i>low-fibre cereals (<6g/100g)</i>	17.2	32.1	0.00	(0.00-23.5)	18.0	33.1	0.00	(0.00-23.5)	16.5	31.1	0.00	(0.00-23.8)
Porridge & hot oats cereals (made up)	24.6	69.8	0.00	(0.00-0.00)	28.7	77.8	0.00	(0.00-0.00)	20.5	60.8	0.00	(0.00-0.00)
Potatoes & potato products	113	91.2	94.1	(50.0-156)	109	86.5	92.3	(48.5-149)	117	95.6	102	(53.7-170)
<i>of which</i>												
Boiled, baked & mashed potatoes	51.0	69.4	29.3	(0.00-79.2)	51.8	67.5	31.3	(0.00-81.2)	50.2	71.5	22.7	(0.00-76.9)
Chipped, fried, roasted, processed & homemade potato products	62.0	62.7	52.4	(0.00-93.4)	56.9	61.2	44.8	(0.00-89.9)	67.0	64.0	60.1	(0.00-105)
Total Milk	218	223	164	(44.0-329)	263	255	206.6	(56.6-369)	175*	178	128	(36.5-258)
<i>of which</i>												
Whole milk	135	204	22.1	(0.00-212)	163	240	37.4	(0.00-277)	107	157	9.2	(0.00-179)
Reduced fat milk	75.6†	161.2	0.00	(0.00-68.5)	98.4	194.3	0.00	(0.00-113)	53.3	116.5	0.00	(0.00-43.8)
Non-dairy alternatives	7.8	43.1	0.00	(0.00-0.00)	1.0	12.8	0.00	(0.00-0.00)	14.6	58.7	0.00	(0.00-0.00)
Total meat	220	120	211	(135-277)	224	116	215	(145-276)	215	124	204	(125-284)
<i>of which</i>												
Meat dishes	83.2	102	54.7	(0.00-130)	78.1	95.3	54.3	(0.00-120)	88.2	107.4	59.6	(0.00-139)
Fresh meat	57.6	61.3	45.8	(0.00-83.3)	64.6	67.6	52.5	(1.2-89.1)	50.8	53.6	40.6	(0.00-78.7)
Processed meat	78.7†	64.7	64.3	(26.5-115)	81.2	62.3	66.4	(29.8-124)	76.2	67.0	59.9	(23.5-113)
Total fruit and vegetables	253	206	203	(90.6-381)	221.7	179.9	162.2	(84.3-348)	283.4	224.4	240.8	(95.6-438)
Total Fruit	173	178	113	(32.1-279)	157	162	109	(31.9-252)	188	192	124	(32.1-317)
<i>of which</i>												
Discrete fruit	110	130	63.7	(0.00-159)	90.5	107	56.9	(0.00-130)	129	148	76.3	(13.7-193)
Fruit juices & smoothies	62.6	114	0.00	(0.00-81.3)	66.8	119	0.00	(0.00-77.9)	58.5	110	0.00	(0.00-81.6)

Total vegetables	80.3	92.4	58.0	(14.6-104)	64.4	75.8	46.6	(8.2-83.5)	95.8*	104	65.2	(20.2-142)
<i>of which</i>												
Discrete vegetables	70.3	82.5	54.2	(12.7-92.1)	58.5	68.8	41.9	(5.2-79.2)	82.0	92.7	60.7	(18.5-106)
Vegetable dishes	9.9	35.4	0.00	(0.00-0.00)	5.9	26.2	0.00	(0.00-0.00)	13.9	42.3	0.00	(0.00-0.00)
Total confectionery/snacks	102	67.0	92.6	(56.6-142)	95.2	66.6	83.0	(42.3-135)	109.2	66.9	100.0	(63.5-147)
<i>of which</i>												
Biscuits, crackers, cakes, pastries, buns & desserts	52.9	55.5	38.6	(12.7-73.3)	48.7	54.1	33.7	(9.3-67.8)	57.0	56.6	44.8	(14.0-80.8)
Chocolate, sweets, savoury snacks, sugars & preserves	42.8	39.3	32.5	(13.2-63.0)	40.7	38.3	28.8	(12.3-57.8)	44.9	40.3	36.7	(15.4-65.1)
Cereal bars	6.6	16.8	0.00	(0.00-0.00)	5.8	14.2	0.00	(0.00-0.00)	7.3	18.9	0.00	(0.00-0.00)
Water as a beverage	1199	993	1008	(495-1630)	1065	940	900	(403-1507)	1332	1028	1075	(611-1724)
Soft drinks (added sugar)	96.8	158	0.00	(0.00-143)	101	161	0.00	(0.00-151)	92.9	156	0.00	(0.00-140)
Soft drinks (no added sugar)	58.6†	127	0.00	(0.00-45.5)	67.5	135	0.00	(0.00-58.6)	49.8	120	0.00	(0.00-14.5)
Energy drinks	13.4	70.4	0.00	(0.00-0.00)	19.7	87.3	0.00	(0.00-0.00)	7.2	48.0	0.00	(0.00-0.00)

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products;

† Statistically different from that of previous value in the same column via Wilcoxon Signed Rank Test and adjusted for multiple testing

* Statistically different (P < 0.001) from that of boys within the rows via Independent Samples T Test and adjusted for multiple testing

Table 7 Mean daily intake of food groups (g/10MJ) in teenagers aged 13-18 years (n 428), by age group

	13-15y (n=236)				16-18y (n=192)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
	g/10MJ				g/10MJ			
Total Bread	114	66.8	103	(67.5-156)	115	68.3	105	(66.3-158)
of which								
White Bread	79.6	64.3	68.6	(29.3-116)	74.4	62.9	62.2	(22.9-110)
Wholemeal & brown bread	22.9	38.1	0.00	(0.00-32.1)	27.9	41.0	0.00	(0.00-49.9)
Breakfast cereals	65.1	77.8	44.4	(8.2-93.4)	62.2	77.1	39.8	(0.00-86.8)
of which								
Ready-to-eat breakfast cereals	40.9	42.1	30.1	(0.00-66.0)	37.2	41.7	26.9	(0.00-53.9)
<i>high-fibre cereals ($\geq 6\text{g}/100\text{g}$)</i>	23.2	32.7	0.00	(0.00-38.8)	20.5	34.3	0.00	(0.00-33.7)
<i>low-fibre cereals ($< 6\text{g}/100\text{g}$)</i>	17.7	33.7	0.00	(0.00-24.5)	16.7	30.1	0.00	(0.00-23.5)
Porridge & hot oats cereals (made up)	24.2	72.7	0.00	(0.00-0.00)	25.0	66.3	0.00	(0.00-0.00)
Potatoes & potato products	111	89.1	92.4	(48.9-151)	115	93.9	98.5	(53.7-158)
of which								
Boiled, baked & mashed potatoes	47.0	63.0	30.7	(0.00-69.9)	55.9	76.6	27.3	(0.00-88.4)
Chipped, fried, roasted, processed & homemade potato products	64.1	63.7	55.4	(0.00-93.56)	59.5	61.7	48.6	(0.00-93.4)
Total Milk	233	231	166	(49.2-356)	200	213	150	(32.3-270)
of which								
Whole milk	145	209	48.3	(0.00-233)	122	197	0.00	(0-187.712)
Reduced fat milk	82.9	176	0.00	(0.00-63.9)	66.7	140	0.00	(0-71.6329)
Non-dairy alternatives	5.3	37.6	0.00	(0.00-0.00)	10.9	49.0	0.00	(0.00-0.00)
Total meat	218	122	211	(132-276)	221	118	211	(136-282)
of which								
Meat dishes	89.3	107	59.5	(0.00-141)	75.7	94.4	51.7	(0.00-119)
Fresh meat	49.3	52.8	41.1	(0.00-76.4)	67.8	69.1	58.2	(13.1-96.3)
Processed meat	79.7	63.7	66.0	(29.1-114)	77.4	66.1	61.0	(25.1-122)
Total fruit and vegetables	253	214	200	(85.1-385)	253	196	208	(95.6-380)
Total Fruit	183	188	119	(31.3-304)	159	164	105	(33.5-257)
of which								
Discrete fruit	114	138	69.4	(0.00-169)	105	121	62.8	(4.8-157)
Fruit juices & smoothies	69.4	118	0.00	(0.00-95.3)	54.2	110	0.00	(0.00-60.9)

Total vegetables	69.5	72.3	53.7	(16.1-91.5)	93.5	111	62.4	(12.2-126)
of which								
Discrete vegetables	60.8	62.2	49.0	(14.2-87.6)	82.0	101	60.7	(11.3-107)
Vegetable dishes	8.7	31.8	0.00	(0.00-0.00)	11.5	39.4	0.00	(0.00-0.00)
Total confectionery/snacks	105	63.0	99.3	(61.2-144)	99.2	71.7	84.3	(50.4-140)
of which								
Biscuits, crackers, cakes, pastries, buns & desserts	53.6	51.5	45.0	(16.0-72.9)	52.0	60.2	34.4	(8.7-75.6)
Chocolate, sweets, savoury snacks, sugars & preserves	44.2	40.9	32.1	(14.5-63.2)	41.1	37.3	32.9	(12.3-62.5)
Cereal bars	7.0	18.9	0.00	(0.00-0.00)	6.1	13.7	0.00	(0.00-0.00)
Water as a beverage	1071	915	970	(428-1431)	1358	1063	1041	(612-1816)
Soft drinks (added sugar)	99.6	158	0.00	(0.00-151)	93.4	159	0.00	(0.00-141)
Soft drinks (no added sugar)	71.4	146	0.00	(0.00-75.9)	42.8	98.3	0.00	(0.00-8.1)
Energy drinks	7.9	50.3	0.00	(0.00-0.00)	20.1	88.9	0.00	(0.00-0.00)

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

No statistical differences ($P < 0.001$) in intakes were noted between younger teenagers (13-15y) and older teenagers (16-18y)

Table 8 Mean daily intake of food groups (g/10MJ) in teenagers aged 13-18 years (*n* 428), by social class

	Professional workers (n=242)				Non-manual workers (n=75)				Skilled manual workers (n=63)				Semi-skilled/unskilled workers (n=39)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
	g/10 MJ				g/10 MJ				g/10 MJ				g/10 MJ			
Total Bread	118.4	69.7	105	(68.5-163)	111	67.4	103	(65.7-152)	117	64.1	111	(70.7-157)	97.8	58.9	102	(50.0-134)
<i>of which</i>																
White Bread	80.0	68.1	66.9	(25.3-119)	76.7	52.7	70.2	(38.5-111)	79.6	62.9	70.7	(36.0-117)	59.5	56.4	46.0	(14.1-90.0)
Wholemeal & brown bread	26.6	39.7	0.00	(0.00-48.2)	17.4	36.1	0.00	(0.00-21.2)	26.5	40.1	7.8	(0.00-38.4)	29.8	42.3	10.2	(0.00-56.2)
Breakfast cereals	62.7	70.4	44.5	(4.7-94.8)	73.1	89.0	42.2	(10.9-97.5)	53.5	65.8	33.6	(0.00-78.6)	73.6	111	39.5	(0.00-81.3)
<i>of which</i>																
Ready-to-eat breakfast cereals	41.6	43.7	30.1	(0.00-65.0)	43.2	44.0	34.9	(0.00-62.5)	33.3	37.3	26.8	(0.00-47.9)	25.9	30.7	10.9	(0.00-49.8)
<i>high-fibre cereals (≥6g/100g)</i>	22.6	35.2	0.00	(0.00-38.8)	21.2	30.3	0.00	(0.00-37.3)	23.2	34.5	0.00	(0.00-33.6)	18.7	28.0	0.00	(0.00-36.4)
<i>low-fibre cereals (<6g/100g)</i>	19.0	34.6	0.00	(0.00-25.8)	22.1	34.8	0.00	(0.00-31.2)	10.2	24.7	0.00	(0.00-10.0)	7.2	17.0	0.00	(0.00-0.00)
Porridge & hot oats cereals (made up)	21.1	62.3	0.00	(0.00-0.00)	29.8	75.2	0.00	(0.00-0.00)	20.2	57.7	0.00	(0.00-0.00)	47.7	113.5	0.00	(0.00-0.00)
Potatoes & potato products	108	92.3	92.4	(47.7-147)	106	85.2	83.1	(46.8-157)	126	82.3	117.7	(61.7-174)	133	113	117	(57.3-181)
<i>of which</i>																
Boiled, baked & mashed potatoes	50.4	71.2	26.2	(0.00-77.6)	52.9	72.9	32.2	(0.00-74.5)	53.0	58.0	44.4	(0.00-90.3)	54.5	75.2	14.5	(0.00-87.5)
Chipped, fried, roasted, processed & homemade potato products	57.8	62.4	43.6	(0.00-92.5)	53.3	56.6	45.1	(0.00-81.9)	72.9	53.9	75.2	(35.7-101)	78.4	85.4	63.7	(2.7-119)
Total Milk	229	221	173	(54.6-349)	237	219	185	(50.1-347)	156	168	126	(14.5-249)	226	314	125	(21.3-293)
<i>of which</i>																
Whole milk	133	213	0.00	(0.00-212)	165	195	94.7	(0.00-295)	107	131	52.8	(0.00-181)	127	263	0.00	(0.00-173)
Reduced fat milk	86.2	164	0.00	(0.00-112)	67.2	167	0.00	(0.00-41.6)	46.3	118	0.00	(0.00-10.5)	85.0	203	0.00	(0.00-61.4)
Non-dairy alternatives	9.7	49.7	0.00	(0.00-0.00)	4.2	30.4	0.00	(0.00-0.00)	2.6	21.0	0.00	(0.00-0.00)	13.6	51	0.00	(0.00-0.00)
Total meat	218	122	212	(134-278)	218	109	196	(152-263)	230	135	223	(126-286)	210	114	193	(129-273)
<i>of which</i>																
Meat dishes	88.3	106	63.1	(0.00-133)	86.1	98.4	65.2	(0.00-131)	69.2	88.8	33.3	(0.00-106)	71.6	101.0	27.0	(0.00-103)
Fresh meat	57.4	59.9	43.8	(0.00-86.4)	52.8	51.7	44.2	(0.00-79.6)	68.3	76.7	53.6	(23.2-83.8)	52.1	59.3	39.5	(0.00-75.0)
Processed meat	71.9	63.0	55.5	(21.5-106)	79.6	66.5	61.4	(22.7-126)	92.3	62.9	85.4	(47.4-142)	86.5	68.8	68.3	(33.1-128)
Total fruit and vegetables	276	205	230	(118-398)	219	218	138	(59.1-345)	232	187	191	(73.7-405)	229	206	173	(54.8-352)
Total Fruit	193	184	136	(46.9-311)	146	182	91.6	(0.00-196)	160	159	106	(20.7-271)	132	149	75.6	(0.00-211)
<i>of which</i>																
Discrete fruit	119	131	83.1	(24.9-164)	97.7	134	45.2	(0.00-145)	115	134	63.0	(0.00-184)	88.2	119	52.8	(0.00-122)
Fruit juices & smoothies	74.2	127.9	0.00	(0.00-111)	47.8	81.8	0.00	(0.00-75.1)	44.9	87.9	0.00	(0.00-52.6)	43.7	99.4	0.00	(0.00-36.6)
Total vegetables	83.2	94.1	61.8	(15.1-100)	73.4	98.8	52.7	(0.00-96.3)	72.9	67.4	53.1	(22.4-97.4)	97.3	109	62.8	(22.4-131)
<i>of which</i>																
Discrete vegetables	70.8	80.5	56.9	(14.7-91.6)	63.8	88.4	31.8	(0.00-81.8)	68.0	65.6	50.4	(21.6-87.4)	91.5	108	61.8	(10.2-123)
Vegetable dishes	12.3	39.2	0.00	(0.00-0.00)	9.6	42.0	0.00	(0.00-0.00)	4.8	18.3	0.00	(0.00-0.00)	5.9	15.5	0.00	(0.00-0.00)
Total confectionery/snacks	105	70.1	91.5	(59.5-140)	94.7	58.2	93.6	(53.6-142)	102	57.0	99.2	(61.5-134)	105	74.3	97.8	(38.7-156)
<i>of which</i>																
Biscuits, crackers, cakes, pastries, buns & desserts	57.8	61.1	41.2	(16.4-81.0)	41.6	40.9	32.2	(2.9-63.3)	52.2	47.5	38.6	(18.2-72.9)	50.5	57.2	25.8	(9.3-74.0)
Chocolate, sweets, savoury snacks, sugars & preserves	40.3	37.5	29.5	(11.6-60.2)	46.2	43.3	36.3	(19.1-61.8)	47.0	40.1	36.1	(13.2-69.9)	45.8	37.8	27.4	(17.8-77.5)
Cereal bars	7.0	15.7	0.00	(0.00-0.00)	7.0	13.9	0.00	(0.00-8.1)	2.9	7.0	0.00	(0.00-0.00)	8.5	32.2	0.00	(0.00-0.00)

Water as a beverage	1193	970	1031	(510-1569)	1240	1143	988	(504-1620)	1137	936	921	(410-1712)	1224	969	973	(450-1870)
Soft drinks (added sugar)	80.0	130	0.00	(0.00-132)	131	189	46.3	(0.00-208)	87.9	137	0.00	(0.00-126)	117	223	0.00	(0.00-178)
Soft drinks (no added sugar)	40.4	90.6	0.00	(0.00-11.9)	90.2	160	0.00	(0.00-157)	77.2	138	0.00	(0.00-98.5)	51.0	158	0.00	(0.00-0.00)
Energy drinks	11.9	73.1	0.00	(0.00-0.00)	27.3	92.7	0.00	(0.00-0.00)	3.2	18.5	0.00	(0.00-0.00)	6.7	29.4	0.00	(0.00-0.00)

Excludes N missing values where information on social class was not obtained from participants

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

No statistical differences (P<0.001) in intakes were noted between teenagers belonging to the four social class groups

Table 9 Mean daily intake of food groups (g/10MJ) in teenagers aged 13-18 years (n 428), by parental education level

