The provision of breakfast at secondary schools in Northern Ireland

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The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

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- My health. I was being treated for acute myeloid leukaemia throughout my four years of study. This was not always easy, but my supervisors realised that my research gave me something to live for and encouraged me to keep going when times were hard.

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whether I had managed to do any work during my stay in the hospital, I was able to reply that I had completed most of the systematic review of the literature. Dr Huifeng Zhang came to visit me most weeks I was in the hospital so that I could discuss some of my literature reviews with her. While in the hospital, I had my 'Eureka-moment' and firmed up my research topic.

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Abstract

In recent years, there has been a marked increase in breakfast skipping in pupils attending secondary school – few European countries have been exempt. Breakfast skipping tends to increase with age and to be more common in girls than in boys. The literature on the subject indicates that this is undesirable in terms of health, academic performance, and behaviour at school. Not only do pupils who skip breakfast suffer, but so do their fellow (breakfast eating) pupils and teachers.

Lack of sleep is one explanation of why many pupils don't eat breakfast at home. Many go to bed late and get up at the last minute to arrive at school on time. If pupils do not eat breakfast at home (or on the way to school), a possible solution is for them to eat breakfast on arrival at school. While this could be a 'packed breakfast' brought from home, there is an obvious case for schools providing breakfast themselves.

A survey of the 193 secondary schools in Northern Ireland revealed that, before the COVID-19 pandemic, 130 offered breakfast before the formal school day. However, only 7.0% of the pupils at these 'breakfast schools' took advantage of the service. Given the late bedtimes, there is a case for considering serving breakfast at the start of the school day – rather than before.

A simple, nutritious breakfast can be provided for an average total cost of £1, which equals £200 per pupil a year. While many parents will be able to afford such a payment, those pupils entitled to free school lunches would also need to be provided with a complimentary breakfast. It would be helpful if a sample of secondary schools in Northern Ireland could trial 'breakfast in the classroom' for one school year.

Table of Contents (Page numbers)

Chapter 4: A survey of the breakfast eating habits and opinions of secondary school pupils in Northern Ireland – Summer Term 2021 162

Lists of tables and illustrations (Page numbers)

Chapter 3

Chapter 4

CHAPTER 1
A systematic review of the literature

- **Methodology**
- **PRISMA flow diagram**
- **Papers that set the scene**
- **Previous systematic reviews**
- **Commentaries or research proposals**
- **Quantitative studies**
- **Qualitative studies**
- **Summary of 97 articles included in the central review**
- **A review of the grey literature – 22 papers**
- **List of 119 documents reviewed**

1. Methodology

According to the **Centre for Cognitive Ageing and Cognitive Epidemiology at the University of Edinburgh**:

- *'A **systematic review** answers a specific research question by collecting and summarising all empirical evidence that fits pre-specified eligibility criteria.'*

Again, according to the **University of Edinburgh**[116], *'the massive expansion of research output, both in peer-reviewed publications and unpublished sources, means it is difficult to establish what work has been done already. If research is to be up to date, the literature must be checked continuously.'*

Sources in red are referenced at the end of this document.

Dr Katie Adolphus of the University of Leeds stated at a lunchtime seminar run by the Nutrition Society *(February 2021)* that when evaluating a systematic review of the literature, the following five factors should be taken into consideration:

1. The quality of the studies included in the review

2. The consistency of results in the studies included – does it all lead somewhere or just add to the feeling of confusion?

3. The number of studies included in the review. There is some idea of an 'optimal number'. All critical studies should be included, but thousands of studies would be unwieldy.

4. The likely impact of the study results – is the outcome of practical importance or just 'academic interest.'

5. The generalisability of the results. Has the review been so narrow and specific that it may be of no broader interest or relevance?

An initial literature search was carried out in January 2019 using **MEDLINE**. MEDLINE is a bibliographic database of life sciences and biomedical information. It includes bibliographic information for articles from academic journals covering medicine, nursing, pharmacy, dentistry,

veterinary medicine, and health care. Compiled by the United States National Library of Medicine, MEDLINE is freely available on the Internet.

This first literature search using Ovid MEDLINE(R) covered 23 years from 1 January 1996 to 31 December 2018. The investigation revealed 162 articles with' Breakfast' <u>and</u> 'School(s)' in their title.

An additional 27 articles were also identified by other means *(five of these articles were published before 1996 – the earliest being in 1984)*, giving 189 (162 + 27) items. **Seventy-four of these articles were eventually included in the systematic review**.

The main reasons for excluding an article were:

- The article was not published in English

- The article was not available free of charge

- Although not a 'perfect' duplicate, the piece was 'by and large' a copy of an item already included

- Despite the title, the article was not primarily about breakfast or school-age pupils

- The paper had little applicability in a UK setting

- The article was thought to be somewhat 'second-rate'

The 27 additional articles were discovered by reading some of the 162 items in the MEDLINE search. These articles sometimes referred to earlier publications that seemed to be 'important'. Some of these articles were also discovered due to reading some of the grey literature. **The grey literature is referred to later**.

Of the 74 'initial' articles, there were:

- 7 systematic reviews
- 3 commentaries or research proposals
- 54 quantitative studies
- 10 qualitative studies

Because new articles are being published almost every month, one must look at a systematic review of the literature as an ongoing process. The initial literature search was carried out in January 2019. The search was subsequently updated in May 2020 using **Web of Science**, which has 90 million-plus records and covers the period from 1900. This search engine supports 256 disciplines drawn from the sciences, social sciences, arts, and humanities.

One advantage of using a second search engine is that it can complement the first – there is less chance of a critical piece of literature 'hiding under the radar'.

Using Web of Science, this subsequent literature search covered the 40 months from 1 January 2016 to 30 April 2020. This search revealed 95 articles with' Breakfast' <u>and</u> 'School(s)' in their title, totalling 284 articles (189 + 95).

Almost half of these 95 articles *(46)* appeared in the initial literature research. After screening and assessment for eligibility, the second search added a further 23 items to the literature review *(giving 97 articles in total).*

Of the 23 'new' articles, there were:

- 1 commentary *(making 4 in total)*
- 19 quantitative studies *(making 73 in total)*
- 3 qualitative studies *(making 13 in total)*

With the total number of systemic reviews remaining at 7, all 97 articles received a classification.

The combined results of the two literature searches *(plus the 'additional' 27 articles)* are summarised in the following **PRISMA Flow Diagram**. The results of the two searches were exported to **EndNote online,** which removed the 46 duplicates.

2. PRISMA Flow Diagram

Keywords for the two searches were articles with 'BREAKFAST' and 'SCHOOL(S)' in their title

Identification

| Records identified through database searching *(162 + 95)* (n = 257) | Additional records identified through other sources (n = 27) |

All records identified (n = 284)

Screening

Records screened by EndNote (n = 284) → Duplicates excluded (n = 46)

Eligibility

Full-text articles assessed for eligibility (n = 238) → Full-text articles excluded, with reasons (n = 141)

Included

Studies included in qualitative synthesis (n = 13)

Studies included in quantitative synthesis (n = 73)

Systematic reviews included (n = 7)

Commentaries included (n = 4)

97 studies included in total (13 + 73 + 7 + 4)

$[(257 + 27) - (46 + 141)] = 97$

The **geographical breakdown** of the 97 articles was as follows:

- Brazil   1
- Canada   4
- Denmark   1
- France   1
- Germany   1
- Greece   1
- Holland   1
- India   1
- Italy   2
- Jamaica   2
- Mexico   2
- New Zealand   1
- Norway   2
- South America   2
- Spain   1
- United Kingdom   16 (16% of total)
- United States   51 (53% of total)
- Various countries combined   7

Age is less easy to summarise, but the 97 articles can reasonably be divided into the following three categories:

- Children only (up to age 11)   30
- Adolescent only (age 11 and over)   27
- Children and adolescents   40

The selection of studies included in the systematic review reflects that school breakfast provision is more common at the primary school level. The United States stands out from other countries in its school breakfast provision.

Finally, the **dates of publication** of the 97 articles were as follows:

- Prior to 1996   5
- 1996 – 2000   3
- 2001 – 2005   8
- 2006 – 2010   12
- 2011 – 2015   25
- 2016 – 2020   44

3. Papers that set the scene

Four papers seemed particularly good at 'setting the scene'. They are mentioned here at the start but are also referred to in the listings which follow.

The paper by **Kennedy and Davis**[58] (1998) contains some interesting information on the history of the School Breakfast Program (SBP) in the United States.

In the 1966 Child Nutrition Act, the SBP was created as a pilot project to provide meals for children "in poor areas and areas where children had to travel a great distance to school." The original intent of this legislation was to offer breakfast to children from low-income households who would otherwise have none.

Amendments to the Child Nutrition Act in 1975 made the SBP permanent. Congress intended to make the program available in all schools where it was needed to enhance the well-being of school-age children.

To expand the availability of the SBP, Congress passed the 1989 Child Nutrition Act, requiring the Secretary of Agriculture to award funds to states wishing to implement the SBP in schools with a large proportion of children from low-income households. Between 1988 and 1998, the monies brought more than 2.6 million children into the programme.

The paper by **Egner et al.**[30] (2014) brings the story of the SBP in the US more up to date.

In 2010, 11.7 million children participated in the SBP, 9.7 million of whom (83.5%) received free or reduced-price breakfasts. About 22% of children participated in the SBP on a typical day in the 2009-2010 school year. Participation was higher among boys than girls and minority children than white children. Students eligible for free meals were more likely to participate than higher-income children. Children living in rural areas were more likely to participate than those living in urban areas.

Around this time (2010), more focus was placed on the nutritional value of the breakfast served. Nutrition is the subject of the paper by **Vaudrin et al.**[92] (2018). Their paper looked at School Breakfast (and lunch) participation rates between 2008 and 2015.

The 2010 Healthy, Hunger-Free Kids Act (HHFKA) aligned the SBP requirements with the Dietary Guidelines for Americans. SBP standards were implemented in the school year 2013-2014. The alignment involved more fruit and whole grains and a gradual reduction in sodium content. After an initial dip, the HHFKA did not harm school meal participation over time.

The paper by **Hoyland et al.**[105] (2012) was explicitly concerned with the UK and focussed on breakfast consumption in schoolchildren and school breakfast clubs.

Data were collected during June and July 2012 in 38 primary and 27 secondary schools. The results indicated that 86% of children ate something before school (whether at home, on the way to school or at a school breakfast club). A third of the remaining 14% of breakfast-skippers reported not eating anything until lunchtime. The extent of breakfast skipping was higher in girls than in boys and higher in secondary than primary school pupils.

Breakfast skipping also varied by UK region, such that the highest levels were evident in Scotland and the North West of England, and the lowest in the East of England. Within secondary schools, breakfast skipping was higher in schools in urban areas and areas of high deprivation. Of the 86% of children who did eat breakfast, 4% reported consuming it at breakfast club and a further 4% on the way to school. 56% of schools in England were operating a breakfast club at the time of the survey, with greater availability at primary than secondary school.

Information on the 97 papers included in the literature review

4. Previous systematic reviews *(7 papers in total)*

Seven of the articles included in this systematic review can best be regarded as systematic reviews. The two papers by **Adolphus et al.**[1,2] (2016 and 2017) are concerned with the effect of breakfast on cognition *(the process by which knowledge is acquired),* while the review by **Basch**[13] (2011) is concerned with breakfast and the achievement gap. The study by **Baxter**[17] (2008) is concerned with the accuracy amongst children in reporting what they ate for breakfast, while the review by **Gibney et al.**[37] (2018) reviews the importance of breakfast in human nutrition. It launches a breakfast research initiative designed to standardise breakfast guidelines. The report by **Godin et al.**[41] (2015) considers some of the 'grey literature' on school breakfast provision in Canada, while that by **Hoyland et al.**[54] (2009) once again reviews the effect of breakfast on the cognitive performance of children and adolescents.

Towards the end of this paper *(before the list of references),* I have provided summary information on each paper. The seven systematic reviews are shaded **light-turquoise** for ease of identification. Not

surprisingly, these seven systematic reviews contain much helpful background information.

For example, in their two reports, **Adolphus et al.**[1,2] state:

Breakfast is generally accepted as the most important meal of the day and is purported to confer several benefits for diet quality, health, and cognitive and academic performance.

Children and adolescents who habitually consume breakfast are more likely to have better micro-and macro-nutrient intake, less likely to be overweight or obese, and more likely to have higher physical activity levels. Several observational studies have reported that between 20% and 30% of children and adolescents skip breakfast despite the wealth of benefits.

Observational studies have associated regular breakfast consumption with a lower BMI, lower risk of chronic disease, and higher diet quality.

Basch[13] reports:

Diet has a pervasive and profound impact on human health. Specific nutrient inadequacies can affect brain development during childhood and have lifelong health consequences, including cognitive effects. A complete outline of diet and dietary intake disparities concerning health and educational outcomes is far beyond the scope of this paper. The current focus is breakfast. Breakfast alone is addressed here because of its importance to academic outcomes and because it can be addressed at school.

Skipping breakfast is a prevalent behaviour among American youth and is one of the various factors contributing to a poor-quality diet. Despite the full availability of school breakfast programs, most American adolescents do not participate. The wisdom of our elders instinctively recognised the importance of breakfast as the "most important meal of the day," epitomised by the now common practice of sending home a letter before standardised tests urging the student to have a good breakfast on the morning of the test day.

Baxter et al.[17] report:

Breakfast consumption plays an essential role in children's health. It is associated with improved nutritional adequacy, more healthful body weight, and benefits to cognitive function (particularly memory), academic performance, school attendance, psychosocial function, and mood.

Gibney et al.[37] report:

There are extensive reports of breakfast's contributions to daily food and nutrient intakes, and many studies have compared daily food and nutrient intakes by breakfast consumers and skippers. However, significant variation exists in the definitions of

breakfast and breakfast-skippers and the methods used to relate breakfast nutrient intake to overall diet quality.

Godin et al.[41] report:

Grey literature is an essential source of information for large-scale review syntheses.

Grey literature is materials and research produced by organisations outside traditional academic publishing and distribution channels. Standard grey literature includes reports (annual, research, technical, project, etc.), working papers, government documents, white papers, and evaluations. Organisations that produce grey literature include government departments and agencies, civil society or non-governmental organisations, academic centres and departments, and private companies and consultants.

It will be discovered in this evaluation of school breakfast clubs that the grey literature complements the material found in refereed journals. The focus is sometimes different, but ignoring the wealth of information available would be unwise.

Hoyland et al.[54] report:

Breakfast consumers tend to have higher micronutrient intakes, partly because of the fortification of breakfast cereals and a better macronutrient profile than breakfast skippers. Regular breakfast cereal consumers have healthier body weights and engage in healthier lifestyle behaviours than those who skip breakfast. Similarly, children who regularly eat breakfast tend to have a lower BMI and are less likely to be overweight than those who eat breakfast less frequently. Studies in children suggest that breakfast eaters are more likely to meet daily nutrient intake guidelines than children who eat breakfast infrequently or skip breakfast.

Moreover, the percentage of children eating breakfast in the UK has declined along with the nutrient quality of breakfast foods selected, with implications for nutrient status and energy intake.

5. Commentaries or research proposals *(4 papers in total)*

Four of the articles included in this systematic review do not fit the criteria of being either (i) quantitative studies, (ii) qualitative studies, or (iii) systematic reviews. These four studies are shaded in pale pink in the summary pages for ease of finding. The papers by **Egner et al.**[30] (2014) and **Kennedy and Davis**[58] (1998) have already been referenced.

The paper by **Marcason**[70] (2008) is fascinating because it takes the story of school breakfast back by over 100 years:

As early as 1917, the US Surgeon General said, "This is expensive stupidity…trying to educate children with half-starved bodies". Marcason concluded her comments by saying, 'Food and nutrition professionals are uniquely qualified to help schools develop nutrition integrity standards and encourage the importance of eating breakfast'.

Rather uniquely, the article by **Mhurchu et al.**[72] (2010) is a study protocol for the effects of a free school breakfast programme on school attendance, achievement, psychosocial function, and nutrition in New Zealand. This paper is included because, although lacking results, it raises some important issues and acts as an excellent example for other future studies. The author's state:

Approximately 55,000 children in New Zealand do not eat breakfast on any given day. The trial aims to determine the effects of the breakfast intervention on school attendance, psychosocial function, dietary habits, and food security. The breakfast intervention trial described in the paper is the first of its kind in Australasia.

6. Quantitative studies *(73 papers in total)*

Not surprisingly, most papers included in this systematic review (73 out of 97) refer to quantitative studies. Although they differ in terms of the geographical area covered, age groups analysed, and dates when the studies were carried out, they often overlap. It would be tedious commenting on each one individually. However, I have provided summary information on each paper later in this systematic literature review *(before the coverage of the grey literature)*. The 73 quantitative studies are shaded pale-lemon in the summary pages for ease of identification.

One way of sub-dividing these studies is to classify them according to whether they are specifically concerned with school breakfast provision or not. Many studies have been included in this systematic review because they provide useful information on the importance of breakfast in general.

If all children regularly ate a nutritious breakfast at home before leaving for school, there would be little need for school provision. In this respect, breakfast is different from lunch. In an ideal world, it might be possible to leave breakfast provision to the home, but this approach would never work for lunch *(which is eaten in the middle of the school day)*. Ignoring packed lunches, one would hardly recommend that children go home each day at midday to enjoy a nutritious lunch.

Of the 73 quantitative studies, 44 had school breakfast provision as one of their main focuses, while the other 29 reviews considered more general issues. The table below classifies the studies.

Studies with a clear focus on school breakfast	5; 6; 7; 12; 14; 15; 16; 21; 23; 24; 25; 26; 27; 28; 33; 36; 39; 40; 42; 45; 46; 47; 52; 53; 55; 61; 62; 63; 64; 66; 69; 71; 74; 75; 76; 77; 79; 80; 84; 85; 86; 91; 92; 95
Studies without a clear focus on school breakfast	3; 4; 11; 18; 19; 22; 29; 31; 34; 38; 49; 50; 51; 56; 57; 61; 65; 67; 68; 73; 78; 82; 83; 87; 89; 93; 94; 96; 97

Another way of classifying the 73 studies is to say whether the focus was primarily on nutrition or schoolwork. The table below classifies the studies.

Focus on nutrition	4; 5; 7; 11; 12; 14; 15; 16; 18; 19; 21; 22; 23; 24; 26; 28; 29; 31; 34; 36; 38; 40; 42; 46; 47; 50; 55; 56; 57; 59; 61; 62; 64; 67; 68; 76; 78; 80; 87; 89; 91; 93; 95; 97
Focus on schoolwork	3; 6; 25; 27; 53; 73; 75; 82; 83; 96
Focus on both	33; 51; 63; 69; 79; 86
Focus on neither	39; 45; 49; 52; 65; 66; 71; 74; 77; 84; 85; 92; 94

44 of the 73 papers (60%) focused on nutrition, while 10 focused on school work. Six focussed on both, while 13 focussed on something else. For example, the papers by **Gleeson**[39] (1995) and **Shanafelt**[84] (2019) concentrated on economic issues.

What is striking about these 73 quantitative studies is the degree of agreement – there is little contradiction in the findings. Whether the study dated back to 1995 (as with **Chandler et al.**[25]) or was as recent as 2020 (as with **Grannon et al.**[45]), the underlying message was invariably the same. The same is true whether the focus was predominantly on the primary school age group (as with **Baxter et al.**[15,16,17,18] (2009, 2016, 2008, 2002)) or the secondary school age group (as with **Gordon et al.**[42] (1995)). Whether the study was based in the United States or the United Kingdom made little difference.

There were no authentic voices of dissent, just comments such as too much focus is placed on food chosen rather than food consumed (**Guinn et al.**[47] (2013)). Several papers mentioned the inaccuracy of the statistics, particularly when children were asked to recall what they had eaten. Child

and adolescent recall were the focus of the work by **Baxter et al.**[15,16,17,18] (2009, 2016, 2008, 2002); **Johnson et al.**[56] (2002); and **Turconi et al.**[89] (2003).

Epidemiologists often look at randomised control trials (RCTs) as the 'gold standard' for quantitative studies. Ten papers reported the results of RCTs; **Baranowski et al.**[11] (2003); **Bauer et al.**[14] (2020); **Crepinsek et al.**[28] (2006); **Hearst et al.**[53] (2019); **Moore et al.**[74] (2013); **Mumm et al.**[75] (2004); **Murphy et al.**[76] (2011); **Nanney et al.**[77] (2019); **Shemilt et al.**[86] (2004); and **Viggiano et al.**[93] (2014). We have yet to see the findings of the RCT proposed by **Mhurchu et al.**[72] (2010). While not contradicting the results of most of the other quantitative studies, it is interesting to note the uncertainty expressed in the paper by Shemilt et al.

The various quantitative studies differed in the amount of data analysed and the sophistication of the statistical methods used. At one extreme, one might mention the **Ask et al.**[7] (2006) paper, an observational study reporting a small pilot study. On the other extreme, articles such as those by **Adolphus et al.**[3] (2019); **Afeiche et al.**[4] (2017); **Affenito et al.**[5] (2013); **Anzman-Frasca et al.**[6] (2015); **Bartfeld and Ahn**[12] (2011); **Caspi et al.**[24] ((2017); **Corcoran et al.**[27] (2016); **Frisvold**[33] (2014); **Gearan et al.**[36] (2020); **Gleason and Dodd**[40] (2009); **Gordon et al.**[42] (1995); **Hallstrom et al.**[49] (2011); **Maurer**[71] (1984); **Nelson et al.**[78] (2007); **Powell et al.**[79] (1998); **Sampasa-Kanyinga and Hamilton**[83] (2017); and **Shemilt et al.**[85] (2004) all employed rigorous statistical analysis using relatively large sample sizes.

It would have been helpful if these 73 quantitative studies yielded clear/unified evidence for the effect of breakfast on nutrition (health), learning (performance at school), behaviour and other psychosocial skills. However, this was not the case, so it was impossible to perform a meta-analysis, as the studies differed too much.

Nevertheless, the underlying message was clear – **a nutritious breakfast has significant health, learning, and behaviour benefits**. What is not so clear is the extent of these benefits; and the contribution of breakfast at school – as against breakfast in other locations.

7. Qualitative studies (13 in total)

Thirteen of the 97 papers selected in this systematic review were qualitative studies. Qualitative studies may not have the 'headline-

grabbing' appeal of quantitative studies. Still, they help get behind the figures and help us understand more clearly what is going on at the individual level. Quantitative studies can sometimes feel very 'black and white', while the data provided in qualitative studies can be far more colourful and help paint a 'memorable' picture. Social research should be a bit like 'painting with numbers.' Quantitative studies produce the basic outline and put the numbers in the picture, but qualitative studies do the colouring.

To help understand this point, we can go back to the 1970s and the studies on smoking amongst teenagers in the UK. The various quantitative studies were very clear about the prevalence of smoking and its damage to health. Nevertheless, when this information was presented to teenagers, it seemed to have little impact on their behaviour – they went on smoking.

However, a few qualitative studies tried to understand why teenagers smoked, and one focus group found that some teenagers said they would be upset if others thought 'they smelt of stale tobacco smoke.' As a result, advertising campaigns *(to discourage teenage smoking)* switched from emphasising the harm to health to highlighting the damage to personal relationships. This new approach was found to be far more effective!

Perhaps if we want teenagers to eat a nutritious breakfast each morning, we should shift the emphasis from the health benefits to a consideration of the benefits in terms of exam results and enjoyment of school. These benefits are more immediate and not so affected by discounting. Qualitative studies can be instrumental in helping us understand what quantitative studies are showing. Qualitative studies should be regarded as a complement to quantitative studies, not as a substitute. After all, we want both quantity and quality!

All thirteen qualitative studies focus on various aspects of school breakfast clubs, so they have a more precise focus than some quantitative studies. The thirteen qualitative studies are shaded pale-green in the summary pages for ease of identification.

The first paper by **Askelson et al.**[8] (2017) considered the views of school administrators on the School Breakfast Programme. School administrators were asked to give their opinions on where breakfast is best served. Which is better (i) in the cafeteria before the formal start of the school day, or (ii) in classrooms at the start of the school day? One administrator smugly responded as follows:

- *"We already offer it the only way it will work. Parents can either choose to participate or not. We don't see the need to try and improve it."*

Other responses were a little more helpful, for example:

- *"Kids who ride a bus get here in plenty of time to eat breakfast, but kids who get a ride from an adult have to rely on the adult to bring them early to school."*

Most of us probably assume that school breakfast will be served the same way as school lunch. However, *(if it is served)* breakfast at home is rarely served in the same way as dinner.

The second paper by **Askelson et al.**[9] (2017) explored parents' attitudes and perceptions about school breakfast. Some of the responses were as follows:

- *"I prefer that my kids eat at home where I can control what they are eating. Also, I know I can provide a healthy breakfast at home, but I am less sure what they offer at school breakfast. We make time to sit down and eat breakfast daily together. That is our preference as a family."*

- *"My child wants to eat school breakfast, but currently it is sugar cereals, and at least one ingredient has high-fructose corn sugar and food colourings. Not ideal for brain food."*

These responses suggest that it is essential *(at least to some parents)* to ensure that schools only serve nutritious food at breakfast time.

The paper by **Bailey-Davis et al.**[10] (2013) explored student and parent perceptions of free school breakfast.

Comments from students included:

- *"I think some people don't eat school meals because they get teased."*

- *"If I'm eating cereal, I might get a bag of chips or juice at the corner store. Then depending on what school breakfast is, I would go and get breakfast and eat it."*

These comments suggest it may not be wise to give students too much freedom over school breakfast. Naturally, they cannot be force-fed, but there may be much to commend breakfast being made part of the regular school day.

Comments from parents ranged from:

- *"Free is awesome because times are hard",* to:

- *"I think they are ashamed of it because they get free breakfast."*

Another parental comment was:

- *"I try to make him eat before he leaves because if he gets to school and doesn't like breakfast, he won't eat it and will be hungry all day."*

These comments suggest that parents think breakfast at school can be a good idea. Once more, they indicate that the menu needs to be planned carefully – being both nutritious and appealing – and possibly breakfast should be provided to all. However, it should not be hard to conceal which students receive complimentary breakfast.

The paper by **Blondin et al.**[20] (2015) considered the issue of food waste at a free School Breakfast Programme. Comments made included the following:

- *"They were very excited, thrilled to know that there were bananas, and when we opened them, they were all over-ripe."*

- *"The oranges were not eaten – they couldn't peel them; it was a problem."*

- *"Some of them eat just a small portion where they may have had breakfast at home, so they'll tend to throw it away."*

- *"If they were given unlimited time, they might eat more."*

Although these comments relate to breakfast provision in a primary school, it is evident that the quality of food served matters. Having a delicious-sounding breakfast menu is not enough.

The paper by **Folta et al.**[32] (2016) is concerned with school staff, parent, and pupil perceptions of breakfast in the classroom. One catering manager made the following comment:

- *"The children are eating. They're getting that balanced meal in the morning. Kids would walk by before (when it was served in the cafeteria), and, you know, if they don't see their friends out there, they would just go. Or, if they were running late, they didn't get to eat. But now (when it is served in the classroom), they're eating. And you know, even if it's just a glass of milk they're getting or some fruit, they're putting something in their stomachs. Some vitamins that are going in their body in the morning."*

Again, this suggests there is much to commend serving breakfast in the classroom as part of the formal school day.

One headteacher made the following comment:

- *"I love walking into my classrooms and seeing my children all sitting down and eating their breakfast, you know, and it's a beautiful sight. Teachers are reading to them. Some of them are playing Beethoven music and asking what sounds you hear."*

Perhaps this is a rather idyllic picture – I'm not sure how many Principals of Secondary Schools in Northern Ireland would make such a comment – *O ye of little faith! (Matthew 8:26)*

The paper by **Gallegos-Martinez and Reyes-Hermandez**[35] (2016) considered the views of teachers and pupils on nutrition, health, and school breakfast. One comment made by a teacher was:

- *"Not all my students come to have breakfast because from my group of about 29, only 15 have breakfast, and they finish it all. They eat amaranth with honey bars; what they don't eat are the raisins and dry fruit."*

Another teacher commented:

- *"For those with certain economic difficulties, the milk and cereal they get here have all the necessary nutrients. To learn, they need to be well-fed."*

It is reassuring to know that many teachers appreciate the benefits of their students eating a nutritious breakfast.

The first paper by **Graham et al.**[43] (2015) is concerned with seeing how breakfast clubs affect the quality of the start of the school day. The study was conducted in three primary schools in the North East of England. A sample of 30 children was closely *(though unobtrusively)* observed using filming during the operation of the club. They were filmed while eating breakfast and during 'play-time' after breakfast. The researchers then watched the films and classified behaviour as positive or negative. They came up with several comments, but the following were common.

Positive behaviours:

- *The pupils were pouring fruit juice for each other*

- *The pupils were playing catch with each other*

- *The pupils enjoy chatting with each other*

Negative behaviours:

- *The children were rowing during the playing of a game*

- *The children were crawling around the floor of the breakfast room*

- *The children were wandering around the room and not focussing on eating breakfast*

It was noted that positive behaviour was far more common than negative behaviour. It was concluded that breakfast clubs encouraged children to start the school day positively. Sadly, it was impossible to observe these pupils during registration, morning assembly, and the first lesson, so it is unclear whether the positive behaviour spilt over to the rest of the school day.

The second paper by **Graham et al.**[44] (2015) is a follow-up of the article above, asking parents, children, and school staff what they consider are the main advantages and disadvantages of breakfast clubs.

Comments from parents included:

- *"Good variety of healthy foods."*

- *"I'm concerned about the sugar added to the cereals."*

Comments from children included:

- *"Enjoyable start to the day."*

- *"I want more of my friends to attend."*

Comments made by staff included:

- *"Breakfast provided for those who would otherwise skip."*

- *"Cost of attendance excluded some children."*

The advantages seemed to outweigh the disadvantages for all three stakeholder groups. The few difficulties identified related to practical issues such as lack of adherence to school food standards, breakfast club staff missing class preparation time, and concerns that some children

were being excluded from participating due to costs associated with attendance.

The paper by **Haesly et al.**[48] (2014) is concerned with the impact on staff of improving access to the School Breakfast Program. Comments included the following:

- *"I think the camaraderie with the staff and students was great. They said the first adult they saw in the morning greeted them."*

- *"I used to have at least a couple of kids who would come in and be stressed out about not having eaten anything, and can I excuse them to go down to the vending machine or whatever. I had none of that this year."*

- *"The breakfast program sometimes can be construed as for the low-income students. When you bring breakfast to the entryway where all students are coming in, and anybody can grab it, there is no singling out or identification. It's a little bit more of a level playing opportunity."*

- *"At first, the pupils were questionable, and they didn't know what was going on, which goes back to the marketing. Once they caught on to the concept, they responded very well."*

One School Principal said:

- *"There are all kinds of things you can select from to improve your school. Breakfast clubs is one that I would suggest you go for."*

Praise indeed! Evidence suggests that few parents, teachers, or students used to school breakfast (well-delivered) doubt its value. The challenge is converting non-believers.

The paper by **Knoblock-Hahn et al.**[60] (2016) is concerned with how community food banks support school breakfast. Comments included the following:

- *"It's difficult to get buy-in from janitors. If you can get them on board, you are on to a winner. They liked knowing it wasn't any more work for them and that their work is appreciated."*

- *"It did not take long for teachers to become the biggest advocates. Children were more attentive, orderly, and involved in learning opportunities."*

These comments are helpful, for they show the importance of getting the whole school community involved in the delivery of the programme. It is

crucial to 'get everyone on board.' Practical considerations should not be ignored.

The paper by **Sahota et al.**[82] (2013) is concerned with factors influencing the take-up of free school meals (including breakfast) in primary and secondary school children in England. The study took place in four primary schools and four secondary schools in Leeds. The participants included headteachers, school administrators, parents, and pupils. Comments from headteachers included the following:

- *"We have one or two children who are very, very good at manipulating mummy.'*

- *"We have a cash system, so students who are entitled to a free school meal have a special card, and you worry that this is highlighting them as students that are different, but there doesn't seem to be any sort of stigma."*

Comments from parents included the following:

- *"It's diabolical; it's okay being healthy, but they're used to having chips; there are too many healthy options."*

Comments made by pupils included the following:

- *"Inside, there's one line for sandwiches and one for hot meals. The sandwich line moves quickly, so I go in it because I want my dinner today."*

- *"Because when there's nothing in school that you like, you're thinking, I might as well go out of school and go to the chip shop or something like that."*

These comments emphasise the importance of taking the views of all stakeholders into account. The benefits of school breakfast need to be explained to all, and practical problems need to be sorted out.

The paper by **Stokes et al.**[88] (2019) concerns teachers' attitudes toward breakfast. A distinction is made between breakfast in the school canteen and breakfast in the classroom.

Comments on 'traditional' breakfast in the school canteen included:

- *"The options look very appetising and nutritious."*

- *"I love that the kids get to visit and enjoy a meal together."*

- *"There is always a lot of leftover food that is wasted."*

- *"Students are often late for class because they eat breakfast in the canteen."*

Comments on breakfast in the classroom included:

- *"Every student has the opportunity to eat."*

- *"There is no negative stigma attached to having breakfast."*

- *"A fast, effective, and needed resource for at-risk populations."*

- *"I hate the spills and messes in the classroom."*

- *"I hate the amount of time it takes away from my instruction."*

- *"I hate the added responsibility of the teacher to take care of it all."*

In conclusion, teachers had mixed views on breakfast in the classroom and traditional cafeteria breakfast.

The paper by **van Kleef et al.**[90] (2016) concerns breakfast barriers and opportunities for children living in a disadvantaged neighbourhood in Holland. The study's objective was to explore parents', children's, and 'expert' beliefs and experiences about breakfast. The study was based in Rotterdam and involved focus group discussions. Comments recorded from what mothers said included:

- *Parents want their children to eat breakfast every day*

- *Parents believe that children perform better at school if they have breakfast*

- *Parents believe that children can skip breakfast; it does not bother them*

- *Parents worry if children go to school without breakfast*

- *Parents do not want to argue with their children about breakfast*

- *There is not enough time in the morning to have breakfast*

- *Breakfast is too expensive*

- *It is a lot of work to prepare breakfast*

The authors concluded that 'experts' perceived more problems and challenges relating to healthy breakfast habits than mothers and children. They concluded that there was much to be said in favour of serving breakfast at school.

8. Summary of 97 articles included in the central review

Ref No	First named author	Date of paper	Country	Age group	Topic of paper	Type of study	Main findings	Notes
1	Adolphus	2016	Various	Children & adolescents	Effects of breakfast on cognition	Systematic review	(1) There are serious methodological problems with much current research (2) Lack of research on adolescents	45 studies reported in 43 articles
2	Adolphus	2017	Various	Children and adolescents	Challenges in examining the effects of breakfast on cognition and appetite	Systematic review	New evidence has contradicted prior research, questioning whether breakfast is, indeed, the most important meal of the day	Concludes that more research needs to be done on the effects of breakfast on children and adolescents
3	Adolphus	2019	West Yorkshire United Kingdom	16-18 years	Association between breakfast consumption on school days and academic performance	Quantitative study cross-sectional study	Habitual school-day breakfast consumption amongst adolescents is a significant correlate of GCSE attainment	Some rigorous analysis using ordinal logistic regression. Those who didn't eat breakfast performed significantly worse at GCSE Maths
4	Afeiche	2017	Mexico	4 -13-year olds	Relationship between quality of breakfast and quality of day-long diet	Quantitative study	Improving the nutritional quality of breakfast tends to improve the overall quality of nutrition for the whole day. Focussing on breakfast may be a good way of improving diet in general	(1) Some proper and rigorous statistical analysis (2) Focus very much on the nutritional profile

5	Affenito	2013	United States	5-18-year olds	Relationship between cereal consumption at breakfast and health	Quantitative study	School breakfast programme offers opportunities for more cereal consumption, leading to healthier BMI and nutrient profile	(1) Rigorous statistical analysis (2) Focus on nutrition and BMI
6	Anzman-Frasca	2015	United States	5-11-year olds	The effect of breakfast in the classroom on performance at school	Quantitative study	Breakfast in the classroom leads to an increase in proportions eating breakfast and increased attendance rates at school	Some quite sophisticated statistical methods were employed. Evidence of effect on academic performance was inconclusive
7	Ask	2006	Norway	15-year-olds	Changes in dietary profile following 4-month pilot school breakfast	Quantitative study	School breakfast improved both BMI and nutrition profile	(1) A small pilot study (2) Useful, healthy eating index
8	Askelson	2017	United States	Primary and secondary schools	Views of school administrators on the school breakfast programme	Qualitative study	School administrators suggest reasons to explain low participation rates. No single factor stands out	Some valuable ideas of ways to increase participation
9	Askelson	2016	United States	4-16-year olds	Exploring parents' attitudes and perceptions about school breakfast	Qualitative study	School breakfast has essential health and academic benefits for children and can assist low-income families, but participation remains low in some states	Identifies barriers that make SBP the less desirable choice – for example, not tying in with school bus timetables

10	Bailey-Davis	2013	United States	8-12-year olds	Student and parent perceptions of free school breakfast and consumption	Qualitative study	Students were commonly purchasing food and beverages on the way to school, which conflicted with parent rules	Recommends that students are involved in menu planning and in finding ways of reducing social stigma
11	Baranowski	2003	United States	8-9-year olds	Evaluation of a multi-media game played at school to improve the dietary outcome	Quantitative study	The aim of the game (Squire's Quest!) was to encourage children to increase their fruit, juice, and vegetable intake	An RCT was conducted, and children in the experimental group increased their FJV consumption by 1.0 servings per day compared with the control group
12	Bartfeld	2011	United States	4-11-year olds	Effect of school breakfast programme on food security among low-income households	Quantitative study	Increasing the availability of school breakfast may be an effective strategy to maintain food security among young children in low-income households	Extensive statistical analysis using probit models of food insecurity
13	Basch	2011	United States	Children and adolescents	Breakfast and the achievement gap	A systematic review (not much statistical analysis)	School breakfast programmes can help urban minority youth who are not likely to get proper nutrition for the rest of the day. These young people are most likely to skip breakfast	Skipping breakfast harms academic achievement by adversely affecting cognition and absenteeism

14	Bauer	2020	United States	9-12-year-olds	The effect of breakfast in the classroom on total breakfast consumption	Quantitative study	Comparison of optional breakfast before school in canteen and 'compulsory' breakfast in the classroom	A randomised control trial by the whole school. Breakfast in the classroom improved the type of food eaten but had little effect on breakfast skipping
15	Baxter	2009	United States	9-10-year olds	Accuracy of children's school-breakfast reports (and lunch)	Quantitative study	Accuracy is inversely related to retention interval. By shortening the retention interval, accuracy can be improved	Definitions of retention interval, intrusion rate correspondence rate, omission rate and inflation ratio
16	Baxter	2016	United States	9-10-year olds	Accuracy of recall of school breakfast (and lunch) – update of earlier work	Quantitative study	Accuracy falls off quite significantly the longer the period from breakfast. Researchers should choose the shortest interval that is practical	Interestingly, the location of the school breakfast influences recall accuracy
17	Baxter	2008	United States	9-10-year olds	Children's recalls from 5 studies – the accuracy of reporting breakfast	A systematic review of 5 studies	Children's' recall tends to be reduced, though interview format (free-style or checklist) and interview time affect accuracy. The interview format is important	Hot food options were more acutely recalled than cold options

18	Baxter	2002	United States	9-10-year olds	Low accuracy of breakfast and lunch recall	Quantitative study	Children reported eating less than half the items they were observed eating	40% of what they reported as having eaten was not eaten
19	Bellisle	2018	France	Children, adolescents, and adults	Details of breakfast consumption	Quantitative study	Most of the participants (all three groups) were regular breakfast consumers. Breakfast contributes significantly to diet quality	A helpful list of items consumed at breakfast. Good nutritional information
20	Blondin	2014	United States	Elementary schools. 4-11-year olds	Details of food waste at a school breakfast programme	Qualitative study	Interviewed stakeholders – pupils, parents, teachers, catering managers, and principals about food waste. Some interesting comments	Stakeholders recognise waste as a problem with many causes. Should find ways to use leftover food productively
21	Blondin	2017	United States	Elementary schools 8-10-year olds	Costs of milk waste in a classroom breakfast programme	Quantitative study	A carton of milk was served to each pupil as part of breakfast in the classroom. The amount of milk not consumed was measured	Significant amounts of milk were wasted, reducing the nutritional value of breakfast, wasting money, and damaging the environment
22	Blundell-Birtill	2019	United Kingdom	4-18-year olds	Determinants of portion size in children and adolescents	Quantitative study	The paper uses the UK National Diet and Nutrition Survey (NDNS) data. As expected, portion size increases with age, with boys larger than girls	Snacking is a significant problem. Portion sizes at main meals would be more appropriate if there were not so much snacking. Should consider downsizing

23	Burghardt	1995	United States	5-17-year olds (grades 1-12	Details of meals offered at school breakfast (and lunch)	Quantitative study	On average, school breakfasts provide at least 25% of the recommended dietary allowance for most nutrients	An extensive list of breakfast items broken down according to elementary, middle, and high schools
24	Caspi	2017	United States	Children and adolescents	Effect of school breakfast participation on purchasing behaviour in food stores and cafes	Quantitative study	Increasing participation in school breakfast may result in a modest reduction in purchases at food establishments	Useful information on a healthy eating index. Report of odds ratios
25	Chandler	1994	Jamaica	8-9-year olds	School breakfast improves verbal fluency in undernourished children	Quantitative study	Undernourished children's performance improved significantly on a test of verbal fluency when they received breakfast	The study is particularly relevant in those areas where undernourishment is prevalent
26	Christensen	2019	Denmark	16-18-year-olds	The effect of introducing a free breakfast club on eating habits	Quantitative study	Introducing a free breakfast improved the quality of food eaten at breakfast and reduced the rate of breakfast skipping	The programme was particularly beneficial to those from lower-income households. Some of the students in the schools were older than 18. Doubts on whether the programme would be so successful in the long term