	Primary/intermediate (n=31)				Secondary (n=51)				Tertiary (n=344)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
	g/10 MJ				g/10 MJ				g/10 MJ			
Total Bread	107	59.7	104	(58.1-144)	114	72.0	107	(61.5-158)	115	67.6	104	(68.1-157)
<i>of which</i>												
White Bread	65.3	60.4	51.1	(0.00-120)	79.6	60.9	77.6	(28.4-113)	78.1	64.6	66.3	(28.0-114)
Wholemeal & brown bread	32.2	52.4	0.00	(0.00-53.4)	24.1	43.9	0.00	(0.00-31.3)	24.5	37.4	0.00	(0.00-42.6)
Breakfast cereals	44.5	57.8	27.4	(0.00-66.2)	56.7	73.6	41.4	(0.00-80.2)	66.3	79.4	43.9	(1.6-95.3)
<i>of which</i>												
Ready-to-eat breakfast cereals	24.1	28.3	13.88	(0.00-44.1)	35.7	39.9	28.4	(0.00-52.5)	41.0	43.0	29.6	(0.00-64.1)
<i>high-fibre cereals ($\geq 6\text{g}/100\text{g}$)</i>	15.0	19.6	0.00	(0.00-29.0)	22.2	33.7	0.00	(0.00-39.7)	22.4	34.3	0.00	(0.00-37.6)
<i>low-fibre cereals ($< 6\text{g}/100\text{g}$)</i>	9.1	16.1	0.00	(0.00-16.9)	13.6	27.8	0.00	(0.00-14.0)	18.5	33.7	0.00	(0.00-25.3)
Porridge & hot oats cereals (made up)	20.3	56.1	0.00	(0.00-0.00)	21.0	62.7	0.00	(0.00-0.00)	25.3	72.0	0.00	(0.00-0.00)
Potatoes & potato products	120	93.3	103	(55.5-162)	116	88.5	104	(50.4-174)	113	91.5	93.8	(49.7-154)
<i>of which</i>												
Boiled, baked & mashed potatoes	37.1	54.6	0.0	(0.00-52.4)	47.8	61.2	0.0	(0.00-85.6)	53.0	71.8	31.5	(0.00-81.1)
Chipped, fried, roasted, processed & homemade potato products	83.4	73.3	76.2	(17.0-126)	68.3	62.8	64.3	(0.00-103)	59.5	61.5	47.6	(0.00-89.9)
Total Milk	195	264	131	(10.5-258)	207	224	145	(16.4-328)	222	220	164	(49.4-337)
<i>of which</i>												
Whole milk	92.8	149	0.00	(0.00-175)	136	217	0.00	(0.00-221)	139	207	37.4	(0.00-212)
Reduced fat milk	101	223	0.00	(0.00-150)	66.2	143	0.00	(0.00-79.0)	73.7	157	0.00	(0.00-59.6)
Non-dairy alternatives	0.8	4.3	0.00	(0.00-0.00)	5.5	24.1	0.00	(0.00-0.00)	8.9	47.2	0.00	(0.00-0.00)
Total meat	222	114	223	(130-279)	241	125	205	(142-312)	216	120	211	(133-276)
<i>of which</i>												
Meat dishes	59.4	84.5	33.3	(0.00-97.4)	85.3	96.5	67.2	(0.00-142)	84.7	104	56.8	(0.00-130)
Fresh meat	64.6	83.7	39.5	(0.00-101)	70.6	74.2	63.8	(16.9-94.4)	55.1	56.8	43.8	(0.00-80.9)
Processed meat	98.2	63.4	84.9	(48.2-144)	85.3	66.5	80.4	(31.7-125)	76.2	64.5	61.3	(24.6-112)
Total fruit and vegetables	207	217	110	(51.1-3978)	221	203	139	(55.4-353)	261	205	216.4	(102-384)
Total Fruit	132	160	73.8	(0.00-229)	139.9	156.2	73.0	(0.00-258)	180.6	181.9	120.0	(39.8-295)
<i>of which</i>												
Discrete fruit	109	137	59.1	(0.00-182)	71.0	102.9	20.7	(0.00-128)	115.2	132.3	74.6	(22.8-164)
Fruit juices & smoothies	23.2	86.8	0.00	(0.00-0.00)	68.9	128.0	0.00	(0.00-80.4)	65.4	114.4	0.00	(0.00-90.0)

Total vegetables	74.9	111	36.3	(5.1-82.6)	81.4	93.6	55.4	(7.4-121)	80.6	90.9	60.7	(16.1-97.2)
<i>of which</i>												
Discrete vegetables	67.3	111	25.6	(1.1-80.6)	70.9	84.6	43.0	(7.4-109)	70.5	79.5	55.4	(14.8-91.4)
Vegetable dishes	7.6	19.7	0.00	(0.00-0.00)	10.5	30.9	0.00	(0.00-0.00)	10.1	37.2	0.00	(0.00-0.00)
Total confectionery/snacks	89.5	58.7	70.1	(49.2-140)	98.7	70.8	86.5	(44.3-147)	104	67.4	94.5	(59.0-142)
<i>of which</i>												
Biscuits, crackers, cakes, pastries, buns & desserts	40.2	49.9	26.1	(8.2-53.7)	43.4	45.5	30.8	(13.3-67.9)	55.5	57.3	41.2	(12.7-80.6)
Chocolate, sweets, savoury snacks, sugars & preserves	43.1	43.7	30.9	(6.2-61.2)	45.9	42.2	34.5	(13.1-70.3)	42.3	38.6	32.2	(13.4-63.0)
Cereal bars	6.2	13.4	0.00	(0.00-6.7)	9.5	29.1	0.00	(0.00-12.5)	6.2	14.4	0.00	(0.00-0.00)
Water as a beverage	1138	1155	973	(192-1555)	1251	1066	1026	(371-1728)	1200	971	1011	(510-1626)
Soft drinks (added sugar)	163	255	26.1	(0.00-151)	133	196	70.1	(0.00-189)	86.1	138	0.00	(0.00-136)
Soft drinks (no added sugar)	51.2	101	0.00	(0.00-59.9)	90.1	173	0.00	(0.00-124)	54.9	122	0.00	(0.00-34.6)
Energy drinks	71.2	208	0.00	(0.00-0.00)	26.3	80.9	0.00	(0.00-0.00)	6.4	32.7	0.00	(0.00-0.00)

Excludes N missing values where information on social class was not obtained from participants

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

No statistical differences ($P < 0.001$) in intakes were noted between parental education groups

Table 10 Mean daily intake of food groups (g/10MJ) in teenagers aged 13-18 years (*n* 428), by BMI classification

	Healthy Weight (n=310)				Overweight/obese (n=92)			
	Mean	SD	Median	IQR (P25 - P75)	Mean	SD	Median	IQR (P25 - P75)
	g/10MJ				g/10MJ			
Total Bread	117	66.9	107	(68.5-161)	108	71.0	102	(55.3-147)
<i>of which</i>								
White Bread	78.9	63.6	68.6	(27.0-116)	74.5	64.1	60.8	(27.9-109)
Wholemeal & brown bread	26.5	40.9	0.00	(0.00-43.5)	20.6	32.8	0.00	(0.00-31.8)
Breakfast cereals	61.9	72.3	42.1	(0.00-91.2)	59.5	87.7	39.5	(0.00-81.3)
<i>of which</i>								
Ready-to-eat breakfast cereals	40.1	42.9	29.6	(0.00-62.5)	34.9	39.5	25.0	(0.00-57.4)
<i>high-fibre cereals (≥6g/100g)</i>	22.3	34.3	0.00	(0.00-37.8)	20.5	31.3	0.00	(0.00-38.2)
<i>low-fibre cereals (<6g/100g)</i>	17.8	33.7	0.00	(0.00-23.3)	14.4	26.8	0.00	(0.00-23.1)
Porridge & hot oats cereals (made up)	21.8	63.7	0.00	(0.00-0.00)	24.5	77.8	0.00	(0.00-0.00)
Potatoes & potato products	110	92.0	89.6	(47.9-159)	120	84.1	113	(68.4-145)
<i>of which</i>								
Boiled, baked & mashed potatoes	50.7	70.1	28.1	(0.00-75.5)	47.8	63.5	28.6	(0.00-81.1)
Chipped, fried, roasted, processed & homemade potato products	59.6	63.7	46.7	(0.00-89.0)	72.1	58.9	69.9	(22.2-112)
Total Milk	214	213	164	(41.8-329)	244	262	157	(69.8-357)
<i>of which</i>								
Whole milk	137	198	37.4	(0.00-215)	126	230	0.00	(0.00-160)
Reduced fat milk	68.1	150	0.00	(0.00-40.6)	111	198	0.00	(0.00-166)
Non-dairy alternatives	8.6	46.3	0.00	(0.00-0.00)	7.1	38.0	0.00	(0.00-0.00)
Total meat	220	119	210	(136-276)	211	126	191	(127-273)
<i>of which</i>								
Meat dishes	85.8	105	60.3	(0.00-132)	70.9	90.7	40.2	(0.00-113)
Fresh meat	54.5	55.8	45.1	(0.00-80.2)	63.5	73.8	47.4	(0.00-91.4)
Processed meat	80.1	66.0	63.4	(27.2-123)	76.2	56.5	68.6	(32.7-112)
Total fruit and vegetables	252	201	207	(95.9-373)	248	217	191	(76.6-388)
Total Fruit	174	173	119	(34.3-287)	161	185	94.4	(20.7-243)
<i>of which</i>								
Discrete fruit	112	129	68.2	(0.00-161)	94.8	121	59.2	(0.00-135)
Fruit juices & smoothies	61.6	113	0.00	(0.00-81.9)	66.6	123	0.00	(0.00-77.9)

Total vegetables	78.0	88.2	60.7	(14.5-105)	86.7	104	54.3	(12.4-124)
<i>of which</i>								
Discrete vegetables	68.2	78.4	54.7	(11.9-91.6)	75.9	91.8	51.7	(12.4-96.8)
Vegetable dishes	9.9	35.6	0.00	(0.00-0.00)	10.7	38.0	0.00	(0.00-0.00)
Total confectionery/snacks	102	66.9	92.6	(58.2-140)	102	66.9	97.6	(48.0-146)
<i>of which</i>								
Biscuits, crackers, cakes, pastries, buns & desserts	52.0	52.0	40.8	(14.1-73.5)	53.4	63.2	32.1	(5.8-72.1)
Chocolate, sweets, savoury snacks, sugars & preserves	42.6	39.4	32.6	(13.7-61.3)	44.9	40.9	29.6	(13.1-66.5)
Cereal bars	7.6	18.5	0.00	(0.00-1.3)	3.7	10.7	0.00	(0.00-0.00)
Water as a beverage	1172	984	1002	(481-1569)	1325	1036	1089	(559-1863)
Soft drinks (added sugar and)	89.2	143	0.00	(0.00-137)	134	204	0.00	(0.00-222)
Soft drinks (no added sugar)	51.4	112	0.00	(0.00-28.0)	78.3	167	0.00	(0.00-81.5)
Energy drinks	11.0	56.5	0.00	(0.00-0.00)	24.0	110	0.00	(0.00-0.00)

Excludes 26 participants where anthropometric measurements were not obtained from the participant (*n* 3), or where the participant's BMI indicated thinness (*n* 23).

'Overweight/obese' includes 64 participants classified as having overweight and 28 participants classified as having obesity.

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

No statistical differences ($P < 0.001$) in intakes were noted between teenagers with a healthy BMI (18.5-24.9 kg/m²) and those classified as having overweight and obesity (>25.0 kg/m²) for intakes of selected food groups

Discussion

The aim of this chapter was to examine the dietary quality of teenagers in Ireland and to identify any differences in dietary quality between sex, age group, socio-economic status and weight status. The findings of this study will help to inform strategies to improve the diets of teenagers in Ireland. Current FBDG in Ireland for teenagers (similar to other population groups) recommend basing meals on a variety of vegetables, salad and fruit, choosing wholemeal breads, high-fibre breakfast cereals, reduced fat milk and dairy products, lean meat and protein sources, limiting ‘top shelf foods’ (including sugary drinks) to once or twice a week, drinking plenty of fluids (water is best) and using baking, boiling, stewing and steaming as cooking methods rather than frying (Food Safety Authority of Ireland, 2019). The present study has found that the overall quality of the diet in teenagers needs to be improved with respect to consumption of staple foods recommended in FBDG such as milk, bread, meats and beverages. Moreover, previous findings from the NTFS II show that ‘top shelf’ foods contributed 18% to daily kilocalories as well as 21% to saturated fat intakes, 61% to free sugar intakes and 10% to sodium intakes (Irish Universities Nutrition Alliance, 2021).

Overall, there were very few differences in nutrient and food group intakes across sex, age group, socio-economic status and weight status after adjusting for energy intake. While boys had a higher MDI of energy compared to girls, there were few other differences noted in nutrient and food group intakes. There were no differences in the MDI of energy, nutrients or food groups across categories of age group, socio-economic status or weight status.

Overall dietary quality and differences between sexes and age groups

Findings from the NTFS II show that staple foods for teenagers include breads, potatoes, cereals, milks, meats, fruits and vegetables. Intakes of fruit and vegetables were well below that recommended 5-7 servings, at less than three servings per day. The average consumption of milk was about one glass per day as whole milk rather than reduced fat milk. Only 42% of teenagers consumed wholemeal & brown bread and 45% consumed high-fibre ready-to-eat breakfast cereals. Dietary fibre intakes were also below recommendations, while salt intakes were above recommendations. A large proportion of teenagers had inadequate intakes of calcium (51%) and vitamin

D (94%), vitamin C (48%), folate (33%), vitamin A (28%), riboflavin (20%) and vitamin B6 (14%) (Irish Universities Nutrition Alliance, 2021). Adequate intakes of these nutrients are essential in order to support bone formation, normal cell function and growth and a healthy immune system (European Food Safety Authority 2017, Carr and Maggini, 2017). Additionally, 9% of teenage girls as inadequate intakes of iron, which may lead to iron store depletion due to menstrual blood losses (Moschonis et al., 2013).

The present study has found that the overall dietary quality of teenagers in Ireland is unfavourable as dietary patterns show higher intakes of ‘white bread’ compared to ‘wholemeal & brown bread’ (77g/10MJ vs. 25g/10MJ, $P < .001$), higher intakes of ‘whole milk’ compared to ‘reduced fat milk’ (135g/10MJ vs. 76g/10MJ, $P < .001$), higher intakes of ‘processed meat’ compared to ‘fresh meat’ (79g/10MJ vs. 58g/10MJ, $P < .001$) and higher intakes of ‘soft drinks (added sugar)’ compared to ‘soft drinks (no added sugar)’ leading to intakes of saturated fat, free sugars and salt which are above recommendations and intakes of dietary fibre which are below recommendations. There were no differences between the intakes of ‘high-fibre RTEBC’ compared to ‘low-fibre RTEBC’ or between the intakes of ‘boiled, baked and mashed potatoes’ and ‘chipped, fried, roasted, processed & homemade potato products’.

In Ireland, with the exception of iron, where recommendations are higher for girls than for boys (10mg/day vs. 7mg/day), nutrient recommendations are not generally differentiated by sex. (Food Safety Authority of Ireland, 2011). Furthermore, FBDG for teenagers in Ireland are not differentiated by sex, with the exception of ‘wholemeal cereals and breads, potatoes, pasta and rice’, where the recommended intake for boys is 4-7 servings, depending on physical activity level and the recommended intake for girls is 3-4 servings, depending on physical activity level. Additionally, teenagers have a higher requirement for ‘milk, yogurt and cheese’ than all other age groups (Food Safety Authority of Ireland, 2019). This study found that boys had a higher MDI of energy than girls (8.8MJ vs. 6.5MJ, $P < .001$), as well as higher MDI of riboflavin (2.3mg/10MJ vs. 2.0mg/10MJ, $P < .001$) and calcium (1123mg/10MJ vs. 992mg/10MJ, $P < .001$) which could be attributed to boys having a higher MDI of ‘white bread’ (87.9g/10MJ vs. 66.8g/10MJ, $P < .001$) and ‘total milk’ (263g/10MJ vs. 175g/10MJ, $P < .001$) than girls as it is common for bread to be fortified with calcium

in Ireland and milk is a natural source of calcium and riboflavin. Boys also had a lower MDI of PUFA (5.7%E vs. 6.5%E, $P < .001$) and ‘total vegetables’ (64.4g/10MJ vs. 95.8g/10MJ, $P < .001$) when compared to girls. These differences in dietary intakes between boys and girls could be attributed to different eating styles. For example, it has been reported that girls have been found to be more likely to be motivated by health, weight control, mood and ethical concern than boys (Daly et al., 2022). Findings from other surveys across Europe show that teenage boys (10-18.9y) had higher intakes of energy than girls, but there were generally no differences in the intakes of protein, total fat saturated fat, MUFA, PUFA, carbohydrate, total sugars, free sugars, dietary fibre, sodium, vitamin A, vitamin D, riboflavin, vitamin B6, folate, vitamin C, calcium and iron (with the exception of some countries, where boys had higher intakes of protein, total fat, saturated fat, MUFA, and total carbohydrates than girls and lower intakes of total sugars than girls) based on crude calculations of energy-adjusted intakes from data provided (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Sette et al., 2011, Joffe et al., 2009, Lopes et al., 2017, Royo-Bordonada et al., 2003, Van Rossum et al., 2020, Bates et al., 2020, Turkey Ministry of Health, 2014). Somewhat in keeping with the findings of the present study, findings from other surveys across Europe show that boys generally had higher intakes of ‘total bread’(267-277g/10MJ vs. 222-229g/10MJ) and ‘total meat’(64.7-250g/10MJ vs. 50.8-224g/10MJ) and lower intakes of ‘total fruit and vegetables’ (453-576g/10MJ vs. 598-630g/10MJ), ‘total fruit’ (69.8-132g/10MJ vs. 89.3-197g/10MJ) , fruit juice’(79g/10MJ vs. 98g/10MJ) and ‘total vegetables’(96.8-159g/10MJ vs. 84.0-178g/10MJ) when compared to girls (Elmadfa et al., 2012, Pedersen et al., 2015, Turkey Ministry of Health, 2014).

In Ireland, recommendations for energy, iron and calcium intakes are lower for children and younger teenagers (5-13y) than they are for older teenagers (14-18y), while recommendations for total fat, saturated fat, sugars and vitamin D are not differentiated by age group in this cohort. Additionally, the dietary fibre recommendation is age-dependent for all children and teenagers (age+5g/day) (Food Safety Authority of Ireland, 2011). The present study has found no differences in the MDI of energy, nutrients or food groups between younger and older teenagers. This is somewhat surprising as older teenagers have been shown to have different eating motivators to their younger counterparts as they are more likely to be influenced by

mood and ease of preparation than younger teens (Daly et al., 2022). However, it is worth noting that a review of the literature has found that an inverse association between age and accurate reporting was consistent in teenagers (Forrestal, 2011). Findings from Turkey show that while energy intakes were higher in older teenagers (15-18y) (7.2-8.4MJ vs. 7.1-9.6MJ) when compared to younger teenagers (12-14y), there were no differences in the intakes of any of the nutrients reported for this age group (protein, total fat, saturated fat, MUFA, PUFA, carbohydrate, sodium, dietary fibre, vitamin D, folate, calcium or iron). Moreover, when compared to younger teenagers, older teenagers had higher intakes of ‘total bread’ (222-277g/10MJ vs. 229-267g/10MJ) and ‘total fruit and vegetables’ (453-629g/10MJ vs. 576-598g/10MJ), but lower intakes of ‘total meat’ (50.8-64.7g/10MJ vs. 52.4-80.1g/10MJ) (Turkey Ministry of Health, 2014). Additionally, findings from Sweden show that ‘discretionary food’ (e.g., sweets, chocolate, pizza, cakes and SSB) were consumed consistently by all age groups examined (Lindroos et al., 2021).