27	Corcoran	2016	United States	5-17-year olds	The effect of breakfast in the classroom (BIC) on obesity and academic performance	Quantitative study	Although BIC does eat into teaching time, there is no evidence that it negatively affects academic performance. Also, there is no evidence that it raises obesity rates	Plenty of rigorous statistical modelling and extensive results in an appendix (not printed out)
28	Crepinsek	2006	United States	5-11-year olds	Dietary effects of universal free school breakfast	Quantitative study	Although offering the free breakfast increased participation in school breakfast, it did not lower the rate of breakfast skipping	A randomised control trial conducted at a whole-school level. The programme showed little impact on dietary intake over a 24-hour period.
29	Dykstra	2016	United States	7-9-year olds	Breakfast-skipping and selecting low-nutritional quality foods for breakfast	Quantitative study	16.9% of students surveyed skipped breakfast, and 19.4% simply purchased something from a corner store for breakfast	Selection of foods of low nutritional quality in the morning is standard. Novel ways should be explored to improve things
30	Egner	2014	United States	5-14-year olds	School breakfast program; A view of the present; and future planning	Commentary	The SBP can ensure that all school-aged children consume breakfast and has been linked to better nutrition and body weight	Despite the benefits, only 25% of children participate in SBP. Expansion of SBP has challenges

31	Fismen	2012	Norway	11-16-year olds	The effects of family affluence and cultural capital on adolescents' eating behaviour	Quantitative study	Higher family affluence was shown to predict breakfast consumption (OR = 1.61).	There is a need to develop appropriate indicators for adolescent socioeconomic status. Cultural capital (books etc.) is too often ignored
32	Folta	2016	United States	5-9 -year olds	Staff, parent, and pupil perceptions of breakfast in the classroom	Qualitative study	The study shows the importance of engaging school staff and parents when planning. The reasons behind the programme need to be clear	Some interesting comments from principals, catering managers, teachers, parents, and pupils
33	Frisvold	2014	United States	9-12-year olds	Nutrition and cognitive achievement – evaluation of SBP	Quantitative study	Better nourished children perform better in school. SBP can make a significant contribution to ensuring that low-income children acquire the benefits of better nutrition	A rigorous study with some sophisticated modelling of the data. Even the most affluent areas have their pockets of low-income
34	Gaal	2018	United Kingdom	5-18-year olds	Breakfast consumption in the UK – nutrient intake and diet quality	Quantitative study	The prevalence of irregular breakfast consumption was the highest amongst adolescents. We need to find ways of making breakfast more nutritious	Coverage of adults in addition to children and adolescents. Uses nutrient-rich food index

35	Gallegos-Martinez	2016	Mexico	3-7-year olds	Representations by parents, teachers, and children on food, nutrition, health, and school breakfast	Qualitative study	Although it is recognised that there are health benefits from a school breakfast, children think it is 'tedious' food that does not vary. Parents often support their child's view and agree not to use the programme	Suggestions for the SBP include adding some hot foods to the menu and changing the location of where breakfast is served to make it 'more fun'
36	Gearan	2020	United States	5-18-year olds	How changing guidelines have improved the nutritional value of school breakfast and lunches	Quantitative study	The updated nutrition standards for school meals significantly improved nutritional quality. Schools need to be given guidelines	The study calculates Healthy Eating Indexes for school lunches and breakfasts. On average, the score for breakfast increased from 50% to 71%
37	Gibney	2018	Canada, Denmark, France, Spain, the UK, and the USA	All ages, though much of the evidence comes from studies of children and adolescents	Review of the importance of breakfast in human nutrition: The International Breakfast Research Initiative, which aims to standardise breakfast guidelines	Systematic review	While breakfast is often referred to as the most important meal of the day and has been implicated in weight control in recent years, the literature remains inconclusive as to the specific health benefits of breakfast. This review proposes a harmonised approach to nutritional impact	The project's primary goal is to define optimal breakfast food and nutrient intakes. This data will be of value to public health nutrition policymakers, food manufacturers and consumers to optimise food choice

38	Gibney	2018	Canada, Denmark, France, Spain, the UK, and the USA	Children (6-12 years), adolescents (13-17 years), and adults	A proposal from the International Breakfast Research Initiative to develop a breakfast-specific nutrient recommendation	Quantitative study	For all six countries, adolescents have the poorest record (compared to other age groups) for regular breakfast consumption	The USA has the worst record, followed by the UK, Spain, France, and Denmark. Canada has the best record
39	Gleason	1995	United States	6-18-year olds	Participation in the School Breakfast Program (and lunch)	Quantitative study	Students who are entitled to free or reduced-price meals are more likely to join the SBP	Among paying students, participation is negatively related to the meal price
40	Gleason	2009	United States	4-18-year olds	School breakfast programs (not school lunch) are associated with lower BMI	Quantitative study	School breakfast programs may be a protective factor against rising rates of childhood obesity by encouraging regular breakfast eating	Multivariable regression models were used to examine the relationship between meal participation and BMI
41	Godin	2015	Canada	5-18-year olds	Applying systematic review search methods of the grey literature	Systematic review	The search strategies for identifying and screening publications for inclusion were manageable, comprehensive, and intuitive	Fifteen papers met all eligibility criteria and were included in the case study systematic review. These 15 publications were all invaluable
42	Gordon	1995	United States	11-18-year olds	Dietary effects of the National School Breakfast Program (and School lunch Program)	Quantitative study	The study uses 24-hour dietary recall data. Considers whether the effects of the SBP vary with age, sex, or family income	It uses econometric estimation procedures and includes a useful list of binary variables used in the analysis

43	Graham	2015	England (United Kingdom)	3-11-year olds	Breakfast clubs: starting the school day in a positive way	Qualitative study	A small study in which children's behaviour was monitored. Positive behaviour was displayed at the breakfast club during some of the games played	It was impossible to investigate whether these positive behaviours continued in the classroom. Assessment of behaviour was subjective
44	Graham	2015	North East England (United Kingdom)	5-11-year olds	Advantages and disadvantages of breakfast clubs	Qualitative study	Interviews with 14 parents, 21 children, and 17 school staff. Helpful observations on the advantages and practical disadvantages of breakfast clubs	Some useful information on breakfast timing, the price charged, and food served. Also, information on other activities available at the club
45	Grannon	2020	United States	14-16-year olds	Participation in 'second-chance' school breakfast programmes	Quantitative study	'Second chance' breakfast is served during the mid-morning break. Offering it reduced the rate of breakfast skipping	It was particularly popular with students who had 'difficult' journeys to school in terms of length of travel and poor timekeeping of buses etc.
46	Graves	2008	United States	8-9-year olds	Assessment of the school breakfast environment in 4 rural schools	Quantitative study	The top-ranked foods chosen by children at SBP were not particularly nutritious. Perhaps menus could be improved	Too many foods high in saturated fats were selected. A useful list of items included on the menus

47	Guinn	2013	United States	8-9-year olds	Examining the relationship between food eaten at school and BMI	Quantitative study	Too much focus has been placed in the past on food chosen rather than food consumed. Focussing on consumption alters the relationship	Children with higher BMIs ate more of their portions of school meals. It is vital to select menus carefully
48	Haesly	2014	United States	11-16-year olds	Impact on the staff of improving access to SBP	Qualitative study	There appear to be numerous advantages for both staff and students by improving access to SBP. Benefits seem to outweigh the negatives, such as time and effort	Some valuable comments on BMI and academic performance. SBP improve social relations between staff and pupils
49	Hallstrom	2011	10 European cities (the UK not included)	12-18-year olds	Factors affecting the choice of food at breakfast	Quantitative study	Breakfast consumption and choice of food associated with the region of Europe; sex; and socio-environmental factors	Logistic regression analysis was used. The factors which influence present breakfast habits should inform policies intended to improve things
50	Hassan	2018	Brazil	10-16-year olds	Changes in breakfast frequency and composition	Quantitative study	Pupils are put into three groups: breakfast-skippers, irregular breakfast eaters, and regular eaters	Pupils were analysed over three years as they moved groups (usually towards breakfast skipping). Gender was found to be important

51	Hearst	2016	United States	14-15-year olds	Barriers to and benefits from breakfast consumption among rural adolescents	Quantitative study	A significant number of adolescents are breakfast skippers. Skippers stated fewer school benefits and more barriers to eating breakfast	Future interventions should focus on making the facts more explicit. A valuable list of benefits and barriers
52	Hearst	2018	United States	14-15-year olds	Altering the school breakfast environment	Quantitative study	A school-based policy can successfully reduce perceived barriers to eating school breakfast	Improving access to and perceptions of school breakfast had an immediate and significant effect
53	Hearst	2019	United States	14-16-year olds	Effect on school grades of promoting school breakfast	Quantitative study	Free school breakfast reduced the prevalence of breakfast skipping. Improvements in grades were most apparent in students from more impoverished homes	Randomised controlled trial at whole-school level. Intervention schools offered free breakfast. Breakfast was 'grab-and-go'
54	Hoyland	2009	Various countries	5-18-year olds	A systematic review of the effect of breakfast on the cognitive performance of children and adolescents	Systematic review	Forty-five studies were included in the final review. Most of these suggested a positive effect. However, the result tends to be higher in those nutritionally compromised	More work needs to be done on adolescents. Apparent benefits of SBP may be linked to increased attendance and fewer absences

55	Jacoby	1998	South America	5-10-year olds	Good prospects from a new SBP in Peru	Quantitative study	The ready-to-eat breakfast consisted of cake and an instant milk-like beverage. The program resulted in an improved nutritional profile	The authors said that it would be advisable to generate cost estimates and balance them against the invaluable benefits to nutrition and education
56	Johnson	2002	England (United Kingdom)	13-16-year olds	Adolescent food habits checklist: reliability and validity of a measure of healthy eating	Quantitative study	Correlations indicate a high level of validity, and the checklist is shown to have high test-retest reliability	A handy example survey form is included, and the scoring system is well-explained
57	Karatzi	2017	Greece	9-13-year olds	Late-night over-eating associated with breakfast skipping	Quantitative study	Late-night overeating is associated with skipping or consuming a smaller breakfast	In children with low physical activity levels, it is associated with increased body mass index. Late bedtimes do not help
58	Kennedy	1998	United States	8-12-year olds	A review of the Department of Agriculture School Breakfast Program	Review article	A handy history of the SBP, including user numbers by year. Looks at factors affecting participation in the SBP	The review Includes details of a weekly menu of food served at the SBP. Also, comments on the effectiveness of the program. Suggests areas for future research

59	Kesztyus	2017	Germany	5-9-year olds	Skipping breakfast is detrimental for primary school children	Quantitative study	To reach all children and avoid skipping breakfast, schools should offer a nutritious breakfast at the start of the school day to all pupils	Skipping breakfast contributes to the epidemic rise in childhood obesity. A focus must be given to girls and those already obese
60	Knoblock-Hahn	2016	United States	5-18-year olds	How community food banks support school breakfast	Qualitative study	School breakfast programs are the preferred option, but where they cannot be started, food banks should be encouraged to stock more breakfast items and offer them to families with school-age children	A valuable list of barriers to best practice. Many comments pointed to the importance of getting teachers to believe in the importance of their pupils having a nutritious breakfast
61	Lambert	2005	England (United Kingdom)	11-18-year olds	Using smart card technology to monitor the eating habits of children in a school cafeteria	Quantitative study	The study demonstrated the power of smart card technology for monitoring food/nutrient choice over limitless time	One distinct advantage is that only the bursar knew who was paying for the food – parents or the local authority. Gets over the stigma of free school meals
62	Larson	2016	United States	13-14-year olds	Eating breakfast together as a family; the experiences of adolescents living in rural areas	Quantitative study	While those who eat breakfast tend to have a better nutritional profile than breakfast-skippers, those who eat breakfast as a family tend to eat even more healthily. SBP can learn from this	A successful SBP can build on this idea and make breakfast a social occasion involving staff and pupils. Pupils should not just be consumers; they can also be involved in planning and delivery. SBP is an excellent opportunity for healthy food promotion

63	Larson	2017	United States	13-16-year olds	A low-cost, grab-and-go breakfast intervention for adolescent rural school students	Quantitative study	A low-cost, grab-and-go breakfast may get over some objections schools give to running a more conventional SBP. The take-up of these breakfasts was encouraging	This study demonstrated the potential for grab-and-go breakfast programs to better nutrition and academic outcomes for adolescents. These programs are not over-demanding in terms of resources
64	Lawman	2014	United States	8-10-year olds	Breakfast patterns among low-income children in an urban area	Quantitative study	Increasing school breakfast provision has been advocated to prevent childhood obesity. However, little is known about breakfast patterns outside of school	Policies that increase school breakfast participation without an understanding of breakfast habits outside of school may result in children consuming multiple breakfasts
65	Lazzeri	2016	Thirty-one countries were taking part in the HSBC survey. 29 European countries plus Canada and the United States	11-15-year olds	HSBC Study 2002-2010. Trends in breakfast eating among adolescents in 31 countries	Quantitative study	Survey of 11-year-old, 13-year-old, and 15-year-old boys and girls. The average percentage of daily breakfast eating varied from 40.8% in the US to 72.6% in the Netherlands	Data were analysed by age and sex for each of the 3 years. Family affluence and structure are also considered. While some countries showed an increase in breakfast consumption, others displayed a decrease

66	Leatherdale	2016	Canada	12-16-year olds	Changes in a school breakfast club program	Quantitative study	It is tempting in a quantitative study to sum results across schools to increase sample size and statistical significance	In this study, the 43 participating schools had very different experiences when the SBP was changed. The study highlights the need for additional evaluation to bring out the best
67	Levin	2012	Scotland (United Kingdom)	12-15-year olds	Trends in adolescent eating behaviour: a cross-sectional study	Quantitative study	Fruit and vegetable consumption increased, and the use of sweets, chips and crisps fell between 2002 and 2010	There are persistent inequalities across the family affluence scale gradient. Alongside population programmes, special initiatives should be aimed at more deprived groups
68	Levin	2013	Scotland (United Kingdom)	15-year-olds	Urban-rural differences in adolescent eating behaviour: a cross-sectional study	Quantitative study	Teenagers living in rural areas tended to have the healthiest diets. However, the four biggest cities (Glasgow, Edinburgh, Dundee, and Aberdeen) didn't score worst	In large towns of between 10,000 and 125,000 residents, adolescents had the most deficient diet. This finding warrants further study

69	Littlecott	2016	Wales (United Kingdom)	9-11-year olds	Association between breakfast consumption and educational outcomes	Quantitative study	Significant positive associations between self-reported breakfast consumption and educational outcomes were observed. We need to explore the mechanisms by which breakfast and performance are linked	The study should help in understanding how to promote breakfast consumption among schoolchildren. Communicating the findings on educational benefits to schools may enhance buy-in to things such as breakfast clubs to improve the performance of pupils
70	Marcason	2008	Unites States	5-18-year olds	Resources for a school breakfast programme	Review article	A handy summary by the American Dietic Association for those wanting to find further sources of information	Particularly interesting is that the review goes back over 100 years (to 1917), when the then US Surgeon General first commented on the issue
71	Maurer	1984	United States	5-18-year olds	Evaluation of school nutrition programs: factors affecting student participation	Quantitative study	The results from the participation studies are analysed, and estimates are obtained for the effects of free meals or subsidised meals on attendance. In this way, a demand curve for breakfast and lunch is estimated	Multivariable regression analysis is used to determine the effects of various factors on attendance. For both breakfast and lunch, price is the single most important predictor of participation

72	Mhurchu	2010	New Zealand	5-13-year olds	Study protocol of the effects of a free school breakfast programme	Proposal for a quantitative study	The effects to be measured are school attendance, achievement, behaviour, and nutrition	Although this is a study protocol with no actual results from the RCT, it contains much useful background information on the situation in NZ
73	Monteagudo	2012	Spain	7-17-year olds	Proposal for a Breakfast Quality Index (BQI) for children and adolescents	Quantitative study	Breakfast was not consumed by 7% of participants. BQI score was highest for children aged 7-9-years and decreased with age	Females scored higher in all age groups. The lowest score was for males aged 14-17 years. A simple list of items included and a scoring system explained
74	Moore	2013	Wales (United Kingdom)	9-11-year olds	Impacts of free breakfast initiative on breakfast consumption	Quantitative study	Universal breakfast provision may reduce socioeconomic inequalities in the consumption of healthy breakfast items and the rate of breakfast skipping	The study was an RCT involving 55 intervention and 56 control schools. Breakfast skipping declined in more deprived schools, not just in more affluent schools
75	Mumm	2004	United States	13-14-year olds	Increasing social support for breakfast: Project BreakFAST	Quantitative study	The study showed clear benefits for school staff and pupils in general (not close friends) in supporting a behaviour change to include breakfast consumption	The FAST in BreakFAST stands for Fuelling Academics and Strengthening Teens. The study was an RCT and showed the benefits of making breakfast more socially acceptable

76	Murphy	2010	Wales (United Kingdom)	9-11-year olds	An RCT of free healthy breakfasts in primary schools	Quantitative study	Evaluation of the impact of free school breakfast. Students in intervention schools reported more healthy food items consumed and more positive attitudes towards breakfast	The intervention did not reduce breakfast skipping; instead, pupils substituted breakfast at home for breakfast at school. There was no effect on academic performance or classroom behaviour, which may require targeting breakfast skippers
77	Nanney	2019	United States	14-16-year olds	Trial to increase attendance at a school breakfast programme	Quantitative study	A randomised control trial at the whole-school level. The trial increased attendance rates, but not by as much as expected	Methods tried were having a grab-and-go breakfast in the atrium, having extended hours of opening, and allowing eating in the corridor
78	Nelson	2007	England (United Kingdom)	4-18-year olds	The contribution of school meals to food consumption and nutrient intakes	Quantitative study	School meals need substantial improvement to meet guidelines for healthy eating – some force of law is needed	The study was a secondary analysis of the 1997 National Diet and Nutrition Survey of young people
79	Powell	1998	Jamaica	6-8-year olds	An RCT of the effects of breakfast in rural primary school children	Quantitative study	Sixteen schools were included in the study. The provision of breakfast produced small benefits in nutritional status, attendance, and achievement	The study involved multiple regression analysis

80	Robinson-O'Brien	2010	United States	9-12-year olds	Contribution of SBP (and lunch) to fruit and vegetable intake	Quantitative study	Despite evidence of the benefits, data suggests that fruit and vegetable consumption is below recommended levels, particularly among low-income children	School meals contribute to daily FV intake, particularly for those with the lowest FV intake. School meals should be high in FVs
81	Sahota	2013	England (United Kingdom)	5-16-year olds	Factors influencing take-up of free school meals in primary and secondary school children	Qualitative study	Parents found the registration process straightforward - though many secondary schools were not proactive in promoting free school meals	Quality and choice of food were determinants of take-up. Stigma was less of an issue than initially anticipated
82	Sampasa-Kanyinga	2014	Canada	12-17-year olds	Association between breakfast skipping and bullying at school	Quantitative study	Breakfast skipping is increasingly widespread amongst adolescents. Some adolescents skip breakfast because of their body image/weight	Bodyweight and body image are often a cause of bullying – there is an association between breakfast skipping and bullying – particularly in girls. Valuable data on breakfast skipping
83	Sampasa-Kanyinga	2017	Canada	10-18-year olds	Regularly eating breakfast is related to higher academic performance	Quantitative study	The study addresses gaps in the literature by providing supporting evidence for the association. Future research using prospective experimental designs is called for	The study also examines school connectedness. Various odds ratios are reported from logistic regression analysis

84	Shanafelt	2019	United States	11-12-year olds	Economic aspects of expanding school breakfast programme	Quantitative study	The study estimated the cost implications of expanding breakfast. It was found that in most cases, this could be done while maintaining profits	For costs to be controlled, schools may wish to have flexibility with 'grab-and-go' breakfasts and second-chance breakfasts
85	Shemilt	2004	England (United Kingdom)	5-16-year olds	An economic evaluation of school breakfast clubs	Quantitative study	Estimates the costs resulting from the clubs and attempts to investigate the relationship between cost and outcomes	The study includes details of an econometric model. The level of public funding was not a significant determinant of the outcome
86	Shemilt	2004	England (United Kingdom)	5-16-year olds	Evaluation of school breakfast clubs: evidence from a randomised control trial	Quantitative study	Forty-three schools were randomised – 24 to the intervention arm and 19 to the control arm. The intervention was the introduction of a club. Fewer pupils in the intervention group skipped lessons	The observational analysis showed more pupils eating fruit with a breakfast club. However, more intervention pupils showed poor behaviour in class. A mixed picture of benefit and apparent disbenefit
87	Sivaramakr ishnan	2012	India	5-18-year olds	A typical working-day breakfast among children, adolescents, and adults in middle and upper socioeconomic class districts	Quantitative study	81% of the participants had a nutritionally inadequate breakfast. Children often had little more than milk. 37% of adolescents skipped breakfast	Age- and gender-specific challenges in breakfast behaviour need to be addressed. Development of 'nutrient-dense' breakfast foods that can be prepared easily is required

88	Stokes	2019	United States	5-14-year olds	Teachers' experience of school breakfast	Qualitative study	This study specifically studied breakfast in the classroom. Teachers had their likes (such as students not being hungry) and dislikes (such as the mess)	Having a better understanding of the likes and dislikes should help in providing the best experience for both teachers and students
89	Turconi	2003	Italy	14-17-year olds	Reliability of a dietary questionnaire on food habits of adolescents	Quantitative study	The objective was to develop a dietary questionnaire and to examine its reliability. A cross-sectional baseline survey	The instrument appeared to be reasonably reliable. It is low in cost and easy to administer and analyse. The comprehensive questionnaire is included in the paper
90	Van Kleef	2016	Holland	4-11-year olds	Barriers to eating breakfast in disadvantaged neighbourhoods	Qualitative study	Mothers *(not Fathers?!)*, children, and 'experts' were asked their views about eating breakfast	Experts perceived more problems and challenges relating to healthy breakfast habits than mothers and children. Mothers and experts often disagreed!
91	Van Wye	2013	United States	7-9-year olds	Evaluation of Breakfast in the Classroom (BIC) Program	Quantitative study	Pupils offered BIC were less likely to report not eating in the morning but more likely to report eating in 2 or more locations	Students offered BIC on average consumed 95 more calories per morning. The possible effect on overweight cannot be ignored

92	Vaudrin	2017	United States	5-10-year olds	Impact of an Act of 2012 requiring only healthy food be served at SBP	Quantitative study	While it was predicted that a requirement to get rid of unhealthy food in schools would lead to a fall in attendance at SBP, this did not happen in the long run	When the act came into force in 2012, there was an initial reduction (higher than with lunch) among poorer students, but this soon recovered. With time, pupils are likely to accept healthier options
93	Viggiano	2014	Italy	9-19-year olds	Evaluation of a board game (Kaledo) for nutrition education of children and adolescents in school	Quantitative study	Reports the results of an RCT. Kaledo improved nutrition knowledge and dietary behaviour over six months and had a sustained effect on the BMI score (reducing the mean level)	Kaledo may be a valuable tool in childhood and adolescence obesity prevention programmes. It is based on the Mediterranean diet, and modifications would be needed for countries with different diets
94	Villa-Gonzalez	2019	South America	10-18-year olds	Association between method of commuting to school, sleep duration and breakfast consumption	Quantitative study	Those who 'had enough sleep' were more likely to be active in their journey to school	A cross-sectional study of 3 urban schools. There was not so much association with breakfast consumption
95	Wang	2016	United States	9-11-year olds	School breakfast and body mass index	Quantitative study	Concerns that a second breakfast at a school increases the risk of excessive weight gain are unsupported	Students who regularly consumed breakfast at school (including double breakfast eaters) were more likely to be of a healthy weight

96	Whitaker	2019	United States	12-18-year olds	Impact of the school start time on adolescents' mood and health	Quantitative study	Schools were asked to vary their start time between 7.00 am, 7.30 am, and 8.10 am. The effect on safety and mood etc. was estimated	Although not specifically about breakfast, breakfast skipping was more common the earlier the start time. The effect of the time breakfast is served at school is worthy of further study
97	Wolfe	2018	United States	8-15-year olds	Choose health: food, fun, and fitness youth curriculum	Quantitative study	This hands-on experimental curriculum did promote positive behaviour change in participating youth	Some good examples of questions designed to measure the eating habits of young people

9. A review of the 'grey literature'

Although the 97 refereed journal articles are useful, we need to complement them with some grey literature. The advantage of using grey literature is that many reports were produced in the UK, and they were explicitly concerned with school breakfast clubs. Many of the reports were written by those involved in providing school meals rather than academics.

Several surveys routinely collect data on the diet of young people. The **Health Behaviour in School-aged Children (HBSC)** is a survey across various nations, looking at various health-related behaviours among young people aged 11, 13, and 15 years. Since 1982, HBSC has been a pioneer cross-national study gaining insight into young people's well-being, health behaviours, and social context. The research *(which collaborates with the WHO Regional Office for Europe)* is conducted every four years in 50 countries and regions across Europe and North America. With children and young people accounting for 42% of our world's population, HBSC uses its findings to inform policy and practice to improve the lives of millions of young people. Further information is given in the paper by **Inchley et al.**[106] **(2020)**.

Researchers or teachers administer the survey in schools using a paper questionnaire completed under exam conditions and placed in an envelope for confidentiality. The most recent data for England is available for 2018. This survey included a question about how often the young person usually ate breakfast on weekdays. The exact wording of the question was:

- ***How often do you usually have breakfast (more than a glass of milk or fruit juice) on weekdays?*** *(Never/1 day/2 days/3 days/4 days/5 days)*

According to the 2018 survey conducted in England, around two thirds (63%) of young people reported eating breakfast every day during the week. Eating breakfast every day was more common in younger adolescents; 72% of 11-year olds, 58% of 13-year olds and 54% of 15-year olds. Boys of all ages were more likely than girls to report eating breakfast every day during the week (69% vs 56%), but both boys and girls showed a similar pattern of decline as they got older.

Overall, 14% of young people reported never eating breakfast during the week. Never eating breakfast was more common in older adolescents; 8% of 11-year olds, 16% of 13-year olds and 20% of 15-year olds. Girls were more likely than boys to report never eating breakfast during the week (17% vs 11%), and for both genders, the proportion of young people claiming that they 'never eat breakfast' increased with age.

Another useful report is **What About YOUth? Survey (WAY)**. WAY is organised by the **Health & Social Care Information Centre (HSCIC)**[104]. The 2014 study (WAY 2014) reported on the health and well-being of 15-year olds in England. Young people completing the WAY 2014 questionnaire were asked how often they had eaten breakfast in the last seven days. Replies were either 'every day', 'most days', 'some days', or 'not in the past seven days.' The survey findings were as follows:

Weekly breakfast consumption by gender: WAY 2014 (15-year olds)

Weekly consumption	Boys	Girls	Total
Every day	64%	48%	56%
Most days	15%	17%	16%
Some days	13%	21%	17%
Not in past 7 days	8%	14%	11%

These findings are in line with those from HBSC.

Although both the **Health Survey for England (HSE)** and the **National Diet and Nutrition Survey (NDNS)** collect data on young people's diet, neither survey deals specifically with breakfast.

Most of the reports included in this section were written for the constituent parts of the UK. One would be forgiven for assuming that the Department **for** Education is a UK-wide body. However, the Department for Education is only responsible for children's services and education *(including early years, primary schools, secondary schools, higher and further education policy, apprenticeships, and broader skills)* in England – **not** in Wales or Scotland or Northern Ireland. Wales, Scotland, and Northern Ireland all have devolved governments.

The Northern Ireland Executive is the devolved government of Northern Ireland, an administrative branch of the Northern Ireland Assembly. It is answerable to the Assembly and was established according to the Northern Ireland Act 1998, which followed the Good Friday Agreement. The Department **of** Education has responsibility for education and youth services in Northern Ireland.

While some people think life would be simpler if the three devolved governments adopted the same education policies as those in England, this ignores some important considerations, for example:

- The four parts of the UK are all different. While it may be a good idea to promote the Welsh language in schools in Wales, it would not be appropriate to do so in Northern Ireland. While it may be appropriate to encourage all secondary-age students in Northern Ireland to study *(at least to a basic level)* the geography and history of the Republic of Ireland, such a focus would be less appropriate for students living in Scotland.

- Northern Ireland has a population of under 2 million *(1.86m)*, less than 3% of the UK population *(65.64m)*. While England thought it appropriate to have three medical schools and one veterinary college for every 10 million people, Northern Ireland may have a solid case for a medical school and a veterinary college. *(Indeed, at the time of writing, it is proposed to open a <u>second</u> medical school in Northern Ireland.)*

Perhaps more relevant to this study, there are significant regional variations in diet. While the South of England has a 'standard' pattern of three meals a day (breakfast, lunch, and dinner), Northern Ireland has four meals a day (breakfast, lunch, tea, and supper). Both tea and supper can be pretty substantial meals. It is possible that if secondary school students in Northern Ireland tend to eat a meal close to bedtime, they will have less of an appetite for breakfast the following morning. There is also regional variation in what constitutes 'breakfast'. Perhaps not surprisingly, a 'continental breakfast' is more acceptable in the South of England than in Northern Ireland.

As far as this research project is concerned, there are two clear advantages to having education policy devolved in Wales, Scotland, and Northern Ireland:

1. With four education authorities, there is more 'grey literature' available.

2. With more significant variation in school breakfast provision, 'natural' experiments are generated, making evaluation easier.

The provision of breakfast at school is now considered separately in each part of the UK. The UK is made up of four countries:

- England
- Wales
- Scotland

- Northern Ireland
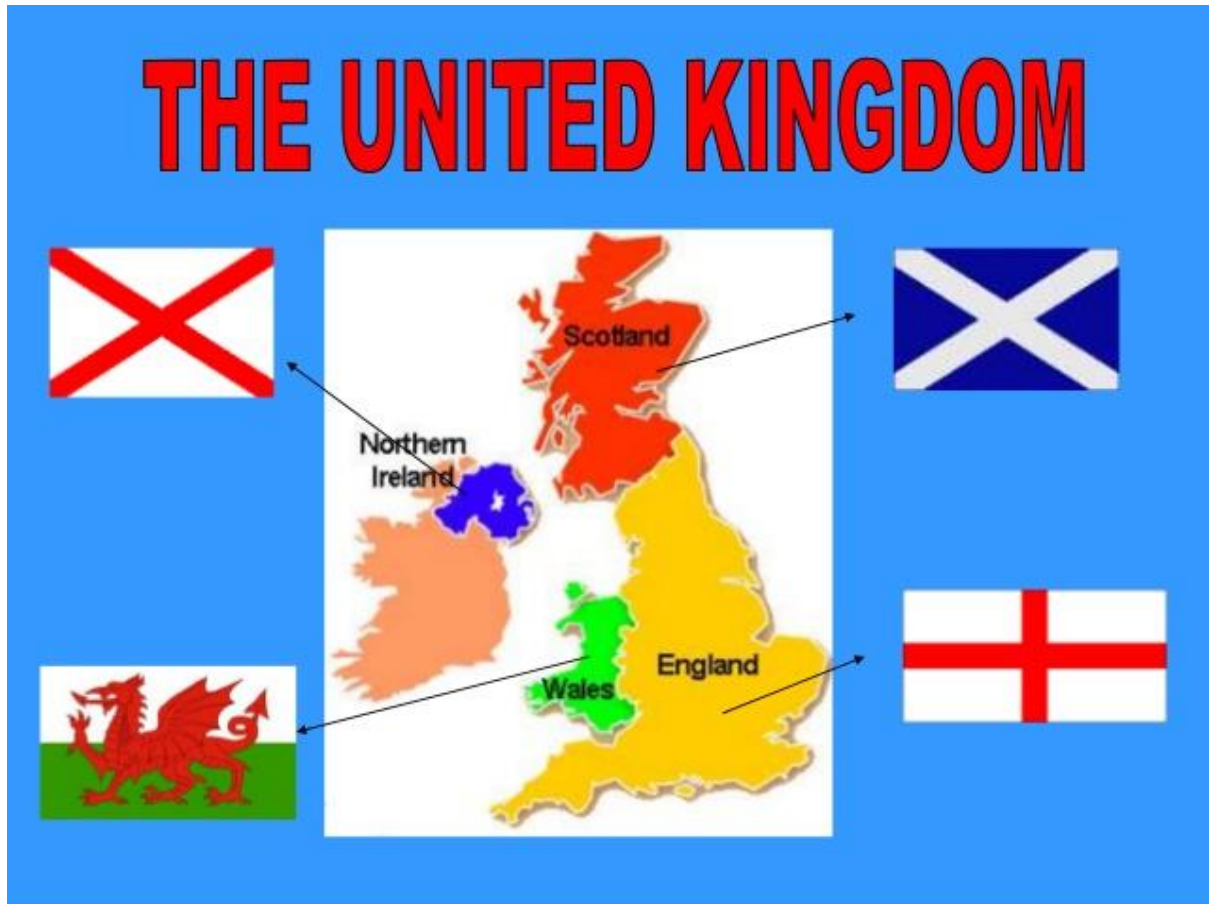
The Irish Republic (Eire) ceased to be part of the United Kingdom in 1922. It is that part of Ireland shaded salmon in the map above.

In **England**, the Department for Education recently issued two valuable documents:

- *Breakfast Clubs Setup and Implementation: Briefing for School Leaders (March 2017)*[99]

- *Evaluation of Breakfast Clubs in Schools with High Levels of Deprivation (March 2017)*[100]

In the first document, we read as follows:

What are the benefits of running a breakfast club?

The following advantages were consistently identified by school staff involved in the evaluation as reasons they wanted a breakfast club. Many of the goals were also identified by pupils and parents.

*1.   **Breakfast clubs can reduce the number of pupils coming to class hungry.***

Reducing hunger in pupils is nearly always the primary reason schools want to introduce a breakfast club. Breakfast clubs can have a tangible impact on reducing the number of hungry children in the morning. Staff felt that many pupils would not eat breakfast if a breakfast club were not available.

*2.   **Breakfast clubs can help pupils eat more healthily.***

Breakfast clubs can encourage pupils to eat more healthily, provided that the food on offer is healthy and nutritious. Some pupils who eat breakfast outside of a breakfast club may be eating fatty and sugary foods, such as take-away food, and not getting a healthy and nutritious start to the day.

*3.   **Breakfast clubs can help pupils' punctuality.***

Breakfast clubs can be a way of encouraging pupils to get to school on time. Providing breakfast free can help parents let their children come in early. Pupils generally like the food on offer and the opportunity to mix with their friends before lessons. Pupils can see the difference in their punctuality.

*4.   **Breakfast clubs can help pupils concentrate and pay attention in class.***

Pupils being hungry has been linked with reduced concentration in class. Schools believe breakfast clubs can positively impact pupils' ability to concentrate and that pupils are better able to settle into class and more ready to learn when they have eaten breakfast.

*5.   **Breakfast clubs can help improve pupils' behaviour.***

Schools link pupils being hungry to poor behaviour. By reducing hunger by introducing a breakfast club, classroom behaviour can be improved. As well as helping individual pupils, having the routine of a breakfast club means pupils generally settle better into class and are more ready to learn, which impacts both the pupils attending breakfast club and the whole class.

6.   Breakfast clubs can help pupils' social development.

Eating breakfast together makes it easier for children to mix with other pupils who are not in the same class and with children in different age groups. It can encourage more reserved pupils to talk to each other and staff, fostering new relationships. Where staff attend, breakfast clubs can also help them get to know pupils better and spot if they are having difficulties in school or outside of school, which may need attention.

The document goes on to offer advice on:

- Developing and testing the club

- Marketing and promoting the club

- Monitoring attendance at the club

The final two sections deal with communication and looking ahead – reviewing whether the breakfast club is sustainable for the coming school year.

In the second document, we read:

This report presents the findings of an evaluation of a programme initiated by the Department for Education (DfE) to set up and run breakfast clubs in schools with over 35% of their pupils eligible for Free School Meals.

A principal aim was to enable schools to build a sustainable club that would continue after the programme ended. The plan was delivered under contract to DfE by the charity **Magic Breakfast***.*

- *Magic Breakfast recruited the schools, provided them with advice and support and organised free food deliveries.*

- *The contract included a six-month setup period, followed by a period of 12 months' free food deliveries to each school.*

The aims of the evaluation were twofold:

- *To assess processes, including barriers and enablers to establishing and sustaining breakfast club provision in schools with high deprivation;*

- *To establish the perceived impact of breakfast clubs on reducing the number of children coming to school without breakfast, improving children's punctuality and behaviour, and to increase their concentration during the morning.*

The programme recruited 184 schools. All schools had over 35% of pupils eligible for free school meals. Nearly all schools sustained their breakfast club; of schools who

responded at a six month follow up, 96% had continued to provide a breakfast club after Magic Breakfast's contract with DfE had stopped.

Most schools in the programme were primary schools (63%). Around a quarter of pupils on the roll attended breakfast clubs; attendance was slightly lower in secondary schools.

The following results were reported amongst the 184 schools recruited:

- *88% had seen improved attainment and attendance*

- *94% had seen more positive social skills*

- *93% saw improved concentration*

- *74% saw enhanced behaviour*

Turning to **Wales**, an essential publication of the Welsh Government is:

- *Free Breakfast in Primary Schools (April 2015)*[119]

It is claimed that Wales leads the way in the UK in terms of almost compulsory provision of free breakfasts in primary schools. Still, perhaps rather oddly, the Welsh Government has shown little interest in breakfast provision at the secondary school level.

The document lists the types of food which should be served at breakfast in primary schools:

- *Cereals with no added sugar such as whole-wheat cereals; cornflakes; rice-based cereals; shredded wholegrain wheat cereals; malted wheat squares; bran flakes; porridge*

- *Milk: Yoghurts; semi-skimmed or skimmed milk*

- *Bread: a variety of slices of bread with thinly spread toppings such as margarine, jam, marmalade, and honey*

- *Fruit: chopped fresh fruit or dried fruit to add to cereals; canned fruit in natural juice; unsweetened fruit and vegetable juices*

Turning to **Scotland**, this country has been most sluggish in taking on board the idea of breakfast clubs. Although the Scottish Government often prides itself on being very proactive in education and health care, the record often paints a different picture regarding low educational attainment and poor child and adolescent health standards. There are no documents on the Scottish Government website concerned with school breakfast clubs.

However, reference can be made to the following four documents from various government departments or agencies:

- *Scottish Government – Better Eating, Better Learning – a New Context for School Food (March 2014)[112]*

- *Scottish Government – Beyond the school gate – improving food choices in the school community (June 2014)[113]*

- *Food Standards Scotland – The Scottish Diet: It needs to change – 2018 update[102]*

- *Scottish Government – Consultation on amendments to the 'Nutritional Requirements for Food and Drink in Schools Regulations' (June 2018)[114]*

Although guidance and directives are offered *(see the first and fourth documents listed above)* concerning what food and drink should be served

in primary and secondary schools in Scotland, this relates almost entirely to lunch. Although there is some reference to food at break-time, the idea of breakfast at school is mainly ignored. Scotland has 32 Councils *(such as the Highland Council)*. Each Council is responsible for providing school meals in their area, and it is apparent that there is significant variation in practice between Councils.

The second document listed above seems a little strange, as once more, it is almost blind to the idea that schools might serve breakfast. Instead, it focuses on what students eat in shops and takeaways close to school and recognises that some students will be purchasing their breakfast in these commercial outlets.

The third document states:

Like most Western countries, Scotland eats too much of the wrong things. It is not just a case of over-indulging occasionally. Many of us are making bad choices about what and how much we eat throughout the day, every day, encouraged by a food and drink environment in which high fat, high salt and high sugar foods are cheap, widely available, and heavily promoted.

Although this hardly 'avoids pointing the finger at the problem', it seems to ignore the fact that much of the western world has a better diet than Scotland. It also largely ignores schools' role in providing healthy food and educating students about what constitutes a healthy diet.

However, we find the following more promising information on the **Magic Breakfast** website:

Magic Breakfast is a leading provider of school breakfast in England. It has just announced that it will extend its support to Scotland, working with schools, local authorities, and funding partners. It aims to eradicate hunger as a barrier to education in areas of social deprivation.

Magic Breakfast provides healthy breakfasts to children who arrive at school too hungry or malnourished to learn. The charity will be working with 13 schools in Edinburgh, Glasgow, Fife, and North Ayrshire, reaching over 400 children every school day. There are plans to begin delivering food and expert support to schools in East Ayrshire, Falkirk, Inverclyde, North Lanarkshire, Renfrewshire, and West Dunbartonshire in late 2018.

26% of children in Scotland are classified as living in relative poverty. By the end of primary school, the more deprived pupils are on average 13 months behind in their vocabulary and ten months behind in problem-solving.

It will be interesting to see how this initiative by Magic Breakfast progresses in future years.

Most relevant to the purposes of this research is the situation in Northern Ireland.

In **Northern Ireland**, the devolved government seemed keen on school breakfast clubs and had issued detailed guidelines about what types of food should be served. Two official publications in the ***School Food: Top Marks*** series were produced by the Public Health Agency, the Department of Education, and the Department of Health, Social Services and Public Policy:

- *Nutritional standards for other food and drink in schools; a guide for implementation (2014)[109]*

- *Healthier breakfast clubs (2015)[110]*

The Department of Education clarifies what may and may not be consumed at a school breakfast club. In the first document it states:

Breakfast is probably the most important meal of the day. It is needed to kick-start the body after a long night's rest. By skipping breakfast, pupils may be missing out on essential vitamins and minerals. The HPA (Health Promotion Agency for Northern Ireland) research shows that almost one-third of 12–17-year-old girls do not eat breakfast on school days.

Eating a breakfast high in fibre can help prevent hunger pangs mid-morning, making pupils less likely to snack on fat and sugar foods.

Breakfast cereals are a great way to start the day. They are fortified with vitamins and minerals that help children meet their daily requirements. Cereals should be served with semi-skimmed milk. Choose high-fibre, low-sugar cereals. Low-fibre, low-sugar cereals such as rice crispies and cornflakes can be offered. Do not add sugar to cereal.

Offer a variety of loaves of bread at breakfast. Try to include wholemeal and granary varieties. Provide margarine that is high in monounsaturates or polyunsaturates. Encourage pupils to spread the margarine thinly. Discourage the use of sugary toppings such as jam and marmalade. Offer alternative toppings for toast, e.g. banana or low-fat soft cheese. Jam and marmalade can be provided, but only at the servery and on request from the children.

Fruit and vegetables provide a good source of vitamins and minerals and count towards the five-a-day target. A variety of fruit must be presented at breakfast, and consider providing vegetables.