Socio-economic status

Reviews of the literature have determined that teenagers with a lower socio-economic status had poorer dietary quality than those with a higher socio-economic status in terms of ‘fruit and vegetable’ and ‘soft drinks’ intakes as well as intakes of fat and refined sugar intakes (Hanson and Chen, 2007, Rasmussen et al., 2006, Darmon and Drewnowski, 2008). The association between socio-economic status has also been more recently examined by surveys carried out in France, Portugal and Sweden and their findings are consistent with the conclusions of these reviews as indicators of socio-economic status, particularly parental education have been shown to have an influence on the dietary quality, with teenagers in a higher socio-economic group generally having better dietary quality than those in a lower socio-economic group, particularly in terms of percent energy from fat and added sugar and daily intakes of food groups such as ‘fruit and vegetables’, ‘processed meat’ and ‘SSB’ as well as dietary quality scores based on adherence to nutrient guidelines and FBDG (Drouillet-Pinard et al., 2017, Vilela et al., 2020, Moraes et al., 2020). Moreover, findings from Cyprus show that children and teenagers where mothers had completed secondary and tertiary education were less likely to have intakes of vitamin B1 and B6 below recommendations, but also more likely to consume more cholesterol than

recommended (Tornaritis et al., 2014). In contrast to these findings from the literature, the present study has found no differences in the intakes of energy, nutrients and food groups between the four social class groups examined or between the four parental education levels. However, the above discussed literature did not examine the relationship between dietary quality and socioeconomic status using energy-adjusted intake data which makes it difficult to make a direct comparison between the findings of the present study and findings from the literature. Additionally, as with findings from children, this study contains a higher proportion of teenagers in a higher social class and a lower proportion of teenagers in a lower social class than the national figures and thus may not fully represent teenagers in this subgroup.

Weight status

Findings from the NTFS II have shown that 24% of teenagers were classified as having overweight or obesity, showing an increase since the previous NTFS where 18% of teenagers were classified as having overweight or obesity (Irish Universities Nutrition Alliance, 2021). A Swedish study which investigated the link between BMI classification and dietary quality showed that teenagers that were classified as having overweight or obesity had lower dietary diversity scores based on adherence to nutrient recommendations and FBDG than teenagers classified as having a healthy BMI (Moraeus et al., 2020). Findings from Greece show that teenagers classified as having overweight or obesity had lower daily intakes of dietary fibre, as well as lower intakes fruits, vegetables, legumes, brown bread and yogurt and higher intakes of snack foods and processed foods such as pizza, sausages and potato chips, but similar intakes of carbohydrate and protein when this was expressed as a percentage of energy intakes when compared to teenagers classified as having a healthy BMI. Additionally, this study carried out in Greece also found that although teenagers classified as having overweight or obesity had lower intakes of niacin and iron, both in teenagers classified as having a healthy BMI and those classified as having overweight or obesity, there was a significant proportion of teenagers in both BMI classifications that did not meet recommendations for folate, vitamin A and iron (Hassapidou et al., 2006). Two separate studies carried out in Australia found modest correlations between BMI z-score and energy intakes and dietary quality scores, but no correlation between BMI z-scores and energy adjusted intakes from, protein, carbohydrate, free sugars and fat (Elliott et al., 2011, Golley et al., 2011, Wong and Louie, 2018). Similarly, a study

carried out in New Zealand found that teenagers classified as having overweight or obesity had similar intakes of energy, and energy adjusted intakes of fat and carbohydrate to the general New Zealand population in the same age group, however this study does identify issues with their data collection and with potential under-reporting (Anderson et al., 2016). Somewhat in keeping with inconsistent findings from the literature, the present study found no differences in the intakes of energy, nutrients or food groups between teenagers who were classified as having a healthy BMI and those classified as having overweight or obesity. While there were mixed messages in the literature regarding the link between BMI classification and dietary quality, where intakes were energy adjusted, findings were findings to those of the present study (i.e., no differences in dietary quality between teenagers classified as having a healthy BMI and those classified as having overweight or obesity). This indicates that there is a need for studies which examine the influence of other lifestyle factors (alongside dietary intakes) on the weight status of teenagers in order to formulate a holistic solution to address the growing obesity issue in teenagers. Additionally, teenagers classified as having overweight/obesity have been found to be more likely to be under-reporters (LioRET et al., 2011, Forrestal, 2011, Rangan et al., 2011). Consequently, it is possible that the lack of differences in the dietary quality between teenagers classified as having a healthy BMI and those classified as having overweight or obesity could be explained by the study population containing more participants classified as having overweight ($n = 64$) than obesity ($n = 28$).

Strengths and limitations

The strengths of this study include the nationally representative sample of teenagers included in the NTFS II and the detailed dietary intake data collected at brand level using a 4-day weighed food diary. Another important strength of this study is that the anthropometric measurements used to calculate BMI were taken by a trained nutritionist in the participant's home, rather than the use of self-reported measurements. Limitations of this study includes the smaller proportion of children with a lower social class and a larger proportion of children with a higher social class compared to the Irish population, however, as dietary quality was found to be poor across all demographic characteristics, this does not affect the recommendations made for future healthy eating policies.

Conclusion

In summary, the overall dietary quality of teenagers in Ireland was found to be unfavourable and there were very few differences observed across sex, age groups and categories of socio-economic status and weight status. This indicates that any healthy eating initiatives aimed at improving the diets of teenagers should target all teenagers, irrespective of these characteristics. Legislation aimed at improving dietary quality on a population level such as taxation of sugar-sweetened beverages as well as minimum taxation on fruit and vegetables have already introduced in Ireland, however, strategies more specific to teenagers, such as a ban on the advertising of unhealthy foods on digital platforms (including social media) which have been introduced in other European countries could be beneficial (European Public Health Alliance, 2019).

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Chapter 6

The association between eating location and dietary quality in teenagers (13-18y) in Ireland

Introduction

According to the World Health Organisation, 340 million children and teenagers aged 5-19 years are living with overweight and obesity, with almost one quarter (24%) of teenagers in Ireland (13-18y) being classified as having overweight and obesity, according to findings from the recent National Teens Food Survey II (NTFS II) (World Health Organization, 2021, Irish Universities Nutrition Alliance, 2021). It is believed that these rates of overweight and obesity are the result of a global increase in the intakes of energy dense foods and an increase in physical inactivity (World Health Organization, 2021). A teenagers' autonomy over their food choices can lead to a diet high in nutrient-poor, energy-dense foods as these are often readily available, inexpensive and socially appealing to teenagers (Neufeld et al., 2022). Understanding where the food consumed by teenagers comes from can help to inform targeted nutrition strategies to improve the nutritional quality of the foods made available to teenagers which may lead to better food choices and a reduction in the rates of overweight and obesity.

Reviews of the literature have identified that there has been a global increase in the consumption of meals 'outside of the home' across all population groups (Janssen et al., 2018, Lachat et al., 2012). This increase in consumption of foods from 'outside of the home' is reflected in findings from large nutrition surveys in the US and Canada, where significant proportions (40-72%) of teenagers have been reported to be consumers of foods from 'outside of the home' (Nishi et al., 2018, Rebolledo et al., 2019). It has been identified that some demographic characteristics such as sex, age group and socio-economic status may have an influence on the consumption of foods from 'outside of the home', however these associations were mixed and inconsistent (Janssen et al., 2018, Adams et al., 2015).

The previous chapter has identified that the dietary quality of teenagers (13-18y) in Ireland was unfavourable. Choices within key food groups such as bread, milk and meat were not in line with food based dietary guidelines (FBDG), with higher intakes of 'white bread' than 'wholemeal & brown bread', higher intakes of 'whole milk' than 'reduced fat milk', higher intakes of 'processed meat' than 'fresh meat'. It has also been shown that this population group have low intakes of fruit and vegetables and a high contribution to energy intakes from 'top shelf' foods (Irish Universities Nutrition

Alliance, 2021). These food choices have resulted in higher intakes of saturated fat, free sugars and salt and lower intakes of dietary fibre than recommended. Furthermore, significant proportions of teenagers had inadequate intakes of vitamin D, calcium, vitamin C, folate, vitamin A, riboflavin and vitamin B6 (Irish Universities Nutrition Alliance, 2021). The previous chapter has also found very few differences in dietary quality across sex, age group or categories of socio-economic and weight status. The literature shows that dietary quality can be influenced by eating location in most population groups, including teenagers (Golper et al., 2021, Toumpakari et al., 2016, Poti et al., 2014, Palla et al., 2020, Ortega et al., 2020).

Food consumed from ‘home’ has been found to be of better dietary quality than food consumed from ‘other people’s homes’ and from ‘outside of the home’, particularly for intakes of ‘non-core foods’ as well as vitamin D, dietary fibre, folate and iron (Golper et al., 2021, Toumpakari et al., 2016). Additionally, foods consumed from some ‘out of home’ locations have been found to be of better dietary quality than others. For example, food consumed from ‘school’ has been associated with better dietary quality than foods consumed from locations which provide food to eat on the go (Poti et al., 2014). According to data from the UK and the US, teenagers are more likely to consume nutrient-poor foods when they are away from home, school or work (Palla et al., 2020, Ortega et al., 2020).

The aim of this chapter was to investigate the association between eating location and dietary quality in teenagers (13-18y) in Ireland and to identify any differences in dietary quality between sex, age groups, or categories of socio-economic status and weight status across different eating locations.

Methods

The analyses for this chapter are based on data from the NTFS II. A detailed survey methodology for the NTFS II including sampling, recruitment, data collection, food quantification and nutrient composition is outlined in chapter 2 and methodology related to dietary quality is outlined in chapter 5. The methods specific to this chapter are outlined below.

Defining eating location

In the context of these analyses, eating location was defined as the location where the food was prepared, irrespective of where it was consumed. This information was provided by the participants in the food diary for each individual eating occasion (any instance when any food or beverages were consumed) in response to an open-ended question ‘where was this meal prepared?’. The data provided for this question was then coded into 13 categories by the nutritionist and further categorised and subcategorised for these analyses as described in **Table 1**. The two main categories were ‘home’ and ‘outside the home’ and it is important to note that in the context of the definition used that foods purchased in a takeaway and consumed at home were coded as ‘outside the home’ whereas lunch prepared at home and brought to/consumed at school was coded as ‘home’. ‘Home’ was then further disaggregated into ‘participant’s own home’ and ‘other homes’ and ‘outside of the home’ was further disaggregated into ‘restaurants & coffee shops’, ‘fast-food/takeaways’, ‘shops’, ‘school’ and ‘other’ locations. The eating location ‘shops’ refers to when the participant purchased and consumed food from a local shop rather than the weekly shop purchased for home use.

Table 1 Breakdown of eating location categories

Location	Location subcategories	Location coding (entered by the nutritionist)
Home	Participant's own home	Home
	Other homes	Friend's home
		Relative/family home
Outside of the home	Shops	Shop bought
	Fast food/takeaways	Fast food chain
		Takeaway (ethnic)
		Takeaway (non-ethnic)
	Restaurants & coffee shops	Restaurant/hotel/public house
		Coffee shop/sandwich bar/delicatessen
	School	School
		After school centre/homework club
	Other locations	Cinema
		Social function

Defining dietary quality

In the context of this chapter, ‘dietary quality’ refers to the energy-adjusted intakes of pre-defined food groups and nutrients. The food groups included in this definition include:

- ‘White bread’ v ‘wholemeal & brown bread’
- ‘High-fibre ready-to-eat breakfast cereals (RTEBC) ($\geq 6\text{g}/100\text{g}$)’ v ‘low-fibre RTEBC ($< 6\text{g}/100\text{g}$)’
- ‘Porridge & hot oat cereals’
- ‘Boiled, baked & mashed potatoes’ v ‘chipped fried, roasted, processed & homemade potato products’
- ‘Whole milk’ v ‘reduced fat milks’
- ‘Fresh meat’ v ‘processed meat’ (products such as bacon, ham, burgers, sausages, meat pies and pastries and other meat products)
- ‘Total fruit & vegetables’
- ‘Total fruit’, including ‘discrete fruit’ and ‘fruit juices & smoothies’
- ‘Total vegetables’, including ‘discrete vegetables’ and ‘vegetable dishes’
- ‘Total confectionery & snacks’, including ‘biscuits, crackers, cakes, pastries, bun & desserts’, ‘chocolate, sweets, savoury snacks, sugars & preserves’ and ‘cereal bars’
- ‘Water consumed as a beverage’
- ‘Soft drinks (added sugar)’ v ‘soft drinks (no added sugar)’

- ‘Energy drinks’

This study also included intakes of the following nutrients in its definition of dietary quality: saturated fat, mono-unsaturated fat (MUFA), poly-unsaturated fat (PUFA), free sugars, dietary fibre, sodium, vitamin A, vitamin D, riboflavin, vitamin B6, dietary folate equivalents (DFE), vitamin C, calcium and iron. The rationale behind the selection of these food groups and nutrients is described in detail in Chapter 5.

Defining socio-economic status and weight status

Data on socio-economic status was collected as part of the ‘health and lifestyle questionnaire’ which was completed by the parent(s)/guardian(s) of each participant as part of the NTFS II. The present study used social class and parental education as indicators of socio-economic status. Details on how this data was used to define socio-economic status and parental education level are outlined in Chapter 2.

Anthropometric measurements were obtained in the home of the participant by a trained nutritionist. In this study, BMI was used as a marker of weight status. Details on how anthropometric measurements were carried out and how weight status was defined are outlined in Chapter 2.

Data analysis

Data analysis was carried out using SPSS® Version 27.0 for Windows (SPSS Inc., Chicago, IL, USA). As the final sample of the NTFS II contained a higher proportion of teenagers of professional workers and a lower proportion of teenagers of semi-skilled and unskilled workers than the national population, a weighting variable was applied when analysing the % contribution to energy intakes in the total population and in consumers only (Table 2). This weighting variable was applied in this analysis as social class was not a variable of interest and was not applied in any other analysis in this chapter. For the present study, data analyses were carried for those who were consumers of food at a given location, except where stated (as total population). Consumers were defined as those who consumed food at a given location at least once during the four-day recording period. Means, standard deviations, medians and interquartile ranges (IQR) were calculated across different locations for eating occasions over the recording period. The percentage contribution of each location to mean daily intake (MDI) of energy was calculated for the total population and by consumers at each location. The percentage contribution of each location to MDI of energy was calculated for consumers at that location only and was also split by sex, age group, BMI classification and indicators of socio-economic status (social class and parental education) to see if there were differences across demographic groups. The MDI of energy and energy-adjusted nutrients and food groups was also calculated from each eating location for consumers at each location and by sex, age group, BMI classification and indicators of socio-economic status.

Statistical analysis

Differences in the contribution (%) of energy at each location to total energy intake in the total population between sexes, age groups and BMI classifications in the total population were calculated using Mann-Whitney U Tests. Differences in the contribution (%) of energy at each location to total energy intake in the total population between social class and parental education groups were calculated using a Kruskal-Wallis test to determine overall differences in intakes between groups and post-hoc Mann-Whitney U Tests to identify where these differences occurred.

Differences in the MDI of energy, nutrients and food groups between ‘home’ and ‘outside of the home’ and between ‘participant’s own home’ and ‘other homes’ were

calculated using Mann-Whitney U Tests. Differences in the MDI of energy nutrients and foods between multiple locations (e.g., ‘restaurants & coffee shops’, ‘shops’, ‘fast food/takeaways’ and ‘school’) were calculated using Kruskal-Wallis tests to determine overall differences and post-hoc Mann-Whitney U Tests to identify where these differences occurred. The Bonferroni adjustment was used to minimise type 1 errors (as a result of multiple testing) by dividing the alpha level (0.05) by the number of comparisons, thus resulting in a significance value of $P < 0.001$.

Results

Eating location characteristics: percentage of consumers, mean number of eating occasions and contribution to energy intake

Table 2 presents the proportion (%) of teenagers who consumed food that was prepared at ‘home’ and ‘outside of the home’, the number of eating occasions in each location and the percentage contribution of energy from foods consumed from ‘home’ and ‘outside of the home’ to the total MDI of energy.

During the recording period, all teenagers (100%) consumed food that was prepared at ‘home’ (‘participant’s own home’: 100%, ‘other homes’: 16%) and 78% of teenagers consumed food that was prepared ‘outside of the home’ (‘shops’: 46%, ‘fast food/takeaways’: 38%, ‘restaurants & coffee shops’: 34%, ‘school’: 24% and ‘other locations’: 4%). Overall, 85% of eating occasions took place at ‘home’ (‘participant’s own home’: 84%, ‘other homes’: 2%). Fifteen percent of eating occasions took place ‘outside of the home’ (‘shops’: 5%, ‘fast food/takeaways’: 3%, ‘restaurants & coffee shops’: 3%, ‘school’: 3%, ‘other locations’: <1%).

In the total population, food consumed from ‘home’ contributed 81% to the MDI of total energy intake (‘participant’s own home’: 79%, ‘other homes’: 2%) and food consumed from ‘outside of the home’ contributed 19% to the MDI of total energy intake (‘fast food/takeaways’: 7%, ‘restaurants & coffee shops’: 5%, ‘shops’: 4%, ‘school’: 2%, ‘other locations’: <1%).

In consumers only, for each location, food consumed at ‘home’ contributed 81% to the MDI of total energy intake (‘participant’s own home’: 79%, ‘other homes’: 11%) and food consumed from ‘outside of the home’ contributed 24% to the MDI of total energy intake (‘fast food/takeaways’: 18%, ‘restaurants & coffee shops’: 16%, ‘other locations’: 10%, ‘school’: 10%, ‘shops’: 9%).

Table 3 presents the contribution (%) of food consumed from each eating location to the MDI of total energy split by sex, age group and BMI classification. Overall, the percentage of energy from food consumed from ‘home’ was higher than that from food consumed from ‘outside of the home’. There were no differences observed in the percent energy from each eating location between sexes, age groups or BMI classifications.

Table 4 presents the contribution (%) of food consumed from each eating location to the MDI of total energy in the total population and split by indicators of socio-economic status (social class and parental education). There were no differences in the contribution (%) of food consumed from each eating location to energy intake between social class groups or between parental education levels, with the exception of ‘fast food/takeaways’ where a higher contribution to the MDI of energy from ‘fast food/takeaways’ was seen in teenagers of parents with primary education only when compared to teenagers of parents with tertiary education (14%E vs. 6%E, $P < .001$).

Mean daily intake of energy and nutrients by eating location

Table 5a presents the MDI of energy and (energy-adjusted) nutrients from food consumed from ‘home’ and ‘outside of the home’ **in consumers at each eating location**. The MDI of energy was higher from food consumed from ‘home’ compared to food consumed from ‘outside of the home’ (1479 kcal vs. 436 kcal, $P < .001$) as were the MDI of protein (17.0%E vs. 13.8%E, $P < .001$), dietary fibre (23.7g/10MJ vs. 18.5g/10MJ, $P < .001$), vitamin A (899µg/10MJ vs. 444µg/10MJ, $P < .001$), vitamin D (4.7µg/10MJ vs. 1.7µg/10MJ, $P < .001$), riboflavin (2.4mg/10MJ vs. 1.3mg/10MJ, $P < .001$), vitamin B6 (2.4mg/10MJ vs. 2.1mg/10MJ), DFE (393µg/10MJ vs. 212µg/10MJ, $P < .001$), vitamin C (92.1mg/10MJ vs. 59.5mg/10MJ, $P < .001$), calcium (1110mg/10MJ vs. 939mg/10MJ, $P < .001$) and iron (15.1mg/10MJ vs. 10.1mg/10MJ, $P < .001$). The MDI of the following nutrients were lower from food consumed from ‘home’ compared to food consumed from ‘outside of the home’: total fat (34.1%E vs. 37.1%E, $P < .001$), MUFA (13.8%E vs. 16.4%E, $P < .001$), PUFA (5.8%E vs. 6.7%, $P < .001$) and free sugars (8.0%E vs. 12.6%E), $P < .001$). There were no differences in the MDI of saturated fat, carbohydrate, total sugars or sodium from food consumed from ‘home’ compared to food consumed from ‘outside of the home’.

Table 5b presents the MDI of energy and (energy-adjusted) nutrients at the ‘participant’s own home’ and at ‘other homes’ **in consumers at each eating location**. The MDI of energy was higher from food consumed from the ‘participant’s own home’ compared to food consumed from ‘other homes’ (1479 kcal vs. 206 kcal, $P < .001$) as were the MDI of PUFA (5.8%E vs. 5.2%E, $P < .001$), dietary fibre (23.7g/10MJ vs. 16.6g/10MJ, $P < .001$), vitamin A (899µg/10MJ vs. 1110µg/10MJ,

$P < .001$), vitamin D ($4.7\mu\text{g}/10\text{MJ}$ vs. $4.2\mu\text{g}/10\text{MJ}$, $P < .001$), riboflavin ($2.4\text{mg}/10\text{MJ}$ vs. $1.8\text{mg}/10\text{MJ}$, $P < .001$), vitamin B6 ($2.4\text{mg}/10\text{MJ}$ vs. $1.9\text{mg}/10\text{MJ}$, $P < .001$), DFE ($393\mu\text{g}/10\text{MJ}$ vs. $348\mu\text{g}/10\text{MJ}$, $P < .001$) and iron ($15.1\text{mg}/10\text{MJ}$ vs. $11.0\text{mg}/10\text{MJ}$, $P < .001$). The MDI vitamin C was lower from food consumed at the ‘participant’s own home’ compared to food consumed from ‘other homes’ ($92.1\text{mg}/10\text{MJ}$ vs. $99.9\text{mg}/10\text{MJ}$, $P < .001$). There were no differences in the MDI of protein, total fat, saturated fat, MUFA, carbohydrate, total sugars, free sugars, sodium and calcium from food consumed from the ‘participant’s own home’ compared to food consumed from ‘other homes’.

Table 5c presents the MDI of energy and (energy-adjusted) nutrients at four ‘out of home’ locations in **in consumers at each eating location**. The MDI of energy was higher from food consumed from ‘fast food/takeaways’ than all other ‘out of home’ locations. The MDI of total sugars and free sugars was higher while the MDI of protein, vitamin A, vitamin D, riboflavin, vitamin B6, DFE, vitamin C, calcium and iron was lower from food consumed from ‘shops’ when compared to all other ‘out of home’ locations. The MDI of MUFA was higher from food consumed from ‘fast food/takeaways’, compared to food consumed from ‘shops’ and ‘school’. The MDI of PUFA was higher from food consumed from ‘fast food/takeaways and restaurants & coffee shops’ than from food consumed from ‘shops’ and ‘school’. The MDI of carbohydrate was higher from food consumed from ‘fast food/takeaways’ and ‘restaurants & coffee shops’ compared to food consumed from ‘shops’. There were no differences in the MDI of total fat and saturated fat between the four ‘out of home’ locations.

Mean daily intake of food groups by eating location

Table 6a presents the energy-adjusted MDI of selected food groups at ‘home’ and ‘outside of the home’ **in consumers at each eating locations**. The MDI of most foods was higher from food consumed from ‘home’ compared to food consumed from ‘outside of the home’, with the exception of the following food groups where the MDI from food consumed from ‘outside of the home’ was higher than food consumed from ‘home’: ‘white bread’ ($81.9\text{g}/10\text{MJ}$ vs. $76.6\text{g}/10\text{MJ}$, $P < .001$), ‘chipped, fried, roasted, processed & homemade potato products’ ($122\text{g}/10\text{MJ}$ vs. $44.2\text{g}/10\text{MJ}$, $P < .001$), ‘total confectionery & snacks’ ($129\text{g}/10\text{MJ}$ vs. $104\text{g}/10\text{MJ}$, $P < .001$),

‘chocolate, sweets, savoury snacks, sugars & preserves’ (69.9g/10MJ vs. 41.2g/10MJ, $P < .001$), ‘cereal bars’ (9.4g/10MJ vs. 7.3g/10MJ, $P < .001$) and ‘water consumed as a beverage’ (1309g/10MJ vs. 1258g/10MJ, $P < .001$). There were no differences in the MDI of ‘non-dairy alternatives’, ‘processed meat’, ‘potato & potato products’, ‘soft drinks (with and without added sugar)’ or ‘energy drinks’ from food consumed from ‘home’ compared to food consumed from ‘outside of the home’.

Table 6b presents the energy-adjusted MDI of selected food groups at the ‘participant’s own home’ and at ‘other homes’ **in consumers at each eating locations**. The MDI of most foods was higher from food consumed from the ‘participant’s own home’ when compared to ‘other homes’. Exceptions to this include the following food groups where the MDI was higher from food consumed from ‘other homes’ than that from food consumed from the ‘participant’s own home’: ‘boiled, baked and mashed potatoes’ (111g/10MJ vs. 61.9g/10MJ, $P < .001$), ‘processed meat’ (82.3g/10MJ vs. 64.7g/10MJ, $P < .001$), ‘biscuits, crackers, cakes, pastries, buns & desserts’ (82.7g/10MJ vs. 54.8g/10MJ, $P < .001$) and ‘chocolate, sweets, savoury snacks & preserves’ (54.8g/10MJ vs. 40.4g/10MJ, $P < .001$). There were no differences in the MDI of ‘porridge & hot oat cereals’, ‘non-dairy alternatives’, ‘vegetable dishes’, ‘cereal bars’, ‘soft drinks (with and without added sugar)’ and ‘energy drinks’ between food consumed from the ‘participant’s own home’ and food consumed from ‘other homes’.

Table 6c presents the energy-adjusted MDI of selected food groups at four ‘out of home’ locations: ‘shops’, ‘fast food/takeaways’, ‘restaurants & coffee shops’ and ‘school’. **in consumers at each eating location**. The MDI of ‘white bread’, ‘RTEBC’, ‘low-fibre RTEBC’, ‘chipped, fried, roasted, processed & homemade potato products’, ‘total meat’, ‘meat dishes’, ‘processed meat’ and ‘total fruit & vegetables’ was lower from food consumed from ‘shops’ when compared to all other ‘out of home’ locations. The MDI of ‘total confectionery & snacks’, ‘biscuits, crackers, cakes, pastries, buns & desserts’, ‘chocolate, sweets, savoury snacks, sugars & preserves’ and ‘cereal bars’ was higher from food consumed from ‘shops’ compared to all other ‘out of home’ locations. The MDI of ‘total fruit’, ‘discrete fruit’, ‘total confectionery & snacks’, ‘chocolate, sweets, savoury snacks, sugars & preserves’ and ‘water consumed as a beverage’ was lowest from food consumed from ‘fast

food/takeaways’. The MDI of ‘total bread’ was highest from food consumed from ‘school’.

The MDI of ‘total bread’ and ‘white bread’ was higher from food consumed from school than that from ‘shops’ and ‘fast food/takeaways’, while the MDI of ‘wholemeal & brown bread’ was higher from foods consumed from ‘school’ than that from ‘fast food/takeaways’. The MDI of ‘RTEBC’ and ‘low-fibre RTEBC’ was lowest from food consumed from ‘shops’ and was higher from food consumed from ‘school’ than that from ‘fast food/takeaways’ and ‘shops’. The MDI of ‘boiled, baked & mashed potatoes’ was higher from food consumed from ‘restaurants & coffee shops’ and ‘school’ than from ‘shops’, while the MDI of ‘chipped, fried, roasted, processed & homemade potato products’ was higher from food consumed from ‘fast food/takeaways’ and lower from food consumed from ‘shops’ compared to all other ‘out of home’ locations. The MDI of ‘total meat’, ‘meat dishes’ and ‘processed meat’ was lower from food consumed from ‘shops’, while the MDI of ‘fresh meat’ was higher from food consumed from ‘restaurants & coffee shops’ compared to all other ‘out of home’ locations. The MDI of ‘total fruit & vegetables’ was lower from food consumed from ‘shops’ compared to all other ‘out of home’ locations and was higher from food consumed from ‘school’ than that from ‘shops’ and ‘fast food/takeaways’. The MDI of ‘total fruit’ and ‘discrete fruit’ was lower from food consumed from ‘fast food/takeaways’ compared to all other ‘out of home’ locations. The MDI of ‘total vegetables’ and ‘discrete vegetables’ was lower from food consumed from ‘shops’ compared to all other ‘out of home’ locations and was higher from food consumed from ‘restaurants/coffee shops’ than that from ‘shops’ and ‘school’. The MDI of ‘total confectionery & snacks’ and ‘chocolate, sweets, savoury snacks, sugars & preserves’ was higher from food consumed from ‘shops’ and was lower from food consumed from ‘fast food/takeaways’ compared to all other ‘out of home’ locations, while the MDI of ‘biscuits, crackers, cakes, pastries, buns & desserts’ was higher from food consumed from ‘shops’ than that from ‘fast food/takeaways’ and the MDI of cereal bars was higher from food consumed from ‘shops’ compared to all other ‘out of home’ locations. The MDI of ‘water consumed as a beverage’ was lowest from food consumed from ‘fast food/takeaways’. The MDI of ‘soft drinks (added sugar)’ was lower from food consumed from ‘school’ than from ‘fast food/takeaways’ and

‘restaurants/coffee shops’, while the MDI of ‘soft drinks (no added sugar)’ was higher from food consumed from ‘restaurants & coffee shops’ than that from ‘school’.

There were no differences in the MDI of ‘breakfast cereals’, ‘high-fibre RTEBC’, ‘porridge & hot oat cereals’, ‘potatoes & potato products’, ‘total milk’ (as well as all types of milk), ‘fruit juices & smoothies’, ‘vegetable dishes’ and ‘energy drinks’ between the different ‘out of home’ locations.

These results are summarised in **table 7**.

Table 2 Proportion of consumers, number of eating occasions over the four-day diary period (mean, SD), and percentage contribution to mean daily energy intake, by eating location*

	<i>n</i>	% Consumers	Number of eating occasions over the 4 days		% Eating occasions	% Eating occasions outside of the home	% Contribution to energy			
			Mean	(SD)			Total population		Consumers only	
							Mean	(SD)	Mean	(SD)
All Homes	428	100	14.8	(4.9)	85.2	-	81.3	(17.7)	81.3	(17.7)
<i>Of which</i>										
Participant's own home	428	100	14.5	(5.0)	83.5	-	79.4	(18.5)	79.4	(18.5)
Other homes	68	15.9	1.8	(2.1)	1.7	-	1.8	(5.7)	11.3	(9.6)
Outside of the home	334	78.0	3.3	(2.2)	14.8	-	18.7	(17.7)	24.1	(16.6)
<i>Of which</i>										
Shops	196	45.8	1.9	(1.3)	5.1	27.1	4.0	(6.5)	8.6	(7.1)
Fast food/takeaways	162	37.9	1.4	(0.73)	3.4	19.6	6.8	(10.6)	17.9	(9.8)
Restaurants & coffee shops	144	33.6	1.8	(1.2)	3.3	17.5	5.2	(9.5)	15.9	(10.2)
School	103	24.1	2.0	(1.5)	2.7	12.2	2.3	(6.3)	9.7	(10.0)
Other locations	16	3.5	1.1	(0.25)	0.3	1.2	0.4	(2.2)	10.1	(5.9)

*Eating location is defined as the location where the meal was prepared, irrespective of where it was consumed

% Contribution to energy has been weighted for social class in order to account for discrepancies between the social class of the NTFS II population and the national population

Table 3 Percent contribution of food consumed from each eating location to mean daily energy intake, by sex, age group and BMI classification

	Sex				Age group				BMI classification			
	Boys (n=212)		Girls (n=216)		13-15y (n=236)		16-18y (n=192)		Healthy weight (n=310)		Overweight and obesity (n=92)	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
	%E											
All Homes	83.4	(17.0)	79.0	(18.1)	81.6	(16.5)	80.7	(19.1)	81.0	(17.7)	81.6	(17.4)
<i>Of which</i>												
Participant's own home	81.6	(17.9)	77.2	(18.7)	79.2	(17.4)	79.7	(19.6)	79.0	(18.6)	80.6	(17.6)
Other homes	1.8	(5.1)	1.7	(5.8)	2.3	(6.6)	1.0	(3.4)	2.1	(5.7)	1.0	(5.2)
Outside of the home	16.6	(17.0)	21.0	(18.1)	18.4	(16.5)	19.3	(19.1)	18.9	(17.7)	18.4	(17.4)
<i>Of which</i>												
Shops	3.9	(6.5)	4.0	(6.3)	3.5	(5.7)	4.5	(7.1)	4.3	(6.5)	3.1	(6.3)
Fast food/takeaways	5.6	(9.3)	8.1	(11.8)	7.0	(10.9)	6.6	(10.4)	6.5	(10.5)	8.1	(11.2)
Restaurants & coffee shops	4.3	(8.5)	6.2	(10.1)	4.6	(8.7)	6.1	(10.1)	5.1	(9.2)	5.3	(9.1)
School	2.4	(6.5)	2.4	(6.5)	2.9	(7.1)	1.9	(5.7)	2.7	(6.7)	1.7	(5.2)
Other locations	0.4	(2.4)	0.4	(2.0)	0.5	(2.5)	0.3	(1.7)	0.4	(2.4)	0.1	(0.87)

Excludes 26 participants where anthropometric measurements were not obtained from the participant (*n* 3), or where the participant's BMI indicated thinness (*n* 23).

'Overweight/obese' includes 64 participants classified as having overweight and 28 participants classified as having obesity.

%E percent energy

*No statistical differences ($P < 0.001$) were noted between sexes, age groups or BMI classifications

Table 4 Percent contribution of food consumed from each eating location to mean daily energy intake, by indicators of socio-economic status (social class and parental education)

	Social class								Parental education					
	Professional workers (n=242)		Non-manual workers (n=75)		Skilled manual workers (n=63)		Semi-skilled/unskilled workers (n=39)		Primary/intermediate (n=31)		Secondary (n=51)		Tertiary (n=344)	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
	%E													
All Homes	82.9	(16.6)	80.7	(17.1)	77.7	(18.1)	81.0	(19.7)	70.9	(20.8)	79.7	(16.7)	82.2	(17.3)
<i>Of which</i>														
Participant's own home	81.3	(17.5)	78.9	(17.3)	75.3	(18.7)	78.9	(20.9)	69.7	(21.0)	79.2	(17.2)	80.3	(18.1)
Other homes	1.6	(4.8)	1.8	(4.8)	2.3	(6.6)	2.1	(8.4)	1.2	(3.8)	0.5	(2.3)	1.9	(5.8)
Outside of the home	17.1	(16.6)	19.3	(17.1)	22.3	(18.1)	19.0	(19.7)	29.1	(20.8)	20.3	(16.7)	17.8	(17.3)
<i>Of which</i>														
Shops	3.7	(6.1)	4.7	(6.7)	3.4	(5.9)	3.5	(6.1)	5.7	(8.2)	4.6	(7.4)	3.7	(6.1)
Fast food/takeaways	5.6	(9.9)	7.0	(11.0)	9.1	(11.1)	7.1	(10.7)	13.6 ^a	(13.6)	7.5 ^{ab}	(11.3)	6.1 ^b	(10.1)
Restaurants & coffee shops	5.2	(9.2)	5.3	(9.9)	5.4	(8.8)	6.0	(11.2)	6.8	(11.0)	6.2	(10.8)	5.0	(9.0)
School	2.3	(6.2)	2.0	(6.1)	3.7	(7.5)	2.3	(7.7)	2.5	(7.8)	2.0	(4.9)	2.5	(6.6)
Other locations	0.4	(2.1)	0.2	(1.4)	0.7	(3.4)	0.2	(1.3)	0.6	(3.3)	0.00	(0.00)	0.40	(2.2)

%E Percent energy

Statistical differences ($P < 0.001$) between parental education levels are denoted by different superscript lowercase letters, no statistical differences were noted between social class groups

Table 5a Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in teenagers aged 13-18 years (*n* 428) at home and outside of the home, in consumers at that location only