Milk and dairy foods provide a good source of protein and a range of vitamins and minerals such as calcium, essential for healthy bones and teeth. Choose low-fat dairy foods such as semi-skimmed milk, low-fat yoghurt and half-fat or light cheese.

The following foods are not allowed at breakfast:

- *Cereal coated with chocolate;*
- *Dried fruit that has been sugared or coated in yoghurt or chocolate;*
- *Cereal bars;*
- *Fruit bars;*
- *Cakes and buns;*
- *All biscuits;*
- *Pastries such as croissants, Danish and tarts;*
- *Chocolate spread;*
- *Any type of confectionery, e.g., chocolate products and sweets;*
- *Savoury snacks, e.g. crisps.*

The second document offers some practical ideas to help market the launch of a breakfast club and then maintain attendance. It states:

A healthier breakfast club provides the right balance and variety of food and drinks on its menu over time. It ensures that the needs of pupils and staff are being met and encourages the whole school community to eat breakfast and try something new.

Given all the enthusiasm expressed in these publications, it was quite a surprise that the NI Government announced in May 2018 that more than 60 schools would lose funding to run schemes for disadvantaged children in 2018/19. This money helped to run breakfast clubs. So, while there are signs that breakfast club provision may be due to expand in Scotland, it would appear to be declining in Northern Ireland.

Other useful grey literature is the reports produced by two companies (**Greggs** and **Kellogg's**), which help fund school breakfast clubs. Two such accounts are:

- *Greggs Breakfast Club programme – 400th school celebration – a preliminary investigation into the characteristics of participating schools (2016)[103]*

- *An Audit of School Breakfast Club Provision in the UK: A report by Kellogg's (2014)[98]*

In the first report, we are told:

The Greggs Breakfast Club Programme was established in 1999, and in 2016 The Greggs Foundation oversaw 400 clubs, providing a nutritious breakfast to over 32,075 primary school children each day. The Greggs Foundation received funding from a range of partners, often private sector companies, including their primary partner, Greggs plc. The Greggs Foundation used the money to support breakfast clubs through an initial start-up grant for equipment such as chest freezers to store food items, or toys and activities for the club. The Greggs Foundation also made a payment each term towards other food items, and Greggs plc donated bread from the nearest shop. Although most clubs were in England, a few were in Scotland and Northern Ireland.

The report's focus was almost entirely on the contribution that the breakfast clubs might make in improving the educational attainment of the pupils.

In the second report, we are told:

According to our research, in 2014, 85% of primary schools in the UK ran a breakfast club. According to the audit, Scotland fared the worst in Breakfast Club provision, while Wales ranked top. Only 72% of primary schools in Scotland had a breakfast club, while in Wales, 96% of primary schools had a breakfast club. Nearly half of the UK's primary schools (45%) provided a free breakfast either at the breakfast club or during school hours.

Breakfast clubs provide a direct and cost-effective way to help prevent child hunger, improve behaviour, and boost academic performance. While many primary schools offer a complimentary breakfast, a substantial number do not. The mean fee is £1.68 per child for those who charge, with a median price of £1.50. A few schools charge for separate items, ranging from 10p to 70p.

Reference has already been made to the contribution of the charity – **Magic Breakfast** to the provision of free before-school breakfast in

England (and more recently also in Scotland). Their Annual Reports include much of interest. For example:

- *Magic Breakfast – Fuel for Learning, and Food for Thought (April 2019)[108]*

The Education Endowment Foundation (in association with the Institute of Fiscal Studies) has produced a substantial report:

- *Magic Breakfast – Evaluation report and executive summary (November 2016)[107]*

Although the analysis and evaluation presented in this report are rigorous, it is very much restricted to the provision by Magic Breakfast. It cannot be easily extended to a model where charitable help is not provided. Nevertheless, the report does contain some valuable observations such as:

Parents spoke of benefits (of breakfast at school), including having less stress in the morning and fewer arguments with their children over breakfast. Parents felt that a school breakfast club helped ease their morning routine and allowed them to get off to work or appointments earlier.

One interesting finding (which may well apply to the more general provision of breakfast in school) is that food and drink costs are estimated to account for around 70% of the total costs. Food and drink costs are relatively easy to calculate – some of the other expenses (staffing, energy, cleaning resources, etc.) are not. The suggestion is that if a school knows the costs per pupil of food and drink, it can add a further 50% to arrive at a reasonably accurate estimate of the average total cost per pupil.

A similar conclusion was reached in the report published by the Education Policy Institute and Cooper Gibson Research:

- *Evaluation of Universal Infant Free School Meals (2018)[115]*

Not surprisingly, with the School Breakfast Programme being established in the United States over 50 years ago, plenty of information on costs is available. A handy source of detailed information is provided by the USDA (United States Department of Agriculture):

- *Economies of scale, the Lunch-Breakfast Ratio, and the Cost of breakfasts and lunches (2015)[111]*

Once more, this confirms that, as a general rule, if one wants to estimate the total cost of providing breakfast at school, one will not be too far off the mark if one adds 50% to the cost of the food and drink served.

Two bodies that are active in presenting nutritional matters to the general public in the UK are the **British Nutrition Foundation (BNF)** and **The Nutrition Society**. Much information is provided on their websites and publications, including the Nutrition Bulletin (BNF). The Nutrition Society has a popular series of textbooks.

For example, in the chapter entitled

- *Nutrition in teenagers/young adults (The Nutrition Society textbook: 'Public health Nutrition'; Wiley Blackwell 2018)*[118]

Elisabeth Weichselbaum writes:

"Teenage is a time of transition into adulthood and is characterised by a high demand for energy and nutrients associated with a rapid growth spurt, making healthy food choices particularly important. However, the food choices of adolescents and young adults are often poor, leading to lower than required intakes of essential nutrients. This can impact health in the short term and have consequences for health in later life. Dietary choices affect not only physical development but also cognitive function and performance. This is particularly relevant for young people who attend school or university, as unhealthy food choices may limit their cognitive capacity. For example, eating breakfast is positively associated with cognitive performance, but is regularly skipped by adolescents and young adults."

Recent editions of the Nutrition Bulletin have included valuable background information on School Breakfast Clubs in the UK. A helpful starting point is:

- *Breakfast consumption in UK children and provision of school breakfast clubs (2012)*[105]

Alexa Hoyland et al. write:

"To counter the incidence of breakfast omission in UK children, school breakfast clubs have been widely set up across the UK. These breakfast clubs can provide a nutritious breakfast for children before school in a safe, supervised environment. They can develop skills and social interactions with school staff and children of all school years. While government legislation varies across the UK, each country has introduced guidelines that focus on improving the provision of food in schools, including at breakfast time.

Although the findings suggest that breakfast skipping remains a considerable problem in children, particularly adolescents, it is encouraging that schools and policymakers acknowledge the importance of breakfast and breakfast clubs for health outcomes. This field would benefit from further research to better understand attendance drivers and establish effective interventions to improve attendance and encourage the breakfast habit at breakfast clubs."

In another helpful article in the Nutrition Bulletin

- *Diet, nutrition, and schoolchildren (2014)*[117]

Elizabeth Weichselbaum and Judith Buttriss write:

"Eating breakfast has been associated with positive effects on cognitive performance, on-task behaviour, and academic performance. The School Food Trust carried out a study looking at the potential benefits of breakfast clubs, comparing 13 primary schools with breakfast clubs to nine schools without, all located in deprived areas of London. One year after introduction, average Key Stage 2 results were statistically significantly higher by 0.72 points in the schools with breakfast clubs compared with a non-significant 0.27-point increase in the schools without breakfast clubs. This difference was sustained over the next few years with no further additions.

Schools believed that they had reaped significant benefits by introducing breakfast clubs, especially in the case of the most socially deprived. The benefits included improved social skills, punctuality of frequently late children, and children's health and concentration levels."

Finally, helpful material is found in Chapter 3 of the recently published textbook 'Transforming Food Environments'

- *The School Food Environment (2022)*[101]

Charlotte Evans et al. write:

"Children and adolescents who habitually consume breakfast are more likely to have favourable macronutrient intakes, including higher intakes of dietary fibre, total carbohydrate, and lower total fat intake. Evidence suggests that daily micronutrient intakes are higher in breakfast consumers than breakfast skippers. Using data from the National Diet and Nutrition Survey (NDNS), a recent study demonstrated that breakfast consumption is associated with higher-quality dietary intake in 1,686 school-age children aged 4 – 18 years. The findings demonstrated that fibre, folate, vitamin C, calcium, iron, and iodine intakes were higher in frequent breakfast consumers. Consequently, school breakfast initiatives represent an opportunity to improve the diet and health of young people."

Sources in red are listed at the end of this document after references for the systematic review.

10. List of 119 articles reviewed

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CHAPTER 2

Estimating the cost of school breakfast

- **Introductory remarks**

- **Three different models of breakfast delivery**

- **Information obtained from visits to schools**

- **Probable cost of providing a basic, nutritious school breakfast**

- **Concluding remarks**

- **Acknowledgements**

- **Appendix 1: Resource use form**

- **Appendix 2: Costing form**

1. Introductory remarks

From the systematic review of the literature, it is clear that there are many potential benefits to be gained if secondary schools routinely offer breakfast. However, these benefits do not come at zero cost. There can be little doubt that school breakfast is a 'good idea', but the 'big question' must be, 'is it a good enough idea?' In other words, do the benefits justify the costs?

Putting a monetary value on the benefits is challenging, but this is not so difficult when considering costs. If the costs are relatively low, 'common sense' may well tell us that the benefits justify the costs. In that case, we may be content to just state the benefits in more general terms. An illustrative example will make the point.

There can be little doubt that in the UK, there have been enormous benefits gained from the mass immunisation programme for COVID-19. Putting a monetary value on these benefits is not easy, but estimating the programme's cost is much simpler. If it turned out that each jab only cost £1, we would have no difficulty in declaring that the programme is a good use of resources. However, we would not be so confident if each jab cost £1,000. In the former case, we would be pleased to state that 'common sense' tells us the benefits justify the costs.

Charities such as Magic Breakfast have demonstrated that serving a simple, nutritious breakfast can be relatively cheap. A healthy breakfast *(such as a bowl of wholegrain cereal or porridge, a slice of toast, and a glass of pure fruit juice)* is usually far cheaper than an unhealthy breakfast *(such as the 'Ulster Fry' shown below)*:

Having worked as an economist for most of my working life, I was keen to do some costing myself. This had the advantage that it gave me an excuse to visit various secondary schools near my home and observe their breakfast service. Using this experience, I designed the online questionnaire completed by 35 School Principals or Catering Managers in Northern Ireland. *This is the subject of Chapter 3.* The school visits also allowed me to chat informally with some of the pupils as they ate their breakfast, which proved helpful in the design of *the pupil questionnaire used in Chapter 4*. One of the schools I visited acted as the pilot for the central survey involving 2,488 pupils in Northern Ireland.

Any costing exercise involves an estimate of resource use. It would be very slipshod just to consider the cost of the food and drink served. There are staff costs, energy costs, etc., that must also be accounted for. Total resource use will depend on the model used for breakfast delivery.

2. Three different models of breakfast delivery

(i) Breakfast service in a central canteen *(dining room)*

The model used here is invariably the same as that used for school lunch. Pupils queue up with a tray and select what they want to eat. They then go through a till and sit down to eat their meal. Schools that use this method typically start breakfast service around 1 hour before the 'formal' school day begins and stop serving around 20 minutes before the formal start. Although this before-school use may not require other activities to give up the use of the dining room, it may cause logistical problems if the school has previously used the space for morning assembly.

It is possible to offer a cooked breakfast with this model, as presumably, the dining room is close to the school kitchen. It seems likely that some of the catering staff will need to start work earlier than before, and of course, the dining room will require heating and lighting. The crockery and

cutlery will also need to go through the dishwasher, and the dining room will require cleaning when breakfast has ended.

(ii) Breakfast service at a central 'pick-up' point

This model is sometimes described as a **'grab-and-go' breakfast**. Food such as bagels, fruit, and a carton of drink are laid out in a temporary serving area *(perhaps close to the school entrance),* and pupils select which items they want in return for a 'daily breakfast ticket'. The choice tends to be quite basic, and there are designated areas where the food can be eaten – including the playground in nice weather. It may be possible to use the school prefects as servers, though facilities and catering staff will also be involved. Breakfast items will usually be available between 30 minutes and 10 minutes before the formal start of the school day, and only disposable cups and plates are used. It is possible to provide some hot food in this model – for example, bacon rolls can be 'made up' in the kitchen and served on a napkin to the pupils.

(iii) Breakfast served in classrooms

This idea is not as novel as it may sound! In the years immediately following the end of World War II, all school pupils in England and Wales were provided with a complimentary bottle of milk to consume in the classroom before the mid-morning break. Provision for secondary aged pupils was ended in 1968, for 7-11-year-olds in 1971, and for 5-7-year-olds in 1979. This breakfast delivery model is relatively standard in

schools in the United States and is similar to how breakfast is served to passengers on an airline.

For practicality *(not least smell)*, hot items are rarely served in this model, but a standard continental breakfast is served to each pupil at their desk. The breakfast is usually eaten during class registration time, though there is no reason why it cannot be eaten just before the start of lesson 1 following morning assembly. Identical breakfast packs are usually made up by the catering staff in the school kitchen and then delivered by the facilities staff to classrooms. A bin liner is provided for pupils to deposit all uneaten food, disposable bowls, etc., at the end of the meal – this is then collected by facilities staff.

The concept of opportunity cost is clear to see. Teachers may not be happy having a valuable lesson or form tutor time devoted to eating breakfast, and they are likely to be very frustrated if food or drink is spilt on the desks and workbooks. However, as breakfast is eaten during the formal school day, it may be possible to ensure that no one misses out. In this model, payment is usually arranged by the bursar on a termly or yearly basis, and it is easy to cater for pupils who are entitled to free school meals.

3. Information obtained from visits to schools

All the local schools that I visited used the first model. The schools were:

- Allerton High School, Leeds *(Contract Catering)*
- Bootham Senior School, York *(School Catering)*
- Garforth Academy, Leeds *(Contract Catering)*
- St John Fisher School, Harrogate *(Council Catering)*
- St Peter's School, York *(School Catering)*

All five schools gave me a warm welcome and even a complimentary breakfast! However, I had a very different experience regarding the availability of cost information depending on whether the school took responsibility for its own catering or used contract caterers.

Bootham Senior School, York and St Peter's School, York, are independent schools with boarding departments. Breakfast is included in the boarding fees, and the Bursars at these two schools were prepared to give me detailed breakdowns of the cost of providing breakfast. This proved helpful because I could compare the cost estimates I made with the actual figures.

On the other extreme, I was amazed how little the Catering Managers and Accounts Departments at the two schools using Contract Caterers knew about costs. It wasn't they were hiding the information from me – they genuinely didn't know! However, they provided me with enough information to make cost estimates of my own, and these suggested that the contract caterers were making quite a profit – given the prices charged to the pupils. Small wonder the Contract Caterers (Compass - Chartwells) didn't want to talk to me!

For the record, I did not attempt to visit North Yorkshire County Council to enquire about the cost of providing breakfast at St John Fisher School, Harrogate. There was little need – I was satisfied that my costing methods provided reasonably accurate estimates.

I had helpful discussions with the Accounts and Prices Team *(part of the Food Statistics Team)* at DEFRA – the Department for Environment, Food and Rural Affairs. They happen to be located in York *(where I live)* and showed a keen interest in my research. They informed me that problems with obtaining statistics on food and drink costs were not restricted to the educational sector; they were also common in the National Health

Service. The method DEFRA employed (if it wanted to make cost estimates) was to obtain the 'food shopping list' from the individual unit manager and then to cost it themselves using the information provided by wholesale food suppliers.

Many school caterers *(whether in-house or contract)* obtain their supplies from Brakes, and their price lists are published online. The online price list shows the maximum price that Brakes charge for a food item. For example, in June 2019, the advertised price for a 2.27kg pack of rindless back bacon was £8.99. There are 50 prime rashers per pack, giving an approximate cost per rasher of 18p.

The Brakes website shows that further trade discounts are available on all their items. It seems likely that larger schools, and those using contract catering, will be able to qualify for significant discounts *(commercial economies of scale)*. DEFRA recommended ignoring these discounts *(as it is challenging to get accurate information on them)* and, in lieu to ignore 'minor' items in the costing exercise. In the case of, say, a bacon roll, these 'minor' items would be cooking oil, butter, tomato ketchup and brown sauce. Only the bacon and bread roll would be costed.

The Accounts and Prices Team assured me that arriving at a reasonably accurate estimate of the staff costs involved in breakfast delivery would not be difficult. I would need a list of the categories of staff employed *(such as chef or kitchen porter)* and information concerning how many hours (and minutes) they were occupied preparing, serving, and clearing away breakfast. Pay scales are widely advertised in the press, and there are unlikely to be many variations between schools – the labour market is very competitive. A review of salary scales indicated typical annual salaries of around:

- £30,000 for a catering manager
- £25,000 for a chef
- £18,000 for a catering assistant
- £13,000 for a kitchen porter

Assuming the school kitchen operates for 8 hours a day, 200 days a year, this gives hourly costs of approximately:

- £19 for the catering manager
- £16 for the chef
- £11 for a catering assistant

- £8 for a kitchen porter

The Catering Manager at St Peter's School, York was willing to provide me with definitive data on staff costs associated with breakfast delivery – these were approximately £22,000 per annum. This figure was reported to the School Governors and calculated by the School Bursar.

The figures in Appendix 2 suggest daily staff costs of £99. As St Peter's serves breakfast 225 days a year, this would give an annual figure of £22,275 – which is remarkably close to £22,000!

The table below shows the figures for food costs as calculated by the School Bursar.

Breakfast service	Number to be served per day	Number of days service per year	Average daily food cost	Annual food cost
Boarding pupils	156	225	£0.90	£31,590
Boarding staff	30	225	£1.00	£6,750
Total annual cost of food and drink served				£38,340

Appendix 2 shows that I estimated daily food costs to be £197.10 – £44,347.50 per annum (assuming 225 days of service). According to my costing exercise, combined food and staff costs per breakfast would be £1.59 (£1.06 + £0.53).

Of course, there are other costs to be considered, such as the paper napkins, and more significantly, cleaning materials, electricity and gas, and depreciation of capital equipment, such as the toaster. It seems unlikely that all these other costs would amount to more than 41p per breakfast served, and so it seems fair to conclude that the average total cost of a breakfast served at St Peter's School, York is no more than £2.

As the information given in Appendix 1 shows, the typical breakfast served at St Pater's is very substantial. The sample menu was as follows:

- Fruit juice
- Porridge or cereals
- Sausage, eggs, baked beans, tomato, mushrooms, hash browns
- Toast
- Yoghurt or fresh fruit
- Hot drinks

Bootham Senior School, York, operates a 7-day cycle for its breakfast menu. The School Bursar gave a figure for the average cost of food and drinks each day. In addition to the rotating menu, each day, pupils may choose from 5 low -sugar varieties of cereal or porridge, homemade yoghurt (with various toppings) and a selection of bread. The menu and average food costs (Summer Term 2019) were as follows:

Monday (£1.02)

- Meats and cheese
- Boiled eggs
- Croissants
- Pain au chocolat
- Cinnamon swirls

Tuesday (89p)

- Bacon
- Fried egg
- Hash browns
- Baked beans
- Mushrooms

Wednesday (£1.10)

- Scrambled egg
- Sausages
- Grilled tomato
- Potato waffles
- Baked beans

Thursday – the same as Monday (£1.02)

Friday (91p)

- Poached egg
- Hash browns
- Mushrooms
- Plum tomatoes
- Baked beans

Saturday (£1.25)

- Bacon
- Sausages
- Scrambled eggs
- Tomatoes and baked beans
- Black pudding

Sunday Bruch served 10.30 – 13.00 (£1.56)

- Bacon
- Sausages
- Omelettes
- Baked beans
- Potato waffles
- Scampi
- Smoked haddock fish cakes
- Chicken bites

It should be noted that except for Sunday Brunch, these food and drink costs are very similar to those reported by St Peter's School.

4. Probable cost of providing a simple, nutritious school breakfast

The breakfast menus at Bootham Senior School, York and St Peter's School, York, are impressive! However, it would be foolish to suggest that this is the sort of fayre that should be offered at all secondary schools in Northern Ireland. The point I wish to make is that if it is possible to provide menus such as these at an average total cost of no more than £2 per pupil, it should be possible to provide a more basic, though adequate, and nutritious breakfast, for an average total cost of £1 per pupil.

I don't wish to get involved in political issues, but I feel bound to comment on the high prices that contract caterers expect a school to charge pupils for breakfast items. For example, in Summer Term 2019, pupils at Allerton High School were charged £1.07 for a bacon bap, while pupils at Garforth Academy were charged £1.25 (2 rashers).

I conclude this section by referring to the Breakfast Club organised by a secondary school in Northern Ireland – St Mary's Christian Brothers'

Grammar School, Belfast. During Autumn Term 2019, they offered a breakfast meal deal in their canteen for £1.00. The menu was as follows:

- 1 Cereal – Weetabix or Cornflakes
- 1 Glass of pure orange
- Scrambled eggs
- 2 slices of toast
- 1 cup of tea

The School Bursar informed me that the breakfast deal was not subsidised – all costs were covered – just!

5. Concluding remarks

I am led to conclude that there is a strong case favouring breakfast being served at secondary school. The literature review reported in Chapter 1 points to high potential benefits, while the information presented in this Chapter (2) suggests relatively low costs. It looks as though school breakfast can be a 'good buy'.

Of course, if school breakfast is provided, someone has to pay for it. Secondary schools in Northern Ireland are required to open for 200 days a year – so if parents are charged £1 a day, the annual cost would be £200.

I wondered how much parents would need to spend to give their son or daughter a can of Diet Coke, a packet of own-brand crisps, and a 2-finger Kit Kat. Checking the Tesco website in April 2022, assuming a ten can fridge pack for the Diet Coke, a bag with 30 packets of variety crisps, and a 21 pack of Kit Kats, the answer was 66p a day, £132 a 200-day year. Some parents will be convinced that the £1 school breakfast deal represents better value for money!

However, many parents would struggle to pay £200 a year and need their son or daughter to be provided with free school breakfasts. For illustration, if the Department of Education offered complimentary breakfast to all pupils at a secondary school with 1,000 pupils, the annual cost would be (say) £200,000 a year.

To put this figure into some context, the pay of a secondary school teacher on the main scale in Northern Ireland was £24,137 - £41,094 per annum (April 2022). Allowing for pension costs and the like, £200,000 would

probably pay for around 5 or 6 teachers. In the School Year 2019-20, the average pupil-teacher ratio in Northern Ireland Secondary schools was 15.8:1. This suggests that a school with 1,000 pupils would have around 63 teachers. 5 or 6 teachers represent just under 10% of the teaching staff.

I have the feeling that an opportunity cost of this magnitude will not be acceptable and that, in practice, parents who can afford to pay £1 each day for breakfast will be expected to pay. After all, if a pupil eats breakfast at school, there will be little need for breakfast at home, so savings will be made here if breakfast was previously served at home.

A feasible suggestion might require parents to pay unless their child is entitled to a free school lunch. If they are entitled to a free school lunch, it would seem reasonable also to provide them with free school breakfast. In 2019, 27.9% of secondary school pupils in Northern Ireland were entitled to free school lunches. If for illustration, our school of 1,000 pupils has 279 pupils entitled to free school breakfast, the annual cost would be around £55,800 – equivalent to the yearly cost of 2 recently qualified teachers. This may be acceptable.

6. Acknowledgements

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- Nick Lewis, Catering Manager, Bootham Senior School, York
- Mick Wood, Catering Manager, Garforth Academy, Leeds
- Claire Gorman, Catering Manager, St John Fisher Catholic High School, Harrogate
- Keith Stimpson, Catering Manager, St Peter's School, York
- Accounts and Prices Team – Department for Environment, Food and Rural Affairs

APPENDIX 1: Resource use form

University of Leeds
School of Food Science and Nutrition

Resources used in providing school breakfast

Details of school

School name	St Peter's School, York
School address and telephone	St Peter's School Clifton York YO30 6AB Tel. 01904 527364
Type of school	Independent Boarding School
Age-range	3-18 years (Senior School 13-18 years)
Number of pupils	1,400 (530 in Senior School)
Name and position of person completing form	Keith Stimpson Catering Manager
Days breakfast served	7 days a week
Time breakfast served	07:15 – 08:20 (later on Sundays)
Location of breakfast service	Senior School Dining Room
Number of pupils eating breakfast	156 (all boarders)
Number of staff eating breakfast	30
Type of food and drink offered (menu details)	- Fruit juice - Porridge or cereals - Sausage, eggs, baked beans, tomato, mushrooms, hash browns - Toast - Yoghurt or fresh fruit - Hot drinks

Details of charging policy for breakfast

Breakfast (and all other meals) are included in the school fees (2019/20):
Years 7 & 8 £26,460 p.a.
Years 8 – 13 £31,080 p.a.
Day pupils are not (usually!) provided with breakfast

Staff involved in delivery of breakfast

Position *e.g. Chef / kitchen porter*	Time involved per day of service *e.g. 1.5 hours*
Chef	1.5
Catering assistant 1	2.5
Catering assistant 2	2.5
Kitchen porter	2.5

Food used in delivery of breakfast

Food item *e.g. Milk (semi-skimmed)*	Quantity per day *e.g. 10 litres*
Sausages	180 sausages
Baked beans	3 x A10 tins (3.12kg)
Hash browns	9kg
Eggs	150
Mushrooms	3kg
Tomatoes	40
Bread	6 loaves
Cereals	5 x 500gm packs
Porridge	2kg
Yoghurt	5 litres
Fruit – type 1	20 apples
Fruit – type 2	20 bananas
Fruit juice	15 litres of fresh orange
Milk (semi-skimmed)	30 litres

Please exclude 'minor' items such as cooking oil

Other consumables used in delivery of breakfast

Item *e.g. Napkins*	Quantity used per day *e.g. 80*
Paper napkins	100

Please exclude 'minor' items such as hand cleansers

Equipment used in delivery of breakfast

Item *e.g. Toaster*	% of daily use for breakfast *e.g. 50%*
Toaster	80%
Oven	20%
Hotplate	30%
Dishwasher	25%

Please exclude items where breakfast use is less than 20%

APPENDIX 2: Costing form

Breakfast Costing Form

Name of school: St Peter's School, York

Staff involved in delivery of breakfast

Position *e.g. Chef; kitchen porter*	Time involved per day of service *e.g. 1.5 hours*	Assumed hourly cost	Assumed daily cost
Chef	1.5	£16	£24.00
Catering assistant 1	2.5	£11	£27.50
Catering assistant 2	2.5	£11	£27.50
Kitchen porter	2.5	£8	£20.00
Total daily staff cost			£99.00
Average staff cost per person (156 pupils & 30 staff)			£0.53

Food used in delivery of breakfast

Food item	Quantity per day	Brakes unit price	Daily cost
Sausages	180 sausages	17p per sausage	£30.60
Baked beans	3 x A10 tins (3.12kg)	£3.49 per tin	£10.47
Hash browns	6kg	£3.04 per kg	£18.24
Eggs	120	11p per egg	£13.20
Mushrooms	3kg	£2.90 per kg	£8.70
Tomatoes	40 (0.175kg each)	£2.09 per kg	£14.63
Bread	6 loaves	£1.77 per loaf	£10.62
Cereals	5 x 500gm packs	£3.22 per kg	£8.05
Porridge	2kg	£2.50 per kg	£5.00
Yoghurt	5 litres (20 pots)	40p per pot	£8.00
Fruit – type 1	20 apples (1kg)	£1.86 per kg	£1.86
Fruit – type 2	20 bananas (2.5kg)	£1.89 per kg	£4.73
Fruit juice	Fresh orange (15 litres)	£2.20 per litre	£33.00
Milk (semi)	30 litres	£1.00 per litre	£30.00
Total daily food cost			£197.10
Average food cost per person (156 pupils & 30 staff)			£1.06

Average food + staff cost per customer £1.59

CHAPTER 3

An overview of breakfast provision in Northern Ireland Secondary Schools – Autumn Term 2019

- **Setting the scene – characteristics of the secondary schools**

- **Getting information on breakfast provision and take-up**

- **Results of online survey *(35 schools)***

- **Analysis of whether a school offers breakfast or not *(193 schools)***

- **Analysis of factors associated with take-up rates *(130 schools)***

- **Analysis of results at a Parliamentary Constituency level**

- **References**

- **Acknowledgements**

- **Appendix 1: Letter to School Principals**

- **Appendix 2: Copy of online questionnaire**

1. Setting the scene – characteristics of the secondary schools

Map 1: The Geographical Location of Northern Ireland

Number of secondary school pupils

The United Kingdom (UK) is made up of four countries:

- England
- Scotland
- Wales
- Northern Ireland

In 2018 the estimated population of Northern Ireland was 1.88 million – that is 2.8% of the UK population of 66.44 million.

In the UK, secondary education covers ages 11 to 18 years. This age group represented just under 10% of the total population in NI. The estimated population *(male and female)* in this age range was as follows:

Table 1: Numbers of adolescents by age in Northern Ireland 2018[1]

Age in years	Estimated population
11	24,809
12	23,642
13	23,070
14	22,791
15	22,337
16	22,355
17	22,519
18	23,357
11 – 18 inclusive	**184,880**

On 1 September 2018, the Department of Education in Northern Ireland had oversight of the education of 141,725 pupils in 193 secondary schools.[2]

The data in **Table 1** might give the impression that pupils attend secondary school for eight years, but this is <u>not</u> the case. Secondary education lasts for seven years (Years 8 – 14, *named Years 7-13 in GB)*. Approximately 50% of 11-year olds are still in Primary Education, and *(for those remaining in secondary education for the full-seven years)* the average age of leaving school is 18.5 years, not 18.99 years. Removing 50% of 11-year-olds and 50% of 18-year-olds from 184,880 leaves an estimated 160,797 adolescents eligible for seven years of secondary education. The fact that 141,725 were being educated suggests that

around 19,072 had left school sometime between the end of the compulsory school age of 16 and age 18, indicating a 'drop-out rate' of 41.6%. The actual figure is close to one-third in Year 13, rising to one-half in Year 14.[2.] The table below shows the number of pupils (by school year group) on 1 September 2018.

Table 2: Number of pupils by Year Group in NI 2018[2]

School Year Group	Number of students
8	23,814
9	22,860
10	22,698
11	22,539
12	21,880
13	15,193
14	12,741
Years 8 – 14 inclusive	**141,725**

The size of secondary school

The average school size was 734 pupils – relatively small compared to secondary schools in England *(where the average size was over 1,000 pupils[3])*. *(21.2%)* had more than 1,000 pupils. Further information is given in the figure below.

Figure 1: School size – number of pupils[2]
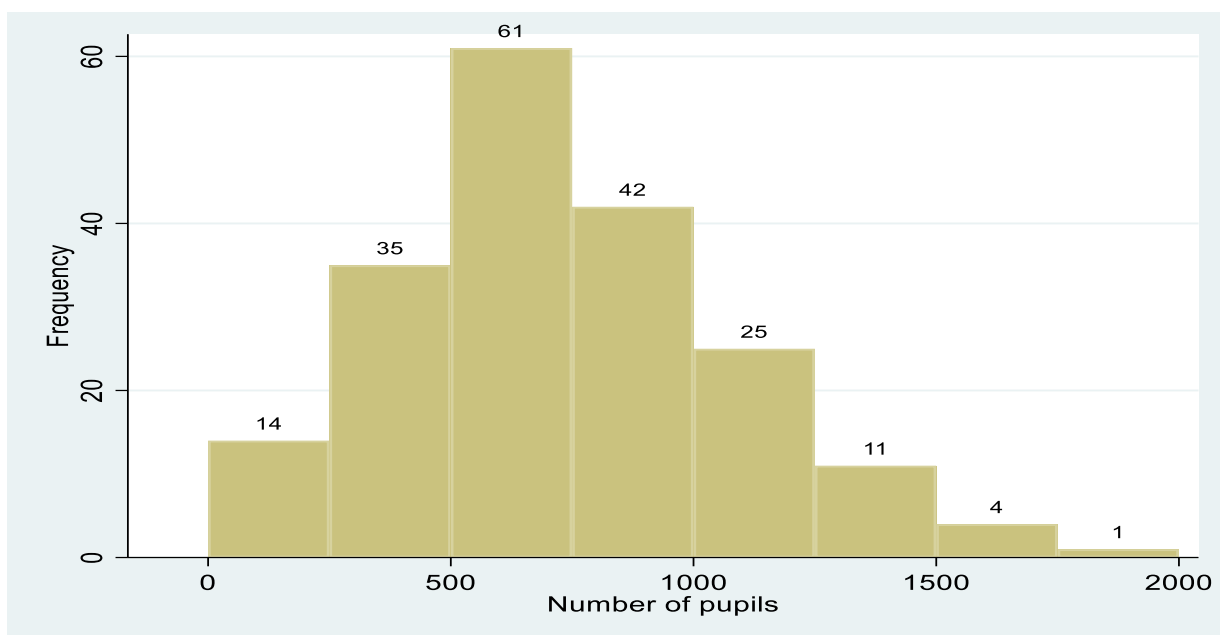
Northern Ireland can be divided into 18 Parliamentary Constituencies for more detailed analysis. There are two main reasons for using this division:

- Unlike Local Government Districts *(which vary considerably in size)*, there is not much variation in the population size of the Parliamentary Constituencies. Therefore, treating some constituencies as more important than others would be inappropriate.

- While Belfast *(with a total estimated population of 341,877 in 2018)*[1] is just a single Local Government District, it comprises four Parliamentary Constituencies *(Belfast East, Belfast North, Belfast South, and Belfast West)*. As will be shown later, these four constituencies differ significantly. Treating Belfast as just one area would mean losing valuable information.

The geographical location of each constituency is shown in **Map 2,** *located towards the end of this chapter.*

Although the total population size of each constituency is similar, there is more variation in the number of secondary school-aged students. Some areas of Northern Ireland have younger populations than others. It should also be borne in mind that some students attend school in a different constituency to where they live. Travelling between constituencies is particularly common in Belfast. In principle, nothing stops a student living in Belfast East from attending School in Belfast North, Belfast South, or Belfast West.

The following table provides further information.

Table 3: Number of schools and number of pupils attending secondary school in each of the constituencies (and average school size)[2]

Constituency	Number of schools	Number of pupils	Average school size
Belfast East	8	6,688	836
Belfast North	10	9,645	965
Belfast South	10	9,209	921
Belfast West	8	7,316	915
East Antrim	8	6,364	796
East Londonderry	11	6,384	580
Fermanagh & South Tyrone	19	9,718	511
Foyle	10	8,920	892
Lagan Valley	7	5,671	810
Mid Ulster	12	8,986	749
Newry & Armagh	16	11,369	710
North Antrim	13	9,148	704
North Down	6	5,940	990
South Antrim	6	4,360	727
South Down	13	7,913	609
Strangford	11	6,714	610
Upper Bann	14	9,893	707
West Tyrone	11	7,487	681
All constituencies	**193**	**141,725**	**734**

While most of the 36 schools in Belfast *(the most urban area in the Province)* were larger than average, most of the schools in Fermanagh and South Tyrone *(the most rural areas)* were considerably smaller than average. By and large rural areas have smaller schools than urban areas.

For further analysis, schools have been split into three size categories:

- **Small schools** – those with no more than 500 pupils *(50 schools in this category)*

- **Medium schools** – those with between 501 and 1,000 pupils *(102 schools in this category)*

- **Large schools** – those with more than 1,000 pupils *(41 schools in this category)*

Three other ways in which constituencies differ are:

1. economic prosperity

2. religious profile

3. type of secondary school *(grammar vs non-grammar)*

Economic prosperity

As far as economic prosperity is concerned, perhaps the most straightforward measure relevant for our purposes is the percentage of secondary school pupils entitled to free school meals. Free school meals *(which cover the cost of lunch)* help many families. The Education Authority for Northern Ireland is responsible for assessing eligibility for Free School Meals based on Department of Education and Department for the Economy criteria. In 2019, Parent(s)/Guardian(s) could apply if their son or daughter was in full-time education and they were in receipt of one of the following benefits:

- Income Support;
- Income-Based Jobseeker's Allowance;
- Income Related Employment and Support Allowance;
- Guarantee Element of State Pension Credit;
- Child Tax Credit or Working Tax Credit with an annual taxable income of £16,190 or less;
- Universal credit with net household earnings not exceeding £14,000 per year.

In 2019, 39,591 secondary school pupils were entitled to free school meals (27.9% of all pupils). This is far higher than the percentage in England, where in January 2018, only 12.4% of secondary pupils were eligible for, and claiming, free school meals.[3] The figure below gives further information on the proportion of pupils entitled to free school meals in individual schools.

Figure 2: Proportion of pupils entitled to free school meals[2]

As a rather crude measure of economic prosperity, schools have been divided into one of three categories:

- **High prosperity area** – fewer than 20% of pupils entitled to free school meals – *58 schools received this classification*

- **Medium prosperity area** – between 20% and 40% of pupils entitled to free school meals – *83 schools received this classification*

- **Low prosperity area** – more than 40% of pupils entitled to free school meals – *52 schools received this classification*

Figure 3 and **Table 4** explore the relationship between the economic prosperity of the school catchment area and public examination results. 'Good results at GCSE' are five or more Grade A* to C passes, while 'good results at A-level' are three or more Grade A* to C passes.

Figure 3: School performance at GCSE and GCE 'A' level by the prosperity of catchment area[4, 5]

School public examination results by catchment area
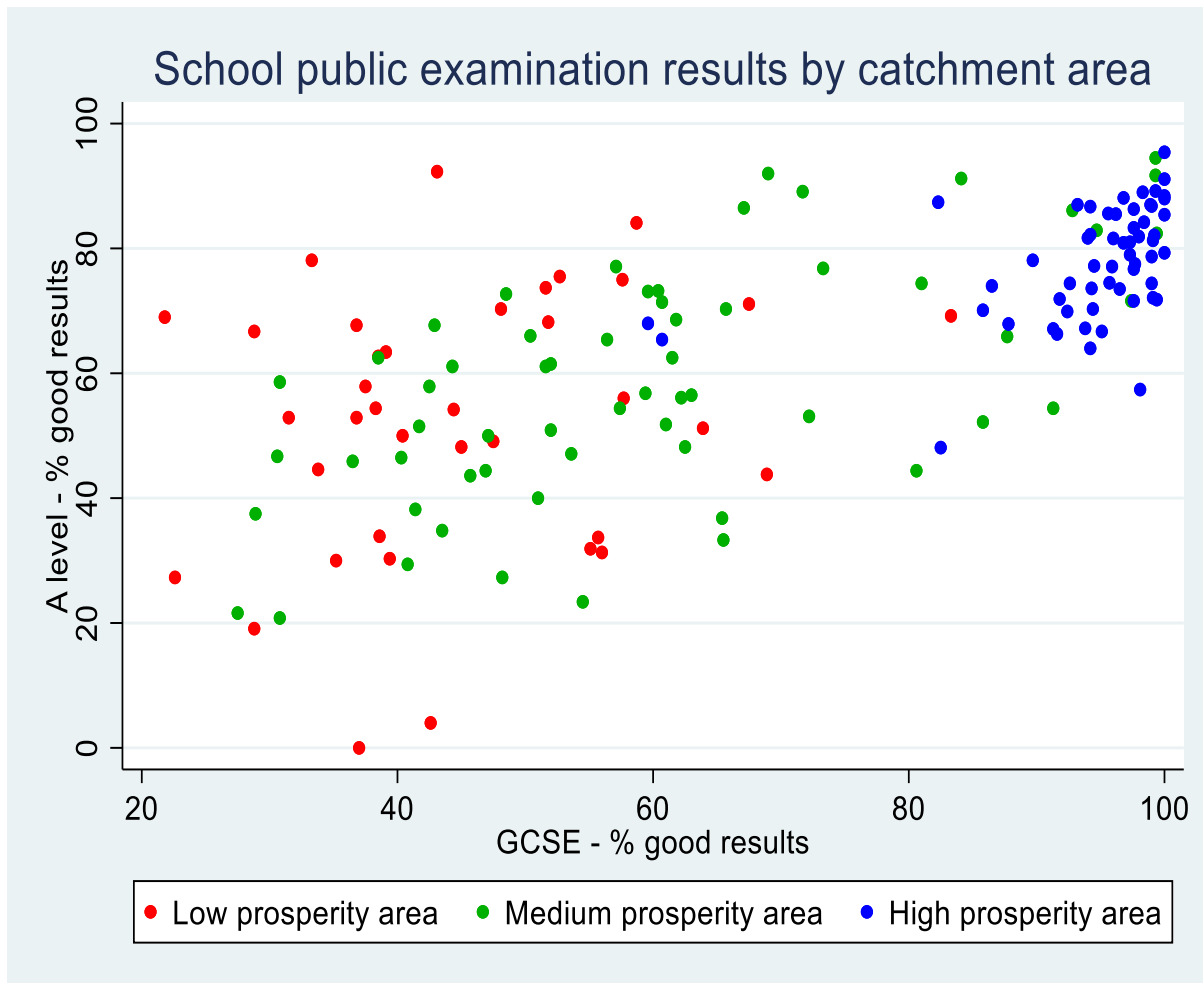
Table 4: Public examination results by the prosperity of the catchment area

Economic prosperity of catchment area	Average percentage of pupils achieving good results at GCSE *183 schools*	Average percentage of pupils achieving good results at A level *156 schools*
Low prosperity	45.3%	52.5%
Medium prosperity	58.5%	58.7%
High prosperity	93.4%	77.7%
All schools	**65.9%**	**64.1%**

Schools that recruited students from high prosperity areas tended to perform much better than schools that recruited from areas of low prosperity. As will be seen later, there was much variation in the economic prosperity of the 18 Parliamentary Constituencies. Ten of the 193

secondary schools were 'Junior High Schools', which only taught to Year 10. These schools did not enter their pupils for GCSE exams. A further 27 schools only taught up to Year 12 and did not enter pupils for A-level exams.

The apparent link between economic prosperity and academic performance is worrying. Those pupils achieving good grades at GCSE and A-level are likely to earn more than those without these qualifications. Anything that can help pupils attending schools in low prosperity catchment areas to achieve more should be welcomed. A nutritious free school breakfast may be one such way.

Religious profile

Religion is a very significant social factor in Northern Ireland, and, unfortunately, many people living in England fail to appreciate the fact. At the time of the 2011 Census, Northern Ireland had a far higher proportion of Christians in the population (93.0%) than Scotland (53.8%), Wales (57.6%) or England (59.4%). Of those identifying as Christian, 52% claimed to be Protestant, and 48% claimed to be Catholic.[6] The results of the 2021 Census have not yet been published, but it is thought it will reveal slightly more Catholics than Protestants.

Other than church attendance, the area where the religious divide between Catholics and Protestants is most apparent is primary and secondary education. Of the 193 secondary schools in the Province, only 13 *(representing just 3.6% of all pupils)* declined to provide a breakdown of their pupils by religion. The three 'traditions' in Northern Ireland are:

- Roman Catholic *(usually abbreviated 'Catholic')*

- Protestant *(Presbyterian, Church of Ireland, Methodist, Baptist etc.)*

- Other *(this category includes Jews, Muslims, and those with 'No religion')*

Of the 180 schools reporting the religion of their pupils:

- 73 had more than 90% Catholic students *(as against Protestant or Other).* For our purposes, these are classified as **'Catholic Schools'**.

- 56 had fewer than 10% Catholic students. For our purposes, these are classified as **'Protestant Schools'**.

- The remaining 51 out of 180 schools could be classified as **'Integrated Schools'**.

It seems preferable to classify the religious profile based on the current students rather than a more historical *(or 'official' management)* criteria. For example, the largest secondary school in the Province is Methodist College Belfast *(affectionately known as 'Methody')*. The name would suggest that the College is strongly Protestant, but nowadays, many Catholics *(almost 400 – over 20% of the pupils)* attend Methody. The school website states: *'Founded by the Methodist Church in 1865, the College is a non-denominational, co-educational grammar school, where pupils of all faiths and none are welcomed into a safe, supportive, and inclusive environment. We aim to provide equal opportunities for all, and the diverse talents of each of our pupils are appreciated, nurtured, and celebrated.'* Few people would disagree that Methody is most appropriately classified as an 'Integrated School' these days.

Figures 4 and 5 provide further information.

Figure 4: Catholicity of schools[2]

Proportion of Catholic students in 180 secondary schools
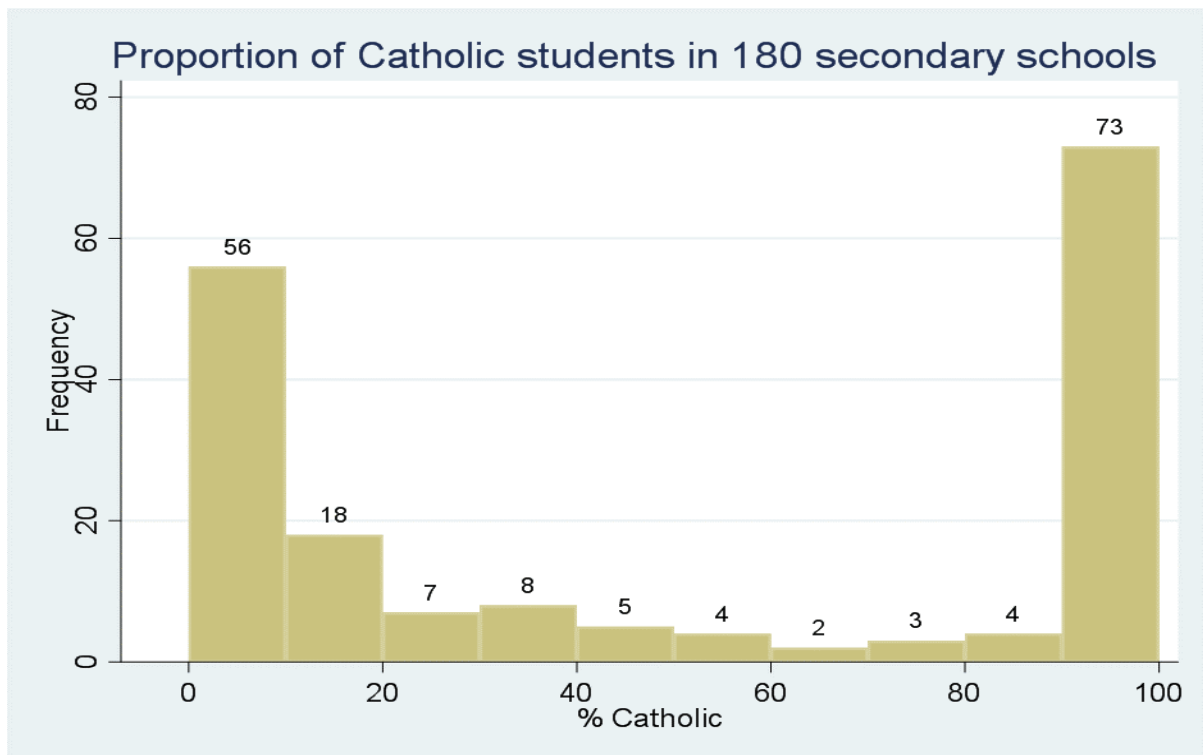
Figure 5: Religious profile of 180 schools – classified by current pupils[2]
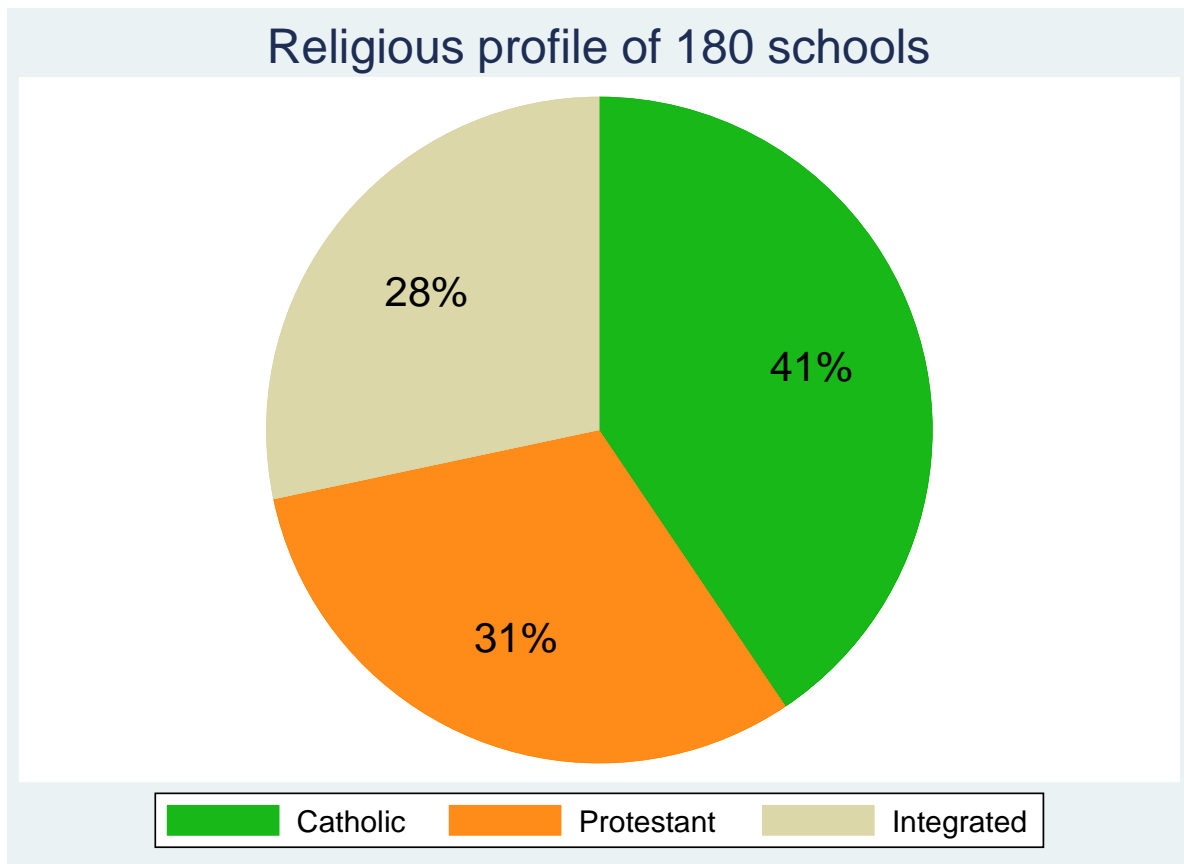
In the 180 schools reporting religion, 51.3% of students were Roman Catholic. As will be seen later, the percentage of Catholic students differs quite dramatically across the 18 Parliamentary Constituencies, which may have some bearing on breakfast provision and take-up.

Type of school *(grammar vs non-grammar)*

Another way secondary schools in Northern Ireland are different from those in other parts of the UK is in selection. The '11-plus' exam was widely used throughout the UK in the three decades following the passing of the 1944 Education Act *(the Butler Act)*. Pupils sat a variety of tests in their final year in Primary School, and their performance decided whether they went to a Grammar School *(those who passed)* or to a Secondary Modern School *(those who failed)*. The test was not popular – and there are notable cases of those who failed subsequently going on to take First Class Honours at Oxford or Cambridge. By 1976, most Local Education Authorities in Great Britain had abolished the tests favouring Comprehensive Education. Northern Ireland did not follow this trend and maintained the exams, eventually rebranded as 'Transfer Tests'.

Of the 193 secondary schools, 66 *(approximately one-third)* were grammar schools, and 127 *(about two-thirds)* were non-grammar *(or simply – secondary)* schools. The proportions differ markedly between the 18 Parliamentary Constituencies. School type will have some bearing on breakfast provision and take-up rates. The average size of Grammar School was 952 students, and the average size of secondary school was 621 students. 62,832 students attended Grammar Schools – representing 44.3% of all students.

Type of school *(single-sex vs co-ed)*

In most parts of the UK, secondary education is mixed *(boys and girls studying together)*, but in Northern Ireland, there are still significant numbers of single-sex schools. In 2019, 16 of the 193 schools were for boys only; 22 were for girls only, and 155 were mixed. It will be shown later that type of school *(single-sex or co-ed)* has a bearing on whether breakfast is served and *(if so)* on take-up rates.

Association between categories

It should be no surprise that there is a degree of association between the various characteristics considered: the size of the school; economic prosperity of the catchment area; religious affiliation; grammar or non-grammar; single-sex or co-ed. **Table 5** classifies the 180 schools *(those that provided information on the religion of their pupils)* by religious tradition and economic prosperity.

Table 5: 180 schools categorised by religious tradition and economic prosperity of the catchment area

Religious tradition / Economic prosperity	Low prosperity	Medium prosperity	High prosperity	All areas
Catholic	25	31	17	73
Protestant	12	23	21	56
Integrated	10	22	19	51
All types of School	47	76	57	180

p = 0.207

While there was little difference between the economic prosperity of the Protestant and Integrated Schools, Catholic Schools were more likely to recruit from areas of low economic prosperity and less likely to recruit from areas of high economic prosperity – though these differences were not statistically significant.

This should serve as a warning. Variations in economic prosperity may explain a difference thought to be due to religion – *or vice-versa*.

2: Getting information on breakfast provision and take-up

The Department of Education provided details of the names of the Principals *(Head Teachers)* of all 193 secondary schools in Northern Ireland.[7] A personal letter was sent to these Principals on 4 November 2019, asking them to arrange for an online survey to be completed by 22 November 2019. Two schools reported difficulties in accessing the online survey, so on 15 November, an email reminder with a '*click here*' link was sent to all schools which had not yet replied.

Please see **APPENDIX 1** for a copy of the letter.

A total of 40 replies were received to the survey, but 5 of these were excluded for the following reasons:

- One was a duplicate – both the Principal and the Catering Manager completed the survey for their school *(fortunately, both replies were similar – the more detailed response was used)*

- Two surveys contained no data

- Two surveys contained too little data – they were incomplete

The schools that sent the four *(non-duplicate)* replies were included in the more 'basic level' survey of all 193 schools.

This part of the report is divided into two sub-sections:

(i) Results of the online survey of 35 schools

(ii) Results of the online survey of 35 schools
+ telephone survey of 158 schools
= data from all 193 schools

3. Results of the online survey *(35 schools)*

The 35 schools which responded in full to the online survey supplied valuable data.

Please see **APPENDIX 2** for a copy of the online questionnaire.

Among these schools:

- 21 served 'breakfast food' both before lessons **and** at break-time
- 7 only served 'breakfast food' before the start of lessons
- 4 only served 'breakfast food' at mid-morning break
- 3 never served 'breakfast food.'

The individual respondents were free to choose what they regarded as 'breakfast food', and there was some variation in how this term was interpreted.

The online survey consisted of 15 questions:

Question 1 asked for the name of the school.

Question 2 asked for the post-code of the school. This information was necessary because, for example, 11 secondary schools in Northern Ireland have 'St Patrick' in their title.

Question 3 asked for the name and position of the person completing the questionnaire. 10 of the 35 surveys had been completed by the School Principal – *and four of these included comments in response to Question 15.*

Question 4 was concerned with the type of catering service used by the school. Just two of the schools reported having a 'volunteer's breakfast club' (run by parents) – *though both recorded that employed catering staff 'were always on hand'*. Also, one school had a volunteer assisting an employee.

5 of the 35 schools used contract caters *(a firm called Mount-Charles being the most common provider)*; 10 had Education Authority catering *(food prepared centrally, then transported to individual schools for finishing off and serving)*; and 20 had full in-house catering. The schools using in-house catering had the most freedom to 'fine-tune' what they served.

Question 5 was concerned with whether the school offered breakfast to students *(before the start of lessons)*. 28 schools replied 'yes', while seven replied 'no'. The 80% 'positive' response from these 35 schools is higher than the percentage of 'positive' responses from all 193 secondary schools. *(This latter figure is 67.4%)*

Question 6 was concerned with days of the week when breakfast was available before the start of lessons. 27 of the 28 schools provided breakfast daily *(Monday – Friday)*, while one school just offered Breakfast on Tuesdays and Thursdays.

Question 7 was concerned with the timing of the breakfast service. Only 2 of the 28 schools served breakfast before 8.00 am. Breakfast service ended no later than 9.00 am in 26 schools, but one school offered breakfast until 9.05 am, and one offered breakfast until 9.15 am.

The average duration of breakfast service was 37 minutes. The maximum was 75 minutes *(8.00 am – 9.15 am)*, and the minimum was 5 minutes. At this latter School, breakfast was served at 8.15 am, and students who were not in the queue were not served.

Question 8 was concerned with the number of students served breakfast before lessons. Numbers varied between 10 and 120, with an average of 55. *Interestingly, in the more basic survey of all 193 schools, the 130 schools that offered breakfast served an average of 54 students a day (further details later).*

Question 9 was concerned with the location of the breakfast service. 23 of the 28 schools served breakfast in the cafeteria; 4 served breakfast in the classroom, while one school had a 'grab and go' breakfast near the school entrance.

Question 10 was concerned with whether students could purchase 'breakfast-type food' (e.g., porridge, toast, a bacon roll etc.) during the mid-morning break. Such purchases were possible in 25 out of 35 schools.

Question 10a was concerned with the timing of the mid-morning break. 33 of the 35 schools reported that they did serve food at break-time – but 8 of these schools claimed that none of the food served would usually be regarded as 'breakfast'. The earliest starting time for the mid-morning break was 9.50 am, and the latest finishing time was 11.35 am. While

food eaten at 9.50 am could perhaps be regarded as 'late breakfast', food eaten at 11.30 am could be better classified as 'early lunch'.

Question 11 was concerned with how students paid for their breakfast food *(whether purchased before lessons, or during the break)*. 3 of the 35 schools never served breakfast-type food. Of the 32 schools which reported serving breakfast, one included breakfast in the school fees *(it was a boarding school)*, and four schools did not charge – breakfast was complimentary. Among the 27 schools which charged: 19 just used electronic *(fingerprint)* payment; 3 only used cash payment; 5 allowed either electronic or cash payment.

Question 12 was concerned with details of breakfast-type food served before the start of lessons or during the mid-morning break. The schools were asked to record items and quantities served 'on a typical day'. *Besides milk and fruit juice, drinks such as tea and coffee are not included.*

Table 6: Food served *(before lessons)* at breakfast club – 28 schools – *in declining order of popularity*

Item on menu	Number of servings
Toast	605
Fruit juice	300
Cereal	295
Fruit	235
Pancakes	196
Croissants	124
Scones	116
Milk	101
Bacon baps	87
Sausage baps	74
Scrambled eggs	67
Bagels	59
Baked beans	55
Sausage rolls	54
Milkshakes	42
Bacon	36
Waffles	36
Fried eggs	30
Yoghurt	28
Sausages	25
Beans on toast	20
Danish pastries	20
Bread roll	17

Bacon & egg muffins	15
Granola	15
Hash browns	15
Pain au chocolate	15
Cream crackers	14
Porridge	14
Cinnamon swirls	12
Rice cakes	12
Muffins	10
Cheese & ham sodas	9
Baguettes	6
Poached eggs	5
Cheese	3
Sandwiches	3

Table 7: 'Breakfast-type' food served at mid-morning break – 25 schools – *in declining order of popularity*

Item on menu	Number of servings
Bacon butties	1048
Toast	820
Sausage baps	415
Bagels	404
Croissants	403
Sausage rolls	400
Fruit juice	365
Pizza	350
Bread rolls	290
Cheese	288
Pancakes	229
Scones	181
Fruit	150
Cheese & ham sodas	68
Muffins	63
Beans on toast	60
Pain au chocolate	57
Cereal	52
Soda bread	50
Yoghurt	45
Cheese muffins	42
Milk	39
Bacon, egg & sausage baps	35
Poached eggs	30
Sandwiches	30

Granola	29
Danish pastries	20
Cheese on toast	16
Egg baps	15
Cream crackers	8
Toasted ham sandwiches	5

Question 13 was concerned with the staffing of the breakfast club. The results are summarised in the table below. Staffing levels were variable, and there was no apparent relationship between staffing and (i) duration of breakfast service or (ii) numbers served. If there was not much to do, staff employed on breakfast service were usually expected to turn their hand towards preparations for mid-morning break or lunch.

Table 8: Staffing of breakfast club (hours worked) – 28 schools

Survey Number	Manager	Chef	Catering Assistant	Teacher	Cashier	Volunteer	TOTAL HOURS PER DAY
1				1		1	**2**
2						0.5	**0.5**
3				1			**1**
4	2		2				**4**
5			1				**1**
6		1	1				**2**
7	0.75	1.5	1				**3.25**
8			2				**2**
9	0.75				0.75		**1.5**
10	0.5	0.5					**1**
11							*No breakfast*
12			2		0.5		**2.5**
13	0.5	0.5	2				**3**
14							*No breakfast*
15	1	1.5	2				**4.5**
16	0.35		0.35				**0.7**
17							*No breakfast*
18				0.5			**0.5**
19	1	1	2				**4**
20							*No breakfast*
21		0.5	0.5				**1**
22	1		0.5				**1.5**
23							*No breakfast*
24	1		1				**2**
25	1.5	1.5					**3**
26	0.5						**0.5**
27							*No breakfast*
28		0.5	0.5				**1**
29	1	2			1		**4**

30							No breakfast
31	0.5		0.5				1
32	2	2					4
33		0.75					0.75
34						2	2
35	1		0.75				1.75

Question 14 was concerned with whether schools received any charitable support *(money or gifts of food)* to help provide breakfast for students. Only two schools out of 35 received such assistance.

Question 15 allowed schools to record any comments which might help clarify their responses. Nine schools responded as follows:

- *We use food from a food bank.*

- *It would be highly beneficial to receive financial support to provide a breakfast club for pupils. We had support for this in the past, and it was well attended.*

- *Breakfast staff are also performing other work as well as breakfast.*

- *We cater for boarders only for breakfast.*

- *Most pupils do not eat breakfast at home. Increasing numbers purchase junk food, e.g., chocolate, sweets and crisps and eat these on their way to school.*

- *I would appreciate it if the Government / Department of Education would fund this resource as often students have no breakfast at the start of the day, and it does affect learning preparedness.*

- *We were used to providing complimentary breakfast as we are a school providing pupils from areas of high disadvantage/deprivation. However, it had to stop due to a lack of funding.*

- *These totals are for the coffee bar only. The main canteen serves a mid-morning snack also; these figures are not included. Please contact me if you need any further information.* I DID!

- *The menu is varied each day so that quantities may vary.*

My initial reaction to obtaining responses from only 35 schools out of 193 *(a response rate of 18%)* was one of disappointment. However, it was subsequently realised that it might be possible to get information from some of the other 158 schools if just essential information were requested over the phone.

Two key questions were identified:

1. **Does the school offer breakfast before the start of lessons?** *An analysis of the detailed replies from the 35 schools indicated that breakfast is most likely served each day from Monday to Friday (assuming breakfast is provided). It is not essential to gather information on this from <u>all</u> schools.*

2. **If the school does offer breakfast on a 'typical school day', how many students have some breakfast at school before lessons begin?** *This information can be combined with data on the total number of students in the school to calculate the percentage of students having school breakfast.*

It would be helpful to know what food is served at breakfast. Still, the information provided by the 35 schools which responded to the online survey provided plenty of information on breakfast provision. If a proper analysis were to be made of nutritional standards, it would be necessary to know what individual students eat.

Tables 6 and 7 suggest that slightly more breakfast food is *served (and presumably eaten)* at mid-morning break than at the breakfast club. However, it is impossible to say what proportion of food served at mid-morning break should be regarded as breakfast without more detailed information from individual students. While one student who purchases a bacon roll at 11.00 am may genuinely be eating breakfast, another student may have eaten a 'proper' breakfast at home at 7.00 am and would not regard the 11.00 am bacon roll as part of their breakfast.

The results given in **Table 8** show much variation in staffing levels at the breakfast club, and it seems unlikely that much extra information would be gleaned if more schools had responded to the online survey.

The final date for responding to the online survey was Friday, 22 November, and so the decision was made on Monday, 25 November, to contact all the remaining 158 schools by phone and ask:

1. **Does your school offer breakfast before the start of lessons?**

2. **If 'yes', how many students eat breakfast served at school** *(on a 'typical day' before lessons)*?

After many repeated telephone calls, by Wednesday, 11 December 2019, the information had been obtained from all but four schools. On Thursday, 12 December, an email was sent to these four schools 'offering them a final chance' to respond by noon on Monday 16 December. By the afternoon of 12 December, an answer to the two 'basic' questions had been received from all 193 secondary schools in Northern Ireland – representing a 100% response rate.

The remainder of this paper just considers the provision of breakfast before the start of lessons – it does <u>not</u> consider food and drink served at the morning break.

Attention is first given to whether breakfast is available or not. This is followed by an analysis of attendance rates in those schools serving breakfast.

4. Analysis of whether a school offers breakfast or not *(193 schools)*

The 'headline' result is that 130 schools (67.4%) reported running breakfast clubs, and 63 schools (32.6%) reported never serving breakfast.

Figure 6: Provision of Breakfast before lessons

Does the school run a breakfast club? - 193 schools

32.6%   67.4%

Yes - 130 schools   No - 63 schools
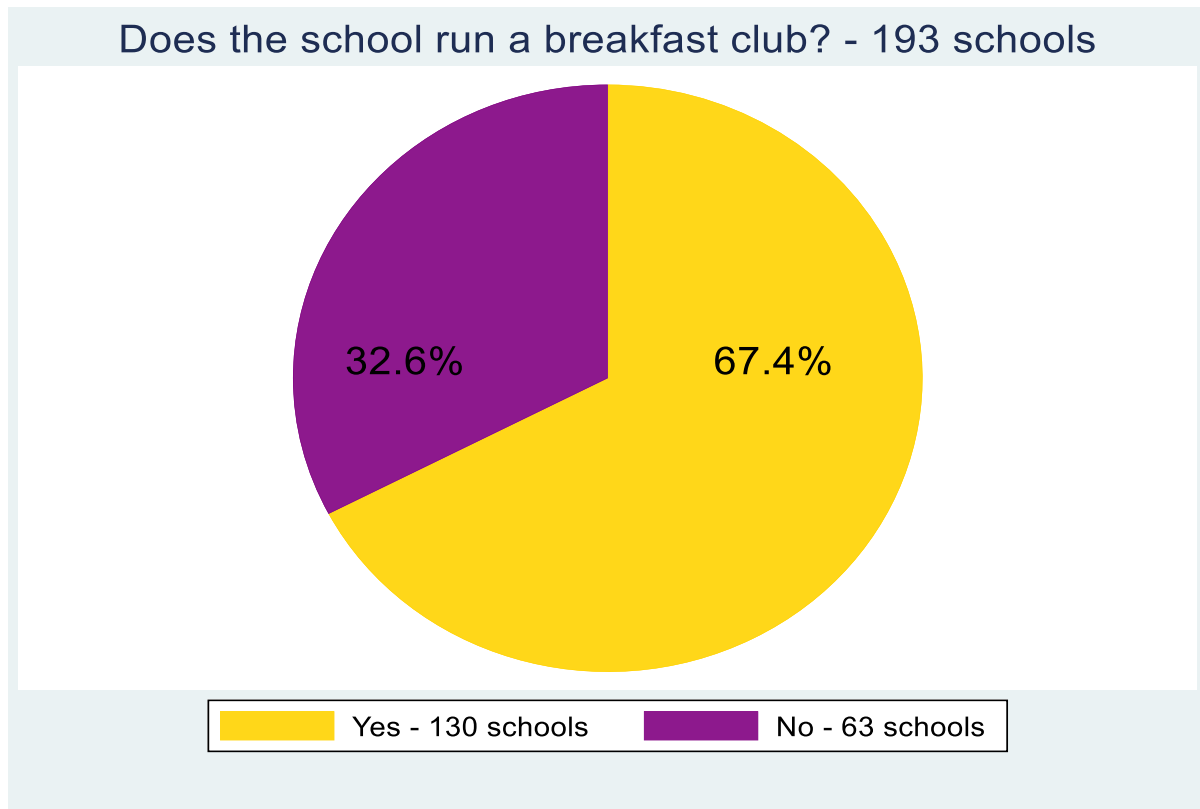
The one factor that stands out above all others is the importance of school size. This influences both the likelihood of a school offering breakfast and *(if it does)* the take-up rate. *The effect on take-up rates is considered later.*

School Size

Table 9: The influence of school size on the availability of breakfast

School Size	Breakfast club		Total
	Yes	**No**	
Small *(500 or less)*	28 *(56.0%)*	22	50
Medium *(501 – 1,000)*	70 *(68.6%)*	32	102
Large *(More than 1,000)*	32 *(78.1%)*	9	41
All sizes of school	**130 *(67.4%)***	**63**	**193**

p = 0.077*

* A brief note about 'p-values'. A p-value of 0.077 indicates that if there is no association between school size and breakfast provision in general, the probability of finding a sample of schools that show as much association as this is 7.7%. This percentage represents a low probability, so we can be reasonably confident that there is <u>some</u> association between school size and breakfast provision. In practice, one should only refer to an association as 'statically significant' if the p-value is less than 0.050.

In our 193 schools, small schools were less likely to offer breakfast than large schools.

Other ways in which schools were classified (in addition to size) were as follows:

- Gender of students *(boys-only, girls-only, or mixed)*

- Type of School *(Grammar or Secondary)*

- The physical environment of the school *(urban or rural)*

- The religious tradition of the School *(Catholic, Protestant, or Integrated)*

- Economic prosperity of catchment area *(high, medium, or low)*

- Parliamentary constituency in which the school is located

Gender of students

Single-sex schools were more likely to run breakfast clubs than mixed schools.

Table 10: Breakfast provision by gender of students at school

Gender of students	Breakfast club		Total
	Yes	**No**	
Boys only	14 *(87.5%)*	2	16
Girls only	18 *(81.8%)*	4	22
Mixed (co-ed)	98 *(63.2%)*	57	155
All schools	**130 (67.4%)**	**63**	**193**

p = 0.044

These differences in provision may well have been influenced by school size. On average, single-sex schools had 20% more pupils than mixed schools. **Table 11** provides further information.

Table 11: 193 schools categorised by gender of students and school size

Type / size of school	**Small** *<500*	**Medium** *500 – 999*	**Large** *>999*	**All sizes**
Boys-only	2	10	4	16
Girls-only	2	13	7	22
Mixed (co-ed)	46	79	30	155
All types of School	**50**	**102**	**41**	**193**

p = 0.169

Most small schools (92%) were mixed, and small schools were less likely to offer breakfast than large schools.

Type of School (Grammar vs Secondary)

Grammar schools were more likely to run breakfast clubs than secondary schools. Still, again, this was probably due to the influence of school size, and the difference was not statistically significant. The average grammar school had 952 students compared with an average of 621 students in secondary schools.

Table 12: Breakfast provision by type of school (grammar school or secondary)

Type of School	Breakfast club		Total
	Yes	No	
Grammar	49 *(74.2%)*	17	66
Secondary	81 *(63.8%)*	46	127
All schools	**130 *(67.4%)***	**63**	**193**

p = 0.141

Physical environment (urban vs rural)

The Department of Education classifies schools according to whether they are in an urban or a rural area. A school located in an urban area was more likely to run a breakfast club than a school in a rural area.

Table 13: Breakfast provision by location of school (urban or rural)

Location of School	Breakfast club		Total
	Yes	No	
Urban area	110 *(71.0%)*	45	155
Rural area	20 *(52.6%)*	18	38
All schools	**130 *(67.4%)***	**63**	**193**

p = 0.031

The difference in the percentages is statistically significant and *(perhaps surprisingly)* is <u>unlikely</u> to be much influenced by school size. The average size of the 155 urban schools was 772 pupils, while the average size of the 38 rural schools was 579 pupils.

Religious tradition

Table 14: Breakfast provision by the religious tradition of school

Religion tradition	Breakfast club		Total
	Yes	No	
Catholic	53 *(72.6%)*	20	73
Integrated	36 *(70.6%)*	15	51
Protestant	34 *(60.7%)*	22	56
All schools*	**123 *(68.3%)***	**57**	**180**

p = 0.327

It will be recalled that 13 schools out of 193 declined to provide details of the religious breakdown of their student population. This table just contains data for 180 schools.

The relatively low percentage of Protestant schools offering breakfast is surprising – and there is no obvious explanation. School size is unlikely to have had much influence. The average size of a Catholic School was 807 students, the average size of a Protestant School was 751 students, and the average size of an Integrated School was 700 students. However, it must be acknowledged that the observed differences are not statistically significant.

Economic prosperity of catchment area

Table 15: The relationship between economic prosperity and the availability of school breakfast

Economic prosperity	Breakfast club		Total
	Yes	No	
High	40 *(69.0%)*	18	58
Medium	50 *(60.2%)*	33	83
Low	40 *(76.9%)*	12	52
All schools	**130 *(67.4%)***	**63**	**193**

p = 0.126

It is reassuring to note that 76.9% of schools classified as serving an area of low economic prosperity offered breakfast. Of course, it is one thing offering breakfast, and another thing students availing themselves of the offer – *more on take-up rates later.*

One way schools in the three prosperity groups differ was in their size. The average size of the school in an area of high prosperity was 930 students; the average size of the school in an area of medium prosperity was 675 students, and the average size of the school in an area of low prosperity was 610 students.

Of course, this observation is encouraging, as it has already been noted that small schools were less likely to offer breakfast than large schools. There is a need to use more sophisticated statistical methods to explore the relationship between breakfast provision, economic prosperity, and school size.

Table 16: The relationship between the economic prosperity of the catchment area and the size of the school

Economic prosperity	School size			
	Small	Medium	Large	All sizes
High prosperity	2	38	18	58
Medium prosperity	28	39	16	83
Low prosperity	20	25	7	52
All prosperity categories	**50**	**102**	**41**	**193**

p = 0.000

Parliamentary Constituency

Given that there are 18 Parliamentary Constituencies in Northern Ireland, an analysis by constituency requires a different analytical approach to that used in studying the effects of school size; gender; type of school; physical environment; religious tradition; and economic prosperity. For such an analysis, it would not be helpful to present the results in a two-way table and give a p-value. The results can be better presented using mapping, *and this will be done after an initial analysis of take-up rates.*

5. Analysis of factors associated with take-up rates *(130 schools)*

The 'headline' statistic is that an estimated 7,004 students (out of 141,725) were served breakfast before lessons began - implying a 'crude' take-up rate of 4.9% on a typical school day**.**

The total number of students attending the 63 schools that never served breakfast was 41,506. The total number of students attending the 130 schools which did run breakfast clubs was 100,219. Therefore, given that the total number of students having school breakfast was 7,004, it is estimated that **7.0% of students availed themselves of the service in those schools that ran breakfast clubs.**

One school reported that *(on a 'typical day')* just two pupils had school breakfast (0.3%), while at the other extreme, one school said that 45 students (45.9%) had breakfast, and another reported that 270 students (40.7%) had breakfast. For analysis purposes, take-up rates are more meaningful than the number of students eating breakfast.

Figure 7 gives further information on take-up rates.

Figure 7: Take-up of breakfast in schools with breakfast clubs

Breakfast at school - 130 schools
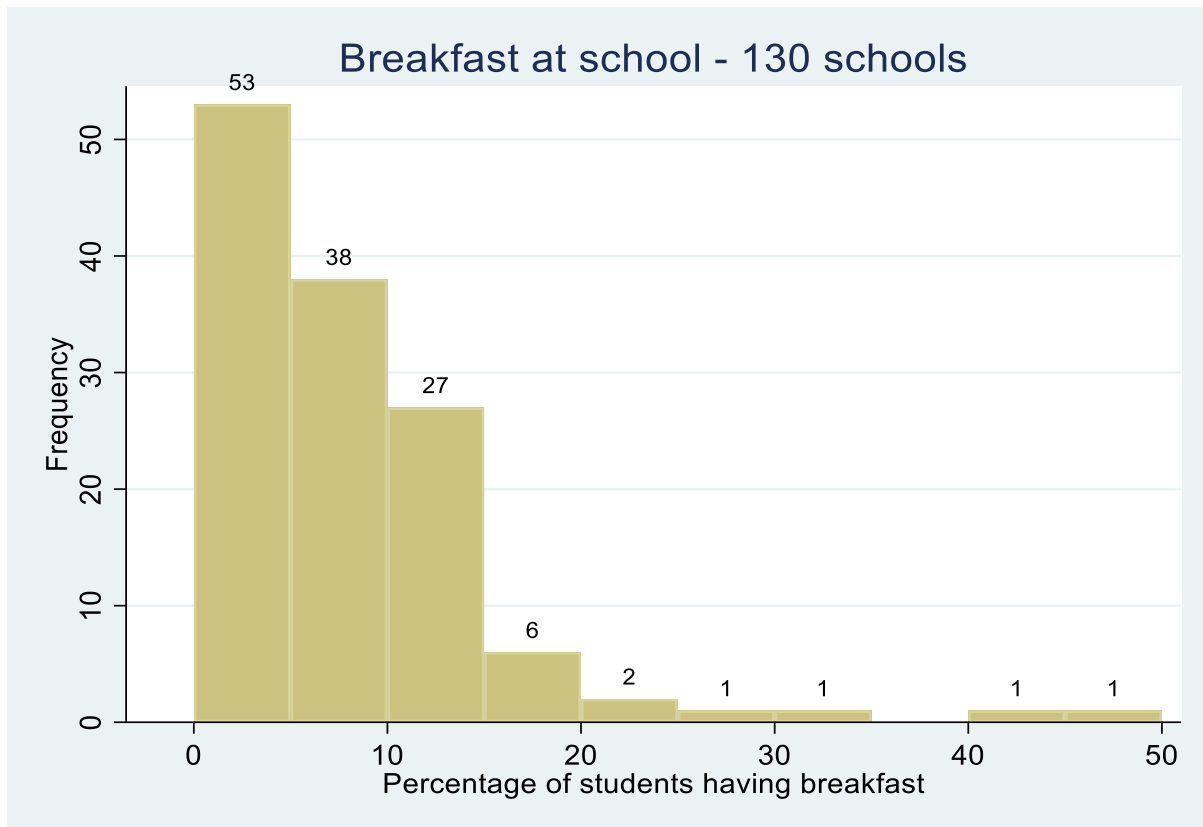
Only six schools could claim that more than 20% of their students took advantage of breakfast service – indeed, amongst the 130 schools which served breakfast, take-up rates were no more than 10% in 91 schools. Take-up rates varied with school size.

Table 17: The relationship between take-up rates and school size

School Size	Number of schools offering breakfast	Total number of students having breakfast	Total number of students	Take-up rate of breakfast
Small *(<501 students)*	28	890	9,953	8.9%
Medium *(501 – 1,000)*	70	4,134	51,163	8.1%
Large *(>1,000 students)*	32	1,980	39,103	5.1%
All sizes of school	**130**	**7,004**	**100,219**	**7.0%**

While schools with less than 1,000 students typically had over 8% of students eating breakfast, schools with 1,000 or more students usually had little more than 5% of students breakfasting. It would appear that while the main challenge for smaller schools is to persuade them to offer

breakfast **(see Table 11)**, the main challenge for larger schools is to convince students to turn up to school breakfast **(see Table 17)**.

The relationship between the take-up of school breakfast and the provision of free school meals

For obvious reasons, free school meals are a significant help to low-income families. However, free school meals apply to lunch only – Breakfast is not covered. Among the 28 breakfast-serving schools that responded to the online survey, only 2 received charitable help *(in one case, food provided by a food bank)*. Several of the replies to Question 15 indicated frustration at the lack of funding from either government or charity.

Some of the staff from the 158 schools contacted by telephone also mentioned this issue. Two secretaries informed me of teachers purchasing food with their own money to help provide breakfast to students in their tutor groups. ***The question of school breakfast funding is discussed more fully in Part 3.***

Figure 8 shows that for the 130 schools offering breakfast, there was no clear relationship between the proportion of pupils entitled to free school meals and the take-up of breakfast.

Figure 8: Take-up of breakfast and free school meals
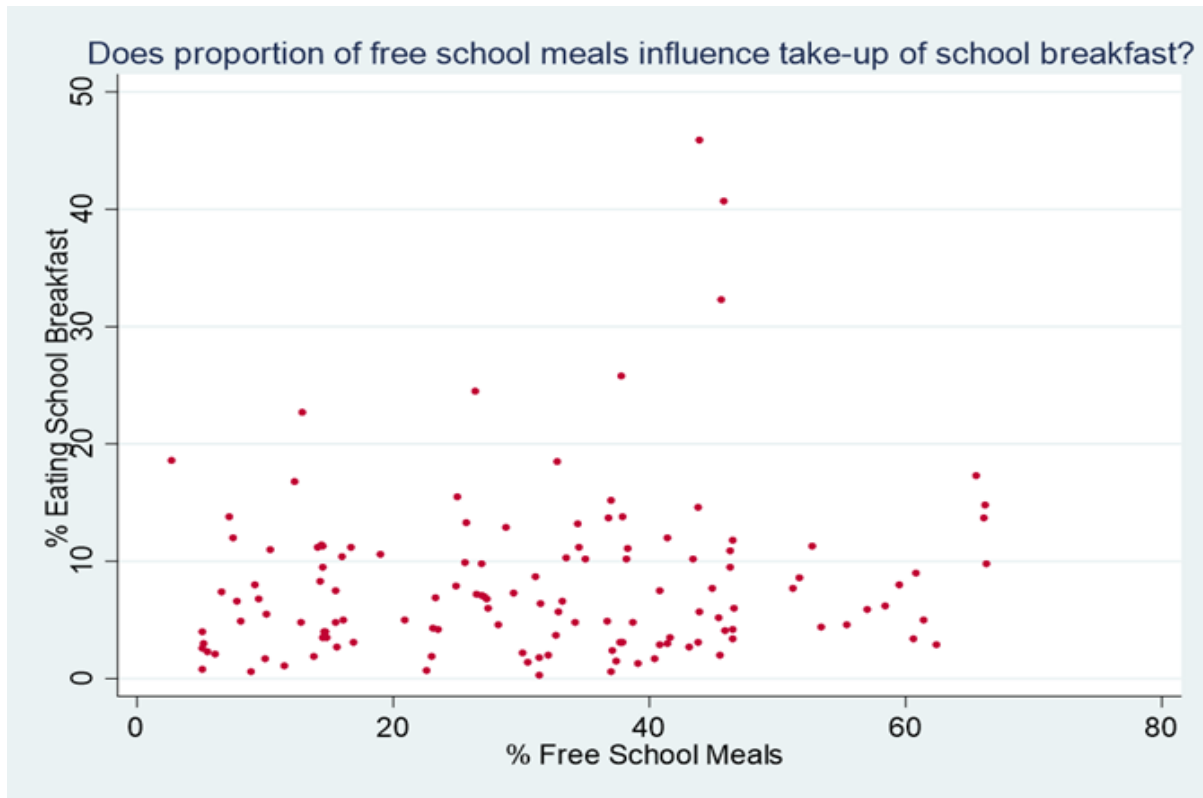
Not too much attention should be focussed on the three schools where more than 30% of students had school breakfast – two of the schools were very small; indeed, one had fewer than 100 students (see **Figure 7**).

The relationship between the provision of school breakfast and public examination results

The literature indicates that eating breakfast can significantly improve concentration, learning, and behaviour. So, it may be thought that schools that ran breakfast clubs would have better public examination results than those that didn't. **Table 18** examines the evidence.

Table 18: Public examination results by breakfast club status

School Type	Average percentage of students achieving good results at GCSE *183 schools*	Average percentage of students achieving good results at A level *156 schools*
Breakfast club	66.6% *(126 schools)*	65.3% *(114 schools)*
No breakfast club	64.5% *(57 schools)*	61.0% *(42 schools)*
All schools	**65.9% (183 schools)**	**64.1% (156 schools)**

Not surprisingly, whether a school ran a breakfast club or not appeared to have little influence on exam results. There are three main explanations:

- On average, in the 130 schools with breakfast clubs, only 7% of students attended – 93% didn't. It is eating breakfast that matters, not whether it is available or not.

- Some of the telephone conversations with the 158 schools that provided information indicated that the younger students (typically Years 8 and 9) attended breakfast club – rather than students in Years 12 – 14 *(the GCSE and A level years)*.

- The schools differed in many other ways – it is not as if they were all identical other than breakfast provision. Many factors will have influenced the results shown in **Table 18**.