	Home (n=428)				Outside of the home (n=334)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR
Energy (kcal)	1479	602	1398	(1080-1813)	436	348	339*	(179-583)
Energy (MJ)	6.2	2.5	5.9	(4.5-7.6)	1.8	1.5	1.4*	(0.75-2.4)
Protein (%E)	17.0	3.9	16.4	(14.4-18.8)	13.8	6.9	13.2*	(9.0-17.1)
Total fat (%E)	34.1	6.1	34.1	(30.0-38.2)	37.1	11.5	38.2*	(32.3-44.1)
Saturated fat (%E)	14.3	3.6	14.2	(11.6-16.9)	13.6	6.4	13.4	(9.5-17.3)
Monounsaturated fat (%E)	13.8	3.2	13.5	(11.8-15.6)	16.4	6.5	16.9*	(12.9-20.0)
Polyunsaturated fat (%E)	5.8	1.8	5.6	(4.6-6.7)	6.7	3.3	6.5*	(4.6-8.5)
Carbohydrate (%E)	48.1	6.5	48.1	(44.2-52.5)	47.8	12.1	46.3	(40.6-52.7)
Total sugars (%E)	16.0	5.5	15.5	(12.3-19.5)	17.2	14.2	14.1	(6.4-23.7)
Free sugars (%E)	8.0	4.6	7.1	(4.5-10.9)	12.6	12.5	9.6*	(3.1-17.5)
Dietary fibre (g/10MJ)	23.7	6.6	23.2	(18.9-27.4)	18.5	8.4	18.0*	(13.8-22.4)
Sodium (mg/10MJ)	2715	717	2619	(2248-3126)	2925	1871	2795	(1952-3602)
Vitamin A (µg/10MJ)	899	651	715	(459-1203)	444	732	241*	(106-505)
Vitamin D (µg/10MJ)	4.7	3.8	3.8	(2.1-6.2)	1.7	2.8	1.1*	(0.39-2.2)
Riboflavin (mg/10MJ)	2.4	1.1	2.2	(1.6-2.9)	1.3	1.3	1.0*	(0.81-1.4)
Vitamin B6 (mg/10MJ)	2.4	1.0	2.2	(1.8-2.7)	2.1	3.6	1.5*	(0.83-2.4)
DFE (µg/10MJ)	393	217	341	(253-481)	212	258	174*	(111-239)
Vitamin C (mg/10MJ)	92.1	70.4	74.3	(41.8-125)	59.5	109	24.0*	(5.5-65.4)
Calcium (mg/10MJ)	1110	365	1049	(856-1281)	939	1741	693*	(460-1076)
Iron (mg/10MJ)	15.1	5.3	14.4	(11.6-17.8)	10.1	4.9	9.6*	(7.5-11.4)

%E: Percentage of total energy

DFE: Dietary folate equivalents

*Statistically different ($P < 0.001$) from that at home within the rows via Mann-Whitney U Test and adjusted for multiple testing

Table 5b Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in teenagers aged 13-18 years (*n* 428) at the participant's own home and at other homes, in consumers at that location only

	Participant's Own Home (n=428)				Other Homes (n=68)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR
Energy (kcal)	1479	602	1398	(1080-1813)	206	212	158*	(86.0-261)
Energy (MJ)	6.2	2.5	5.9	(4.5-7.6)	0.87	0.89	0.66*	(0.36-1.1)
Protein (%E)	17.0	3.9	16.4	(14.4-18.8)	15.4	9.9	14.4	(7.8-20.7)
Total fat (%E)	34.1	6.1	34.1	(30.0-38.2)	34.6	15.3	36.6	(26.5-42.4)
Saturated fat (%E)	14.3	3.6	14.2	(11.6-16.9)	15.8	8.9	15.6	(9.8-21.0)
Monounsaturated fat (%E)	13.8	3.2	13.5	(11.8-15.6)	13.4	7.3	13.2	(8.8-16.6)
Polyunsaturated fat (%E)	5.8	1.8	5.6	(4.6-6.7)	5.2	3.4	4.8*	(2.9-6.8)
Carbohydrate (%E)	48.1	6.5	48.1	(44.2-52.5)	48.0	17.8	47.8	(40.2-55.3)
Total sugars (%E)	16.0	5.5	15.5	(12.3-19.5)	22.8	21.4	19.5	(8.4-29.0)
Free sugars (%E)	8.0	4.6	7.1	(4.5-10.9)	17.1	21.4	11.4	(2.6-24.3)
Dietary fibre (g/10MJ)	23.7	6.6	23.2	(18.9-27.4)	16.6	10.0	15.8*	(10.5-23.7)
Sodium (mg/10MJ)	2715	717	2619	(2248-3126)	3110	4074	2355	(1164-3813)
Vitamin A (ug/10MJ)	899	651	715	(459-1203)	1110	3820	466*	(166-894)
Vitamin D (µg/10MJ)	4.7	3.8	3.8	(2.1-6.2)	4.2	10.1	1.2*	(0.01-3.5)
Riboflavin (mg/10MJ)	2.4	1.1	2.2	(1.6-2.9)	1.8	2.0	1.2*	(0.83-2.0)
Vitamin B6 (mg/10MJ)	2.4	1.0	2.2	(1.8-2.7)	1.9	2.2	1.4*	(0.71-2.8)
DFE (µg/10MJ)	393	217	341	(253-481)	348	584	192*	(65.9-351)
Vitamin C (mg/10MJ)	92.1	70.4	74.3	(41.8-125)	99.9	268.5	30.4*	(2.8-86.1)
Calcium (mg/10MJ)*	1110	365	1049	(856-1281)	1295	1875	769	(463-1516)
Iron (mg/10MJ)	15.1	5.3	14.4	(11.6-17.8)	11.0	7.2	10.0*	(7.9-13.0)

%E: Percentage of total energy

DFE: Dietary folate equivalents

*Statistically different ($P < 0.001$) from that at participant's own home within the rows via Mann-Whitney U Test and adjusted for multiple testing

Table 5c Mean daily intake of energy and nutrients (%E or /10MJ) from food sources only in teens aged 13-18 years (n) at out of home locations

	Shops (n=198)				Fast food/takeaways (n=162)				Restaurants & coffee shops (n=144)				School (n=103)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR	Mean	SD	Median	IQR	Mean	SD	Median	IQR
Energy (kcal)	163	165	127 ^a	(52.8-213)	326	205	266 ^b	(193-407)	273	187	235 ^c	(140-340)	182	221	117 ^a	(48.6-226)
Energy (MJ)	2.7	2.8	2.1 ^a	(0.89-3.6)	1.4	0.86	1.1 ^b	(0.81-1.7)	1.1	0.78	0.98 ^c	(0.59-1.4)	0.76	0.93	0.49 ^a	(0.20-0.95)
Protein (%E)	8.2	6.6	6.3 ^a	(4.7-9.7)	14.8	6.7	14.2 ^b	(10.0-17.9)	16.9	9.1	16.0 ^b	(11.0-20.9)	13.1	6.8	13.3 ^b	(8.5-17.5)
Total fat (%E)	34.2	17.7	37.1	(21.9-48.0)	39.3	8.8	39.0	(34.2-44.5)	38.2	12.5	39.4	(31.8-45.7)	32.5	16.4	35.0	(23.5-44.2)
Saturated fat (%E)	14.8	10.3	14.3	(5.8-22.9)	12.0	5.5	11.3	(7.8-15.6)	14.1	7.6	14.7	(7.8-18.4)	13.1	8.7	12.8	(5.8-19.8)
Monounsaturated fat (%E)	14.6	9.7	14.1 ^a	(7.1-20.1)	18.5	5.8	18.5 ^b	(14.6-21.5)	16.5	6.3	16.7 ^{ab}	(12.6-20.4)	13.5	7.9	13.8 ^a	(8.5-18.8)
Polyunsaturated fat (%E)	4.5	3.5	4.0 ^a	(2.0-6.5)	8.3	4.0	8.0 ^b	(5.2-11.4)	7.4	3.8	7.1 ^b	(4.7-9.7)	5.8	3.6	5.6 ^{ab}	(3.4-8.0)
Carbohydrate (%E)	53.8	20.5	50.2 ^a	(41.6-63.2)	45.5	10.3	45.6 ^b	(39.5-52.7)	43.8	12.9	42.8 ^b	(36.1-49.4)	47.3	20.4	46.8 ^{ab}	(37.8-56.3)
Total sugars (%E)	31.0	21.8	29.5 ^a	(13.0-45.7)	10.4	9.6	8.1 ^b	(3.2-14.7)	14.7	15.4	10.4 ^b	(4.2-20.4)	15.4	21.1	6.9 ^b	(2.7-20.2)
Free sugars (%E)	24.5	20.5	22.4 ^a	(7.9-36.9)	8.0	9.0	5.6 ^b	(0.99-12.9)	11.0	14.9	7.1 ^b	(1.1-15.7)	7.0	12.8	1.6 ^b	(0.24-9.3)
Dietary fibre (g/10MJ)	4.0	4.1	3.2 ^a	(1.6-5.4)	19.6	6.8	19.0 ^b	(15.1-23.1)	17.2	9.1	17.3 ^b	(12.0-20.7)	20.3	12.8	18.8 ^b	(14.3-24.7)
Sodium (mg/10MJ)	705	1551	445 ^a	(202-754)	2870	1454	2862 ^b	(1968-3666)	3075	1898	2853 ^b	(1676-4113)	3074	2009	3407 ^b	(1741-4045)
Vitamin A (ug/10MJ)	145	605	39.8 ^a	(0.00-95.7)	354	842	196 ^b	(68.6-401)	679	1312	341 ^c	(105-784)	505	1192	178 ^{bc}	(10.3-618)
Vitamin D (µg/10MJ)	0.47	3.1	0.001 ^a	(0.00-0.16)	2.1	3.2	1.2 ^{bc}	(0.35-2.7)	2.2	2.3	1.4 ^b	(0.68-3.2)	1.2	1.5	0.88 ^c	(0.00-1.6)
Riboflavin (mg/10MJ)	0.39	0.82	0.20 ^a	(0.09-0.38)	1.2	0.69	1.1 ^b	(0.85-1.4)	1.2	0.74	1.1 ^b	(0.81-1.5)	1.1	1.3	0.99 ^b	(0.50-1.4)
Vitamin B6 (mg/10MJ)	1.6	13.1	0.19 ^a	(0.06-0.44)	1.7	1.2	1.4 ^b	(0.67-2.4)	2.0	1.4	1.8 ^b	(1.2-2.6)	1.9	1.7	1.5 ^b	(0.84-2.4)
DFE (µg/10MJ)	68.6	384	21.5 ^a	(10.6-49.3)	220	154	179 ^b	(126-274)	204	141	186 ^b	(125-261)	247	266	193 ^b	(119-272)
Vitamin C (mg/10MJ)	23.1	108	0.00 ^a	(0.00-8.2)	46.3	83.9	20.2 ^b	(8.3-47.8)	69.0	112	32.4 ^b	(6.1-77.2)	83.9	277	12.1 ^b	(0.00-65.3)
Calcium (mg/10MJ)	259	613	158 ^a	(80.1-242)	747	591	525 ^b	(291-984)	832	500	723 ^b	(413-1200)	924	842	805 ^b	(363-1357)
Iron (mg/10MJ)	1.9	1.3	1.9 ^a	(1.1-2.5)	10.6	7.1	9.2 ^b	(7.2-11.2)	11.2	6.4	10.2 ^b	(7.7-13.0)	10.1	7.5	9.7 ^b	(7.2-12.0)

%E: Percentage of total energy

DFE: Dietary folate equivalent

Statistical differences (P < 0.01) between eating locations are denoted by different superscript lowercase letters

Table 6a Mean daily intake of food groups (g/10MJ) in teenagers aged 13-18 years (*n* 428) at home and outside of home, in consumers at that location only

	Home (n=428)				Outside the home (n=334)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR
	g/10MJ				g/10MJ			
Total Bread	117	79.6	107	(60.0-161)	100	145	41.6*	(0.00-162)
<i>of which</i>								
White Bread	76.6	74.2	60.9	(16.3-115)	81.9	136	0.00*	(0.00-114)
Wholemeal & brown bread	27.4	47.2	0.00	(0.00-44.6)	12.0	58.4	0.00*	(0.00-0.00)
Breakfast cereals	76.6	91.2	53.4	(0.00-107)	1.3	22.9	0.00*	(0.00-0.00)
<i>of which</i>								
Ready-to-eat breakfast cereals	47.5	49.7	37.0	(0.00-75.2)	0.00	0.00	0.00*	(0.00-0.00)
<i>high-fibre cereals (≥6g/100g)</i>	26.3	39.6	0.00	(0.00-44.8)	0.00	0.00	0.00*	(0.00-0.00)
<i>low-fibre cereals (<6g/100g)</i>	76.6	74.2	60.9	(16.3-115)	12.0	58.4	0.00*	(0.00-0.00)
Porridge & hot oats cereals (made up)	29.1	82.7	0.0	(0.00-0.00)	1.3	22.9	0.00*	(0.00-0.00)
Potatoes & potato products	107	108	85.1	(27.2-149)	133	201	0.00	(0.00-205)
<i>of which</i>								
Boiled, baked & mashed potatoes	62.3	90.1	28.2	(0.00-98.2)	10.5	75.2	0.00*	(0.00-0.00)
Chipped, fried, roasted, processed & homemade potato products	44.2	58.7	23.1	(0.00-72.1)	122.4	179.1	0.00*	(0.00-199)
Total Milk	264	266	211	(52.1-380)	38.4	280	0.00*	(0.00-0.00)
<i>of which</i>								
Whole milk	162	239	24.1	(0.00-269)	19.0	160	0.00*	(0.00-0.00)
Reduced fat milk	92.2	201	0.00	(0.00-82.0)	18.8	231	0.00*	(0.00-0.00)
Non-dairy alternatives	9.8	55.7	0.00	(0.00-0.00)	0.5	6.5	0.00	(0.00-0.00)
Total meat	216	132	200	(129-284)	202	224	154*	(0.00-319)
<i>of which</i>								
Meat dishes	88.3	112	53.9	(0.00-139)	51.9	161	0.00*	(0.00-0.00)
Fresh meat	61.0	68.7	48.5	(0.00-87.4)	39.9	107	0.00*	(0.00-0.00)
Processed meat	66.3	64.4	47.8	(15.7-97.5)	109.8	142	39.9	(0.00-185)
Total fruit and vegetables	286	242	243	(90.6-441)	131	388	0.00*	(0.00-103)
Total Fruit	196	209	129	(21.4-313)	95.9	380	0.00*	(0.00-0.00)
<i>of which</i>								
Discrete fruit	123	152	69.1	(0.00-179)	68.7	330	0.00*	(0.00-0.00)
Fruit juices & smoothies	72.8	137	0.00	(0.00-97.7)	27.2	197	0.00*	(0.00-0.00)
Total vegetables	90.2	109	61.2	(10.0-124)	35.0	89.5	0.00*	(0.00-17.5)

<i>of which</i>									
Discrete vegetables	79.8	98.7	54.7	(7.4-105)	28.8	78.3	0.00*	(0.00-14.6)	
Vegetable dishes	10.3	40.5	0.00	(0.00-0.00)	6.3	36.6	0.00*	(0.00-0.00)	
Total confectionery/snacks	104	72.4	90.8	(52.6-144)	129	172	63.2*	(0.00-188)	
<i>of which</i>									
Biscuits, crackers, cakes, pastries, buns & desserts	55.1	61.0	36.4	(5.5-84.5)	49.6	107	0.00*	(0.00-54.3)	
Chocolate, sweets, savoury snacks, sugars & preserves	41.2	39.8	30.2	(10.4-62.3)	69.9	136	0.00*	(0.00-78.7)	
Cereal bars	7.3	20.6	0.00	(0.00-0.00)	9.4	48.7	0.00*	(0.00-0.00)	
Water as a beverage	1258	1106	1027	(453-1706)	1309	2804	652*	(0.00-1559)	
Soft drinks (added sugar)	65.5	154	0.00	(0.00-57.8)	267	618	0.00	(0.00-343)	
Soft drinks (no added sugar)	47.8	120	0.00	(0.00-0.00)	1608	27356	0.00	(0.00-0.00)	
Energy drinks	8.9	65.8	0.00	(0.00-0.00)	57.5	443	0.00	(0.00-0.00)	

%E: percentage of total energy

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

*Statistically different ($P < 0.001$) from that at home within the rows via Mann-Whitney U Test and adjusted for multiple testing

Table 6b Mean daily intake of food groups (g/10MJ) in teenagers aged 13-18 years (n 428) at the participant's own home and at other homes, in consumers at that location only

	Participant's Own Home (n=428)				Other Homes (n=68)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR
	g/10MJ				g/10MJ			
Total Bread	117	80.6	107	(59.5-164)	54.3	120	0.00*	(0.00-34.1)
<i>of which</i>								
White Bread	76.9	74.9	60.9	(16.0-117)	43.9	114	0.00*	(0.00-0.00)
Wholemeal & brown bread	27.3	47.3	0.00	(0.00-44.6)	10.4	44.8	0.00*	(0.00-0.00)
Breakfast cereals	77.3	92.0	54.1	(0.00-111)	39.2	241	0.00*	(0.00-0.00)
<i>of which</i>								
Ready-to-eat breakfast cereals	48.4	50.7	38.3	(0.00-76.8)	43.9	114	0.00*	(0.00-0.00)
<i>high-fibre cereals (≥6g/100g)</i>	26.8	40.4	0.00	(0.00-45.4)	6.8	47.5	0.00*	(0.00-0.00)
<i>low-fibre cereals (<6g/100g)</i>	76.9	74.9	60.9	(16.0-117)	43.9	114	0.00*	(0.00-0.00)
Porridge & hot oats cereals (made up)	28.8	83.0	0.00	(0.00-0.00)	28.7	237.0	0.00	(0.00-0.00)
Potatoes & potato products	106	110	84.4	(22.4-149)	143	342	0.00*	(0.00-24.7)
<i>of which</i>								
Boiled, baked & mashed potatoes	61.9	91.6	25.3	(0.00-98.4)	111	330	0.00*	(0.00-0.00)
Chipped, fried, roasted, processed & homemade potato products	44.4	59.7	22.3	(0.00-73.5)	32.6	102	0.00*	(0.00-0.00)
Total Milk	273	310	217	(54.1-386)	203	669	0.00*	(0.00-0.00)
<i>of which</i>								
Whole milk	170	293	24.1	(0.00-274)	119	503	0.00*	(0.00-0.00)
Reduced fat milk	93.4	199.5	0.00	(0.00-82.0)	83.6	461	0.00*	(0.00-0.00)
Non-dairy alternatives	9.8	55.8	0.00	(0.00-0.00)	0.0	0.0	0.00	(0.00-0.00)
Total meat	216	138	201	(125-285)	190	289	0.00*	(0.00-406)
<i>of which</i>								
Meat dishes	89.7	115.8	52.7	(0.00-142)	62.9	232	0.00	(0.00-0.00)
Fresh meat	62.0	71.8	48.2	(0.00-89.6)	44.5	142	0.00*	(0.00-0.00)
Processed meat	64.7	63.1	47.2	(14.9-96.7)	82.3	174	0.00*	(0.00-75.5)
Total fruit and vegetables	76.9	74.9	60.9	(16.0-117)	43.9	114	0.00*	(0.00-0.00)
Total Fruit	198	211	131	(12.0-313)	30.0	136	0.00*	(0.00-0.00)
<i>of which</i>								
Discrete fruit	124	152	71.2	(0.00-182)	23.0	130	0.00*	(0.00-0.00)
Fruit juices and smoothies	73.9	139	0.00	(0.00-98.6)	7.0	42.9	0.00*	(0.00-0.00)
Total vegetables	90.3	110	61.2	(7.7-124)	59.7	170	0.00*	(0.00-0.00)

<i>of which</i>								
Discrete vegetables	80.2	100	55.0	(3.5-105)	45.5	144	0.00*	(0.00-0.00)
Vegetable dishes	10.2	39.6	0.00	(0.00-0.00)	14.1	95.2	0.00	(0.00-0.00)
Total confectionery/snacks	103	73.3	90.4	(46.8-144)	151	195	52.5	(0.00-252)
<i>of which</i>								
Biscuits, crackers, cakes, pastries, buns & desserts	54.8	61.6	35.2	(0.67-84.3)	82.7	168.0	0.00*	(0.00-81.7)
Chocolate, sweets, savoury snacks, sugars & preserves	40.4	39.5	29.8	(9.9-60.3)	54.8	114.1	0.00*	(0.00-54.7)
Cereal bars	7.2	20.7	0.00	(0.00-0.00)	13.0	73.2	0.00	(0.00-0.00)
Water as a beverage	1258	1106	1034	(465-1696)	1073	1972	0.00*	(0-1301.0484)
Soft drinks (added sugar)	60.0	149	0.00	(0.00-26.0)	437	1205	0.00	(0.00-132)
Soft drinks (no added sugar)	45.3	120	0.00	(0.00-0.00)	3096	24245	0.00	(0.00-0.00)
Energy drinks	8.9	65.8	0.00	(0.00-0.00)	0.0	0.0	0.00	(0.00-0.00)

%E: percentage of total energy

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

*Statistically different ($P < 0.001$) from that at participant's own home within the rows via Mann-Whitney U Test and adjusted for multiple testing

Table 6c Mean daily intake of food groups (g/10MJ) in teenagers aged 3-18 years (*n* 428) at out of home locations: restaurants & coffee shops, fast food/takeaways, shops and school, in consumers at that location only

	Shops (n=198)				Fast food/takeaways (n=162)				Restaurants & coffee shops (n=144)				School (n=103)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR	Mean	SD	Median	IQR	Mean	SD	Median	IQR
	g/10MJ				g/10MJ				g/10MJ				g/10MJ			
Total Bread	64.1	152	0.00 ^a	(0.00-0.00)	59.0	103	0.00 ^{ab}	(0.00-106)	105	154	0.00 ^{bc}	(0.00-169)	210	225	144 ^c	(0.00-384)
<i>of which</i>																
White Bread	45.6	131.0	0.00 ^a	(0.00-0.00)	52.1	99.3	0.00 ^b	(0.00-86.1)	84.9	145	0.00 ^{bc}	(0.00-128)	163	208	0.00 ^c	(0.00-330)
Wholemeal & brown bread	7.5	47.5	0.00 ^{ab}	(0.00-0.00)	2.1	19.5	0.00 ^a	(0.00-0.00)	8.8	45.1	0.00 ^{ab}	(0.00-0.00)	44.1	142	0.00 ^b	(0.00-0.00)
Breakfast cereals	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	4.1	41.2	0.00	(0.00-0.00)
<i>of which</i>																
Ready-to-eat breakfast cereals	45.6	131	0.00 ^a	(0.00-0.00)	52.1	99.3	0.00 ^b	(0.00-86.1)	84.9	145	0.00 ^{bc}	(0.00-128)	163	208	0.00 ^c	(0.00-330)
high-fibre cereals ($\geq 6\text{g}/100\text{g}$)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)
low-fibre cereals ($< 6\text{g}/100\text{g}$)	45.6	131	0.00 ^a	(0.00-0.00)	52.1	99.3	0.00 ^b	(0.00-86.1)	84.9	145	0.00 ^{bc}	(0.00-128)	163	208	0.00 ^c	(0.00-330)
Porridge & hot oats cereals (made up)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	4.1	41.2	0.00	(0.00-0.00)
Potatoes & potato products	8.3	72.0	0.00	(0.00-0.00)	273	258	246	(0.00-387)	143	240	0.00	(0.00-230)	42.7	183	0.00	(0.00-0.00)
<i>of which</i>																
Boiled, baked & mashed potatoes	0.00	0.00	0.00 ^a	(0.00-0.00)	4.5	47.0	0.00 ^{ab}	(0.00-0.00)	35.0	159	0.00 ^b	(0.00-0.00)	9.3	94.3	0.00 ^b	(0.00-0.00)
Chipped, fried, roasted, processed & homemade potato products	8.3	72.0	0.00 ^a	(0.00-0.00)	268	257	243 ^b	(0.00-381)	108	169	0.00 ^c	(0.00-215)	33.4	159	0.00 ^d	(0.00-0.00)
Total Milk	68.8	447	0.00	(0.00-0.00)	41.4	188	0.00	(0.00-0.00)	17.5	127	0.00	(0.00-0.00)	79.9	525	0.00	(0.00-0.00)
<i>of which</i>																
Whole milk	44.6	339	0.00	(0.00-0.00)	20.3	146	0.00	(0.00-0.00)	12.2	121	0.00	(0.00-0.00)	29.9	161	0.00	(0.00-0.00)
Reduced fat milk	22.1	294	0.00	(0.00-0.00)	21.2	122	0.00	(0.00-0.00)	3.6	36.4	0.00	(0.00-0.00)	49.5	503	0.00	(0.00-0.00)
Non-dairy alternatives	2.1	29.7	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	1.7	16.9	0.00	(0.00-0.00)	0.42	4.2	0.00	(0.00-0.00)
Total meat	53.2	141	0.00 ^a	(0.00-0.00)	246.7	299	193 ^b	(0.00-370)	294	291	250 ^b	(0.00-427)	214	275	91.9 ^b	(0.00-327)
<i>of which</i>																
Meat dishes	5.3	60.8	0.00 ^a	(0.00-0.00)	83.8	280	0.00 ^b	(0.00-0.00)	74.0	224	0.00 ^b	(0.00-0.00)	37.7	157	0.00 ^b	(0.00-0.00)
Fresh meat	17.5	67.0	0.00 ^a	(0.00-0.00)	17.9	80.9	0.00 ^{ac}	(0.00-0.00)	96.6	197	0.00 ^b	(0.00-85.7)	16.4	57.5	0.00 ^c	(0.00-0.00)
Processed meat	30.4	106	0.00 ^a	(0.00-0.00)	145	172	71.8 ^b	(0.00-270)	123	173	0.00 ^b	(0.00-229)	160	241	0.00 ^b	(0.00-273)
Total fruit and vegetables	45.6	131	0.00 ^a	(0.00-0.00)	52.1	99.3	0.00 ^b	(0.00-86.1)	84.9	145	0.00 ^{bc}	(0.00-128)	163	208	0.00 ^c	(0.00-330)
Total Fruit	148.6	522	0.00 ^a	(0.00-0.00)	0.86	7.8	0.00 ^b	(0.00-0.00)	73.1	432	0.00 ^a	(0.00-0.00)	340	1147	0.00 ^a	(0.00-0.00)
<i>of which</i>																
Discrete fruit	109.1	435	0.00 ^a	(0.00-0.00)	0.86	7.8	0.00 ^b	(0.00-0.00)	25.5	138	0.00 ^a	(0.00-0.00)	303	1101	0.00 ^a	(0.00-0.00)
Fruit juices and smoothies	39.5	237	0.00	(0.00-0.00)	0.00	0.00	0.00	(0.00-0.00)	47.6	411	0.00	(0.00-0.00)	36.6	354.1	0.00	(0.00-0.00)
Total vegetables	10.9	55.8	0.00 ^a	(0.00-0.00)	36.9	106	0.00 ^{bc}	(0.00-12.7)	74.6	213	0.00 ^b	(0.00-90.9)	38.0	188	0.00 ^c	(0.00-0.00)
<i>of which</i>																
Discrete vegetables	9.3	53.3	0.00 ^a	(0.00-0.00)	23.8	62.3	0.00 ^{bc}	(0.00-9.7)	68.3	210	0.00 ^b	(0.00-39.1)	18.4	74.5	0.00 ^c	(0.00-0.00)
Vegetable dishes	1.6	16.0	0.00	(0.00-0.00)	13.1	77.4	0.00	(0.00-0.00)	6.2	40.9	0.00	(0.00-0.00)	19.5	175.1	0.00	(0.00-0.00)
Total confectionery/snacks	321	279	368 ^a	(0.00-508)	19.3	64.8	0.00 ^b	(0.00-0.00)	72.7	129	0.00 ^c	(0.00-88.6)	80.8	144	0.00 ^c	(0.00-117)
<i>of which</i>																
Biscuits, crackers, cakes, pastries, buns & desserts	94.5	177	0.00 ^a	(0.00-108)	12.9	54.4	0.00 ^b	(0.00-0.00)	47.5	112	0.00 ^{ab}	(0.00-0.00)	29.1	90.2	0.00 ^{ab}	(0.00-0.00)
Chocolate, sweets, savoury snacks, sugars & preserves	203	274	96.2 ^a	(0.00-401)	6.2	37.2	0.00 ^b	(0.00-0.00)	23.3	57.2	0.00 ^c	(0.00-9.1)	46.2	119.2	0.00 ^c	(0.00-0.00)
Cereal bars	23.7	92.1	0.00 ^a	(0.00-0.00)	0.27	3.4	0.00 ^b	(0.00-0.00)	2.0	23.9	0.00 ^b	(0.00-0.00)	5.5	32.6	0.00 ^b	(0.00-0.00)
Water as a beverage	2659	8815	0.00 ^a	(0.00-1990)	563	1388	0.00 ^b	(0.00-735)	853	1255	378 ^a	(0.00-1315)	2056	3575	763 ^a	(0.00-2450)
Soft drinks (added sugar)	324	1228	0.00 ^{ac}	(0.00-0.00)	285	447	0.00 ^b	(0.00-570)	247	625	0.00 ^b	(0.00-0.00)	201	1307	0.00 ^c	(0.00-0.00)

Soft drinks (no added sugar)	4011	38362	0.00 ^{ab}	(0.00-0.00)	220.3	775.1	0.00 ^{ab}	(0.00-0.00)	57.7	213.2	0.00 ^a	(0.00-0.00)	8.6	87.3	0.00 ^b	(0.00-0.00)
Energy drinks	654	6520	0.00	(0.00-0.00)	3.5	33.2	0.00	(0.00-0.00)	3.0	35.5	0.00	(0.00-0.00)	4.3	43.5	0.00	(0.00-0.00)

%E: percentage of total energy

Processed meat: bacon, ham, burgers, sausages, meat pies and pastries and other meat products

Statistical differences (P < 0.001) between eating locations are denoted by different superscript lowercase letters

Table 7: Differences in food group intakes across the four 'out of home' locations

	Shops	Fast food/takeaways	Restaurants & coffee shops	School
Total Bread				↑
<i>of which</i>				
White Bread	↓			
Wholemeal & brown bread				↑*
Breakfast cereals		No differences noted		
<i>of which</i>				
Ready-to-eat breakfast cereals	↓			
<i>high-fibre cereals (≥6g/100g)</i>		No differences noted		
<i>low-fibre cereals (<6g/100g)</i>	↓			
Porridge & hot oats cereals (made up)		No differences noted		
Potatoes & potato products		No differences noted		
<i>of which</i>				
Boiled, baked & mashed potatoes	↓*			
Chipped, fried, roasted, processed & homemade potato products	↓			
Total Milk				
<i>of which</i>				
Whole milk		No differences notes		
Reduced fat milk				
Non-dairy alternatives	↓			
Total meat	↓			
<i>of which</i>				
Meat dishes	↓			
Fresh meat			↑	
Processed meat	↓			
Total fruit and vegetables	↓			
Total Fruit			↓	
<i>of which</i>				
Discrete fruit			↓	
Fruit juices & smoothies		No differences noted		
Total vegetables	↓			

<i>of which</i>				
Discrete vegetables	↓			
Vegetable dishes		No differences noted		
Total confectionery/snacks	↑		↓	
<i>of which</i>				
Biscuits, crackers, cakes, pastries, buns & desserts	↑			
Chocolate, sweets, savoury snacks, sugars & preserves	↑		↓	
Cereal bars	↑			
Water as a beverage			↓	
Soft drinks (added sugar)				↓ **
Soft drinks (no added sugar)				↓ ***
Energy drinks		No differences noted		
<hr/> ↑ higher than from all other location ($P < .001$); ↓ lower than from all other locations ($P < .001$) ↑* higher from 'school' than from 'fast food & takeaways' ($P < .001$); ↓* lower from 'shops' than from 'restaurants & coffee shops' and 'school' ($P < .001$); ↓* lower from 'school' than from 'fast food & takeaways' and 'restaurants & coffee shops' ($P < .001$); ↓*** lower from 'school' than from 'restaurants & coffee shops' ($P < .001$)				

Discussion

The aim of this chapter was to investigate the association between eating location and dietary quality in teenagers (13-18y) in Ireland. The main finding of this study was that 85% of all eating occasions took place at the ‘home’ location (with 84% taking place at the ‘participant’s own home’). The majority (78%) of teenagers consumed food from ‘outside of the home’, however, these locations (primarily including ‘shops’, ‘fast food/takeaways’, ‘restaurants & coffee shops’ and ‘school’) accounted for only 15% of all eating occasions. Whilst the majority of the overall energy intake (81%) came from the ‘home’ location, almost one-fifth of energy intake came from ‘outside of the home’ (19%). There were very few differences observed in these eating patterns across sex, age group or categories of weight or socio-economic status. Exceptions to this were that teenagers of parents with primary/intermediate education only had a higher percentage of energy from food consumed from ‘fast food/takeaways’ than those with tertiary education.

When comparing the dietary quality of food consumed from ‘home’ to that from ‘outside of the home’, food consumed from ‘home’ was of better dietary quality for protein, total fat, free sugars, dietary fibre, vitamin A, vitamin D, riboflavin, vitamin B6, folate, vitamin C, calcium and iron. It was of poorer dietary quality, however, for MUFA and PUFA. When comparing the dietary quality of food consumed from the ‘participant’s own home’ to that of food consumed from ‘other homes’, food consumed from the ‘participant’s own home’ was of better dietary quality for PUFA, dietary fibre, vitamin A, vitamin D, riboflavin, vitamin B6, folate and iron. It was, however, of poorer dietary quality for vitamin C. These differences can be explained by the differences in foods consumed from ‘home’ and the ‘participant’s own home’ when compared to ‘outside of the home’ and ‘other homes’. When compared to food consumed from ‘outside the home’ and ‘other homes’, food consumed from ‘home’ and ‘participant’s own home’ included higher intakes of ‘brown & wholemeal bread’, ‘high-fibre RTEBC’, ‘porridge & hot oat cereals’ (when comparing ‘home’ to ‘outside of the home’ only), ‘boiled baked & mashed potatoes’ (when comparing ‘home’ to ‘outside of the home’ only), ‘reduced fat milk’, ‘fresh meat’ and ‘total fruit & vegetables’ and lower intakes of ‘biscuits, crackers, cakes, pastries, buns & desserts’ (when comparing ‘participant’s own home to ‘other homes’ only) and ‘chocolate, savoury snacks, sugars & preserves’.

Eating location characteristics

Food environments globally have been identified as unfavourable for providing healthy food choices in teenagers with nutrient dense foods being insufficiently accessible and nutrient-poor, energy-dense foods being too readily available, inexpensive and socially desirable to this age cohort (Neufeld et al., 2022). Furthermore, the global increase in consumption of meals ‘outside of the home’ has been associated with poorer dietary quality (Janssen et al., 2018, Lachat et al., 2012). The present study is the first time that the association between eating location and dietary quality has been examined in a nationally representative sample of teenagers (13-18y) in Ireland. The present study has found that all teenagers in Ireland consumed food from ‘home’ with 84% of eating occasions taking place at the ‘participant’s own home’ and a further 2% taking place at ‘other homes’. Whilst the majority of teenagers (78%) consumed food from ‘outside of the home’ during the recording period, only 15% of eating occasions took place ‘outside of the home’ with these locations primarily including ‘shops’, ‘fast food/takeaways’, ‘restaurants & coffee shops’ and ‘school’. Whilst the majority of energy intakes in the current study were from the ‘home’ location (81%), almost one-fifth of energy intakes came from ‘outside of the home’ (19% in the total population and 24% in consumers only). The biggest contributors to this were ‘fast food/takeaways’, ‘restaurants & coffee shops’, ‘school’ and ‘shops’ which contributed on average 18%, 16%, 10% and 9% of energy intake, respectively, in consumers at each eating location. The findings of the present study are in line with findings from similar studies, where although a significant proportion of the population consumed food from ‘outside of the home’, the majority of energy was consumed at the ‘home’ location (Nishi et al., 2018, Rebolledo et al., 2019). Findings from a study carried out on low- and middle- income Chilean children and teenagers show that almost all teenagers consumed food prepared at ‘home’, while 72% consumed food from ‘out of home’ locations with the ‘home’ locations contributing 78% to energy intakes and ‘out of home’ locations contributing 22% (Rebolledo et al., 2019). Findings from a large nutrition survey carried out in Canada have shown that over 90% of teenagers consumed food prepared at home with around 30% of teenagers consuming food from ‘fast food’ locations and around 30% of teenagers consuming food from ‘other’ locations. In comparison to our study, this Canadian study reported a much lower contribution to energy from the ‘home’ location

(54-62% in children and adolescents), with 16-26% coming from ‘fast food/takeaways’ and 18-23% coming from ‘other’ locations (Nishi et al., 2018). Similarly, a large nationally representative study in the US has shown that the ‘home’ location (which included ‘home’ and ‘store-bought’) contributed 65% to daily energy intakes (Poti and Popkin, 2011).