6. Analysis of results at a Parliamentary Constituency level

Within the contexts of this research, the 18 Parliamentary Constituencies (shown in **Map 2**) differ significantly. While much can be gained by studying the provision of breakfast at the Province level, looking at provision at a more local level is also helpful. Maps are an ideal medium for illustrating the data.

One striking finding is that while 34% of secondary schools in Northern Ireland are grammar schools, there is considerable variation in this proportion between the different constituencies. In Belfast South *(the constituency containing Queen's University)*, the percentage of grammar schools is over double *(70%)*; while in Strangford, the percentage of grammar schools is barely half of 34% *(18%)*. **Table 19** provides further information.

At the Northern Ireland level, grammar schools were on average 53% larger than secondary schools (952 students vs 621 students); and they were more likely to run breakfast clubs than non-grammar schools.

Table 19: Percentage of secondary schools classified as grammar schools

Parliamentary Constituency	Percentage of Grammar Schools
Belfast South	70.0%
Belfast East	62.5%
North Down	50.0%
Foyle	40.0%
East Antrim	37.5%
West Tyrone	36.4%
South Antrim	33.3%
Newry & Armagh	31.2%
North Antrim	30.8%
South Down	30.8%
Belfast North	30.0%
Lagan Valley	28.6%
Upper Bann	28.6%
East Londonderry	26.3%
Fermanagh & South Tyrone	26.3%
Belfast West	25.0%
Mid Ulster	25.0%
Strangford	18.2%
All constituencies	**34.2%**

Table 20 shows how the 18 constituencies differed in economic prosperity *(as measured by the variation in the percentage of secondary school pupils entitled to free school meals).* While in Belfast East, fewer than one-in-five students were entitled to free school meals, in Belfast West, over one-in-two were. **Map 3** illustrates the variation.

The constituencies also differed in terms of Catholicity. **Table 21** shows that while just over 10% of students in North Down were Catholic, in Belfast West, the percentage was not far off 100%. These dramatic variations are illustrated in **Map 4**.

Map 4 also shows considerable variation in religious makeup within the four Parliamentary Constituencies that compromise the City of Belfast. The map also indicates a high degree of Catholicity in the constituencies along the border with the Republic of Ireland.

Tables 22 – 24 explore how breakfast provision and take-up varied in the different constituencies.

Table 22 shows that while all schools in North Down ran breakfast clubs, in South Antrim, only one-third did. The proportions are illustrated in **Map 5**. The City of Belfast showed marked variation, particularly between Belfast North (60.0%) and Belfast South (90.0%). Outside of Belfast *(except for North Down),* the pattern seemed to be that the further one moved away from Belfast, the more likely it was that a school would run a breakfast club.

While **Table 23** (and **Map 6**) are based on all students attending secondary School, **Table 24** (and **Map 7**) just consider those students who went to a school at which breakfast was served. The percentage of students having breakfast at school *(if available)* varied between 2.8% in Lagan Valley and 10.4% in Foyle.

Finally, **Table 25** shows the number of online survey responses and telephone survey responses by constituency.

Map 2: The 18 Parliamentary Constituencies of Northern Ireland

1 - Belfast North
2 - Belfast East
3 - Belfast South
4 - Belfast West
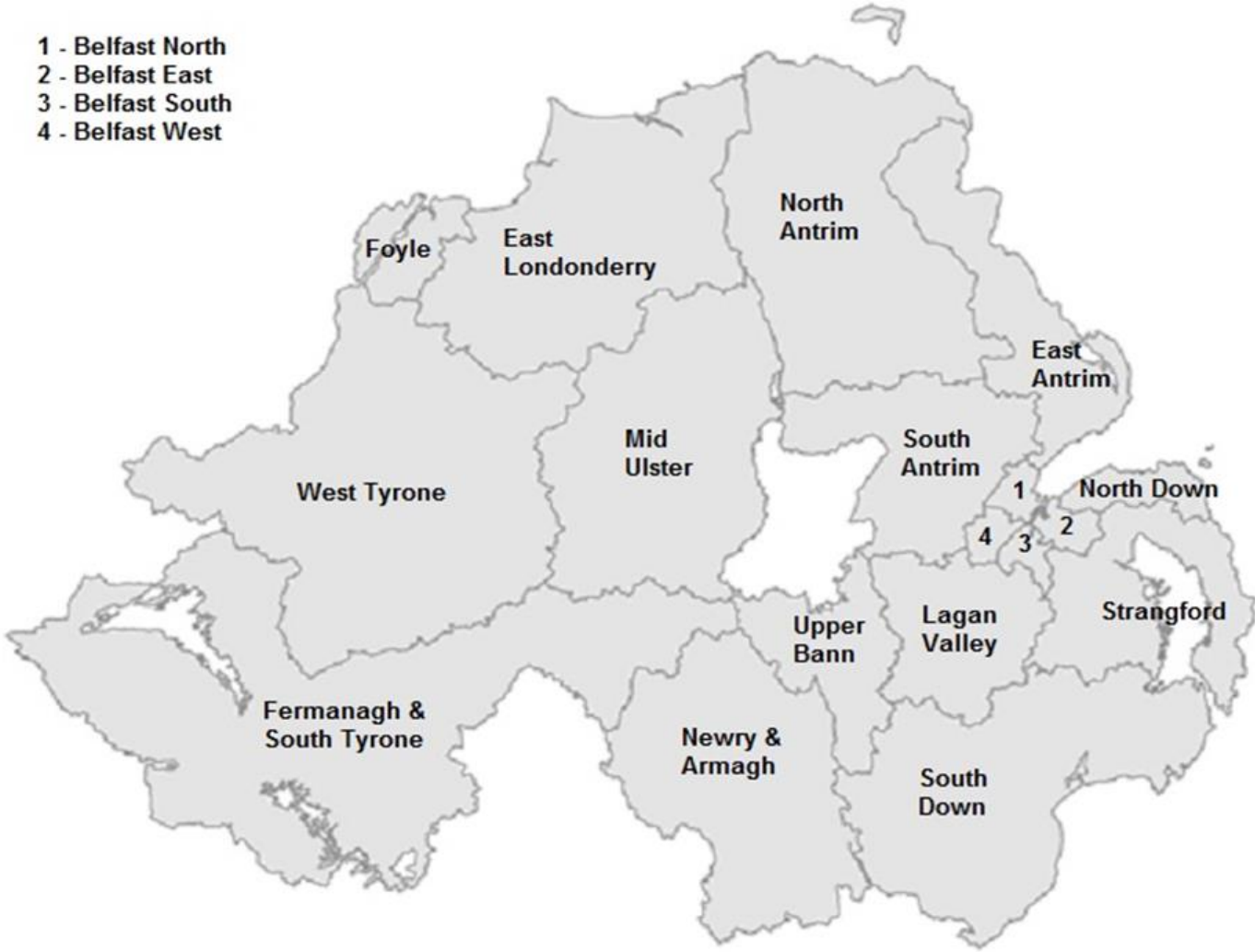
Table 20: NI – Free School Meals by Parliamentary Constituency

Parliamentary Constituency	Total number of schools	Total number of pupils	Total free school meals	Percentage of pupils having free school meals
Belfast East	8	6,688	1,291	19.3%
Belfast North	10	9,645	4,122	42.7%
Belfast South	10	9,209	1,852	20.1%
Belfast West	8	7,316	3,775	51.6%
East Antrim	8	6,364	1,648	25.9%
East Londonderry	11	6,384	1,779	27.9%
Fermanagh & South Tyrone	19	9,718	2,321	23.9%
Foyle	10	8,920	3,557	39.9%
Lagan Valley	7	5,671	1,225	21.6%
Mid Ulster	12	8,986	2,121	23.6%
Newry & Armagh	16	11,369	3,140	27.6%
North Antrim	13	9,148	2,147	23.5%
North Down	6	5,940	1,286	21.6%
South Antrim	6	4,360	918	21.1%
South Down	13	7,913	2,022	25.6%
Strangford	11	6,714	1,643	24.5%
Upper Bann	14	9,893	2,398	24.2%
West Tyrone	11	7,487	2,346	31.3%
Northern Ireland	**193**	**141,725**	**39,591**	**27.9%**

Map 3: Northern Ireland Parliamentary Constituencies – Free School Meals

% Free School Meals
19.3 - 21.5
21.5 - 23.6
23.6 - 24.4
24.4 - 26.5
26.5 - 32.7
32.7 - 51.6

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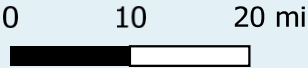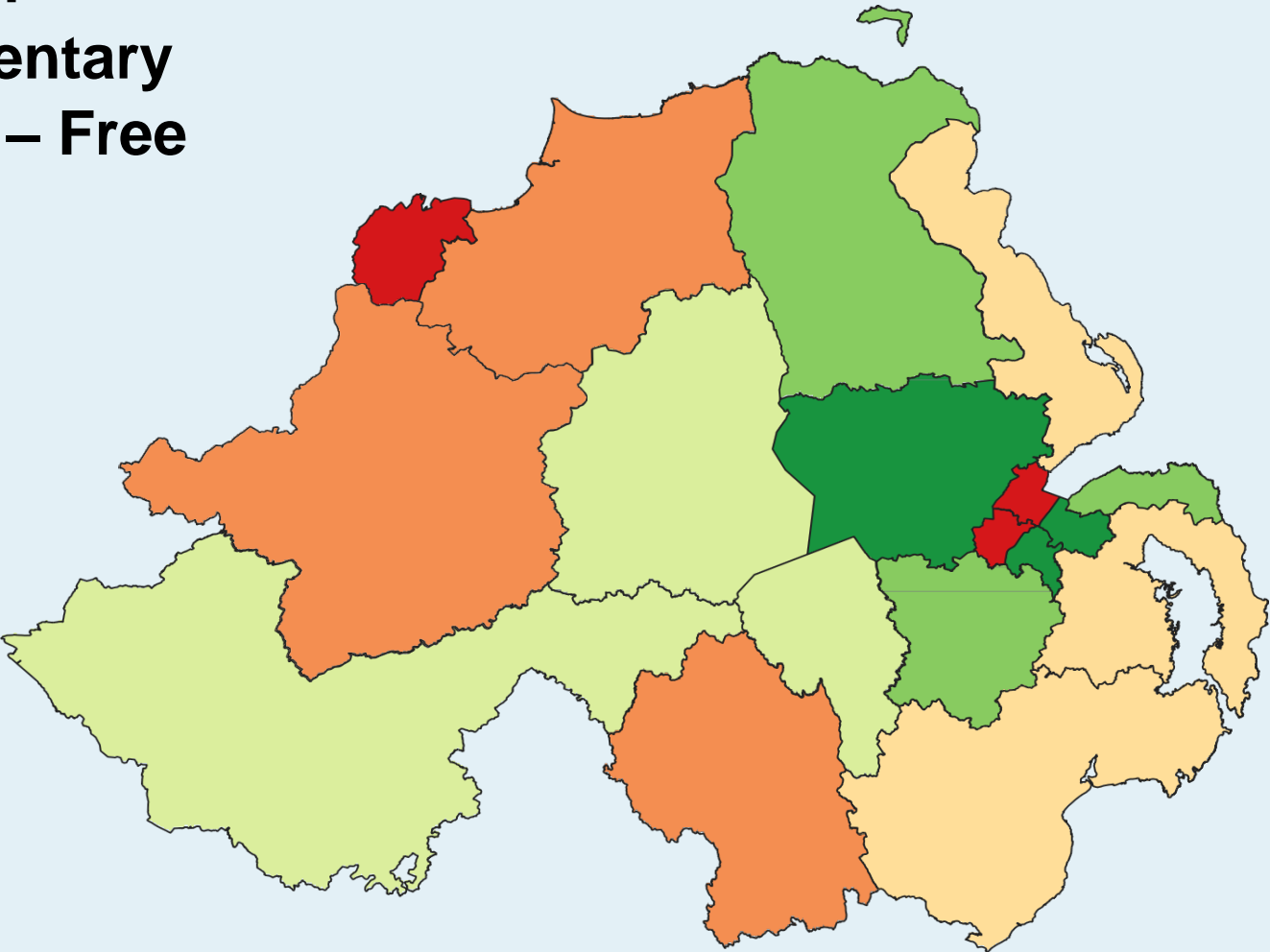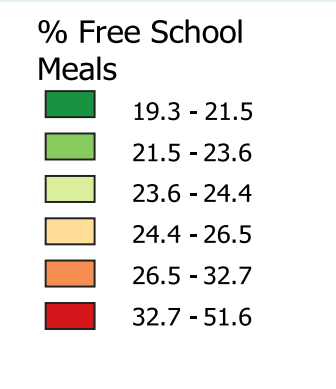
Table 21: NI – Catholic Pupils by Parliamentary Constituency

Parliamentary Constituency	Number of schools reporting religion	Total number of pupils in these schools	Total Catholic pupils in these schools	Percentage of Catholic pupils in schools
Belfast East	8	6,688	1,505	22.5%
Belfast North	10	9,645	5,057	52.4%
Belfast South	10	9,209	3,678	39.9%
Belfast West	7	6,886	6,706	97.4%
East Antrim	7	5,720	1,192	20.8%
East Londonderry	10	6,133	2,729	44.5%
Fermanagh & South Tyrone	17	9,335	6,153	65.9%
Foyle	10	8,920	7,274	81.5%
Lagan Valley	7	5,671	770	13.6%
Mid Ulster	11	8,531	6,315	74.0%
Newry & Armagh	14	10,196	8,082	74.9%
North Antrim	12	8,888	7,295	31.4%
North Down	6	5,940	602	10.1%
South Antrim	6	4,360	632	14.5%
South Down	12	7,573	5,595	73.9%
Strangford	9	6,099	2,011	33.0%
Upper Bann	14	9,893	4,078	41.2%
West Tyrone	10	6,950	4,957	71.3%
Northern Ireland	**180**	**136,637**	**70,131**	**51.3%**

Although there was a total of 141,725 pupils attending 193 schools, 13 schools chose NOT to report the religion of their pupils. These 13 schools had 5,088 pupils, so this table is based on 136,637 pupils (96.4% of 141,725) attending 180 schools.

Map 4: Northern Ireland Parliamentary Constituencies - Catholicity

% Catholic Pupils
- 10.1 - 19.8
- 19.8 - 32.5
- 32.5 - 42.9
- 42.9 - 67.7
- 67.7 - 74.2
- 74.2 - 97.4

0   10   20 mi
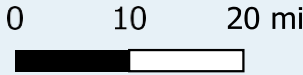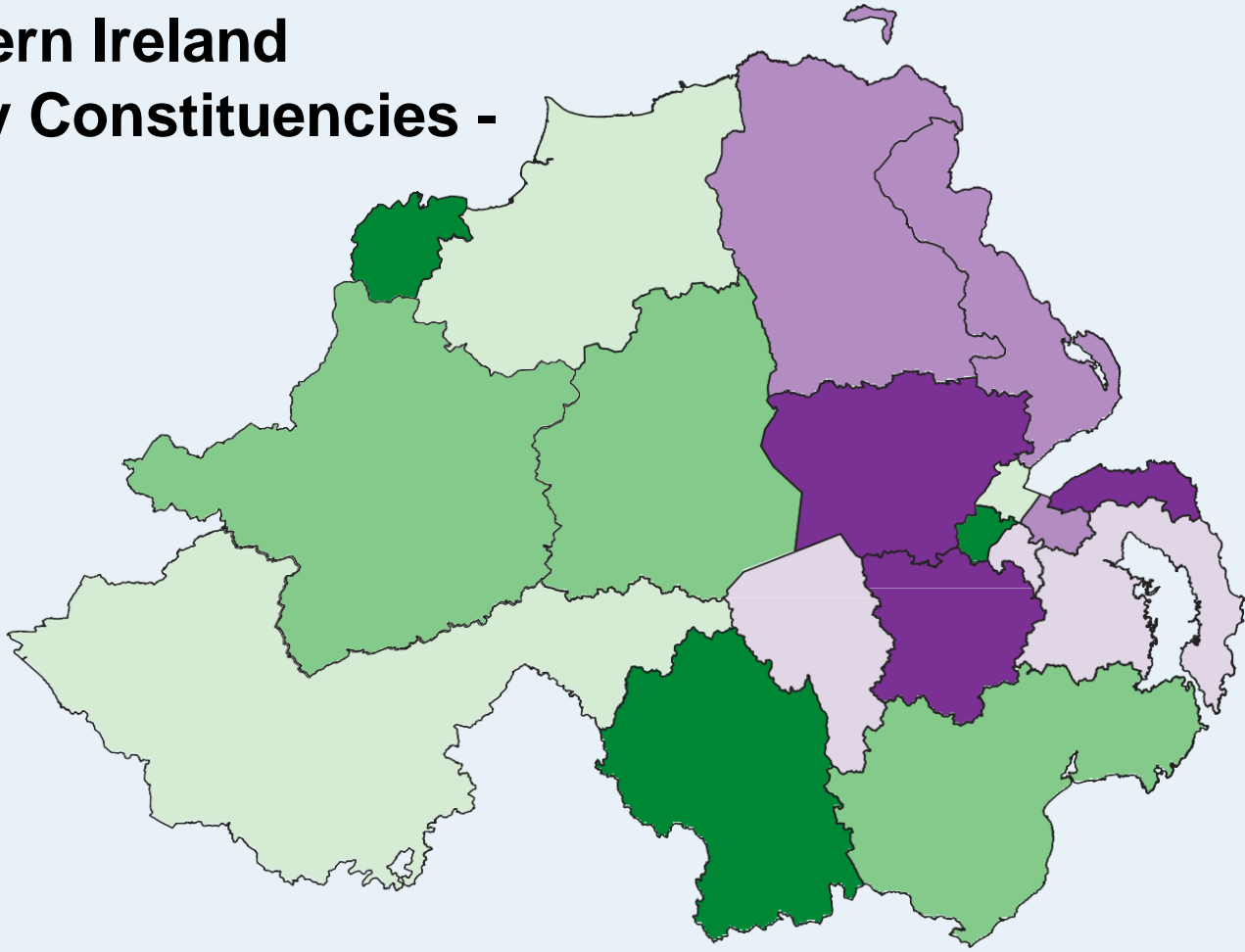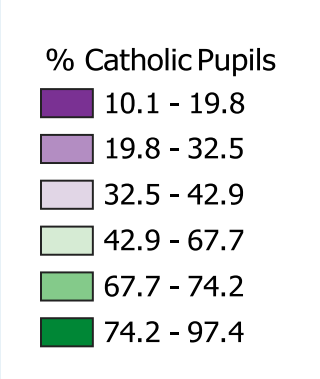
Table 22: Availability of Breakfast by Parliamentary Constituency

Parliamentary Constituency	Number of schools offering breakfast	Number of schools <u>not</u> offering breakfast	Percentage of schools offering breakfast
Belfast East	6	2	75.0%
Belfast North	6	4	60.0%
Belfast South	9	1	90.0%
Belfast West	6	2	75.0%
East Antrim	5	3	62.5%
East Londonderry	7	4	63.6%
Fermanagh & South Tyrone	13	6	68.4%
Foyle	9	1	90.0%
Lagan Valley	3	4	42.9%
Mid Ulster	9	3	75.0%
Newry & Armagh	10	6	62.5%
North Antrim	10	3	76.9%
North Down	6	0	100.0%
South Antrim	2	4	33.3%
South Down	9	4	69.2%
Strangford	5	6	45.5%
Upper Bann	7	7	50.0%
West Tyrone	8	3	72.7%
Northern Ireland	**130**	**63**	**67.4%**

Map 5: Northern Ireland Parliamentary Constituencies Proportion of schools serving breakfast

In NI 67% of schools served breakfast

% of schools serving breakfast

- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100

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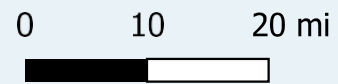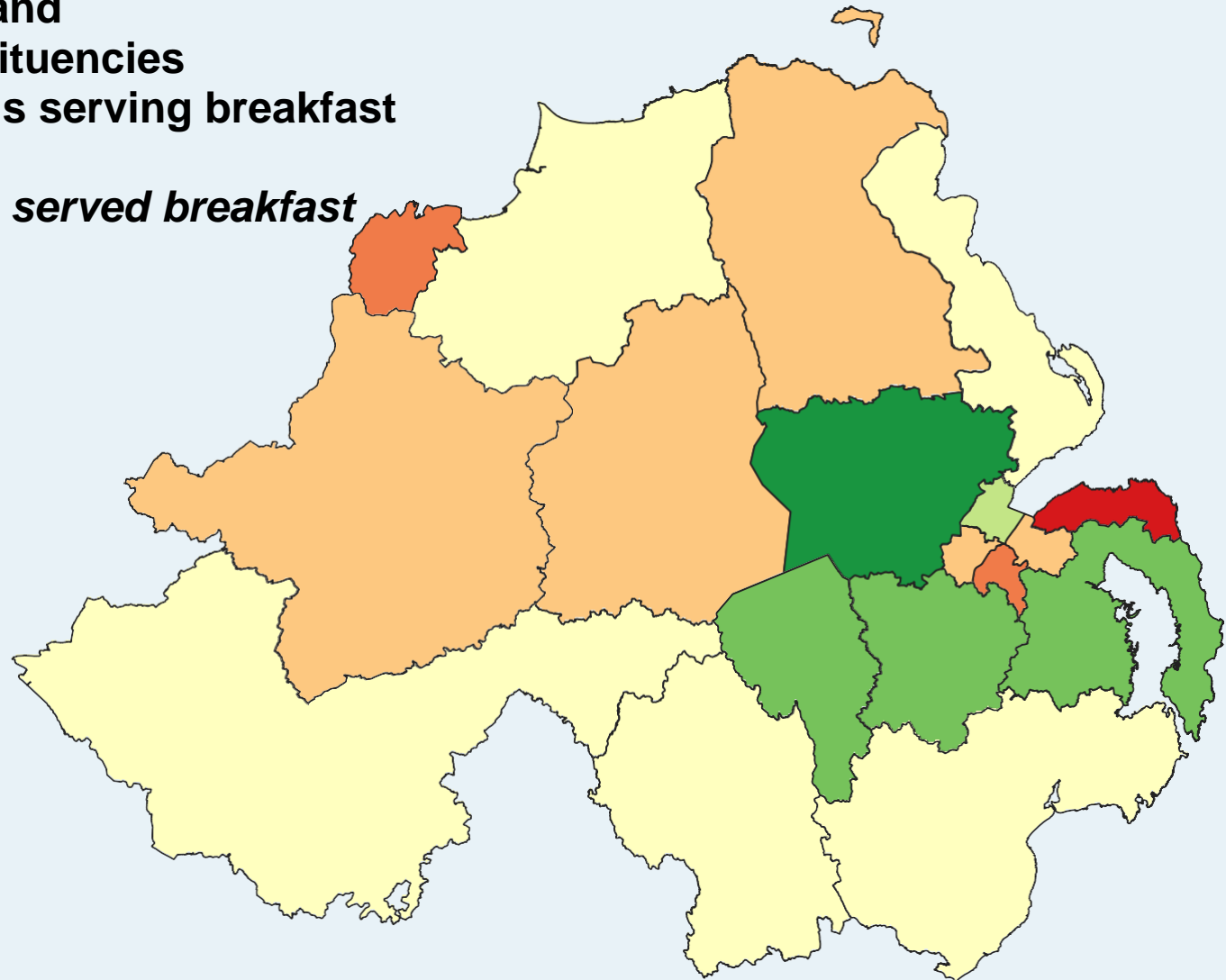
Table 23: School breakfast numbers by Parliamentary Constituency
All 193 schools *(130 offering breakfast + 63 not offering breakfast)*

Parliamentary Constituency	Total number of pupils	Total daily breakfast number	Percentage of students having breakfast at school
Belfast East	6,688	285	4.3%
Belfast North	9,645	385	4.0%
Belfast South	9,209	310	3.4%
Belfast West	7,316	525	7.2%
East Antrim	6,364	250	3.9%
East Londonderry	6,384	200	3.1%
Fermanagh & South Tyrone	9,718	472	4.9%
Foyle	8,920	840	9.4%
Lagan Valley	5,671	85	1.5%
Mid Ulster	8,986	510	5.7%
Newry & Armagh	11,369	510	4.5%
North Antrim	9,148	660	7.2%
North Down	5,940	350	5.9%
South Antrim	4,360	140	3.2%
South Down	7,913	417	5.3%
Strangford	6,714	250	3.7%
Upper Bann	9.893	290	2.9%
West Tyrone	7,487	525	7.0%
Northern Ireland	**141,725**	**7,004**	**4.9%**

Map 6: Northern Ireland Parliamentary Constituencies School Breakfast – All 193 schools

% Breakfast at School

- 1.5 – 3.4
- 3.4 – 5.3
- 5.3 – 7.2
- 7.2 – 9.4
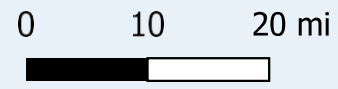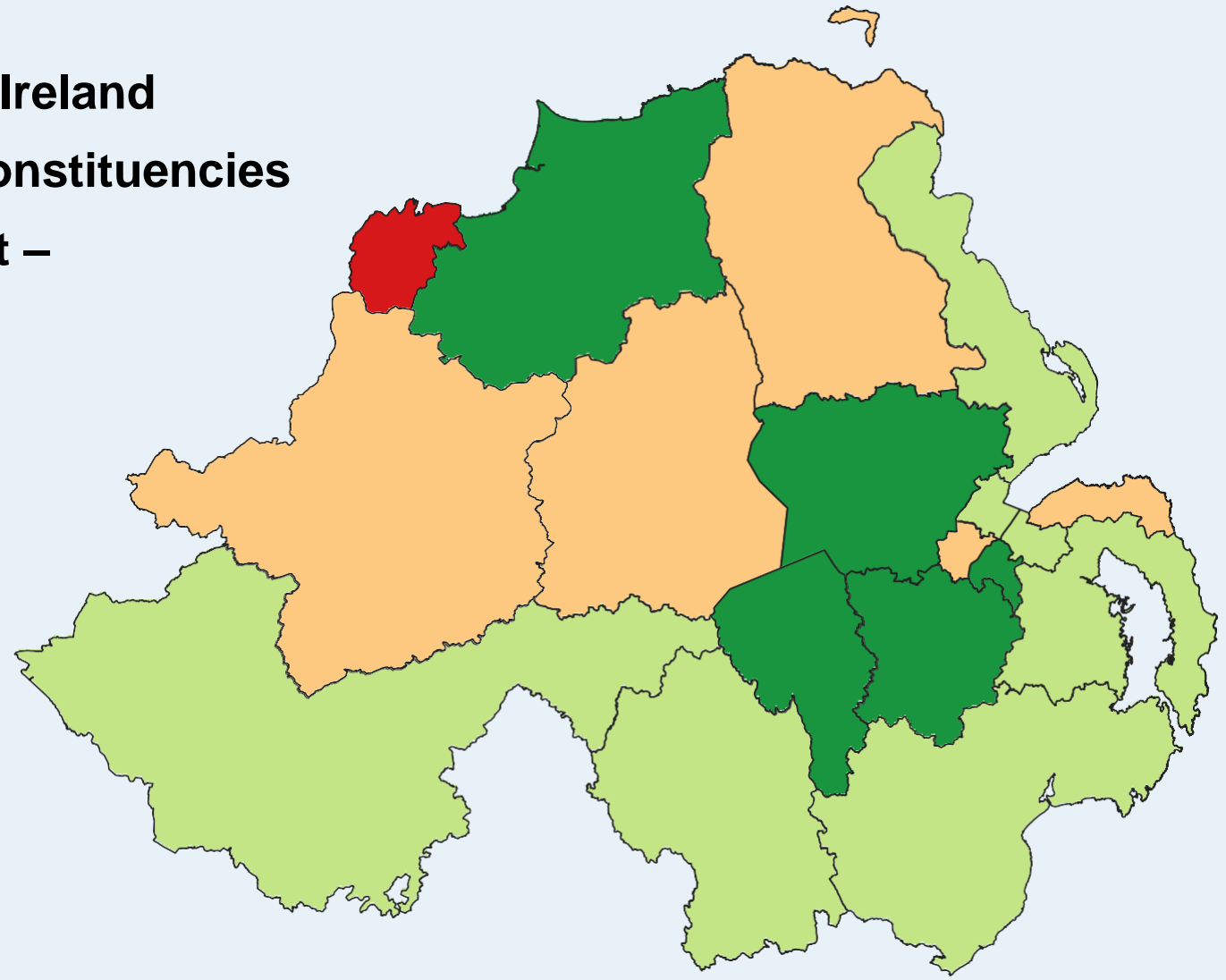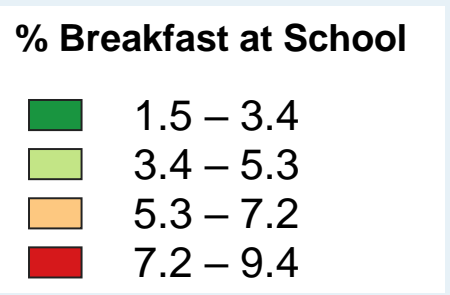
Table 24: School breakfast numbers by Parliamentary Constituency
Just 130 the schools that offer breakfast

Parliamentary Constituency	Total number of pupils	Total daily breakfast number	Percentage of students having breakfast at school
Belfast East	4,905	285	5.8%
Belfast North	6,202	385	6.2%
Belfast South	8,376	310	3.7%
Belfast West	5,839	525	9.0%
East Antrim	3,623	250	6.9%
East Londonderry	4,054	200	8.1%
Fermanagh & South Tyrone	6,246	472	7.6%
Foyle	8,065	840	10.4%
Lagan Valley	3,003	85	2.8%
Mid Ulster	6,799	510	7.5%
Newry & Armagh	8,368	510	6.1%
North Antrim	7,350	660	9.0%
North Down	5,940	350	5.9%
South Antrim	2,019	140	6.9%
South Down	5,725	417	7.3%
Strangford	3,821	250	6.5%
Upper Bann	4,807	290	6.0%
West Tyrone	5,077	525	10.3%
Northern Ireland	**100,219**	**7,004**	**7.0%**

**Map 7: Northern Ireland
Parliamentary Constituencies
School Breakfast –
130 schools offering breakfast**

% Breakfast at School

- 2.8 – 3.7
- 3.7 – 6.5
- 6.5 – 8.1
- 8.1 – 10.4
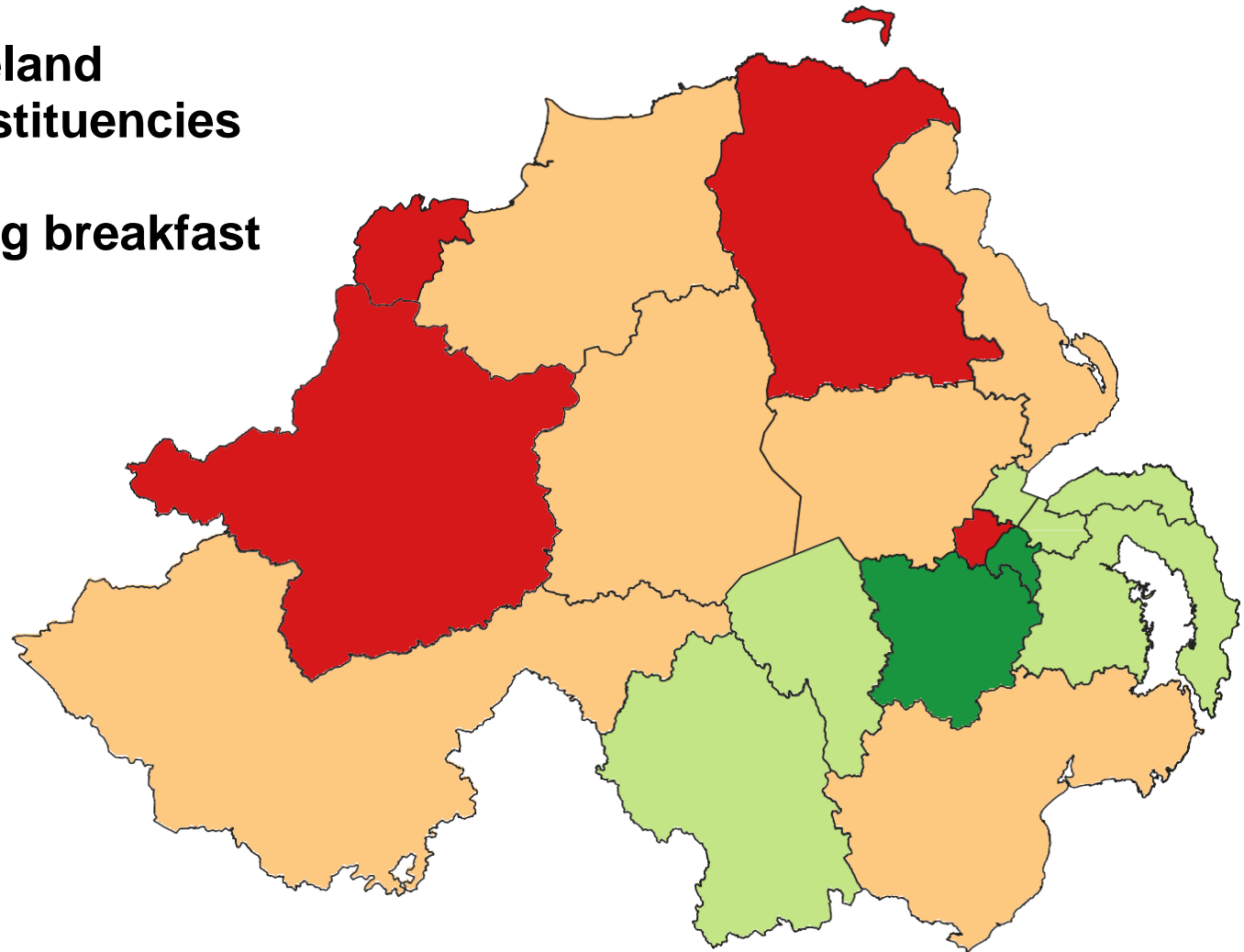
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Table 25: Response to online and telephone surveys by Parliamentary Constituency

Parliamentary Constituency	Number of schools replying to the online survey	Number of schools responding to the telephone survey	Percentage of schools replying to the online survey
Belfast East	1	7	12.5%
Belfast North	2	8	20.0%
Belfast South	2	8	20.0%
Belfast West	0	8	0.0%
East Antrim	2	6	25.0%
East Londonderry	3	8	27.3%
Fermanagh & South Tyrone	5	14	26.3%
Foyle	3	7	30.0%
Lagan Valley	0	7	0.0%
Mid Ulster	2	10	16.7%
Newry & Armagh	4	12	25.0%
North Antrim	3	10	23.1%
North Down	2	4	33.3%
South Antrim	0	6	0.0%
South Down	2	11	15.4%
Strangford	2	9	18.2%
Upper Bann	1	13	7.1%
West Tyrone	1	10	9.1%
Northern Ireland	**35**	**158**	**18.1%**

7. References

1. Northern Ireland Statistics and Research Agency (Department of Finance) – Mid-Year Population Estimates June 2019

2. Department of Education NI – School Enrolment – School Level Data 2018/19

3. Schools, pupils, and their characteristics: January 2019. Department for Education – National Statistics

4. GCSE: Northern Ireland School League Table 2018: The Belfast Telegraph 14 March 2019

5. GCE A-Level: Northern Ireland School League Table 2018: The Belfast Telegraph 21 March 2019

6. Northern Ireland Statistics and Research Agency (Department of Finance) – Religion in Northern Ireland – 2011 Census

8. Acknowledgements

I am grateful to the Heads and Catering Managers of the five schools acknowledged in Chapter 2 for allowing me to observe their breakfast service. This enabled me to pre-test (and modify) the questionnaire in Appendix 2.

I am also grateful to Iris Crook, Tony Crook, Paul Harvey, and Malcolm Smith for pre-testing the online survey form. They each provided helpful feedback, which I was able to process. Bill Richards *(a colleague of mine)* kindly read the entire first draft of this Chapter and provided suggestions for improvement. I was pleased to take his ideas on board.

Paul Harvey *(a former College Principal)* also helped with the wording of the letter to school Principals and read the entire final draft of this Chapter – spotting several phrases which needed clarification *(to avoid ambiguity)* or amendment/removal *(to prevent unintended offence)*. I only followed his advice 90% of the time and must take full responsibility for any remaining errors or shortcomings.

I am grateful to the Principals and Catering Managers of the following 35 secondary schools in Northern Ireland for completing the online survey:

- Aughnacloy High School
- Ballymena Academy
- Ballymoney High School
- Belfast High School
- Belfast Royal Academy
- Devenish College
- Dominican College, Portstewart
- Drumglass High School
- Foyle College
- Larne High School
- Loreto College
- Loreto Grammar School
- Lurgan College
- Mercy College, Belfast
- North Coast Integrated College
- Oakgrove Integrated College
- Our Lady and St Patrick's College, Belfast
- Our Lady's Grammar School, Newry

- Rainey Endowed School
- Rathmore Grammar School
- Saintfield High School
- Slemish College
- St Catherine's College, Armagh
- St Columb's College, Derry
- St Joseph's Grammar School, Donaghmore
- St Louis Grammar School, Kilkeel
- St Mark's High School, Warrenpoint
- St Mary's High School, Belleek
- St Patrick's Grammar School, Armagh
- St Patrick's Grammar School, Downpatrick
- St Patrick's High School, Keady
- Strangford Integrated College
- Sullivan Upper School
- The Royal School, Dungannon
- Victoria College, Belfast

I am also grateful to the other 158 secondary schools staff who provided basic information on breakfast provision.

APPENDIX 1 – Letter to School Principals

PRINCIPAL'S COPY

UNIVERSITY OF LEEDS

Woodhouse Lane, Leeds LS2 9JT

4 November 2019

Name of Principal
Address line 1
Address line 2
Address line 3
Address line 4

Dear Name of Principal

PROVISION OF BREAKFAST IN NI SECONDARY SCHOOLS

A nutritious breakfast can help students live a long and healthy life, but in addition there are plenty of more immediate benefits. It is well established that eating breakfast improves alertness, concentration, mental performance, memory and mood. These benefits have positive spillover effects from individual students to their peers and teachers – *and this is often reflected in a significant improvement in public examination results.*

The University is carrying out some research in this area and therefore I am writing to the Principals of all secondary schools in Northern Ireland requesting information about the provision of breakfast at their school. The information I would appreciate receiving from your school is:

- Whether your school offers breakfast – *and if so*
- Information on the <u>numbers</u> eating breakfast at school
- Details of <u>when</u> breakfast is offered (days of week and time)
- Details of <u>where</u> breakfast is served *(e.g. cafeteria or entrance area)*
- Details of <u>what</u> is on the breakfast menu (and quantities served)
- Information on method by which payment is made *(e.g. cash or finger print)*
- Details of staff involved in providing breakfast (including any volunteers)
- Information on type of catering used *(e.g. in-house or contract)*

Information is being gathered by means of an on-line questionnaire which should take between 5 and 10 minutes to complete.

- There are <u>no</u> questions relating to either prices charged or the cost of ingredients.
- No commercial organisation should gain from this research which has been entirely financed through private means.

Assuming you agree to this request, I imagine you will be asking a member of your catering or facilities team to complete the questionnaire, and so I am enclosing a copy of this letter for you to pass on to them. Thank you for taking the time to read this letter – further information is provided overleaf. I hope you will agree to your school taking part.

Kind regards

Yours sincerely

Reverend Peter Simpson

Nutritional Epidemiology Group – School of Food Science and Nutrition
Email: fsprs@leeds.ac.uk   Direct Dial: 0113 343 7506

The **Eat Well Guide** produced by the NHS provides 8 tips for healthy eating:

1. **Base your meals on higher fibre starchy carbohydrates (which include potatoes, bread, rice, pasta and cereals)**
2. **Eat lots of fruit and veg (at least 5 portions a day)**
3. **Eat more fish, including a weekly portion of oily fish (such as salmon or mackerel)**
4. **Cut down on saturated fat and sugar (such as sausages and cakes)**
5. **Eat less salt: no more than 6g a day (about a teaspoonful) for adults and children aged 11 and over**
6. **Get active and be a healthy weight**
7. **Do not get thirsty**
8. **Do not skip breakfast**

Some adolescents skip breakfast because they think it will help them lose weight. But a healthy breakfast high in fibre and low in fat, sugar and salt can form part of a balanced diet and help young people enjoy good health.

It is therefore worrying that breakfast skipping increases as one moves through the secondary school years – *as shown in the table below.*

Proportion of young people who don't eat breakfast every school day – 2014

Country	11-year-olds		13-year-olds		15-year-olds	
England	**Boys:**	**17%**	**Boys:**	**29%**	**Boys:**	**36%**
	Girls:	**26%**	**Girls:**	**49%**	**Girls:**	**52%**
Wales	**Boys:**	**30%**	**Boys:**	**39%**	**Boys:**	**41%**
	Girls:	**38%**	**Girls:**	**57%**	**Girls:**	**56%**
Scotland	**Boys:**	**21%**	**Boys:**	**32%**	**Boys:**	**43%**
	Girls:	**25%**	**Girls:**	**47%**	**Girls:**	**57%**
Northern Ireland	**Boys:**		**Boys:**		**Boys:**	
	Girls:		**Girls:**		**Girls:**	
Irish Republic	**Boys:**	**18%**	**Boys:**	**26%**	**Boys:**	**27%**
	Girls:	**21%**	**Girls:**	**33%**	**Girls:**	**38%**
All of Europe in HBSC	*Boys:*	*27%*	*Boys:*	*33%*	*Boys:*	*38%*
	Girls:	*30%*	*Girls:*	*42%*	*Girls:*	*48%*

Source: WHO: Health Behaviour in School-aged Children (HBSC)

Because Northern Ireland is not included in the World Health Organisation – Health Behaviour in School-aged Children survey, we don't have any comparable statistics for young people living in the Province. The record of breakfast skipping by young people living in the Irish Republic is better than that for young people living in Great Britain – but one can only speculate about the more local record.

I am interested in Northern Ireland because I lectured at Queen's Belfast for 11 years and still visit the Province once a year in connection with my examining duties. Much work has been done on the provision of breakfast in secondary schools in Great Britain and I am eager to extend this work to schools in Northern Ireland.