Eating location characteristics by demographics

As identified by a recent review of the literature, there are mixed findings regarding the link between demographic characteristics such as sex, age group, socio-economic status and the consumption of meals from ‘outside of the home’, albeit the majority of studies used in this review were carried out in adult populations (Janssen et al., 2018). The present study has found very few associations between eating location and demographic characteristics. The exception to this was that teenagers of parents with primary/intermediate education only had a higher percentage of energy from food consumed from ‘fast food/takeaways’ than teenagers of parents with tertiary education (13.6%E vs. 6.1%E, $P < .001$). Findings from the National Diet and Nutrition Survey (NDNS 2008-2012) in the UK have reported that children and teenagers living in households of higher occupational social class were significantly less likely to consume take-away meals at home once a week or more than those living in less affluent households, but no association was found between categories of parental education (Adams et al., 2015). As previously mentioned, data from the UK shows a link between the availability of fast food outlets and increasing levels of area deprivation (Public Health England, 2018). Examining the link between indicators of social class and proximity to fast food outlets in Ireland could be a useful step in identifying whether these communities that should be targeted by any future healthy eating legislation such as increasing the availability and accessibility of healthier options.

Dietary quality by eating location

Findings from the National Diet and Nutrition Survey (NDNS) in the UK show that in teenagers, most of the energy coming from ‘non-core foods’ (foods which were classified using specific cut-off points for fat and sugar content using the healthy eating guidelines) was consumed with ‘friends’, whilst the least amount of energy

coming from ‘non-core foods’ was consumed with ‘parents/carers’ and that percent ‘non-core’ energy was higher at ‘friend’s/relative’s house than at ‘home’ (Toumpakari et al., 2016). The present study has found that the dietary quality of food consumed from the ‘participant’s own home’ was better quality than that of food consumed from ‘other homes’ in terms of both nutrient and food group intakes. Overall, food consumed from the ‘participant’s own home’ showed better adherence to FBDG than the food consumed from ‘other homes’ (Food Safety Authority of Ireland, 2019).

Frequent consumption of meals prepared ‘outside of the home’ has been associated with lower intakes of nutrients such as vitamin D, dietary fibre, folate and iron as well as lower intakes of fruit and vegetables based on findings from NHANES in the US (Golper et al., 2021). Similarly, the present study has found that when comparing the ‘home’ location to ‘outside of the home’, food consumed from ‘home’ was of better dietary quality in terms of both nutrient and food group intakes. Food choices are more consistent with FBDG when prepared at ‘home’ when compared to food prepared ‘outside of the home’ (Food Safety Authority of Ireland, 2019). Food consumed from ‘home’ being of better dietary quality to food consumed from ‘outside of the home’ is a common finding in the literature. A study carried out in low- and middle- income Chilean children and adolescents show that while foods obtained at home were less energy dense, energy adjusted intakes of sodium were higher from foods consumed from ‘home’ compared to foods consumed from ‘outside of the home’ and percent energy from saturated fat and total sugars was similar from food consumed from the ‘home’ locations and from food consumed from ‘outside of the home’. This Chilean study also found that the top calorie contributors for foods consumed from ‘home’ were ‘cereal-based foods’, ‘grain-based desserts’, ‘mixed dishes’ and ‘SSB’, while the top calorie contributors ‘outside of the home’ were ‘mixed dishes’, ‘sandwiches’, ‘grain-based desserts’, ‘SSB’ and ‘cereal based foods’ (Rebolledo et al., 2019).

It has been previously established that the dietary quality of food consumed from ‘outside of the home’ is not as favourable as the dietary quality of food consumed from the ‘home’ location, however the literature suggests that the different ‘out of home’ locations can vary, with some locations such as ‘school’ being associated with better dietary quality and others such as ‘fast food’ being associated with poorer dietary quality based on findings from the US (Poti et al., 2014, Tyrrell et al., 2017). The present study has found that the dietary quality of food consumed from ‘shops’ was

generally poorer than the other ‘out of home’ locations examined, particularly in terms of intakes of protein, total sugars, free sugars, dietary fibre, vitamin A, vitamin D, riboflavin, vitamin B6, folate, vitamin C, calcium and iron. This can be explained by the food group intakes observed from this location. Intakes of ‘total RTEBC’, ‘fresh meat’ and ‘total fruit and vegetables’ were lower while intakes of ‘total confectionery/snacks’ were higher from food consumed from ‘shops’ compared to all other ‘out of home’ locations. These findings indicate that food consumed from ‘shops’ were the least compliant with FBDG of all ‘out of home’ locations examined for teenagers in Ireland. In line with the findings of our study which found that the MDI of ‘total sugar’ and ‘added sugar’ was higher from food consumed from ‘shops’ than from all other ‘out of home locations’, findings from the NHANES show that the percent energy from added sugar was higher from ‘stores’ than from ‘schools’ or ‘fast food’ (Poti et al., 2014). In contrast to findings for children, the present study did not find that ‘school’ provided better dietary quality than the other ‘out of home’ locations. A study carried out in 2007 found that some secondary school pupils had access to tuck shops and vending machines which may not offer the best lunch options in terms of dietary quality (Kelly and Nic Gabhain, 2007), however, more recent data is needed in order to understand if this is still relevant to schools today.

The main types of ‘out of home’ food service establishments available in Ireland were included in the following two categories: ‘restaurants & coffee shops’ and ‘fast food/takeaways’ (Bord Bia, 2021). The present study has found that the food consumed from these two locations was very similar in terms of dietary quality. Although energy intakes were higher from foods consumed from ‘fast food/takeaways’, there were no differences observed between them in terms of nutrient intakes, with the exception of vitamin A, where intakes were higher from food consumed from ‘restaurants & coffee shops’ than from ‘fast food/takeaways’ (676µg/10MJ vs. 145µg/10MJ, $P < .001$). There were some differences, however, in the intakes of food groups from foods consumed from ‘fast food/takeaways’ and ‘restaurants & coffee shops’. Foods consumed from ‘restaurants & coffee shops’ provided higher intakes of ‘fresh meat’ (96.6g/10MJ vs. 17.5g/10MJ, $P < .001$), ‘total fruit’ (73.1g/10MJ vs. 0.86g/10MJ, $P < .001$) as well as ‘total confectionery & snacks’ (72.7g/10MJ vs. 19.3g/10MJ, $P < .001$) and lower intakes of ‘chipped, fried, roasted, processed & homemade potato products’ (108g/10MJ vs. 268g/10MJ, $P < .001$). In

keeping with the findings of the present study, findings from NHANES in the US show that both ‘fast food’ and ‘full-service restaurants’ were associated with increased intakes of protein, saturated fat and sodium as well as SSB in teenagers (Powell and Nguyen, 2013). Overall, there is a need for better menu choices to be made available to teenagers, which are more favourable in terms of dietary quality, but also palatable and accessible.

Strengths and limitations

This is the first study to provide data on the association between eating location and dietary quality in a nationally representative sample of teenagers in Ireland. The key strengths of this study include the nationally representative sample of teenagers aged 13-18 years in Ireland included in the NTFS II and the detailed dietary intake information collected through a 4-day weighed food diary with detailed information on the eating location at meal level. Another important strength of this study includes the detailed food composition data, in particular the brand-level information provided from the food packaging and food outlets during the survey. Limitations of this study includes the smaller proportion of teenagers with a lower social class and a larger proportion of teenagers with a higher social class compared to the Irish population. This was mitigated by weighting the data in analysis where social class was not a variable of interest.

Conclusion

In summary, the main finding of this study was that the quality of the diet in teenagers in Ireland is mainly driven by food consumed from ‘home’, particularly the ‘participant’s own home’ as this is where the majority of eating occasions took place however, one fifth of energy intake came from food consumed from ‘outside the home’. There were no differences observed in food or nutrient intakes across eating locations between sexes, age groups or categories of socio-economic or weight status. This shows that policy makers should focus mainly on the home environment when devising policies aimed at improving the diets of teenagers. These policies could include enhanced nutrition education for teenagers as well as tax increases on unhealthier foods.

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Chapter 7

General Discussion

The prevalence of childhood overweight and obesity is a key issue globally, with 340 million children and teenagers aged 5-19 years currently living with overweight and obesity worldwide (World Health Organization, 2021). The World Health Organization has identified that a global increase in the intakes of energy dense foods combined with an increase in physical inactivity is a key contributor to these rates of overweight and obesity (World Health Organization, 2021). Dietary habits developed during childhood are often carried into adulthood and can contribute to the development or progression of diet related chronic diseases such as obesity and cardiovascular disease (Liberali et al., 2020, Kaikkonen et al., 2014, Eilender, 2016). Moreover, the teenage years are a unique life stage differentiated from childhood by an increase in independence in all aspects of the lifestyle but also increased ownership surrounding dietary patterns and food choice, which can lead to a diet which is high in energy-dense, nutrient-poor foods (Neufeld et al., 2022). It has been shown that across Europe, intakes of saturated fat, free sugar and salt are above recommendations, while intakes of MUFA, PUFA, dietary fibre, iron, vitamin D and folate are below recommendations (Rippin et al., 2019, Walton et al., 2021).

A review of the literature (Chapter 1) has shown that the overall dietary quality of school-aged children and teenagers across Europe was unfavourable, with some differences in the intakes of nutrient and food group noted across sexes, age groups and categories of socio-economic and weight status (Rasmussen et al., 2006, Novaković et al., 2014, Pérez-Escamilla et al., 2012). Additionally, the ‘home’ location was associated with better dietary quality in children and teenagers, with some differences in dietary quality noted across different ‘out of home’ locations.

The overall aim of this thesis was to use data recently collected as part of the National Children’s Food Survey II (2017-18) and the National Teens’ Food Survey II (2019-20) to examine the dietary quality of school-aged children and teenagers in Ireland by demographic characteristics and eating location.

The first objective of this thesis was to use recent nationally representative dietary intake data to examine the dietary quality of school-aged children and teenagers in Ireland and to identify any differences in dietary quality between sex, age group and categories of socio-economic and weight status. Dietary quality was defined using energy-adjusted intakes of pre-defined food groups and nutrients. The selected food

groups were included in this definition on the premise that they best describe dietary quality based on current food-based dietary guidelines (FBDG). The nutrients included in this definition were selected as their intakes are generally not in line with recommendations, both in Ireland and across Europe. Overall, this study found that the dietary quality of both school-aged children and teenagers in Ireland was unfavourable and only slight differences were seen across sex, age groups, and categories of socio-economic and weight status. For both population groups, intakes of key food groups were generally not compliant with current FBDG as there were higher intakes of ‘white bread’ compared to ‘wholemeal & brown bread’, ‘whole milk’ compared to ‘reduced fat milk’ and ‘processed meat’ compared to ‘fresh meat’. Children’s intakes of ‘high-fibre RTEBC’ were, however, higher than ‘low-fibre RTEBC’, however, teenagers had similar intakes of ‘high-fibre RTEBC’ and ‘low-fibre RTEBC’. ‘Soft drinks (with and without added sugar)’ were consumed in similar amounts by children, however, teenagers had higher intakes of ‘soft drinks (added sugar)’ than ‘soft drinks (no added sugar)’. Further findings from the NCFS II and the NTFS II show that intakes of fruit and vegetables were below recommendations and that almost a fifth of calorie intakes were provided by ‘top shelf’ foods, but they also show that water was the main beverage consumed, which is a positive finding (Irish Universities Nutrition Alliance, 2019). These dietary intakes and lack of compliance with FBDG have led to intakes of saturated fat, free sugars and salt which are above recommendations and intakes of dietary fibre and key micronutrients below recommendations.

For school-aged children, this study found that boys and older children had higher mean daily intake (MDI) of energy than girls and younger children, but generally, the MDI of nutrient and food group were similar between these groups which is similar to what has been found in other studies of this age group (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Joffe et al., 2009, Hansen et al., 2015, Lopes et al., 2017, Ruiz et al., 2016, Ruiz et al., 2017, Van Rossum et al., 2020, Bates et al., 2020, Turkey Ministry of Health, 2014). Exceptions to this were that younger children had a higher MDI of calcium and ‘discrete fruit’ and a lower MDI of ‘fresh meat’ than older children which is in keeping with findings from the literature., (Elmadfa et al., 2012, De Ridder et al., 2016, Turkey Ministry of Health, 2014).

In the present study, teenage boys had a higher MDI of energy than teenage girls however as with the younger children, the MDI of nutrients and food groups were for the most part similar between groups. Exceptions to this included that teenage boys had a higher MDI of riboflavin and calcium compared to girls, which could be explained by the higher MDI of ‘white bread’ and ‘total milk’ in boys when compared to girls. Boys also had a lower MDI of PUFA and ‘total vegetables’ than girls. Other studies have also shown that boys had a higher MDI of energy than girls, but the MDI of micronutrient were similar with the exception of vitamin C (higher in girls) (Elmadfa et al., 2012, De Ridder et al., 2016, Tornaritis et al., 2014, Pedersen et al., 2015, ANSES, 2017, Joffe et al., 2009, Hansen et al., 2015, Lopes et al., 2017, Ruiz et al., 2016, Ruiz et al., 2017, Van Rossum et al., 2020, Bates et al., 2020, Turkey Ministry of Health, 2014). Additionally, other studies have found that boys had a higher MDI of bread and meat but a lower MDI of fruit and vegetables than girls (Elmadfa et al., 2012, Pedersen et al., 2015, Turkey Ministry of Health, 2014).

The present study showed no differences in the MDI of energy, nutrients or food groups between age groups among teenagers which is in contrast with the literature that found older teenagers had a higher MDI of energy than younger teenagers as well as a higher MDI of ‘total bread’, ‘total fruit and vegetables’ and a lower MDI of ‘total meat’, however, ‘discretionary food’ (e.g., sweets, chocolate, pizza, cakes and sugar-sweetened beverages (SSB)) were consumed consistently by all age groups examined and there were no differences in the MDI of nutrients between younger and older teenagers (Turkey Ministry of Health, 2014, Lindroos et al., 2021),

The evidence associating categories of weight status or socio-economic status with dietary quality in children and teenagers is inconsistent (Mak et al., 2013, Olstad et al., 2021, Quader et al., 2017, Golley et al., 2011, Elliott et al., 2011) however parental education has been shown to have a greater effect on dietary quality than other indicators of socio-economic status (Drouillet-Pinard et al., 2017, Vilela et al., 2020, Moraeus et al., 2020). The present study found that children whose parents were professional workers had a higher MDI of dietary fibre and ‘wholemeal & brown bread’ and a lower MDI of ‘soft drinks (added sugar)’ than those whose parents were skilled manual workers. It has also found that children whose parents had tertiary education had a higher MDI of dietary fibre and ‘wholemeal & brown bread’ and lower MDI of ‘white bread’ than those with primary parental education only. An

unexpected finding in the present study was that children classified as having a healthy BMI had a higher MDI of saturated fat than children with overweight/obesity, but there were no differences in the MDI of other nutrients or food group between these two groups. The evidence in the literature on this topic is mixed, as some studies have found no associations between BMI and nutrient/food intake in children (Anderson et al., 2016, Elliott et al., 2011, Golley et al., 2011), while others have found that children classified as having overweight/obesity may have higher intakes of certain food groups such sugar-sweetened beverages and lower intakes of milk and fruit juice (Grimes et al., 2013, Watowicz et al., 2015).

Unlike what was found for children, the present study has found no differences the MDI of energy, nutrients or food groups across categories of socio-economic status in teenagers. There were mixed messages in the literature regarding any association between BMI classification and dietary quality, however, where intakes were energy adjusted, findings were similar to those of the present study (i.e., no differences in dietary quality between teenagers classified as having a healthy BMI and those classified as having overweight or obesity) (Elliott et al., 2011, Golley et al., 2011, Wong and Louie, 2018).

The next objective of this thesis was to investigate the association between eating location and dietary quality in school-aged children (5-12y) in Ireland and to identify any differences in dietary quality between sex, age groups, and categories of socio-economic status and weight status across different eating locations. This study defined ‘eating location’ as the location where food was prepared or obtained, regardless of where it was eaten. A review of the literature (Chapter 1) has identified that despite an increase in eating ‘outside of the home’, the ‘home’ location is still where the majority of eating occasions take place for children. In keeping with findings from this review, this study found that that food and nutrient intakes in school-aged children in Ireland are primarily driven by food consumed from ‘home’, particularly the ‘participant’s own home’ where the majority of eating occasions took place (91% at ‘home’; 86% at the ‘participant’s own home’), contributing a large proportion of energy intakes (88% at ‘home’ and 84% at the ‘participant’s own home’). While the majority of children (73%) also consumed food/beverages from ‘outside of the home’, this only accounted for only a small number of eating occasions (9%) and energy intakes (12% in the total population and 16% in consumers of food from ‘outside of the home’ only). There

were very few differences observed across eating location between sexes, age groups, weight status or socio-economic status, however, there were two exceptions to this: younger children had a higher energy MDI from ‘other homes’ than older children and children of parents with primary/intermediate education only had a higher MDI of energy from ‘fast food/takeaways’ than children of parents with tertiary education. Some differences in eating location characteristics between younger and older children were also found in the previous NCFS (2003-04) in Ireland as older children had a higher MDI of energy from ‘outside of the home’ than younger children (Burke et al., 2007). Additionally, in the UK it was found that children living in households with higher occupational status were significantly less likely to consume take-away meals at home once a week or more than those living in less affluent households, but no association was found between categories of parental education (Adams et al., 2015).

Evidence from the previous NCFS as well as from the UK and the US shows that food consumed from or at the ‘home’ location is generally of better dietary quality than that from ‘outside of the home’ in terms of protein, total fat, dietary fibre, calcium, iron, folate and vitamin C as well as non-core foods’ such as ‘red and processed meat’, ‘sugar-sweetened beverages’ and ‘non-milk extrinsic sugars’ (Burke et al., 2007, Ziauddeen et al., 2018, Guthrie et al., 2002). According to findings from the present study, overall, dietary quality of food consumed from ‘home’, particularly the ‘participant’s own home’ was found to be better in terms of protein, fat, PUFA (when comparing ‘participant’s own home’ and ‘other homes’ only), dietary fibre, vitamin D, folate, calcium and iron and free sugars (when comparing ‘home’ to ‘outside of the home’ only). It was of poorer quality than both however, for MUFA and sodium (when comparing ‘home’ to ‘outside of the home’ only). Food consumed from ‘home’ and ‘participant’s own home’ included a higher MDI of ‘wholemeal & brown bread’, ‘high-fibre RTEBC’, ‘porridge & hot oat cereals’, ‘boiled, baked & mashed potatoes’, ‘reduced fat milk’, ‘meat dishes’, ‘fresh meat’ and ‘total fruit and vegetables’ and a lower MDI of ‘chipped, fried, roasted, processed & homemade potato products’, ‘processed meat’, ‘biscuits, crackers, cakes, pastries, buns & desserts’, ‘chocolate, sweets, savoury snacks, savoury snacks & preserves’ and ‘soft drinks’ (both with and without added sugar) when compared to food consumed from ‘outside of the home’ and at ‘other homes’. A review of the literature (Chapter 1) has identified that dietary quality differs across the different types of ‘out of home’ locations with some studies

showing that ‘school’ was associated with better dietary quality than other ‘out of home’ locations such as ‘takeaways’. In the present study, of all ‘out of home’ locations, food consumed from ‘school’ was of better dietary quality, particularly in terms of saturated fat, dietary fibre, free sugars and calcium. Food consumed from ‘school’ included a higher MDI of ‘wholemeal & brown bread’, ‘total milk’, ‘total fruit & vegetables’, ‘total fruit’ and ‘water consumed as a beverage’ and a lower MDI of ‘chipped, fried, roasted, processed & homemade potato products’ and ‘soft drinks (added sugar)’ when compared to the other ‘out of home’ locations. While this may suggest that the current policy on the provision of lunches to primary schools in Ireland is effective in providing food which meets current FBDG (Department of Social Protection, 2019), it is worth noting that food prepared at ‘school’ provided a very small proportion of energy (2% in the total population; 10% in consumers of food at ‘school’ only).