I hope to receive a response from most secondary schools in the Province. Although participating schools will be listed as way of acknowledgement, it will not be possible to identify your school in any publication. Participating schools will be sent a copy of the survey findings once the research is complete.

You can view the questionnaire *(which includes the University of Leeds Research Participant Privacy Notice)* at the following web address:

https://leeds.onlinesurveys.ac.uk/catering

Feel free to experiment with answering the questions, but please only click on **Finish** when your answers are to be recorded as your 'official' school response.

APPENDIX 2 – Copy of online questionnaire

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Breakfast at School Questionnaire - Northern Ireland

Page 1: Introduction

I am conducting research into the provision of breakfast in secondary schools and colleges located in Northern Ireland and should be grateful if
you would provide me with some basic information under three main headings:

1. Information about whether your school offers breakfast before the start of lessons and/or during a mid-morning break - and (if so) numbers of
students served. *This breakfast provision may be through a 'volunteers' breakfast club. If so, please be sure to INCLUDE it.*

2. Information about what is on your breakfast menu and quantities of each item served.

3. Information about catering (and other) staff preparing and serving breakfast. *If any volunteers help, please be sure to INCLUDE
them.* Also, query about any 'charitable support'.

There are 14* questions in total, and experience has shown they should take no longer than 10 minutes to answer. Although I need to know the
name and post-code of your school/college to link it to information on student numbers etc., the information you provide is for statistical
purposes only, and it will **not** be possible to identify your school/college in any publication. *The main reason I need to know the name and
position of the person completing the survey is so that I may be sure the responses can be treated as the 'official' school responses.*

Reverend Peter Simpson –
Nutritional Epidemiology Group –
School of Food Science and Nutrition (fsprs@leeds.ac.uk).

* There is an optional 'Question 15' at the end of the survey should you wish to add any comments.

The University of Leeds Research Participant Privacy Notice can be viewed here.

Page 2: Information about school/college - whether breakfast is served - and (if so) numbers served

1. School/college name.

2. School/college post code (eg BT7 1NN).

3. Name and position of person completing this questionnaire.

4. Type of catering service used *(please choose **one** option - **or two** if there is a 'volunteers' breakfast club).*

☐ Contract catering (e.g. Chartwell; Sodexo)
☐ Education Authority catering
☐ In-house catering
☐ 'Volunteers' breakfast club (e.g. one run by parents)

5. Do you offer breakfast to students *(before the start of lessons)* at least once a week? **Please note - this may be food served at a 'volunteers' breakfast club.**

○ Yes
○ No

If you answered 'Yes' to Question 5 please answer the following questions - if you answered 'No' skip the next four questions and move to Question 10.

6. Days breakfast served before start of lessons *(e.g. Monday - Friday).*

7. Time breakfast served *(e.g. 7:30am - 8:15am).*

8. Number of students served breakfast before start of lessons on a typical day - ***please include anyone served at a 'volunteers' breakfast club.***

[   ]

9. Type of breakfast service *(please choose one option).*

○ Breakfast served in cafeteria
○ Breakfast served in classroom
○ 'Grab and go' breakfast served near school/college entrance

10. Are students able to purchase 'breakfast-type food' *(e.g. porridge; toast; or a bacon roll etc)* at mid-morning break?

○ Yes
○ No

10.a. If 'Yes' what time is mid-morning break? *(e.g. 10:45am - 11:05am).*

[   ]

11. How do students pay for their breakfast-food (whether purchased before lessons or during break)? Please 'click' all options that apply.

☐ Cash
☐ Electronically (e.g. finger-print system)
☐ Breakfast is included in fees
☐ Breakfast is free (to all or some students)
☐ Not applicable - we never serve breakfast-food

Page 3: Breakfast menu - quantities served before start of lessons and during mid-morning break

If pupils (such as Sixth Formers) are able to purchases 'breakfast items' during morning lesson time, please count these as sales during mid-morning break in Question 12 below.

12. *Use as many rows as are needed - just leave other rows blank. Please remember to include quantities served at a 'volunteers' breakfast club.*

	Item on menu e.g. bowl of cereal; bacon roll; glass of fruit juice	Quantity served before start of lessons e.g. 23 (please just record the **number** of portions etc)	Quantity served during mid-morning break e.g. 15 (please just record the **number** of portions etc)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Page 4: Staffing and query about 'charitable support' (+ opportunity for further comments)

13. **Staff (catering - teaching - volunteers) involved in delivery of breakfast** *before start of lessons 'on a typical day'.* **Please use as** many rows as are needed - just leave other rows blank. *Anyone who helps run a 'volunteers' breakfast club should simply be classified as a volunteer.* This question is NOT concerned with staffing at mid-morning break.

	Position e.g. catering manager; chef; catering assistant 1; catering assistant 2; teaching assistant 1; volunteer 1; volunteer 2		**Time in hours** e.g. 0.5; 0.75; 1.0; 1.5; 2.75
1			
2			
3			
4			
5			
6			

14. Some schools receive financial support (or gifts of food) from charities or local churches etc. to help provide breakfast for students. Does your school receive any such support?

○ Yes
○ No

15. If you wish to add any comments *(to help clarify any of your responses)* please do so here:

Page 5: Thanks

Thank you for taking the time to complete this questionnaire. It is much appreciated.

CHAPTER 4

A survey of the breakfast eating habits and opinions of secondary school pupils in Northern Ireland – Summer Term 2021

- **Preamble**
- **Development of the student questionnaire *(pilot study)***
- **The student questionnaire**
- **Selection of school for the main survey**
- **Recruitment of schools for the main survey**
- **Data processing and statistical analysis**
- **Characteristics of 18 schools that participated**
- **A first look at the questionnaire results**
- **Calorie counts since rising**
- **Kaplan-Meier plots and Wilcoxon rank-sum test**
- **Logistic regression analysis – basic principles**
- **Goodness of fit – basic principles**
- **Multivariable analysis – results**
- **Predictions of the multivariable regression model**

- **Goodness of fit – results**
- **Policy recommendations**
- **Epilogue**
- **References**
- **Appendix 1: Sample letter to School Principals**
- **Appendix 2: Sample letter to Parents**
- **Appendix 3: Sample letter to Pupils**
- **Appendix 4: A brief note about Cox regression**
- **Appendix 5: A brief note about multilevel models in logistic regression**
- **Appendix 6: A comparison of the NI survey data with the HBSC data**
- **Appendix 7: A comment on the importance of Breakfast Clubs, even if few pupils attend**

1. Preamble

The Oxford Dictionary defines breakfast as the first meal of the day – it is the meal that breaks the overnight fast. Sixty years ago, this simple definition may have been satisfactory for a survey of secondary school pupils' eating habits. Most pupils would have eaten breakfast at home before leaving for school, and few would have had an opportunity to eat again before school lunch was served – ignoring the all-important bottle of milk *(one-third of a pint)* formerly available for pupils to drink at break time.

During the 1960s *(as economic prosperity rose and pocket money increased)*, many secondary schools started running 'tuck-shops' during morning break, which offered a source of food and drink between breakfast at home and school lunch. Later, during the 1970s and 1980s *(as school rules were relaxed and shopping hours extended)*, it became possible for pupils to purchase *(and perhaps consume)* food and drink on their way to school. A more recent addition has been the introduction of 'breakfast clubs' where schools serve breakfast before the start of the school day.

As a consequence, if one asks pupils today about their breakfast habits, they may refer to one or more of the following four possibilities:

- Food and drink consumed at home before leaving for school.

- Food and drink purchased on the way to school. This may be consumed:

  o Before arriving at school *(perhaps inside a fast-food shop such as McDonald's, or whilst continuing their journey)*

  o On arrival at school before the start of lessons

  o During the mid-morning break.

- Food and drink consumed at a school breakfast club or brought from home for consumption at this time.

- Food and beverages either brought to school or purchased at school for consumption during the mid-morning break. *(I am grateful to the*

pupil referred to in Section 2 for persuading me to include food and drink consumed at this time in the definition of breakfast.)

With this in mind, the current survey defines breakfast as any food and drink consumed within 4 hours of rising from bed. This food may be consumed at 'one sitting' or 'several sittings'. Assuming all pupils get up no later than 8.00 am on school days, this definition excludes any food or drink consumed after midday – which will be deemed the earliest possible starting time for school lunch.

The NHS recommends that teenagers consume between 2,000 and around 3,000 calories a day *(depending on age and gender),* with about 400 calories for breakfast. There can be little doubt that fewer than 400 calories within four hours of waking are insufficient.[1]

The study aims to measure how long it takes *(in minutes)* from a pupil rising in the morning to them having consumed 400 calories. Some pupils will pass this 'milepost' in under 60 minutes *(1 hour),* while others will <u>not</u> pass it before lunch.

For our purposes, the milepost is only 'passed' by those pupils who have consumed at least 400 calories within 4 hours of rising.

This approach lends itself to **survival analysis**[2], which is not commonly used to study pupils' breakfast eating habits.

Survival analysis depends on an identifiable 'event' such as death. In a medical context, patients newly diagnosed with cancer may initially be classified according to whether they are still alive five years after diagnosis. However, the length of time between diagnosis and death is relevant in those who have not survived. A new cancer treatment may be deemed successful if either:

- there is an improvement in the 5-year survival rate and/or

- there is a significant increase in the mean survival period between diagnosis and death in those not surviving 5-years.

In the context of breakfast, not only is consuming *(at least)* 400 calories within 4 hours preferable to not having consumed 400 calories; having consumed 400 calories within 2 hours may be regarded as preferable to

only reaching this 'milepost' 4 hours after rising. Not only is **what** we eat and drink important - **when** we eat and drink is also important.

The two main variables for the survival analysis will be:

- Number of minutes since rising

- Cumulative number of calories consumed at various times since rising

As the number of minutes increases, we expect the cumulative number of calories to increase, meaning that more students will have passed the 400 calorie milepost.

2. Development of the student questionnaire *(pilot study)*

It was intended to investigate student breakfast habits on school days through an online questionnaire. Given the disruption caused by the COVID-19 pandemic, it was decided that:

- Completing the questionnaire should not be too time-consuming. Ideally, it was hoped that most pupils would finish it in under 5 minutes.

- The questionnaire should be suitable for completion at home or school.

- The questionnaire should <u>not</u> contain any controversial questions. This was deemed necessary, as the ethical review had agreed that it could be assumed that parents/guardians/carers gave permission for their child to complete the questionnaire – unless they specifically notified the school or college otherwise.

- It should be possible to complete the questionnaire using a smartphone or iPad and a desktop PC or laptop.

- Where possible, answers should not be 'open-ended'; instead, pupils should choose from a list of options. This would make the analysis of results more straightforward.

- A QR code should be provided for pupils who have QR readers on their smartphones or iPads.

The **early stages of development** were informal and ad-hoc. Discussions were held with the sons and daughters of friends and relatives who had children in secondary school. These could not be classified as focus group discussions, as they were held on a one-to-one basis. Nevertheless, they helped focus my mind on what questions to ask and what responses to offer. The literature review also drew attention to questions asked in similar studies, which aided the wording of questions in this survey.[3]

It is worth recording that before these ad-hoc discussions, I had intended to have a cut-off point at the start of school lessons. Any food consumed later would not be classified as breakfast. One teenage boy persuaded me to think again! Although he ate breakfast at home, he said that many of his friends didn't. Some of them even referred to food eaten at break-time as breakfast. He thought it would be unwise to exclude morning break from my research. I changed my mind – and in hindsight, I am glad I did!

The **subsequent development stage** involved 'prototype' questionnaires formatted using 'Online Surveys' – *formerly, BOS*. Several colleagues and friends tried these out – 'pretending they were school pupils.' This aided the 'fine-tuning' of the questionnaire –whether a question was compulsory or not and whether more than one response could be allowed. After some 'first-aid', the questionnaire started to behave robustly, and it became 'impossible' to get through the questionnaire without following the instructions. This had the advantage that if the questionnaire were completed at school, the teacher in charge would have little to do, and if the questionnaire were completed at home, there would be few frustrated pupils *(or parents).*

The **next stage of development** was to pilot the questionnaire on a group of secondary school pupils. Allerton High School in Leeds had been helpful in previous parts of the research, and both the Head of Food Technology and the Headteacher expressed a willingness to help with further work. After seeing the trial questionnaire, the school agreed to pilot it on their Year 7, 9, and 11 pupils during November 2020.

The Headteacher asked me to prepare a letter to be sent electronically to parents/guardians/carers informing them of the purpose of the study and allowing them to withdraw their child from the survey. As far as I can

recall, only one parent made such a request. Fortunately, they wrote directly to me, and as a result of my reply, they decided to allow their child to participate. This experience was a positive one, as it resulted in me making a minor alteration to the parental letter for use in the main survey. I was also asked to prepare a letter to pupils to be distributed a week after the parental letter. Some of the younger pupils were very impressed to receive a letter on university headed notepaper! This letter explained the purpose of the questionnaire and reassured pupils that they were free to 'drop out' without giving a reason.

The response rate was well over 50% in all year groups – in fact, in Year 9, it was almost 80%. The school offered to get more replies, but I said there was no need, given this was a pilot study. I had enough responses *(235)* for my purposes.

The 'trial' questionnaire worked well – I received no pupil or teachers complaints. However, when transferring the data from Online Surveys to Microsoft Excel, some 'issues' were detected:

- Some of the categories used were inappropriate. For example, one question asked about usual bedtime. It would appear that teenagers go to bed far later than I did when I was their age! Adjustments were needed to the questionnaire for use in the main survey. Three other 'time' questions also required adjustments. These related to arrival at school, the start of the morning break, and the beginning of lunch break. Due to COVID-19, there was a considerable staggering of these times, so additional categories needed to be added to the final version of the questionnaire.

- No one selected some options in the pilot, while other options were selected many times. Some adjustments were made to the final questionnaire – combining some of the less common responses and sub-dividing some of the more common ones.

- Some 'open-ended' questions proved too unwieldy when analysing the data. For example, one question in the pilot study asked pupils to list what items they purchased and consumed during the mid-morning break. The list of items took me by surprise – and these were the results from just one school. It was clear that while some pupils regard morning break as the occasion for a late breakfast, others consider it as the occasion for an early lunch. For the main survey, this question was <u>significantly</u> simplified so that pupils simply had to indicate whether they consumed one or more of four categories of food and drink:

o a hot food item *(such as a bacon roll or a slice of pizza)*

o a cold food item *(such as a sandwich or a scone)*

o a hot drink *(such as tea or coffee)*

o a cold drink *(such as milk or fruit juice)*

This meant that calorie intake estimates would be somewhat rough and ready – but at least the exercise wouldn't involve hundreds of hours dealing with unwieldy lists. In reality, the earlier 'open-ended' approach was not without its problems. For example, if a pupil simply wrote 'pizza' – it was not obvious how many calories had been consumed. – *was it a slice of pizza or a whole pizza; what size and type of pizza was it?*

- The final two questions concerned opinions about the importance of eating breakfast rather than personal breakfast habits. The first of these questions was about the benefits of eating breakfast, and the second was about the opportunity cost of not eating breakfast. In the pilot, respondents were asked to indicate all the options *(from a list)* they agreed with. Some chose just one option – while others chose many. It would be preferable for the main survey if these two questions asked pupils to indicate the <u>one</u> answer they most agreed with.

- Finally, the pilot study questionnaire included a question about the usual starting time of the evening meal. While this information was 'interesting', it was realised that the responses would not be used. It was therefore decided to remove the question from the final version.

The transfer of data from Online Surveys to Microsoft Excel went well, as did the transfer of 'manipulated data' from Excel to Stata *(a popular statistical software package – of which the latest version is Stata 17)*. The survival analysis tools in Stata 17 were to prove most helpful.

In conclusion, the pilot study revealed no serious problems and showed that the questionnaire could provide the desired information. The final version of the questionnaire was 'superior' to the one used in the pilot.

The **last development stage** involved trying the final version out on a few 'guinea pigs'. Teachers at the schools chosen for the main study were invited to try it out for themselves before the end of March 2021. This had

the advantage of assuring schools how quick and easy the questionnaire was and gave a 'last minute' check that the questionnaire was working as intended. No problems were detected. **The development of the student questionnaire was complete.**

3. The student questionnaire

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Breakfast on school days - student questionnaire (Northern Ireland Schools)

Page 1: Welcome!

Dear Student

Many thanks for agreeing to take part in this study about breakfast on school days.

Due to the COVID-19 pandemic, it is possible that today is not a 'typical school day.' Please answer all the questions as you would on a 'typical day' when youattend school/college 'full-time.'

Please answer ALL the questions - it shouldn't take long!

When you have completed the survey, you will receive a receipt - along with a 'thank you'message. If you complete this questionnaire at home, your school/college may ask you to inform them of the last 8 digits of your receipt number. This is simply so they can record who has completed the task.

Best wishes

Peter Simpson - School of Food Science and Nutrition - University of Leeds

The University of Leeds Research Participant Privacy Notice can be viewed here.

Page 2: Some basic information about your school andyourself

1. What is the name of your school/college?

[   ]

2. In which town *(or city or village)* is your school/college located?

[   ]

3. Which Year Group are you in?

- ○ Year 8
- ○ Year 10
- ○ Year 12

4. What is your gender?

- ○ Female (Girl)
- ○ Male (Boy)
- ○ Other
- ○ Prefer not to say

Page 3: The start of a 'typical' school day

5. What time do you get up on most school days?

- ○ Before 6:30
- ○ 6:30 - 6:44
- ○ 6:45 - 6:59
- ○ 7:00 - 7:14
- ○ 7:15 - 7:29
- ○ 7:30 - 7:44
- ○ 7:45 - 7:59
- ○ 8:00 - 8:14
- ○ 8:15 - 8:29
- ○ 8:30 or later

6. Do you usually eat any breakfast **before leaving home**?

- ○ Yes
- ○ No

6.a. What do you usually eat/drink **at home** for breakfast?

- ☐ Bowl of cereal
- ☐ Bowl of porridge
- ☐ Cooked item (such as a bacon roll)
- ☐ Toast
- ☐ Pastries (such as croissants)
- ☐ Fresh fruit
- ☐ Yoghurt
- ☐ Carton/glass of fruit juice

☐ Carton/glass of milk

☐ Hot drink (such as tea or coffee)

☐ Other

6.a.i. If you selected Other, please specify:

[   ]

7. What time do you usually leave home for school?

○ Before 7:00
○ 7:00 - 7:14
○ 7:15 - 7:29
○ 7:30 - 7:44
○ 7:45 - 7:59
○ 8:00 - 8:14
○ 8:15 - 8:29
○ 8:30 - 8.44
○ 8:45 - 8:59
○ 9:00 or later

8. Do you usually eat any breakfast between leaving home and arriving at school?

○ Yes
○ No

8.a. Where do you usually get your food?

○ I bring it from home

○ I buy it on the way to school

○ A friend gives it to me

8.b. What do you usually eat/drink during your journey? *(type in the answer, e.g. packetof crisps, a bar of chocolate, can of diet coke)*

Page 4: Your arrival at school

9. What time do you usually arrive at school?

- ○ Before 7:45
- ○ 7:45 - 7:59
- ○ 8:00 - 8:14
- ○ 8:15 - 8:29
- ○ 8:30 - 8:44
- ○ 8:45 - 8:59
- ○ 9:00 - 9:14
- ○ 9:15 - 9:29
- ○ 9:30 or later

10. Do you usually eat any breakfast between arriving at school and the start of your first lesson?

- ○ Yes
- ○ No

10.a. Where do you get your food?

- ○ I bring it with me to school
- ○ I get the food at school
- ○ A friend gives it to me

10.b. Where do you usually eat your food?

- ○ Class room
- ○ Common room (or similar indoor space)

- ○ Dining hall / school canteen
- ○ Playground (or similar outdoor space)
- ○ Other

10.b.i. If you selected Other, please specify:

[   ]

10.c. Please tell me what you usually eat/drink at this time

- ☐ Bowl of cereal
- ☐ Bowl of porridge
- ☐ Cooked item (such as a bacon roll)
- ☐ Pastries (such as croissants)
- ☐ Toast
- ☐ Fresh fruit
- ☐ Yoghurt
- ☐ Carton/glass of milk
- ☐ Carton/glass of fruit juice
- ☐ Hot drink (such as tea or coffee)
- ☐ Other

10.c.i. If you selected Other, please specify:

[   ]

Page 5: Morning break and lunch

11. What time do you usually start morning break?

○ Before 09:30
○ 9:30 - 9:44
○ 9:45 - 9:59
○ 10:00 - 10:14
○ 10:15 - 10:29
○ 10:30 - 10:44
○ 10:45 - 10:59
○ 11:00 - 11:14
○ 11:15 - 11:29
○ 11:30 or later

12. Do you usually have anything to eat at morning break?

○ Yes
○ No

12.a. Where do you usually get your food?

☐ I bring it into school at the start of the day
☐ I buy it from a vending machine at school
☐ I buy it from the school canteen (or tuck shop)
☐ I go out of school to buy it
☐ A friend gives it to me

12.b. Please tell me what you usually eat/drink at morning break. *You can choosemore than one answer.*

☐ A hot food item (such as a bacon roll or a slice of pizza)

☐ A cold food item (such as a sandwich, or a scone, or a piece of fruit)

☐ A hot drink (such as tea, or coffee, or hot chocolate)

☐ A cold drink (such as milk or fruit juice)

13. What time does your lunch break start?

○ Before 12 noon
○ 12:00 - 12:29
○ 12:30 - 12:59
○ 13:00 (1.00 pm) - 13:29
○ 13:30 - 13:59
○ 14:00 (2.00 pm) or later

Page 6: The end of a 'typical' school day (Monday, Tuesday, Wednesday, Thursday)

14. What time do you usually go to bed?

○ Before 20:30 (8.30 pm)
○ 20:30 - 20:59
○ 21:00 - 21.29
○ 21:30 - 21:59
○ 22:00 - 22:29
○ 22:30 - 22:59
○ 23:00 - 23:29
○ 23:30 (11.30 pm) or later

Page 7: Your views about breakfast

15. In a previous survey, students were asked to list ways in which eating breakfast on a school day helped them. From the list below, please choose the ONE answer that you most agree with.

○ Gives me energy

○ Helps me be in a better mood

○ Helps me be healthy

○ Helps me get better grades

○ Helps me pay attention

○ Keeps me feeling full

○ Wakes me up

○ It does NOT help me

○ Not applicable - I NEVER eat breakfast on a school day

16. In a previous survey, students were asked to record how they felt if they did not eat breakfast on a school day. From the list below, please choose the ONE answer that you most agree with.

○ I do not have energy

○ I feel grumpy

○ I feel hungry

○ I feel tired

○ I have a headache

○ I have a stomach ache

○ I have trouble paying attention in class

○ No problem - I feel just fine

○ Not applicable - I NEVER miss breakfast on a school day

Page 8: Thanks!

Thank you very much for taking the time to complete this questionnaire about breakfaston school days.

I am very grateful.

If you have completed the survey at home, please make a note of the last 8 digits of yourreceipt number, as your school/college may wish to record that you have completed the task.

Note: As explained in the text, during June 2021, two additional answers were added to Question 3 – Year 9 and Year 11.

4.   The selection of schools for the main survey

The choice of school for the pilot study was more one of convenience than anything else. The choice proved to be a wise one, and I am very grateful to the staff and pupils of Allerton High School in Leeds. However, more care was required in selecting schools for the main survey.

One of the study aims was to 'fill in the gaps' in the WHO HBSC *(Health Behaviour of School Children)* study. Amongst the many things examined in this survey is the breakfast habits of children of secondary school age. However, although most European countries are included *(in particular, England, Wales, Scotland, and the Republic of Ireland)*, Northern Ireland is excluded. It will be helpful to report how Northern Ireland compares with these neighbouring countries. *[As will be seen, it would appear that Northern Ireland compares favourably with the other UK countries but less favourably than the Irish Republic. However, as the data for Northern Ireland is not directly comparable with the HBSC data, I have 'relegated' the comparison and discussion to Appendix 3.]*

The HBSC study focuses on three ages:

- 11-year-olds
- 13-year-olds
- 15-year-olds

In the Northern Ireland educational system, these roughly correspond to the following Year Groups:

- Year 8
- Year 10
- Year 12

It was decided to focus on these three years *(though, as explained later, some Year 8 Pupils 'transferred' to Year 9, and some Year 10 pupils 'transferred' to Year 11 during the latter part of June 2021, and these pupils were included).*

If any readers in England are puzzled, it is worth pointing out that the numbering of school years differs in Northern Ireland from that in England. For example, Year 8 in Northern Ireland corresponds to Year 7 in England. In Northern Ireland, most pupils sit their GCSE exams at the end of Year 12, and most pupils sit their GCE 'A' levels at the end of Year 14.

Information provided by the Department of Education (NI) indicated that in 2018, 141,725 pupils were attending one of 193 secondary schools (grammar and non-grammar) in Northern Ireland. The number of pupils in our chosen year groups was:

- Year 8   23,814
- Year 10   22,698
- Year 12   21,880

- giving a total of 68,392 pupils.

In addition to age, the HBSC study classified pupils by gender *(boys or girls)*. Therefore, it would be necessary to divide our pupils into six sub-sets *(3-age x 2-gender)* for comparison.   One-sixth of 68,392 is approximately 11,400 pupils.

Not surprisingly, there is no need to ask all pupils to complete the questionnaire – a sample will suffice. Power calculations indicate the minimum number of pupils required to have at least a 95% chance of detecting differences in habits between two of our six sub-sets.   It all depends on the values of the parameters we expect to observe.

It is impossible to say what proportion of pupils will have reached the milepost until the study is complete. A proxy might use the most recent results from the HBSC study for England *(the 2018 survey)*. These are shown in **Table 1**.

Table 1: The proportion of young people who ate breakfast every weekday in England *(HBSC 2018)*

Age/Gender	Boys	Girls
11-year-olds	77%	67%
13-year-olds	64%	52%
15-year-olds	63%	48%

Using these figures, the power calculations are as follows:

11-year-olds *(10% difference between boys and girls)*

```
Estimated sample sizes for a two-sample proportions test
Pearson's chi-squared test
H0: p2 = p1  versus  Ha: p2 != p1

Study parameters:

        alpha =    0.0500
        power =    0.8000
        delta =   -0.1000  (difference)
           p1 =    0.7700
           p2 =    0.6700


Estimated sample sizes:

          N =         632
  N per group =       316
```

The meaning of everything in the above calculation is clear, other than **power = 0.8000**. Statistical power is not the easiest of concepts to explain. "This test has 80% power" is shorthand for a better statement like: "under several assumptions, including *(but not limited to)* the particular sample size and the particular difference *(delta)*, this test has an 80% probability of rejecting the null hypothesis with a two-sided alternative at a 5% significance level *(alpha = 0.0500)*."

13-year-olds (*12% difference between boys and girls*)

```
Estimated sample sizes for a two-sample proportions test
Pearson's chi-squared test
H0: p2 = p1   versus   Ha: p2 != p1

Study parameters:

        alpha =     0.0500
        power =     0.8000
        delta =    -0.1200   (difference)
           p1 =     0.6400
           p2 =     0.5200

Estimated sample sizes:

          N =          530
  N per group =        265
```

15-year-olds (*15% difference between boys and girls*)

```
Estimated sample sizes for a two-sample proportions test
Pearson's chi-squared test
H0: p2 = p1   versus   Ha: p2 != p1

Study parameters:

        alpha =     0.0500
        power =     0.8000
        delta =    -0.1500   (difference)
           p1 =     0.6300
           p2 =     0.4800

Estimated sample sizes:

          N =          344
  N per group =        172
```

632 + 530 + 344 = 1,506

As the HBSC definition of breakfast *(anything more than a drink and/or piece of fruit before leaving home)* is very different to our measure *(at least 400 calories consumed within 4 hours of rising)*, it is perhaps 'prudent' to add 50% to this figure of 1,506 – suggesting a minimum sample size of around 2,250 pupils.

(At the end of the day, 2,488 pupils completed the questionnaire. This level of response was very pleasing, and there were many statistically significant findings.)

The 68,392 *(Year 8, Year 10, and Year 12)* pupils in Northern Ireland attended one of 193 secondary schools. This gives an average of approximately 350 pupils *(in the three years combined)* per school; suggesting it may be sufficient to involve either:

1. seven or so schools *(2,250 / 350 = 6.43)* – assuming all eligible pupils complete the questionnaire, or

2. approximately 3.3% (one in thirty) of pupils in all 193 schools *(2,250 / 68,392 = 0.033)*.

It is more convenient inviting all pupils in seven schools than one in thirty pupils in all schools. The first approach avoids selecting pupils within a school – how might the other 96.7% *(who are not invited)* react?

Just involving seven schools has its problems. For example, how can we be sure that every eligible pupil will agree to participate?

However, there is a more fundamental problem with this approach. As it is hoped the selected schools will represent all 193 schools, is it possible to choose seven schools to meet the brief? The simple answer is 'NO'.

The Department for Education (NI) has a 'Schools Plus' section on its website that provides a directory of institutions, including schools, youth clubs, contact information and relevant statistics. The site gives background information on all 193 secondary schools, and some of this information is pertinent to pupils' breakfast behaviour and opinions. https://www.education-ni.gov.uk/services/schools-plus

Relevant factors may include (i) location of school; (ii) size of school; (iii) single-sex or mixed; (iv) selective or non-selective intake; (v) religious character of school; (vi) economic profile of school catchment area. If it is

hoped to survey pupils at a sample of schools that will reflect all of these factors, it will be necessary to select more than seven schools.

Informal discussions with the Department of Education suggested that a sample of 20 schools should meet the brief. It was therefore decided to select 20 schools having the following characteristics:

- **Geographical location** – two schools from each of the four Belfast Parliamentary constituencies *(North, South, East, and West)* and two schools from the six counties *(Antrim, Armagh, Derry/Londonderry, Down, Fermanagh, and Tyrone)*.

- **Surrounding environment** – four schools located in a rural area and sixteen in an urban area *(as listed in Schools Plus)*.

- **School size** – four small schools *(500 or fewer pupils)*, twelve medium-sized schools *(501 – 1,000 pupils)*, and four large schools *(more than 1,000 pupils)*.

- **Gender of pupils** – two boys-only schools, two girls-only schools, and sixteen mixed schools.

- **Type of school** – nine grammar schools and eleven secondary (non-grammar) schools.

- **The religious profile of the school** – seven Catholic schools *(more than 90% Catholic pupils)*, eight Protestant schools *(fewer than 10% Catholic pupils)*, and five Integrated schools *(between 10% and 90% Catholic pupils)*.

- **Economic profile of school catchment area** – seven schools with a 'low' profile *(more than 40% of pupils entitled to free school meals)*; six schools with a 'medium' profile *(between 20% and 40% of pupils entitled to free school meals)*; and seven schools with a 'high' profile *(fewer than 20% of pupils entitled to free school meals)*.

One additional characteristic needed to be considered. Although not included in Schools Plus, data from my previous research would be used to select schools according to:

- **Breakfast club status of school** – around two-thirds of schools *(130 out of 193)* ran breakfast clubs before the COVID-19 pandemic,

while one-third of schools didn't. Ideally, we should include 13 or 14 'breakfast schools' and 6 or 7 'non-breakfast schools'.

Although all of the 'breakfast schools' had to suspend this activity at the start of the COVID-19 pandemic, it may be that those schools that usually offer breakfast emphasise the importance of eating breakfast more than those schools that don't. It is also possible they provided more food and drink during the mid-morning break.

Unfortunately, the Department of Education did not wish to select twenty schools for me. However, I was given access to a computer program with all the relevant information on the first seven variables from Schools Plus. This enabled me to make a selection that met my requirements. (*I could not add the eighth characteristic – breakfast club status – to the database, so, if necessary, I would need to make repeated selections until the distribution of this particular characteristic was acceptable.*)

However, there was one significant problem. Three secondary schools in Northern Ireland had given me considerable help in the preparatory stages of the research, and I did not wish to exclude them. Fortunately, because the three schools were all quite different in terms of the first seven variables listed above, it was possible to make the selection so that these schools were 'chosen' – *as if by pure coincidence!* Two of the three schools had run breakfast clubs; one hadn't.

One of the three schools *(Portadown College)* only taught Years 11 – 14, so it was suggested that I should also include one of the two feeder schools: Clounagh Junior High School or Killicomaine Junior High School to complement Portadown College with some Year 8 – 10 pupils. I simply tossed a coin, and the lot fell to Killicomaine.

So, the computer program was run to select 20 schools based on the first seven variables. The computer was 'instructed' to ensure that (i) Killicomaine Junior High School; (ii) Our Lady and St Patrick's College, Knock; (iii) Portadown College; and (iv) St Louise's Comprehensive College, Belfast were included. The 20 schools selected in the first round included 15 'breakfast schools' and five 'non-breakfast schools' – which seemed fine, so no further selections were made.

I showed the list of 20 schools to the Chair of Examiners for GCE Economics in Northern Ireland, who reckoned it to be a 'good' cross-section. There was nothing 'odd' about the list as far as he could make

out. It was therefore decided to accept the following list of schools as final:

I.   Aughnacloy College
II.   Bangor Grammar School
III.   Dundonald High School, Belfast
IV.   Edmund Rice College, Newtownabbey
V.   Friends' School, Lisburn
VI.   Glengormley High School, Newtownabbey
VII.   Kilkeel High School
VIII.   Killicomaine Junior High School, Portadown
IX.   Larne High School
X.   Loreto College, Coleraine
XI.   Malone Integrated College, Belfast
XII.   Methodist College, Belfast
XIII.   Oakgrove Integrated College, Derry
XIV.   Our Lady and St Patrick's College Knock, Belfast
XV.   Portadown College
XVI.   St Fanchea's College, Enniskillen
XVII.   St Joseph's Grammar School, Donaghmore
XVIII. St Louise's Comprehensive College, Belfast
XIX.   St Mary's Christian Brothers' Grammar School, Belfast
XX.   St Mary's College, Irvinestown

5.   The recruitment of schools for the main survey

March 2021 was 'recruitment month'. On Monday 1 March, the Education Minister announced that all pupils in Years 12 to 14 would return to school on Monday 22 March and that the Spring Term would end on Wednesday 31 March. Hopefully, all Years would return at the start of Summer Term – Monday 12 April.   As this news was only announced at the beginning of March, there seemed little point in attempting to recruit schools before then, as School Principals *(mainly working from home)* would have no idea when their pupils would return.

During the first few days of March, an email was sent to the twenty schools selected. The email had eight attachments:

1. A personal letter to the Principal **together with a link to the online questionnaire – See Appendix 1**

2. A sample 'permission letter' to parents **– See Appendix 2**

3. A sample 'invitation letter' to pupils **– See Appendix 3**

4. A PDF of the questionnaire

5. A copy of the University of Leeds Research Privacy Notice

6. Report on the first part of research – written in February 2020

7. Table of HSBC results for 2014 and 2018 *(with NI missing)*

8. A QR code giving easy access to the online questionnaire

Although the email contained much information, this was considered necessary. The attachments showed that everything had been thought through and provided Principals with all they would need for their school to participate. Principals *(or their staff nominees)* were invited to try the questionnaire out for themselves any time before the end of March.

Term finished on 31 March, and by this date, 18 of the 20 schools had agreed *(all being well)* to invite their pupils to complete the questionnaire on any date during Summer Term 2021. The term started on Monday 12 April and ended on Wednesday 30 June.

The two schools which had <u>not</u> agreed to participate were Glengormley High School, Newtownabbey, and St Mary's College, Irvinestown. Neither had declined the invitation – they had simply not accepted *(despite several phone calls)*. It was decided to offer them 'one last chance' at the start of Summer Term – but this offer was ignored. Eighteen schools out of twenty (90%) had been recruited, which was most satisfactory. Glengormley High School and St Mary's College, Irvinestown, are quite different to each other, and no attempt was made to find replacements.

The focus during Summer Term 2021 was to keep in close contact with the 18 participating schools, ensuring that the questionnaires were completed in a timely fashion by the maximum number of eligible pupils. This was more challenging with some schools than others, but all schools had provided at least 49 responses by the end of the term.

The recruitment of pupils within the 18 schools was left to the schools themselves. Some schools aimed to invite as many Year 8, 10, and 12

pupils as possible, while others took a more cautious approach. For example, the Principal of Loreto College made it clear that she would <u>not</u> involve her Year 12 pupils due to the need to focus on their GCSE teacher assessments. In all cases, I asked Principals to try and ensure that a representative sample was taken. For example, it would be better to choose all the pupils in just one Year 8 class than the first 50% of pupils to arrive at school in the morning from two Year 8 classes. Although it was impossible to check, I had no reason to doubt that schools were genuinely attempting to invite a representative cross-section of their pupils.

6. Data processing and statistical analysis

New data was copied daily from Online Surveys into an Excel spreadsheet. The Excel data was saved automatically on the University of Leeds OneDrive. Once in Excel, the data was checked for obvious errors *(such as a pupil giving their name)*. Where necessary, it was 'corrected.' It was thought that some replies would need to be deleted, and it was intended to note all such responses – together with a reason *(such as 'the respondent appeared to be fooling around')*. As things turned out, this was not necessary.

Once the data had been 'checked', some new variables were created. These fell into three groups:

1) **Variables that simply needed coding.** For example, the school name was replaced with a school code. The same was done with Year Group and Gender.

2) **Variables that were calculated manually.** These were estimates of the number of calories consumed within a specific time period *(such as between getting up and leaving home; or during mid-morning break)*. **See the coloured box below**

3) **Variables that were calculated within Excel.** These fell into two broad categories:

   o **Cumulative calorie counts** – e.g., the total number of calories consumed before the start of lessons or by the end of the morning break

- o **Time measurements** – e.g., number of minutes since rising and arriving at school; the number of minutes since rising and the start of morning break; the number of minutes in bed at night

The assumed number of calories used in the relevant calculations is shown below:

At **break time**, the following number of calories were used:

- o A hot food item *(such as a bacon roll or a slice of pizza)* – 300 cals*
- o A cold food item *(such as a sandwich or a scone)* – 200 calories
- o A hot drink *(such as tea, coffee, or hot chocolate)* – 50 calories
- o A cold drink *(such as milk or fruit juice)* – 50 calories

At **other times** *(breakfast at home; breakfast eaten on the way to school; breakfast eaten at school before the start of lessons),* the following numbers of calories were used:

- o Bowl of cereal *(assume added sugar and milk)* – 200 calories
- o Bowl of porridge *(assume added sugar and milk)* – 200 calories
- o Cooked item *(such as a bacon roll)* – 350 calories*
- o Toast *(assume medium slice and butter)* – 150 calories
- o Pastries *(such as croissants)* – 250 calories
- o Fresh fruit *(such as an apple or a banana)* – 50 calories
- o Yoghurt *(assume low-fat fruit)* – 100 calories
- o Carton/glass of fruit juice *(assume 100ml pure unsweetened orange)* – 50 calories
- o Carton/glass of milk *(assume 200ml semi-skimmed)* – 100 calories
- o Hot drink *(such as tea or coffee)* – 50 calories

* The lower calorie count for a bacon roll *(or similar)* served at break-time reflects the less generous portions sometimes served at this time.

Once the data had been checked and manipulated, relevant variables were copied to Stata 17 for statistical analysis.

Survival analysis would form an essential part of the statistical analysis, and the two critical variables for the survival analysis were:

- • Number of minutes since rising

- Cumulative number of calories consumed at various times since rising

These two variables were used to produce **Kaplan-Meier plots,** as explained in Section 10.

7. Characteristics of the 18 schools that participated

Table 2: Identity of schools and number of responses received

School Code	School Name	Location	Number of responses
1	Aughnacloy College	Co Tyrone	53
2	Bangor Grammar School	Co Down	131
3	Dundonald High School	Belfast East	49
4	Edmund Rice College, Glengormley	Belfast North	59
5	Friends' School, Lisburn	Co Antrim	139
6	Kilkeel High School	Co Down	84
7	Killicomaine Junior High School	Co Armagh	265
8	Larne High School	Co Antrim	135
9	Loreto College, Coleraine	Co Derry	380
10	Malone Integrated College	Belfast South	151
11	Methodist College, Belfast	Belfast South	95
12	Oakgrove Integrated College, Derry	Co Derry	51
13	Our Lady & St Patrick's College	Belfast East	170
14	Portadown College	Co Armagh	131
15	St Fanchea's College, Enniskillen	Co Fermanagh	52
16	St Joseph's Grammar School	Co Tyrone	95
17	St Louise's Comprehensive College	Belfast West	259
18	St Mary's Christian Brothers'	Belfast West	189
Total	**ALL SCHOOLS**		**2,488**

Table 3: Characteristics of the 18 schools that participated

School Code	School Type	Economic Prosperity	Religious Affiliation	School Size	School Gender	Breakfast Club
1	1	1	1	0	2	0
2	0	2	1	1	0	1
3	1	0	1	0	2	1
4	1	0	0	1	2	1
5	0	2	2	1	2	1
6	1	2	1	1	2	0
7	1	1	1	1	2	0
8	1	0	1	1	2	1
9	0	2	2	1	2	1
10	1	0	2	1	2	1
11	0	2	2	2	2	1
12	0	0	2	1	2	1
13	0	2	0	2	2	1
14	0	2	1	1	2	0
15	1	1	0	0	1	1
16	0	1	0	1	2	1
17	1	0	0	2	1	1
18	0	1	0	2	0	1

The data below summarises the characteristics of the 18 schools and shows the codes used in **Table 3**.

School Type

0	Grammar	9 schools	1,382 pupils
1	Secondary	9 schools	1,106 pupils

Economic Prosperity

0	Low	6 schools	703 pupils
1	Medium	5 schools	653 pupils
2	High	7 schools	1,132 pupils

Religious Affiliation

0	Catholic	6 schools	823 pupils
1	Protestant	7 schools	848 pupils
2	Integrated	5 schools	817 pupils

School Size

0	Small	3 schools	154 pupils
1	Medium	11 schools	1,621 pupils
2	Large	4 schools	713 pupils

School Gender

0	Boys only	2 schools	319 pupils
1	Girls only	2 schools	311 pupils
2	Mixed	14 schools	1,858 pupils

School Breakfast Club *(pre-COVID)*

| 0 | Yes | 14 schools | 1,954 pupils |
| 1 | No | 4 schools | 534 pupils |

8. A first look at the questionnaire results

There is a limit to the extent to which the raw data is of interest. Most of the data needed to be processed further to enable helpful analysis. However, it is worth looking at some basic data.

Questions 1 and 2 enabled me to identify the school attended by the pupils. The results have already been shown in **Table 2**.

Questions 3 and 4 were concerned with Year Group and gender. 111 pupils *(out of 2,488)* did not wish to be identified as boy or girl. Of the 2,377 who did identify in this way, there were 1,181 boys and 1,196 girls.

Classification by School Year was slightly problematical. It was intended just to study Year 8, 10, and 12 pupils *(in line with HBSC)* – but some Year 8 and 10 pupils moved to their next year's timetables during June 2021 and wished to be recorded as Year 9 or 11. Details are as follows:

- Year 8   1,058 pupils
- Year 9   241 pupils
- Year 10   874 pupils
- Year 11   29 pupils
- Year 12   286 pupils

As only 286 Year 12 pupils completed the questionnaire *(most being too busy finishing off their GCSE assessments)*, for most purposes, the 2,488 pupils have been allocated to one of two broad age groups *(Younger and Older)*:

- **1,299 younger pupils** *(Years 8 and 9)*
- **1,189 older pupils** *(Years 10, 11, and 12)*

Classification by Year Group <u>and</u> Gender is shown in **Table 4**.

Table 4: Distribution of pupils by Year Group and gender

Year Group/Gender	Boys	Girls	Other	Total
Years 8 & 9	659	582	58	**1,299**
Years 10 - 12	522	614	53	**1,189**
Total	**1,181**	**1,196**	**111**	**2,488**

Question 5 focussed on the usual time of getting up on a school day. **Figure 1** summarises the responses:

Figure 1: Histogram showing usual time of getting up
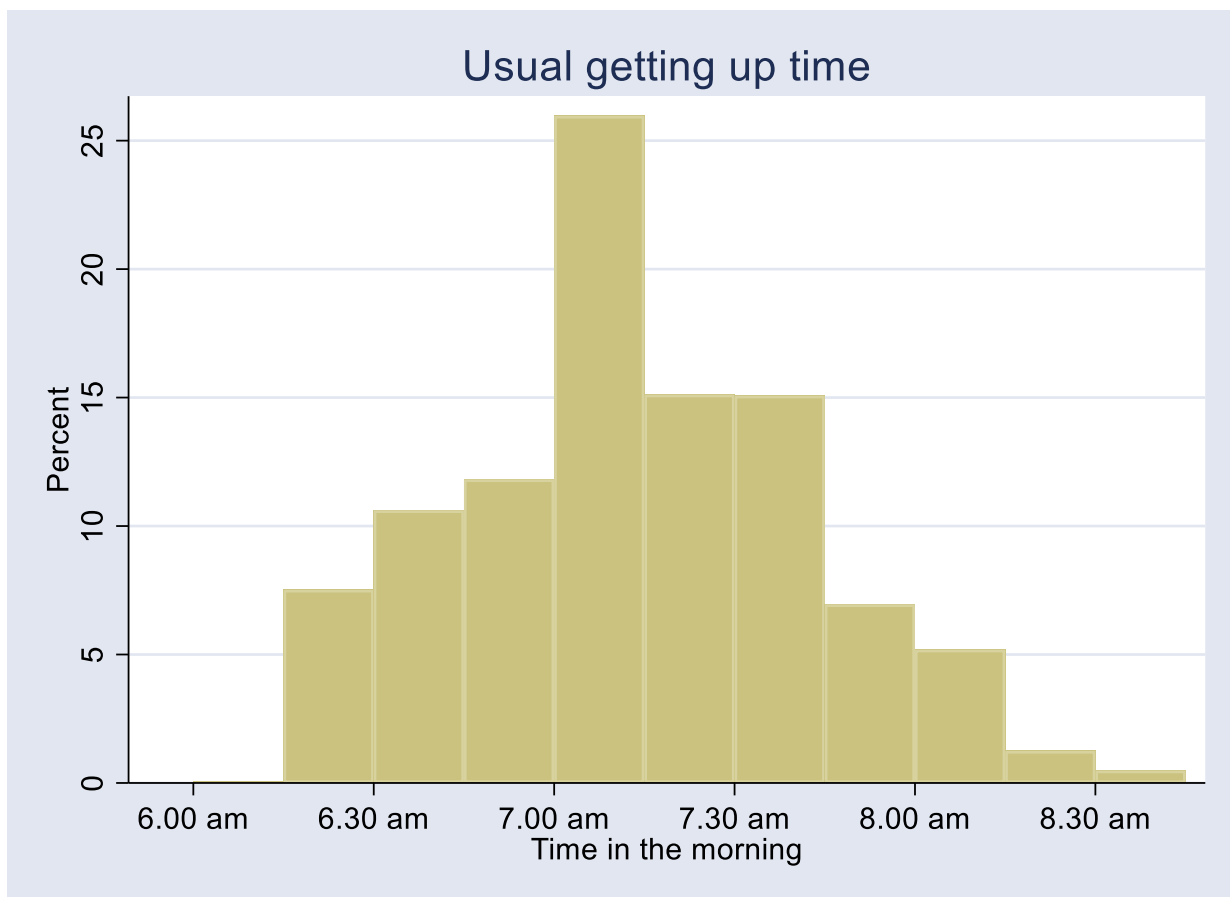
The mean time was 7.14 am. In hindsight, it would have been preferable if the first category had been before 6:00 (rather than before 6:30). It seems likely that some Northern Ireland pupils get up earlier than their counterparts at Allerton High School in Leeds.

Question 6 focussed on breakfast at home. 1,642 out of 2,488 pupils (66.0%) reported having some breakfast at home – 846 pupils claimed to have nothing *(other than water)* to eat or drink at this time.

Details of all food and drink consumed before lessons start *(whether at home, during the journey to school, or on arrival at school)* are summarised in **Table 5** below.

Question 7 was concerned with the time of leaving home for school. **Figure 2** summarises the responses.

Figure 2: Histogram of the usual time of leaving home
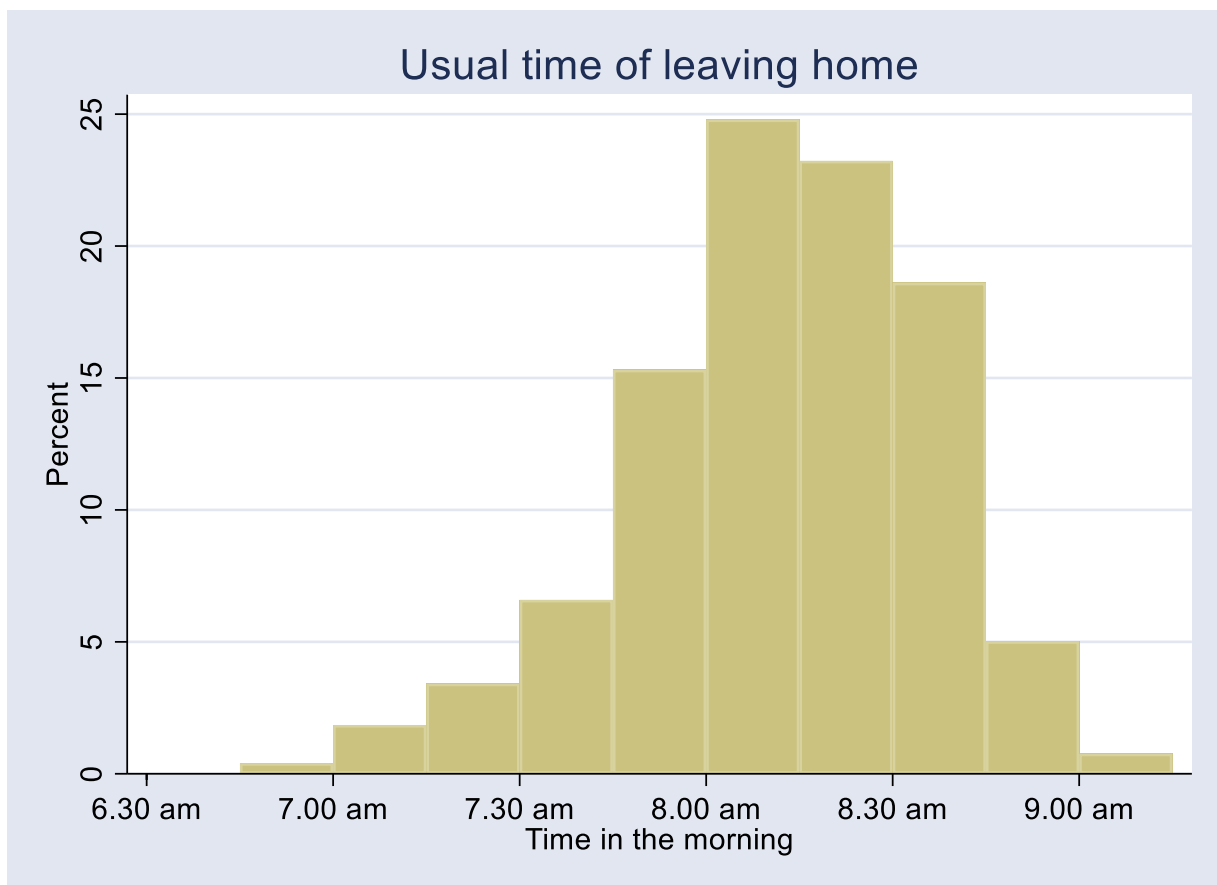
The mean time was 8.12 am.

The responses to **Question 8** indicated that just 267 pupils out of 2,488 (10.7%) usually ate any breakfast between leaving home and arriving at school.

Question 9 inquired about the usual time of arrival at school. **Figure 3** summarises the findings.

Figure 3: Histogram of the usual time of arriving at school

Usual time of arriving at school
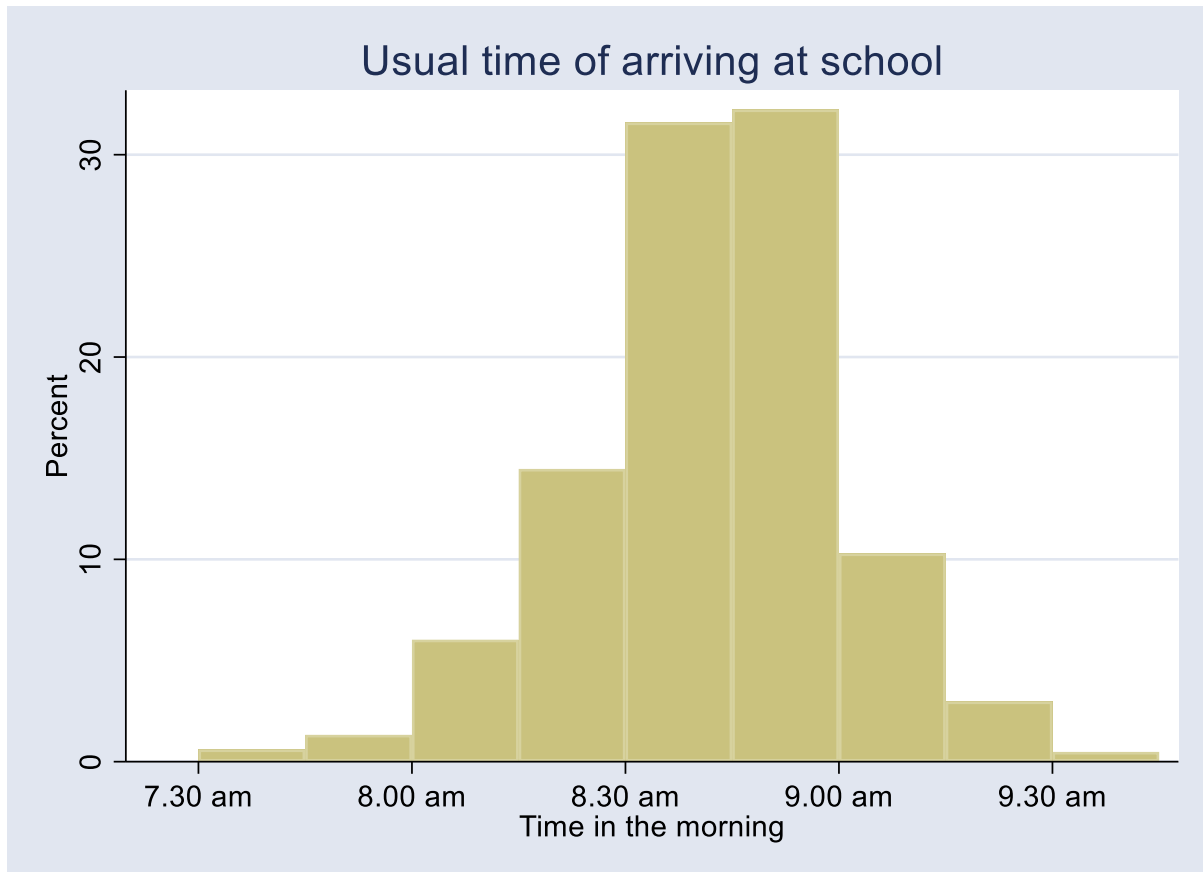
The mean time was 8.42 am.

Question 10 was concerned with whether pupils ate any breakfast between arrival at school and the start of lessons. Only 114 out of 2,488 pupils (4.6%) answered 'yes'.

In total, 1,785 pupils out of 2,488 (71.7%) reported having eaten some breakfast before the start of lessons. 703 pupils hadn't eaten anything. Table 5 provides information on what breakfast items the 2,488 pupils had to eat and drink on a typical school day – *before the start of lessons.*

Table 5: Usual breakfast items eaten before the start of lessons

Food item	Number consuming item	Percentage of 2,488 pupils
Bowl of cereal	1,004	40%
Toast	599	24%
Carton/glass of fruit juice	347	14%
Hot drink *(such as tea or coffee)*	298	12%
Fresh fruit	223	9%
Bowl of porridge	190	8%
Cooked item *(such as a bacon roll)*	185	7%
Carton/glass of milk	151	6%
Pastries *(such as croissants)*	132	5%
Yoghurt	104	4%
Other items *(such as a packet of crisps)*	216	9%

Question 11 was concerned with the usual starting time of the morning break. The results are summarised in **Table 6** and **Figure 4.** There was considerable variation in the timing.

Table 6: The usual start time of morning break

Start time	Percentage of 2,488 pupils in the time-slot
Before 10.00 am	2%
10.00 am – 10.29 am	41%
10.30 am – 10.59 am	28%
11.00 am – 11.29 am	28%
11.30 am or later	1%

Figure 4: Histogram of starting time of morning break

Usual start time of morning break
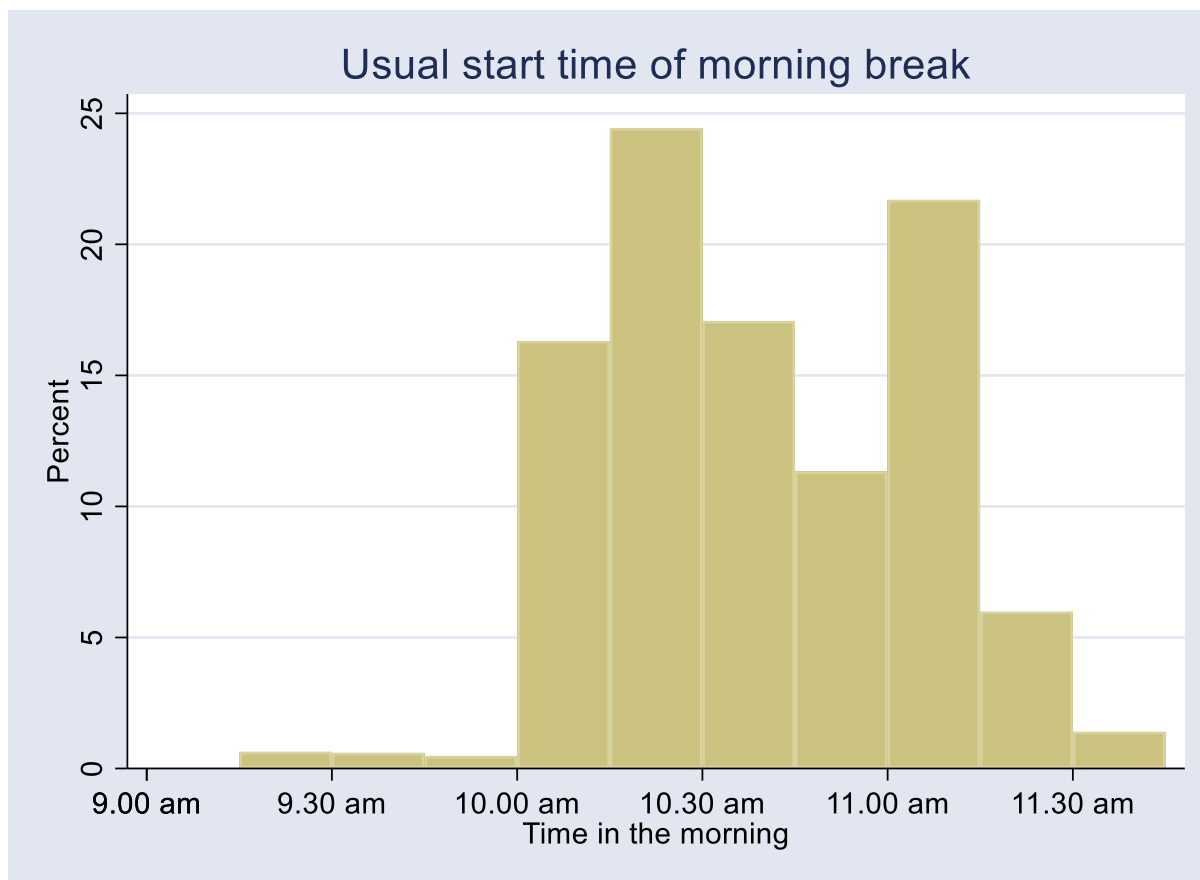
The mean starting time was 10.40 am.

Question 12 was concerned with whether pupils usually ate or drank anything *(other than water)* at morning break. 1,823 out of 2,488 pupils *(73.3%)* indicated that they did.

Table 7 provides information on the percentages of pupils eating or drinking at various times before lunch.

Table 7: Eating during the time before school lunch

Opportunity for eating	Percentage of pupils eating at this time	Percentage of pupils not eating at this time
Before leaving home	66%	34%
Journey to school	11%	89%
On arrival at school	5%	95%
Morning break	73%	27%

Morning break was the single most popular time for eating. **Table 8** summarises the answers to **Question 12** – it indicates what the 1,823 pupils usually consumed at this time.

Table 8: Usual items eaten at morning break

Food or drink item	Number of pupils consuming item	Percentage of 2,488 pupils consuming item
A cold food item *(such as a sandwich, scone, or a piece of fruit)*	1,415	57%
A cold drink *(such as milk or fruit juice)*	642	26%
A hot food item *(such as a bacon roll or a slice of pizza)*	385	15%
A hot drink *(such as tea, coffee, or hot chocolate)*	51	2%

It is cause for concern that 291 pupils out of 2,488 *(11.7%)* **had eaten <u>nothing</u> between rising and the end of the morning break.** Their next opportunity to eat would be lunchtime.

This study did not inquire about what pupils ate or drank for lunch *(or later in the day)*. It can only be hoped that *(other than in exceptional circumstances)* they will all have consumed at least 400 calories by the end of their lunch break.

Question 13 was concerned with the timing of the lunch break. **Figure 5** shows the responses.

Figure 5:   Histogram of starting time of lunch break
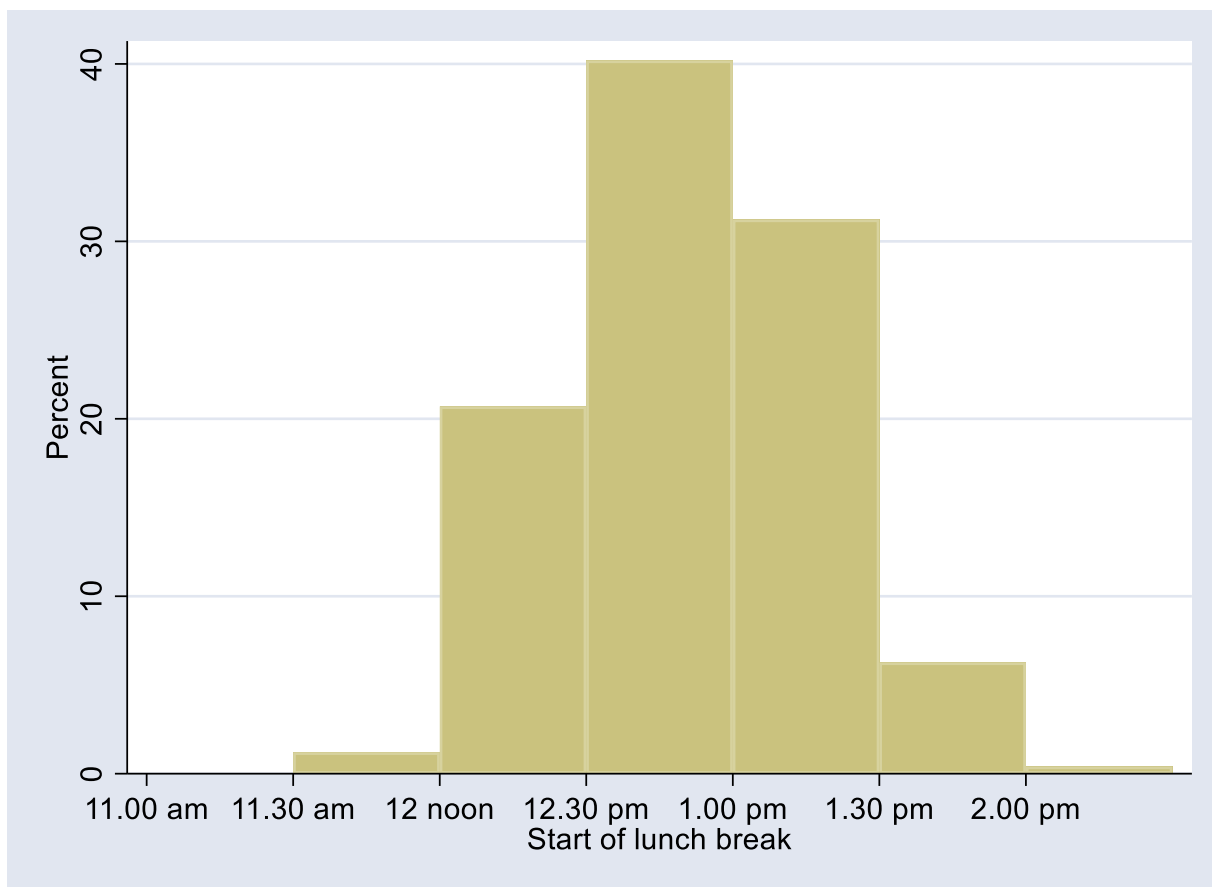
The mean time was 12.50 pm.

Question 14 was concerned with usual bedtimes on weekdays. The responses are shown in **Figure 6**.

Figure 6: Histogram of usual bedtime
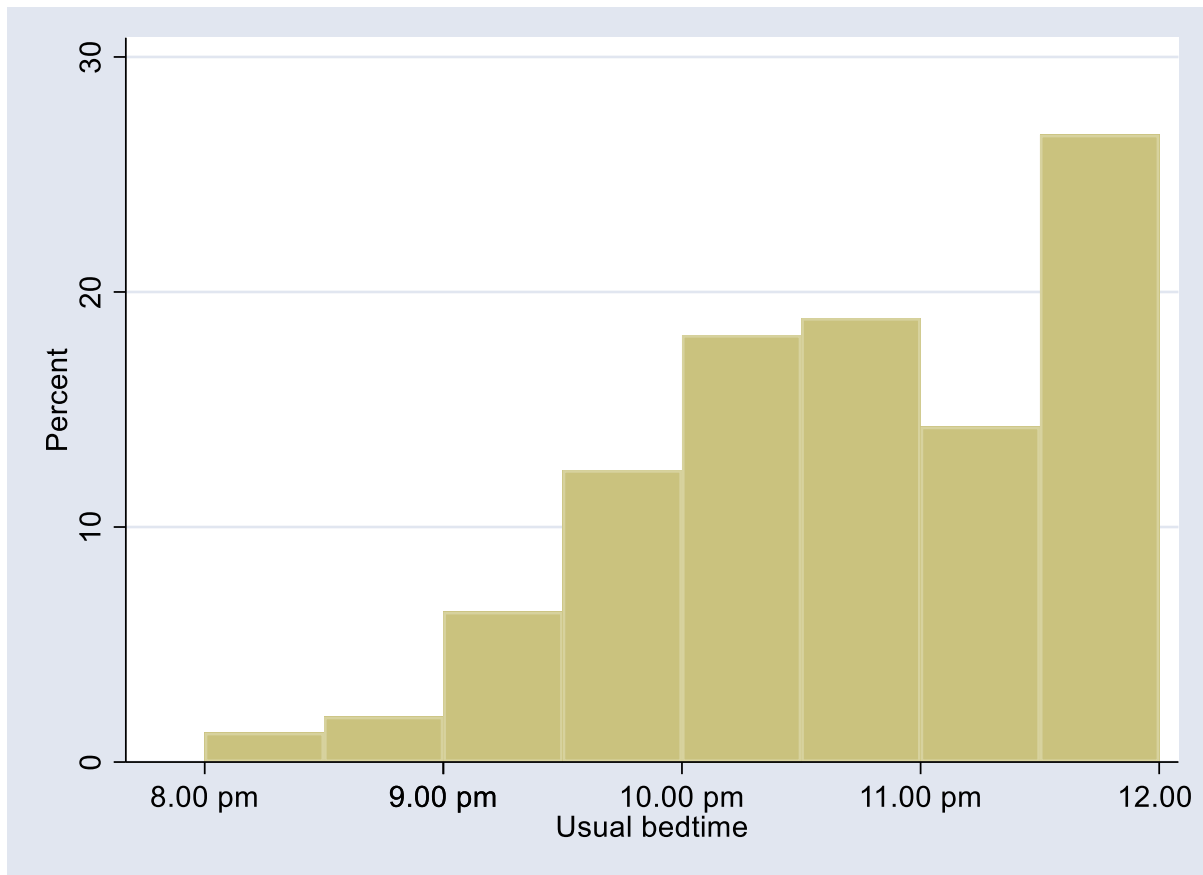
Mean bedtime was *apparently* 10.45 pm. In hindsight, it is a pity that the last category was 23.30 or later, as this was the modal group. The last three classes would have been preferable to have been 23:30 – 23:59; 24:00 – 0:29; and 0:30 or later. **In reality, the mean bedtime was probably much later than 10.45 pm.**

The final two questions were designed to reveal views/opinions about breakfast on school days.

Question 15 focussed on the **benefits** of eating breakfast, and **Question 16** focussed on the **opportunity costs** of <u>not</u> eating breakfast. Some pupils either thought there were no costs/benefits or had no idea because they never ate or skipped breakfast. **Tables 9 and 10** provide further details.

Table 9: Pupil views on the benefits of eating breakfast

Benefit/Gender	Boys *(1,181)*	Girls *(1,196)*	Other *(111)*
Beneficial	85%	75%	58%
Not beneficial	7%	9%	24%
Never eat breakfast	8%	16%	18%

Figure 7 provides further information for the 1,967 pupils *(79.1% of 2,488)* who thought eating breakfast <u>was</u> beneficial. They could choose from a list of seven, the benefit they deemed most important:

1. Gives me energy   799 pupils
2. Helps me be in a better mood   295 pupils
3. Helps me be healthy   123 pupils
4. Helps me get better grades   15 pupils
5. Helps me pay attention   115 pupils
6. Keeps me feeling full   482 pupils
7. Wakes me up   138 pupils

8. *It does NOT help me*   *217 pupils*
9. *I NEVER eat breakfast on a school day*   *304 pupils*

Figure 7: Benefit of eating breakfast *(Question 15)*

The main benefit of eating breakfast on a school day

Legend:
- Energy
- Mood
- Health
- Grades
- Feeling full
- Alert
- Concentration

Pie chart based on 1,967 pupils (out of 2,488) who thought breakfast is beneficial
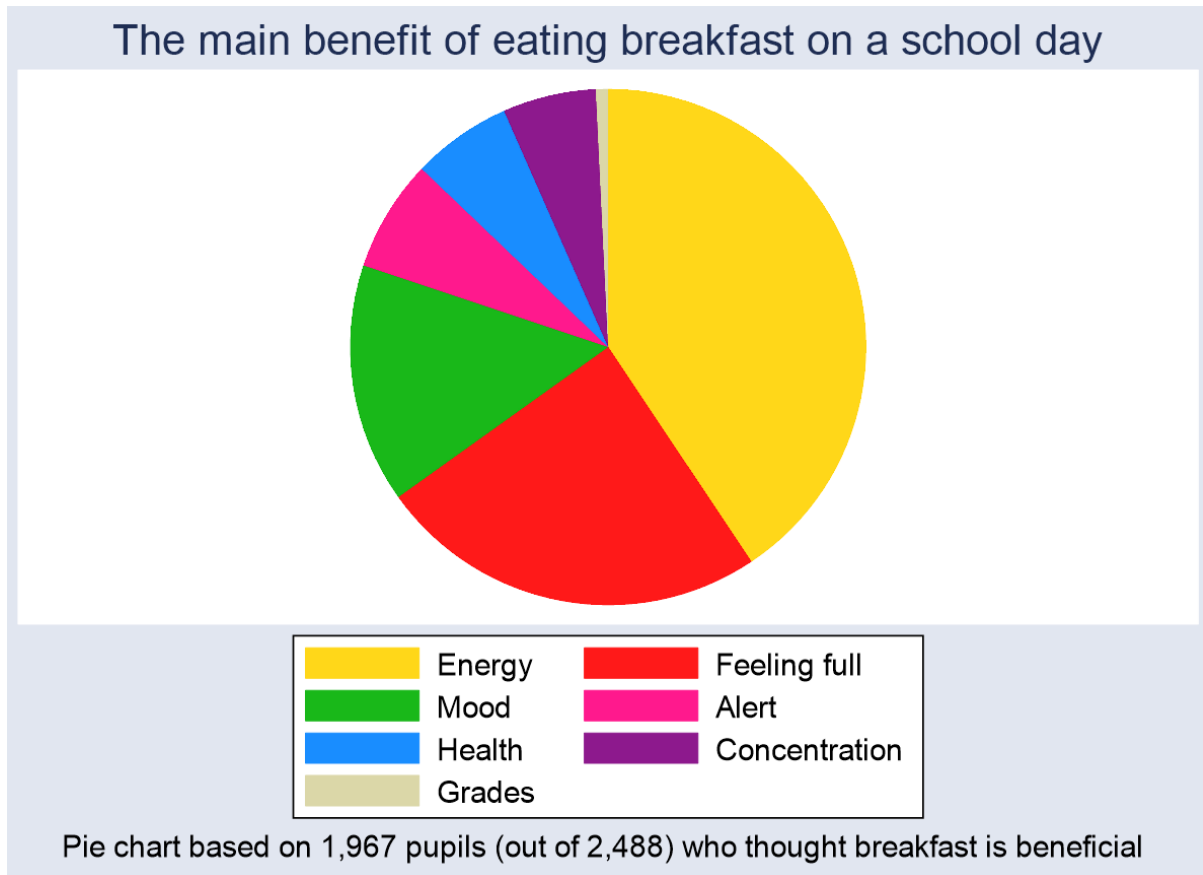
Over 40% of pupils chose option 1 *(gives me energy)*, followed by 25% who chose option 6 *(keeps me feeling full)*. The least popular option was option 4 *(helps me get better grades),* selected by fewer than 1% of pupils. It would appear that pupils favoured short-term benefits over long-term benefits. Perhaps they have a high discount rate.

Table 10: Pupil views on the opportunity cost of not eating breakfast

Cost/Gender	Boys *(1,181)*	Girls *(1,196)*	Other *(111)*
Costly	65%	62%	58%
Not costly	25%	30%	34%
Never miss breakfast	10%	8%	8%

Figure 8 provides further information for the 1,570 *(63.1% of 2,488)* pupils who occasionally skipped breakfast and thought this was costly. They could choose from a list of seven, the cost they considered most important:

1.	I do not have energy	253 pupils
2.	I feel grumpy	132 pupils
3.	I feel hungry	557 pupils
4.	I feel tired	265 pupils
5.	I have a headache	87 pupils
6.	I have a stomach ache	167 pupils
7.	I have trouble paying attention in class	109 pupils
8.	*No problem – I feel just fine*	*699 pupils*
9.	*I NEVER miss breakfast on a school day*	*219 pupils*

Figure 8: The opportunity cost of not eating breakfast *(Question 16)*

Main opportunity cost of not eating breakfast on a school day

Legend:
- Feeling hungry
- Feeling tired
- Lack of energy
- Having stomach-ache
- Feeling grumpy
- Not paying attention
- Having a headache

Pie chart based on 1,570 pupils who occasionally skip breakfast and think it is a bad idea to do so
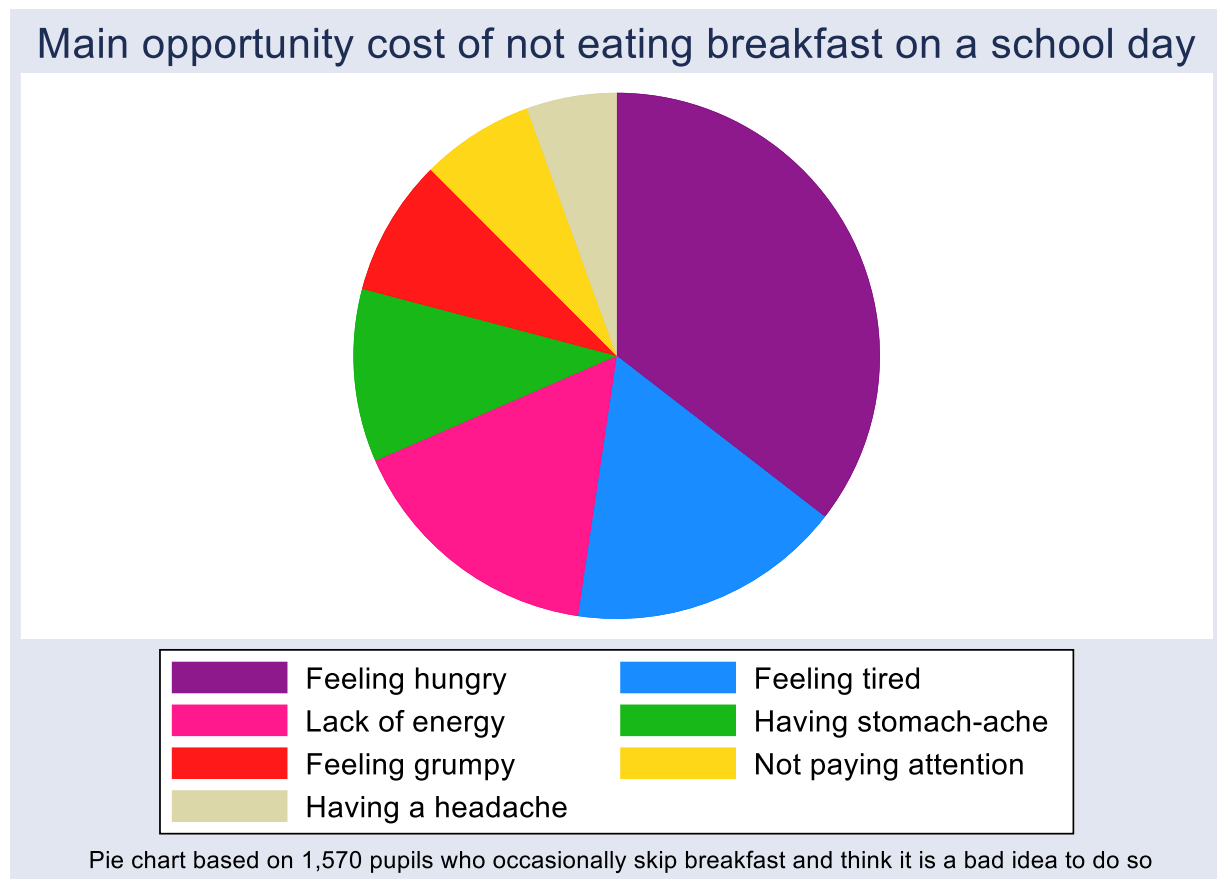
The most popular reply was, 'I feel hungry.' Over 35% of the pupils gave this as the No.1 cost. Some of the other costs were probably partly due to the breakfast skippers feeling hungry.

9. Calorie counts since rising

Combining and linking the responses to several questions makes it possible to picture how the total calorie intake increases as the school day progresses.

Calories consumed at home were estimated using the calorie counter in **Section 6**. **Figure 9** illustrates the results.

Figure 9: Histogram of calories at home
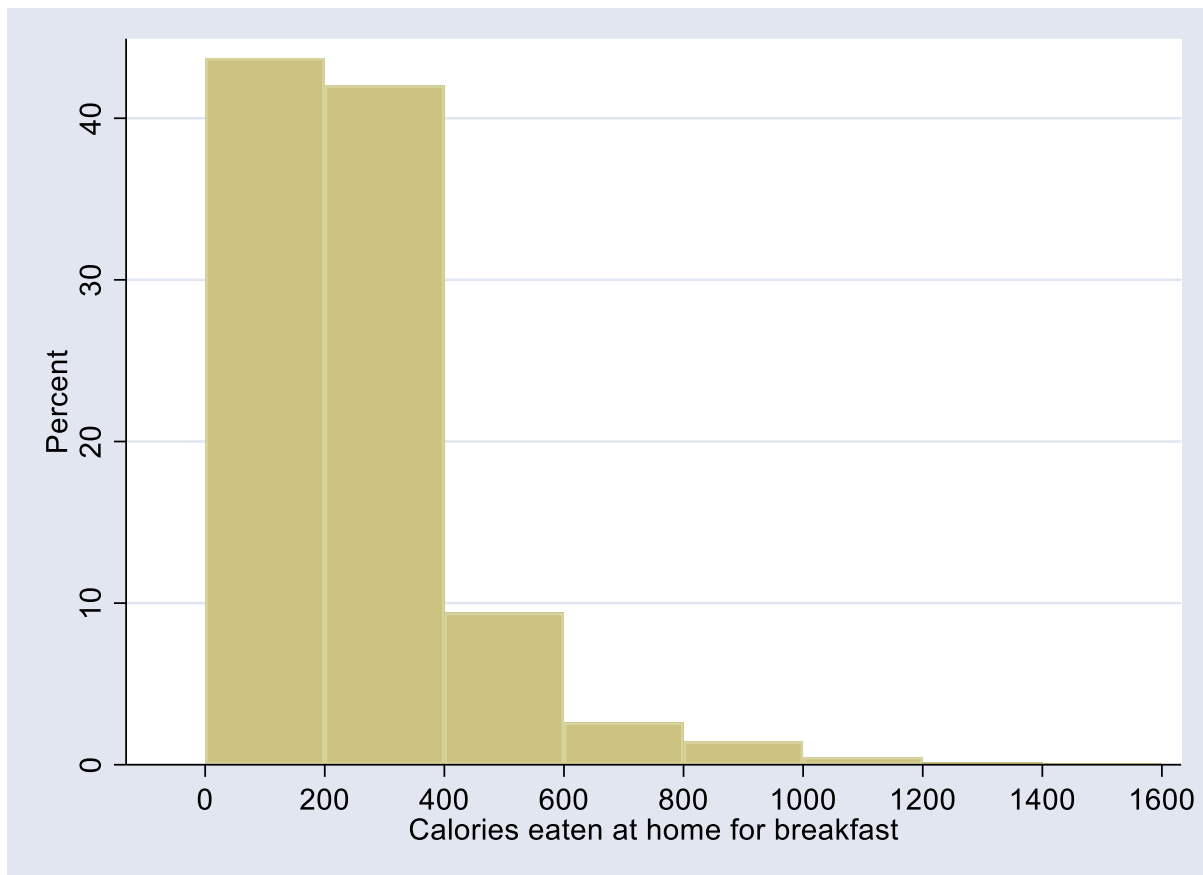
Only 354 pupils *(14.2% of 2,488)* **had consumed 400 or more calories before leaving home. The mean calorie count on leaving home was 192 calories.**

As already stated, less than 11% of pupils had anything to eat or drink during their journey to school. This was a little surprising given the duration of some of the journeys shown in **Figure 10**.

Figure 10: Duration of the journey from home to school

Usual duration of journey to school
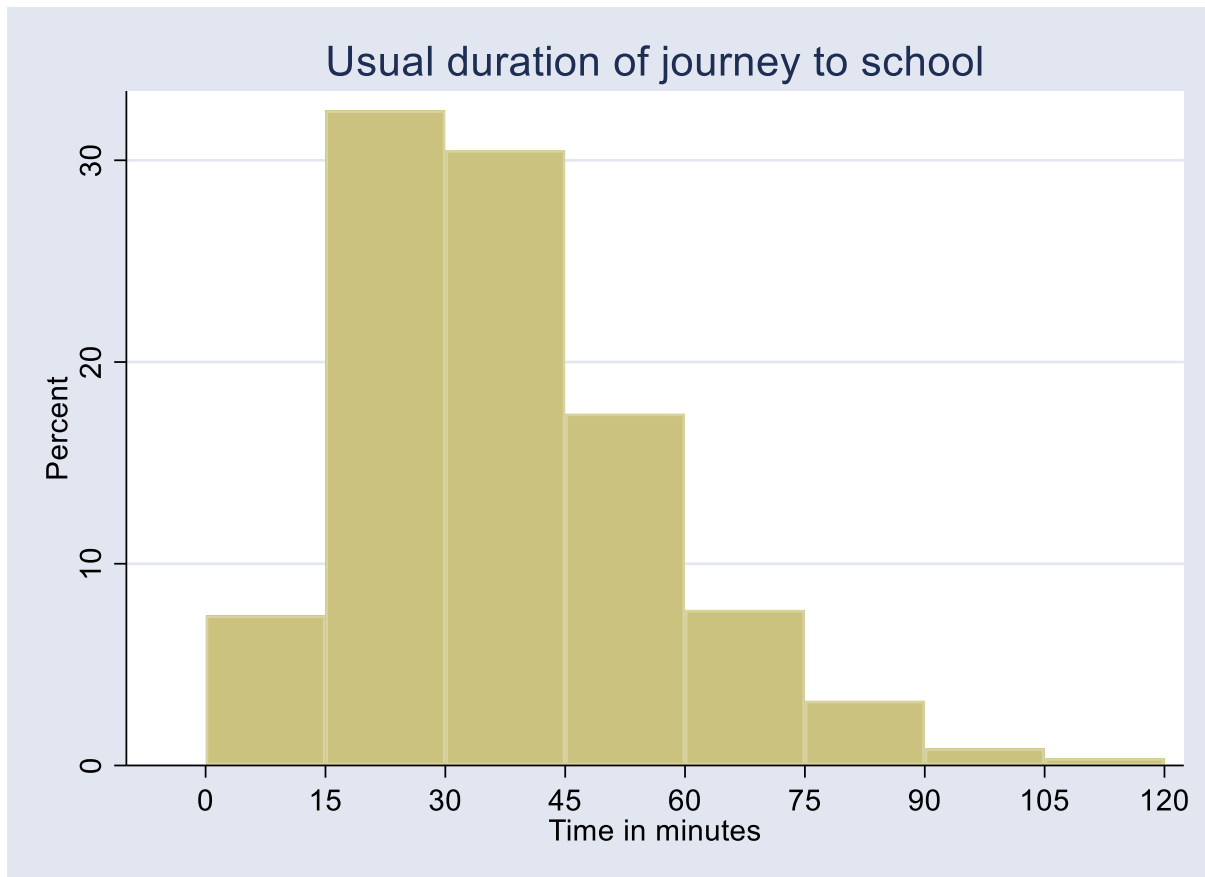
The mean journey time was 38 minutes.