The final objective of this thesis was to investigate the association between eating location and dietary quality in teenagers in Ireland and to identify any differences in dietary quality between sex, age groups or categories of socio-economic status and weight status across different eating locations. As with children, the quality of the diet in teenagers in Ireland is mainly driven by food consumed from ‘home’, particularly the ‘participant’s own home’ as this is where the majority of eating occasions took place. However, unlike with children where less than 10% of energy came from food consumed from ‘outside of the home’, in teenagers, almost one fifth of energy intake (19%) came from food consumed from ‘outside the home’. As for children, a review of the literature (chapter 1) has identified that the food consumed from ‘home’, particularly the ‘participant’s own home’, was of better dietary quality than that from food consumed from ‘outside of the home’. The present study has found that the dietary quality of food consumed from the ‘participant’s own home’ was found to be better when compared to ‘other homes’ and ‘outside of the home’. Food consumed from ‘home’ offered more favourable dietary quality than food consumed ‘outside of the home’ in terms of protein, total fat, free sugars, dietary fibre, vitamin A, vitamin D, riboflavin, vitamin B6, folate, vitamin C, calcium and iron. It was of poorer dietary quality, however, for MUFA and PUFA. When comparing the dietary quality of food consumed from the ‘participant’s own home’ to that of food consumed from ‘other homes’, food consumed from the ‘participant’s own home’ was of better dietary

quality for PUFA, dietary fibre, vitamin A, vitamin D, riboflavin, vitamin B6, folate and iron. It was, however, of poorer dietary quality for vitamin C. These differences can be explained by the differences in foods consumed from ‘home’ and the ‘participant’s own home’ when compared to ‘outside of the home’ and ‘other homes’. When compared to food consumed from ‘outside the home’ and ‘other homes’, food consumed from ‘home’ and ‘participant’s own home’ included a higher MDI of ‘brown & wholemeal bread’, ‘high-fibre RTEBC’, ‘porridge & hot oat cereals’ (when comparing ‘home’ to ‘outside of the home’ only), ‘boiled baked & mashed potatoes’ (when comparing ‘home’ to ‘outside of the home’ only), ‘reduced fat milk’, ‘fresh meat’ and ‘total fruit & vegetables’ and a lower MDI of ‘biscuits, crackers, cakes, pastries, buns & desserts’ (when comparing ‘participant’s own home’ to ‘other homes’ only) and ‘chocolate, savoury snacks, sugars & preserves’. Additionally, in keeping with findings from other studies that show that food consumed from ‘shops’ is of poorer dietary quality than other ‘out of home’ locations such as ‘school’ (Poti et al., 2014), the present study found that of all ‘out of home’ locations, food consumed from ‘shops’ was of poorer dietary quality, particularly in terms of protein, total sugars, free sugars, dietary fibre, vitamin A, vitamin D, riboflavin, vitamin B6, folate, vitamin C, calcium and iron as well as ‘total RTEBC’, ‘fresh meat’ and ‘total fruit and vegetables’ and ‘total confectionery/snacks’.

Public health implications

Childhood and the teenage years are important life stages with distinct nutritional needs and challenges. Adequate nutrition during this time is vital to support growth and development and to prevent the development of diet related noncommunicable diseases later in life (Liberali et al., 2020, Kaikkonen et al., 2014, Eilender, 2016). In line with findings from other European countries (Rippin et al., 2019, Walton et al., 2021), the most recent national nutrition surveys in Ireland (NCFS II and NTFS II) have identified that nutrient and food group intakes are generally not line with current recommendations (Irish Universities Nutrition Alliance, 2019, Irish Universities Nutrition Alliance, 2021). Frequent monitoring of dietary intakes in children and teenagers is important in order to identify dietary inadequacies and to understand why these are occurring, in an effort to inform future policies aimed at improving nutritional outcomes in these population groups.

There were minimal differences in the MDI of these food groups across sex, age group or categories of socio-economic status and weight status after adjusting for energy intakes. This shows that any strategies aimed at improving dietary quality should be aimed at all children and teenagers, regardless of these characteristics. There are currently some initiatives in Ireland aimed at addressing the issues with poor dietary quality and overweight and obesity in children. For example, the Safefood START campaign aims to encourage parents to help their children maintain a healthy weight by limiting treat foods, choosing water and milk over other beverage options, giving children the correct portion size, giving children more fruit and vegetables, being more physically active, limiting screen-time and increasing sleep-time (Safefood, 2022b). While there are no such campaigns aimed at teenagers, there are a number of other national initiatives aimed at reducing rates of overweight and obesity and improving dietary quality in the total population, including teenagers, such as the ‘Healthy Weight for Ireland’ Obesity Policy and Action Plan which aims to use a multifaceted approach which includes policy and surveillance in an attempt to tackle obesity in Ireland (Healthy Ireland, 2016). Continuous monitoring of dietary intakes is vital in order to monitor the success rates of these initiatives. Additional policies such as aggressive marketing restrictions targeting children directly such as a watershed on TV advertising of unhealthy food or restricting the commercial communications for non-nutritious food on digital media. These policies have already been introduced in other European countries (European Public Health Alliance, 2019). The ‘nutrient profile model’ developed by the WHO can be used by governing bodies to determine which foods should not be marketed to children (WHO Regional Office for Europe, 2015). Since the tax on sugar-sweetened beverages was introduced in 2018, there has been a decrease in the consumption of sugar-sweetened beverages in children and teenagers in Ireland, however, soft drinks are still widely consumed in these population groups (Irish Universities Nutrition Alliance, 2019, Irish Universities Nutrition Alliance, 2021). Furthermore, a recent survey also carried out by Safefood has shown that a number of fiscal measures such as price reduction for healthy foods (e.g., fruit and vegetables), tax increase for unhealthier foods and vouchers for healthier foods for low-income families received high support ratings from the Irish public (Safefood, 2022a).

This study found that food and nutrient intakes in school-aged children and teenagers in Ireland is driven by food consumed from ‘home’ however teenagers obtained almost one fifth of their energy from the ‘out of home’ locations compared 12% in children. It is therefore important to continue to educate both of these young population groups regarding healthy dietary patterns as it has previously been shown in Irish adults that up to one-quarter (24%) of energy intakes are obtained from ‘out of home’ which is in line with the increase observed between these two groups in the present study (Irish Universities Nutrition Alliance, 2011).

In children, ‘school’ provided the best dietary quality of the ‘out of home’ locations, however this was not seen in teenagers. While the government offers strict guidelines on the type of foods that should be served in schools as part of the ‘school meals scheme’ for both primary and secondary schools, food is not provided in all primary schools across Ireland and a study carried out in 2007 showed that some secondary schools pupils had access to tuck shops and vending machines which may not offer the best lunch options in terms of dietary quality, however, more recent data is needed in order to understand if this is still relevant in schools today (Department of Social Protection, 2019, Healthy Ireland, 2019, Kelly and Nic Gabhain, 2007). Results from a recent survey carried out by Safefood revealed that there is a high level of acceptance for policies that support a healthier food environment for children, including educational campaigns focusing on children and teenagers in schools and healthier vending machine options (Safefood, 2022a). WHO has proposed a model for the implementation of a food a nutrition policy in schools. This holistic model includes modifying the school environment to provide healthy school meals and subscription schemes for healthy snacks such as milk, fruit and vegetables. It also includes modifications to the school curriculum, communication between governing bodies, parents, school staff, pupils and local retailers in order to implement food and nutrition school policies and the collaboration of the local community (World Health Organization, 2006). School based healthy eating policies have been successfully implemented across Europe. For example, Bulgaria, Estonia, Hungary and Latvia have set food- or nutrient- based standards for foods provided in schools, while Latvia prohibits the sale of sugar- and artificial- sweetened soft drinks in schools. This type of policies has had some success in improving dietary intakes in children by increasing

intakes of nutritious foods and decreasing consumption of fizzy drinks (WHO Regional Office for Europe, 2014).

Five policy actions have been recently identified as having the highest priority for implementation in Ireland. These include school food policies, income support for vulnerable population groups, healthy food subsidies for disadvantaged groups, zoning laws to prohibit the placement of unhealthy food outlets within 400m of secondary schools and implementing a comprehensive policy on nutrition standards for food and beverages provided in the public sector (Harrington et al., 2020).

It is worth noting that while the dietary data collected as part of the NCFS II and the NTFS II are the most recent available data for school-aged children and teenagers in Ireland, these surveys were carried out prior to the Covid-19 pandemic. Some studies have identified that the social isolation period of the pandemic was associated with an increase in overweight and obesity in children and teenagers, as well as disruptions to their eating habits (Stavridou et al., 2021, Ruiz-Roso et al., 2020, Di Renzo et al., 2020). A Bord Bia report shows that in terms of annual consumer spending in the foodservice industry, while there was an increase in 2021 compared to 2020, consumer spending has not yet returned to 2019 levels (Bord Bia, 2021).

Strengths and Limitations

The key strengths of this study include the nationally representative sample of school-aged children and teenagers included in the NCFS II and the NTFS II and the detailed dietary intake data collected at brand level using a 4-day weighed food diary. Another important strength of this study includes the detailed food composition data, in particular the brand-level information provided from the food packaging and food outlets during the survey. Misreporting or under reporting of energy intake is a known limitation of all dietary assessment methods, however, this issue was minimised by a high level of nutritionist-participant interaction (three visits over the 4-day period) with highly trained nutritionists. Additionally, the analysis of energy-adjusted nutrients and food groups partially corrects this bias and allows for better comparing of dietary quality between different groups, irrespective of energy intakes.

Conclusion

This study has found that the overall dietary quality of children and teenagers in Ireland, with little differences observed across sex, age groups and categories of socio-economic status and weight status. Additionally, it has shown that while the majority of children and teenagers consumed food ‘outside of the home’, the majority of eating occasions took place at the ‘participants’ own home’.

Overall, the findings of this study can aid policymakers to create targeted FBDG aimed at improving the dietary quality of school-aged children and teenagers in Ireland. These guidelines should be aimed at all children and teenagers irrespective of demographics. Moreover, policies aimed at improving the food environment of children should focus on the home as this is where these age groups consume most of their meals. However, considering that one fifth of energy consumed by teenagers came from food consumed from ‘outside of the home’ together with the fact that the dietary quality of food consumed from ‘outside of the home’ was poorer in both age groups, any policies aimed at improving the food environment of children and teenagers should also continue to educate both children and teenagers regarding healthy dietary patterns. A multidisciplinary approach is needed which aims to improve dietary quality in these age groups which include families as well as local communities and the food industry. This approach could include enhanced education, reformulation of staple foods as well as monetary initiatives such as increased taxation on unhealthy foods or vouchers for healthier foods for disadvantaged families.

Future research is needed in order to explore other factors which may influence dietary quality, such as day of the week, meal type and proximity of the home or school to food outlets, in order to further inform policy makers.

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Appendix I: NCFS II New Food Groups (NFG)

White sliced pan	Processed and	Poultry
Other white breads	homemade potato	Beef
Brown sliced pan	products	Lamb
Other brown breads	Sweet potatoes	Pork
Other breads	Bananas	Offal
High-fibre cereal	Oranges and easy peelers	Milk (as a beverage) (all types)
Low-fibre cereal	Apples	Water
Porridge & instant hot oat cereal	Grapes	Tea
Pasta	Berries	Coffee
Rice	Raisins and other dried fruits	Soft drink, added sugar
Noodles	Fruit canned in juice/syrup	Soft drink, no added sugar
Other cereals	Other fruits	Water
Pizza	Fruit juice (100% fruit)	Supplements
Other savouries	Smoothies (all types)	Soups, sauces & misc.
Whole milk	Biscuits	Herbs
Semi-skimmed milk	Crackers	Oil
1% fat milk	Rice cakes and flapjacks	
Skimmed milk	Cakes, pastries and buns	
Soya milk	Desserts	
Oat milk	Sugars	
Rice milk	Honey	
Nut milks	Jams	
Hot chocolate	Other sweeteners	
Flavoured milks/milkshakes	Chocolate nut spread	
Creams	Nut butters	
Cheeses	Chocolate confectionery	
Yoghurt	Sugar confectionery	
Fromage frais	Cereal bars/biscuits	
Drinking yoghurts	Potato crisp type snacks	
Ice-creams	Popcorn	
Dairy desserts	Breadsticks and other savoury snacks	
Butter (80% fat)	White fish	
Fat spreads (40-80% fat)	Oily fish	
Non-dairy spreads	Coated fish	
Fat spreads (<40% fat)	Tinned fish	
Baked beans	Shellfish	
Other peas, beans and lentils	Fish dishes	
Broccoli	Eggs (boiled, poached, fried)	
Other green vegetables	Eggs (scrambled)	
Carrots	Omelettes	
Tinned & jarred vegetables	Nuts (roasted/salted)	
Salad vegetables	Nuts (plain)	
Other vegetables	Seeds	
Vegetable dishes	Meat dishes	
Boiled, baked and mashed potatoes	Bacon and ham	
Chipped, fried and roasted potatoes	Burgers	
	Sausages	
	Meat pies and pastries	
	Meat products	

Appendix II: NTFS II New Food Groups (NFG)

White sliced pan	Salad vegetables	Shellfish
Other white breads	Other vegetables	Fish dishes
Brown sliced pan	Vegetable dishes	Eggs (boiled, poached, fried)
Other brown breads	Boiled, baked and	Eggs (scrambled)
Other breads	mashed potatoes	Omelettes
High-fibre cereal	Chipped, fried and	Nuts (roasted/salted)
Low-fibre cereal	roasted potatoes	Nuts (plain)
Porridge & instant hot	Processed and	Seeds
oat cereal	homemade potato	Meat dishes
Pasta	products	Bacon and ham
Rice	Sweet potatoes	Burgers
Noodles	Bananas	Sausages
Other cereals	Oranges and easy peelers	Meat pies and pastries
Pizza	Apples	Meat products
Other savouries	Grapes	Poultry
Whole milk	Berries	Beef
Semi-skimmed milk	Raisins and other dried	Lamb
1% fat milk	fruits	Pork
Skimmed milk	Fruit canned in	Offal
Soya milk	juice/syrup	Milk (as a beverage) (all types)
Oat milk	Other fruits	Water
Rice milk	Fruit juice (100% fruit)	Tea
Nut milks	Smoothies (all types)	Coffee
Hot chocolate	Biscuits	Soft drink, added sugar
Flavoured	Crackers	Soft drink, no added sugar
milks/milkshakes	Rice cakes and flapjacks	Water
Creams	Cakes, pastries and buns	Supplements
Cheeses	Desserts	Soups, sauces & misc.
Yoghurt	Sugars	Herbs
Fromage frais	Honey	Oils
Drinking yoghurts	Jams	Alcoholic beverages
Ice-creams	Other sweeteners	Protein bars/balls
Dairy desserts	Chocolate nut spread	Energy drinks
Butter (80% fat)	Nut butters	Meat alternatives, incl. dishes
Fat spreads (40-80% fat)	Chocolate confectionery	Other fish
Non-dairy spreads	Sugar confectionery	Other milks
Fat spreads (<40% fat)	Cereal bars/biscuits	Game (meat)
Baked beans	Potato crisp type snacks	Breads with added fibre (best of both, etc.)
Other peas, beans and lentils	Popcorn	
Broccoli	Breadsticks and other savoury snacks	
Other green vegetables	White fish	
Carrots	Oily fish	
Tinned & jarred vegetables	Coated fish	
	Tinned fish	

Appendix III – ‘Questions regarding socioeconomic status and parental education collected via the Health & Lifestyle Questionnaire’.

Socioeconomic status and parental education information

Which of the options below best describes your usual situation in regard to work?

- | | |
|--|--------------------------|
| Working for payment or profit | ☐ |
| Working in the home | ☐ |
| Retired | ☐ |
| Student | ☐ |
| Government/employment training scheme | ☐ |
| Unable to work due to permanent sickness/disability. | ☐ |
| Other | |

If **Other**, please specify: _____

If you are working for payment or profit, unemployed or retired answer the following questions about your main job or your last main job.

Otherwise please skip to QUESTION 7

What is (was) your occupation in your main job?

Please **describe your occupation fully and precisely** giving your full job title. For example, use terms such as retail store manager instead of just manager or secondary school teacher instead of just teacher. Civil servants and local government employees should state their grade e.g. senior administrative office. Members of the Gardaí or Army should state their rank. Clergy and religious orders should give a full description.

Main occupation: _____

What do (did) you do in your job?

What does (did) the establishment in which you work (worked) make or do?

In your main job are (were) you a...? (Please tick **ALL** boxes which apply)

- | | |
|---------------------------------|--------------------------|
| Foreman | ☐ |
| Supervisor | ☐ |
| Manager | ☐ |
| Self-employed with employees | ☐ |
| Self-employed without employees | ☐ |
| None of these | ☐ |

Does (did) the establishment in which you work employ...?

- | | |
|---------------------|--------------------------|
| Less than 25 people | ☐ |
| 25 people or more | ☐ |
| Don't know | ☐ |

If you are a FARMER, what land acreage do you farm? _____ (Acres)

What is the highest level of education you have completed to date?

(please tick **ONE** box only)

- | | |
|---|--------------------------|
| Some primary (not complete) | ☐ |
| Primary or equivalent | ☐ |
| Intermediate/Junior/Group Certificate or equivalent | ☐ |
| Leaving Certificate or equivalent | ☐ |
| Apprenticeship/Trade Certificate/FÁS training | ☐ |
| Diploma/Certificate | ☐ |
| Primary Degree/Nursing Qualification | ☐ |
| Postgraduate/Higher Degree | ☐ |
| Other | ☐ |

If **Other**, please specify: _____