The mean number of calories consumed during the journey was just 22 calories. The mean number of calories consumed after arrival at school but before the start of lessons was 11 calories. By the beginning of lessons, the mean number of calories consumed since rising had only increased to 224 calories. Just 461 pupils *(18.5%)* out of 2,488 had consumed at least 400 calories before lessons began – 2,027 *(81.5%)* hadn't. **Figure 11** shows the distribution of total calories consumed before this point in the school day.

Figure 11: Calories consumed before the start of lessons
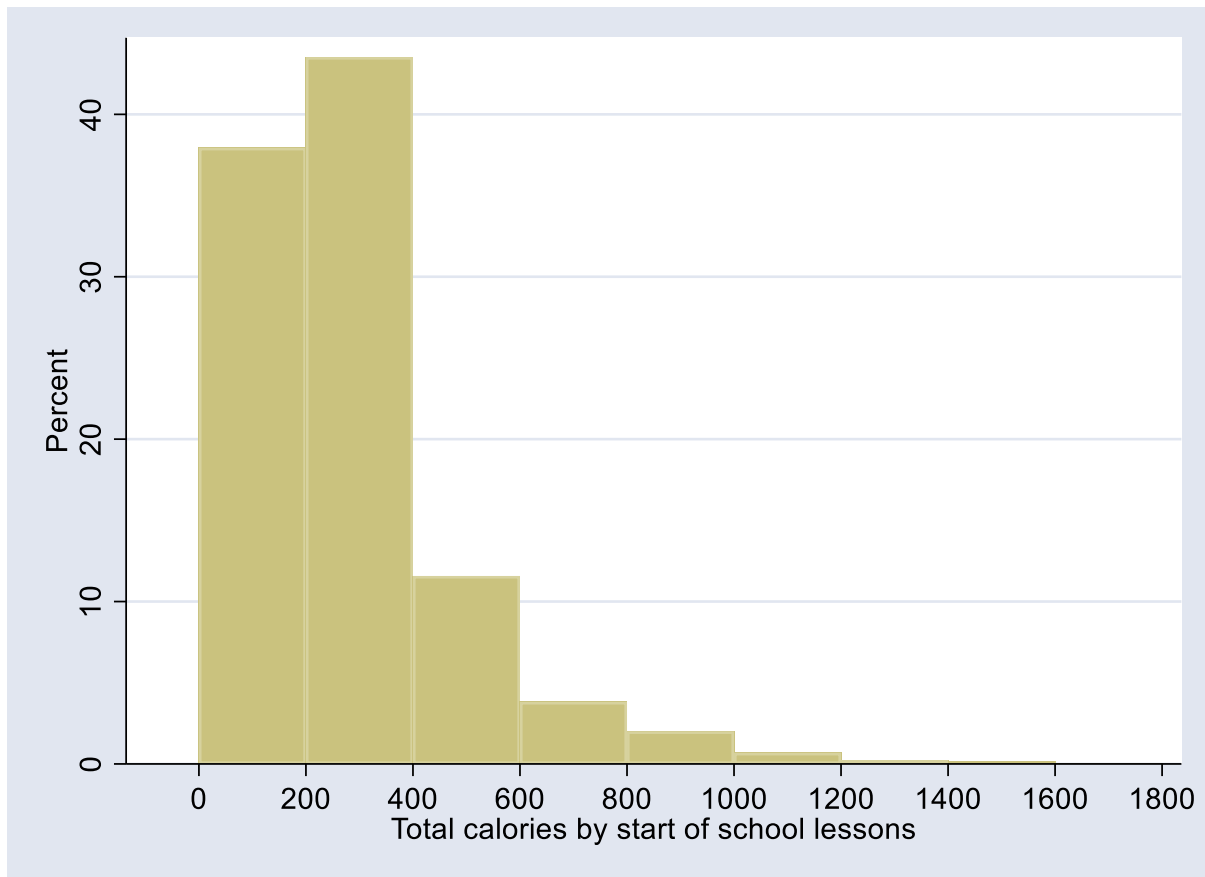
Those students who had little *(or nothing)* to eat before the start of lessons would often have quite a wait until the beginning of morning break. **Figure 12** provides further information. It is alarming that 703 students out of 2,488 *(28.3%)* had eaten nothing before break time.

Figure 12: Time between arrival at school and the start of morning break
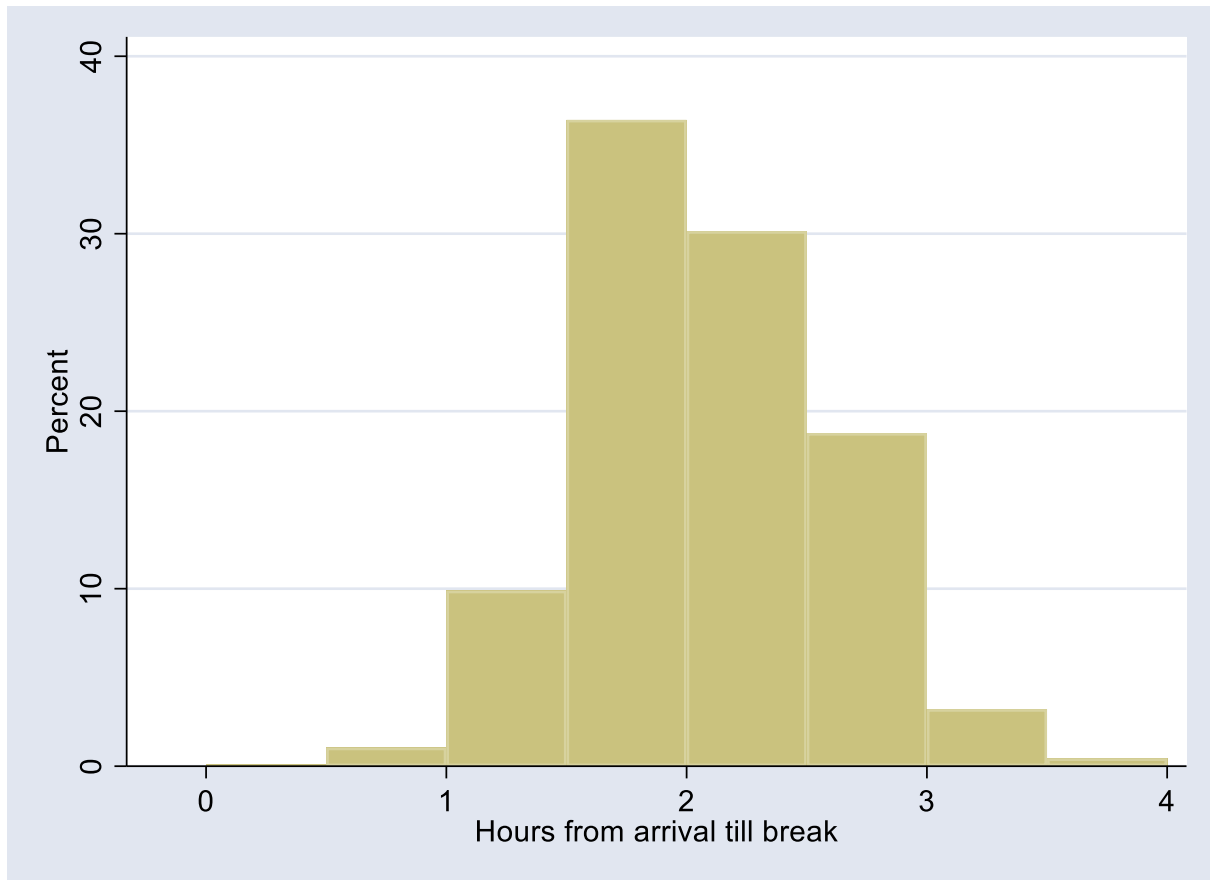
The mean time was 2 hours 5 minutes. One would have thought that the 703 pupils who had not had any breakfast before the start of lessons would have been eager to eat by the time break started. However, the results presented in **Table 11** do not support this hypothesis.

Table 11: Consumers at morning break classified by breakfast behaviour before start of lessons

Refreshment time	Refreshments at break time	No refreshments at break time	Totals
Some breakfast before lessons	1,411 *(79.1%)*	374 *(20.9%)*	**1,785**
No breakfast before lessons	412 *(58.6%)*	291 *(41.4%)*	**703**
Totals	**1,823**	**665**	**2,488**

$\chi^2 = 107.60$; $p < 0.01$

The proportion of breakfast skippers *(defined at the start of lessons)* who did <u>not</u> have anything to eat or drink during morning break *(41.4%)* was significantly higher than in the case of breakfast eaters *(20.9%)*. This suggests that food and drink consumed at break time are more of a complement to food and drink consumed before lessons start – than a substitute.

Some students consumed a significant number of calories during morning break, as illustrated in **Figure 13**.

Figure 13: Calories consumed during morning break
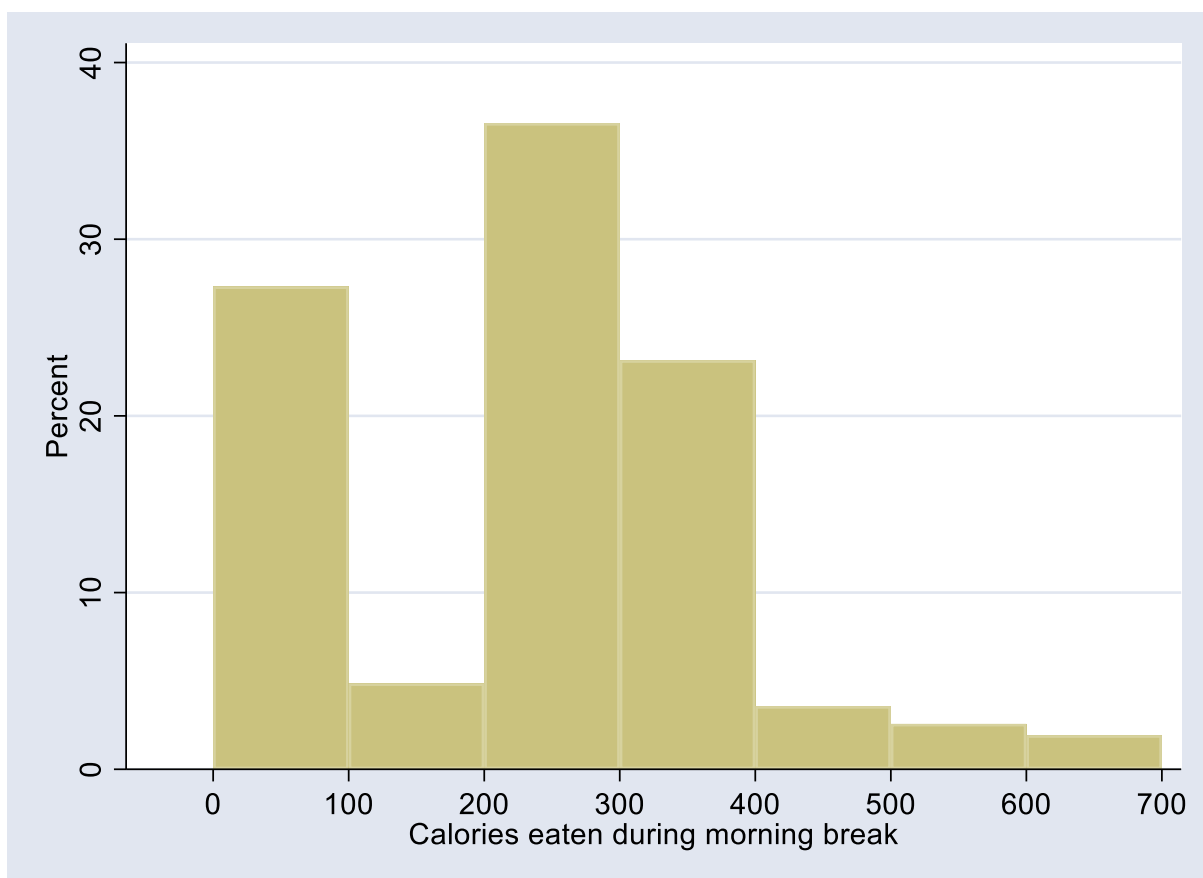
The mean number of calories consumed at this time was 187 calories. Those who skipped breakfast *(as defined at the start of lessons)* consumed 153 calories on average – those who were breakfast eaters consumed *(on average)* 201 calories at breaktime.

Figure 14 shows the total calories consumed by the end of the morning break. This is the sum of calories at home, calories during the journey, calories on arrival at school, and calories consumed during morning break.

Figure 14: Total calories consumed by the end of morning break
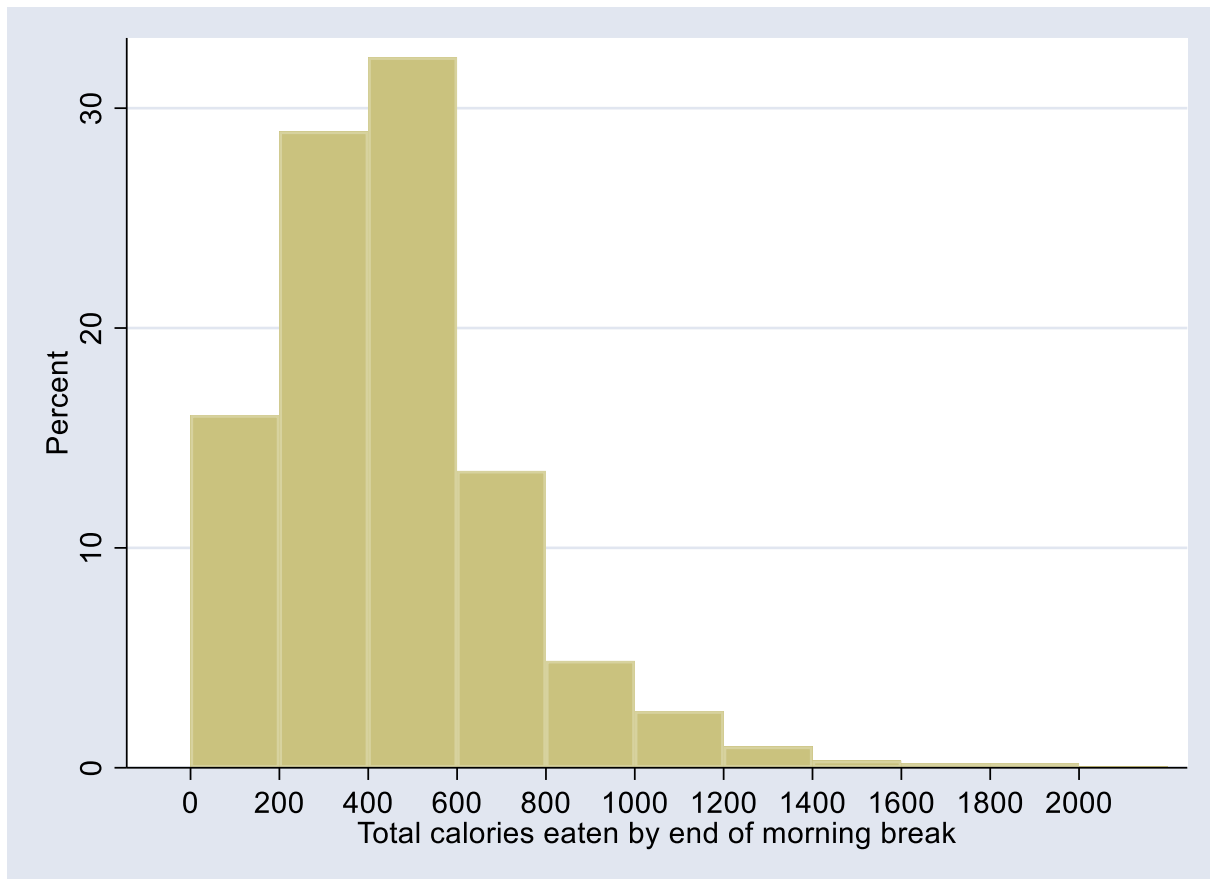
The mean number of calories consumed by the end of the break was 411.

Most of the 2,488 pupils had been up for less than 4 hours by break time, but a few early risers *(who attended schools with relatively late breaks)* will have been up for more than 4 hours. As this study only considers calories consumed within 4 hours of rising, we need to discount any calories consumed after 4 hours. **Figure 15** shows the distribution of calories consumed within 4 hours – the mean number of calories is slightly lower than in **Figure 14**.

Figure 15: Total calories consumed within 4 hours of rising
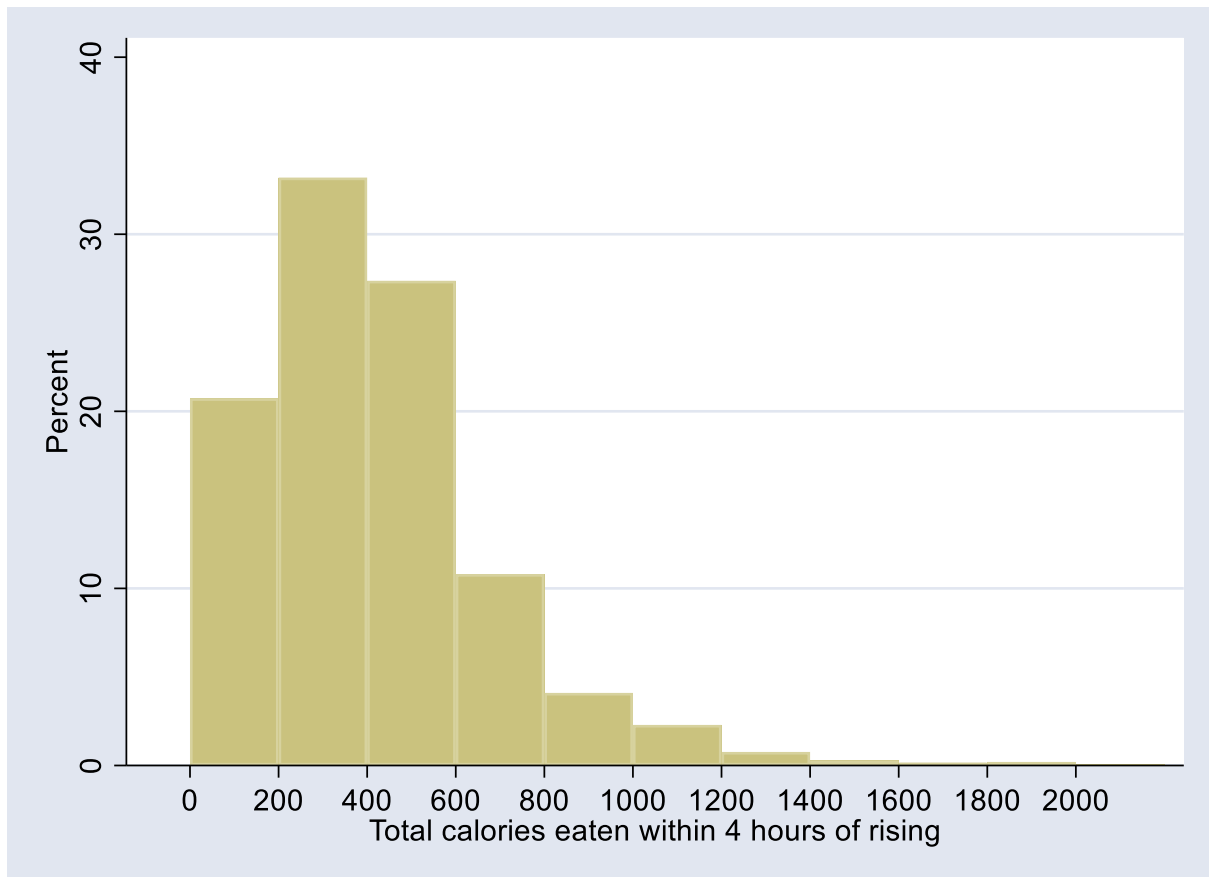
The mean number of calories consumed within 4 hours was 368.

1,336 students *(53.7%)* had <u>not</u> reached the 400 calories milepost within 4 hours of rising; 1,152 students *(46.3%)* had. **Figure 16** depicts this finding in a pie chart.

Figure 16: A pie chart showing whether or not a pupil had consumed at least 400 calories within 4 hours of rising

At least 400 calories within 4 hours of rising

No - 54%   Yes - 46%

As the project concerns breakfast habits on school days, a decision was made only to consider food and drink consumed within four hours of rising. The pupils were <u>not</u> asked any questions about what they had to eat and drink at lunchtime *(or later in the day).* Except in a few exceptional circumstances, one has to hope that all pupils would have consumed a minimum of 400 calories by the end of lunch – though, sadly, this hope was probably <u>not</u> realised.

<u>If it were true</u> that all 2,488 pupils had consumed a minimum of 400 calories within 30 minutes of the start of lunch break, then the distribution of hours until at least 400 calories was eaten would be as shown in **Figure 17**. ***This represents the best-case scenario.*** 45 pupils out of 2,488 *(1.8%)* would have waited more than 7 hours.

Figure 17: Number of hours from rising until at least 400 calories consumed – *best-case scenario*
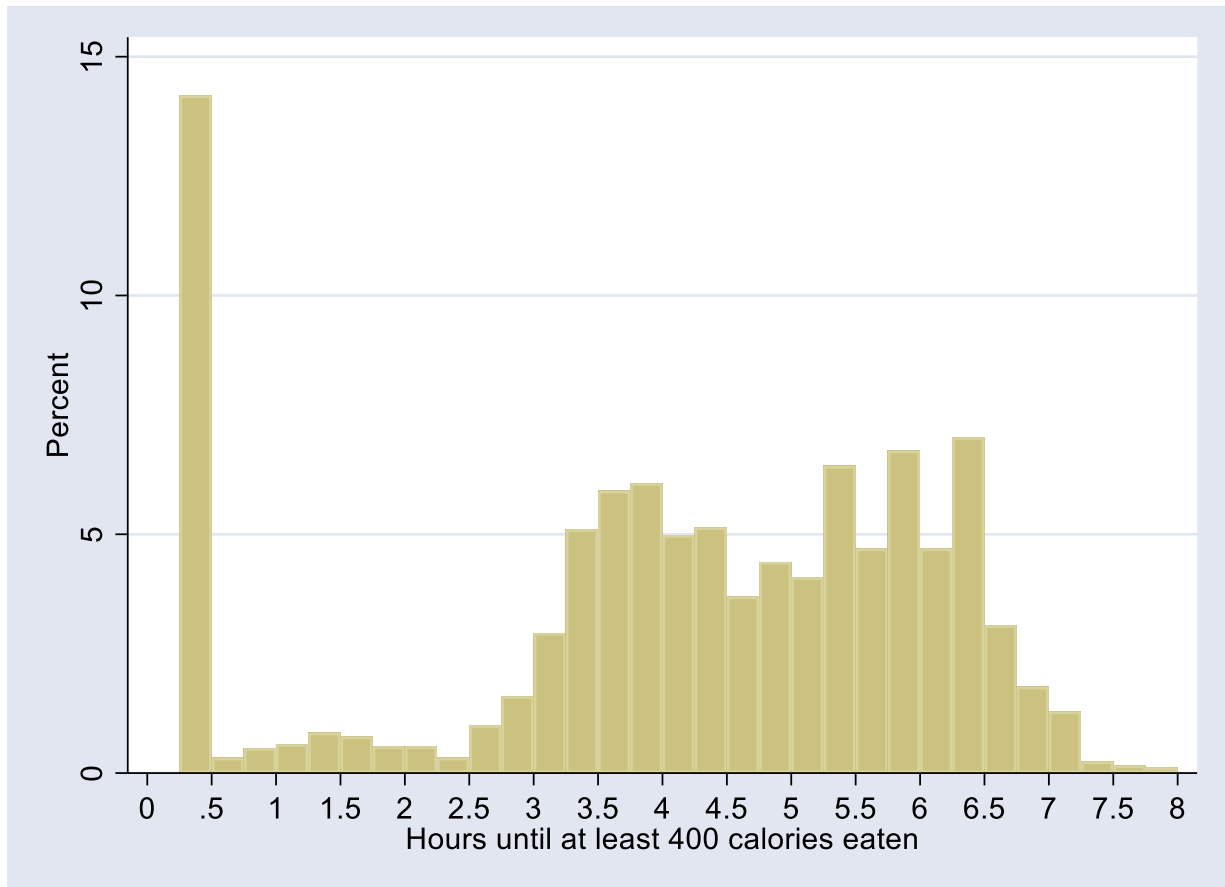
The mean time for this 'best case scenario' is 4 hours 23 minutes. In reality, the mean time will be higher.

Figure 18 shows the distribution of hours from the start of the break to lunch.

Figure 18: Time (in hours) between the start of morning break and the start of lunch
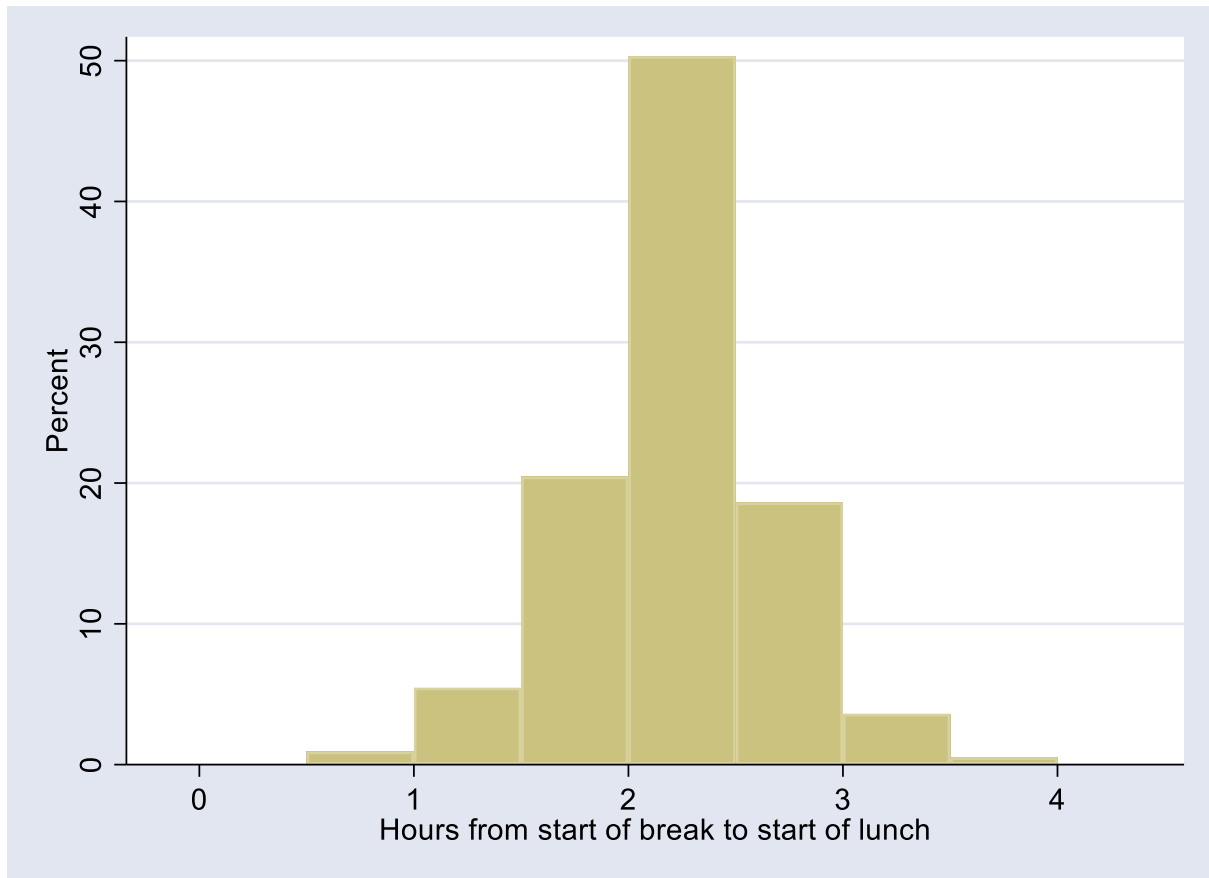
The mean time was 2 hours and 12 minutes. One can only imagine how hungry some of the pupils who had not eaten by the end of morning break must have felt when their lunch break started. This suggestion is even more apparent if one considers the number of hours between rising and the start of the lunch break, which is explored in **Figure 19**.

Figure 19: Time (in hours) between getting up in the morning and the start of lunch break
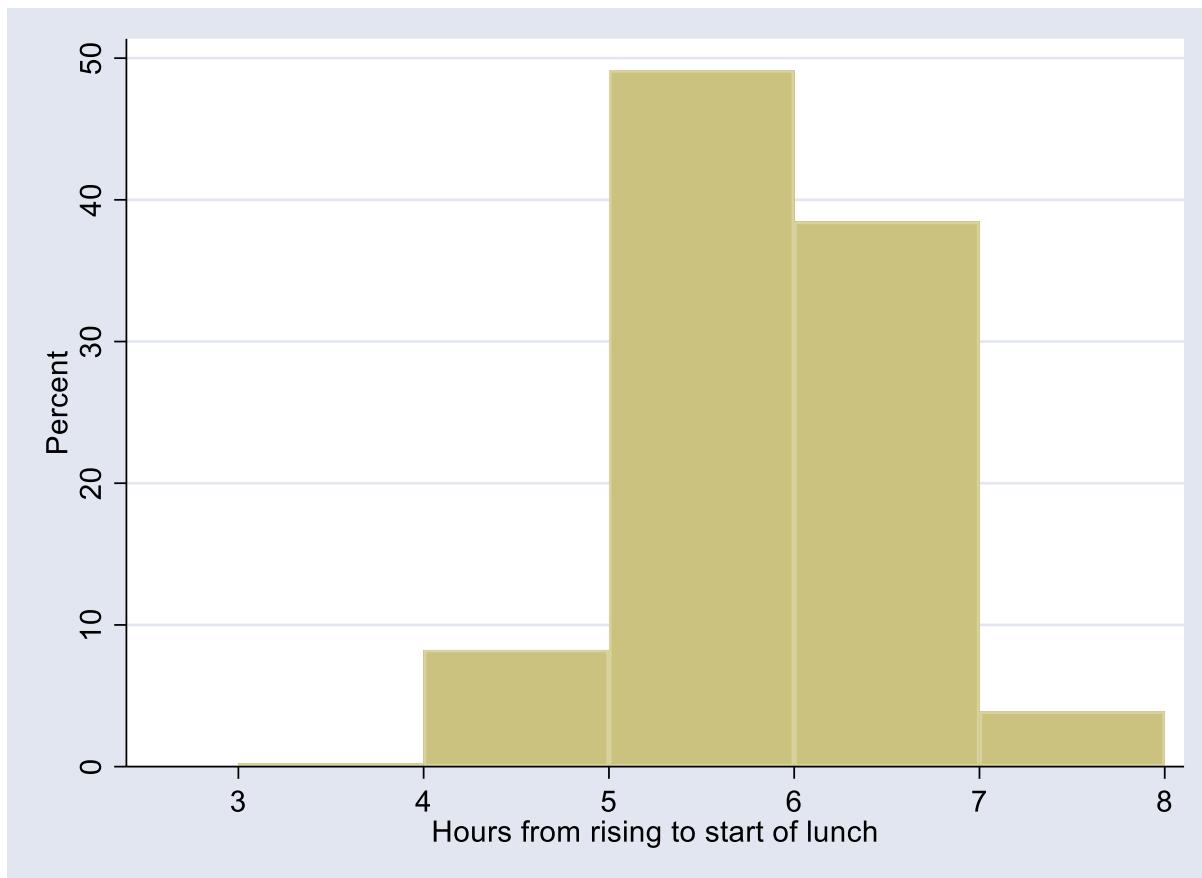
The mean time was 5 hours and 53 minutes.

Table 12 summarises the daily journey toward 400 calories *(from getting up in the morning to the end of the morning break).*

Table 12: Some key statistics concerning breakfast habits

Stage of day	Mean cumulative calories	Number of pupils consuming at least 400 calories	Percentage of pupils having consumed at least 400 calories
Breakfast at home	192	353	14.2%
+ Breakfast during journey	214	420	16.9%
+ Breakfast on arrival	224	461	18.5%
+ Food at morning break*	411	1,369	55.0%

*In case there is any confusion with other results reported here, it should be remembered that this study focuses on food and drink consumed within 4 hours of rising. Some of the food and drink at morning break will have been consumed more than 4 hours after rising, so it will be discounted in most of the analysis. In fact (as already reported), only 46.3% of pupils (1,152) had consumed at least 400 calories within 4 hours of rising.

10. Kaplan-Meier Plots and the Wilcoxon Rank-Sum Test

The statistics presented in **Table 12** are of limited use. They are based on counts of pupils and report arithmetic means. Given that calorie intake is positively skewed (as illustrated by some of the histograms in the previous section), arithmetic means are likely to paint a rather rosy picture. Kaplan-Meier curves allow us to carry out a more thorough and meaningful analysis.

Just as demand and supply diagrams are the 'bread and butter' of much economic analysis, Kaplan-Meier curves are the 'bread and butter' of survival analysis. As mentioned in the preamble, it seems strange that more use has not been made of this tool in other studies. Survival analysis is just a particular case of 'time-to-event' analysis. If this latter term were used more widely, one suspects that Kaplan-Meier curves would be employed more widely in nutritional epidemiology.

With Kaplan-Meier curves, time is measured along the horizontal axis, and the event of interest is measured up the vertical axis. The current study measures time in hours since the pupil got up, and the event of interest is the pupil consuming at least 400 calories. Stata 17 examines the data at the individual pupil level and plots how the percentage of students who

have reached the 400 calorie milestone increases 'as time goes by' until the 4 hours 'cut off point' is reached.

Unless time is measured and recorded continuously, we end up with a series of 'steps' rather than curves. These steps will be 'rising' – rather than 'falling' because as we move towards the 4-hour cut-off point, the percentage of pupils who have consumed at least 400 calories will increase – *rather than decrease.*

Stata 17 needs to be instructed to treat the data as time-to-event data.[4] This is done using the command:

- **stset y, fail(d) id(id)**

where **y is the time variable in hours**. This is the number of hours before a pupil has reached the 400 calorie milepost. *For those pupils who had not reached the milepost by the start of the lunch break, it was assumed that it was reached 30 minutes after the beginning of the lunch break. Of course, this was always more than 4 hours after the pupil had got up, and so this assumption did not affect the Kaplan-Meier plots or the results of the rank-sum tests. Furthermore, it will not affect the logistic regression analysis results reported later on.*

d is the 'failure' variable – coded 1 for a pupil who consumes at least 400 calories within 4 hours and 0 otherwise

id is the pupil survey number (1 through to 2,488)

The command:

- **sts list**

produces the Kaplan-Meier survivor function shown in **Table 13**. We only consider 'failures' *(consuming at least 400 calories)* until the 4-hour cut-off point. Failures afterwards are ignored. This explains why all the Kaplan-Meier plots become flat *(horizontal)* after 4 hours.

The Kaplan-Meier survivor function reproduces some of the results already reported in Section 9.

Table 13: The Kaplan-Meier Survivor Function

Time	At risk	Fail	Net lost	Survivor function	Std. error	[95% conf. int.]	
.25	2488	353	0	0.8581	0.0070	0.8438	0.8712
.5	2135	8	0	0.8549	0.0071	0.8404	0.8682
.75	2127	13	0	0.8497	0.0072	0.8350	0.8631
1	2114	15	0	0.8436	0.0073	0.8288	0.8573
1.25	2099	21	0	0.8352	0.0074	0.8200	0.8492
1.5	2078	19	0	0.8276	0.0076	0.8121	0.8419
1.75	2059	14	0	0.8219	0.0077	0.8063	0.8364
2	2045	14	0	0.8163	0.0078	0.8005	0.8310
2.25	2031	8	0	0.8131	0.0078	0.7972	0.8279
2.5	2023	25	0	0.8031	0.0080	0.7869	0.8181
2.75	1998	40	0	0.7870	0.0082	0.7704	0.8026
3	1958	73	0	0.7576	0.0086	0.7403	0.7740
3.25	1885	127	0	0.7066	0.0091	0.6883	0.7241
3.5	1758	146	0	0.6479	0.0096	0.6288	0.6663
3.75	1612	153	0	0.5864	0.0099	0.5668	0.6055
4	1459	123	0	0.5370	0.0100	0.5172	0.5563
4.25	1336	0	128	0.5370	0.0100	0.5172	0.5563
4.5	1208	0	92	0.5370	0.0100	0.5172	0.5563
4.75	1116	0	110	0.5370	0.0100	0.5172	0.5563
5	1006	0	102	0.5370	0.0100	0.5172	0.5563
5.25	904	0	160	0.5370	0.0100	0.5172	0.5563
5.5	744	0	117	0.5370	0.0100	0.5172	0.5563
5.75	627	0	168	0.5370	0.0100	0.5172	0.5563
6	459	0	117	0.5370	0.0100	0.5172	0.5563
6.25	342	0	175	0.5370	0.0100	0.5172	0.5563
6.5	167	0	77	0.5370	0.0100	0.5172	0.5563
6.75	90	0	45	0.5370	0.0100	0.5172	0.5563
7	45	0	32	0.5370	0.0100	0.5172	0.5563
7.25	13	0	6	0.5370	0.0100	0.5172	0.5563
7.5	7	0	4	0.5370	0.0100	0.5172	0.5563
8	3	0	3	0.5370	0.0100	0.5172	0.5563

Because pupils were not specifically asked, it is assumed that breakfast at home was consumed 15 minutes *(0.25 hours)* after rising. (*Assuming 30 minutes rather than 15 minutes would have been problematical because several pupils who ate breakfast at home departed for school 30 minutes after waking.*) The first line of the survivor function shows that 353 pupils *(1 − 0.8581 = 0.1419, that is, 14.9% of 2,488)* consumed at least 400 calories within 15 minutes of rising. It seems perverse to refer to these 353 pupils as 'failures' – but that's how Stata 17 is set up!

- The **'Time'** column is self-explanatory – hours since getting up.

- **'At risk'** shows the total number of pupils who had not yet consumed at least 400 calories at the start of the time period. *(Most of these periods are 0.25 hours – 15 minutes in length.)*

- **'Fail'** shows the number of students who passed the 400 calorie milepost during that *(15 minutes or so)* period. This is how the number 'at risk' falls as we move from one period to the next. In this study, 'fails' only count up to 4 hours from rising. After 4 hours, pupils who reach the 400 calorie count are recorded as **'Net lost'**. Although all failures are <u>estimates</u>, the latter figures for net losses are <u>guestimates</u> – as they assume that everyone has consumed at least 400 calories within 30 minutes of the start of lunch break.

- The **'Survivor function'** column records the proportion of pupils who have still not reached the 400 calorie count by the end of the 15 minutes. The survivor function has been defined so that those who only pass the 400 calorie count after 4 hours do <u>not</u> pass our milestone – they have reached the finishing line 'too late'.

- The **'Standard error'** and **'95% confidence interval'** columns are self-explanatory.

- The sum of the 16 'Fail' figures *(from 353 to123)* is 1,152. The sum of the 15 'Net lost' figures *(from 128 to 3)* is 1,336. Out of our total of 2,488 pupils, 1,152 *(46.3%)* reached the 400 calorie milepost within 4 hours; 1,336 *(53.7%)* didn't. The 95% confidence interval for this latter percentage is 51.7% to 55.6%.

Assuming our sample is representative of the population, it is fair to conclude that fewer than 50% of secondary school pupils in Northern Ireland consume at least 400 calories within 4 hours of rising.

If the 'cut-off point' had been set at 3 hours rather than 4 hours, only 603 pupils *(24.2%)* would have reached it. If the cut-off point had been set at 5 hours, <u>presumably</u>, 1,584 *(63.7%)* pupils would have reached it.

A Kaplan-Meier curve *(or plot)* shows the key data reported in the survival function in graphical form. One attraction of Kaplan-Meier plots is that you

don't need to be a trained statistician to appreciate what they are showing.[2]

Figure 20 shows the Kaplan-Meier plot for all 2,488 pupils in our study. It clearly shows the 'journey' to our milepost – a minimum of 400 calories. Only those pupils who reached this goal within 4 hours of rising had 'failed'. The plot does <u>not</u> consider how the proportion who have consumed at least 400 calories rises once the 4-hour limit has been exceeded. The curve is drawn up to 8 hours, reflecting the assumption that the final three pupils *(see the survivor function data)* only reached the 400 calorie milepost between 7.5 hours and 8 hours after rising. We have no idea what the 1,336 pupils who did not reach the target within 4 hours had to eat for lunch or dinner *(tea or supper)*.

Figure 20: Kaplan-Meier plot for all pupils in the survey
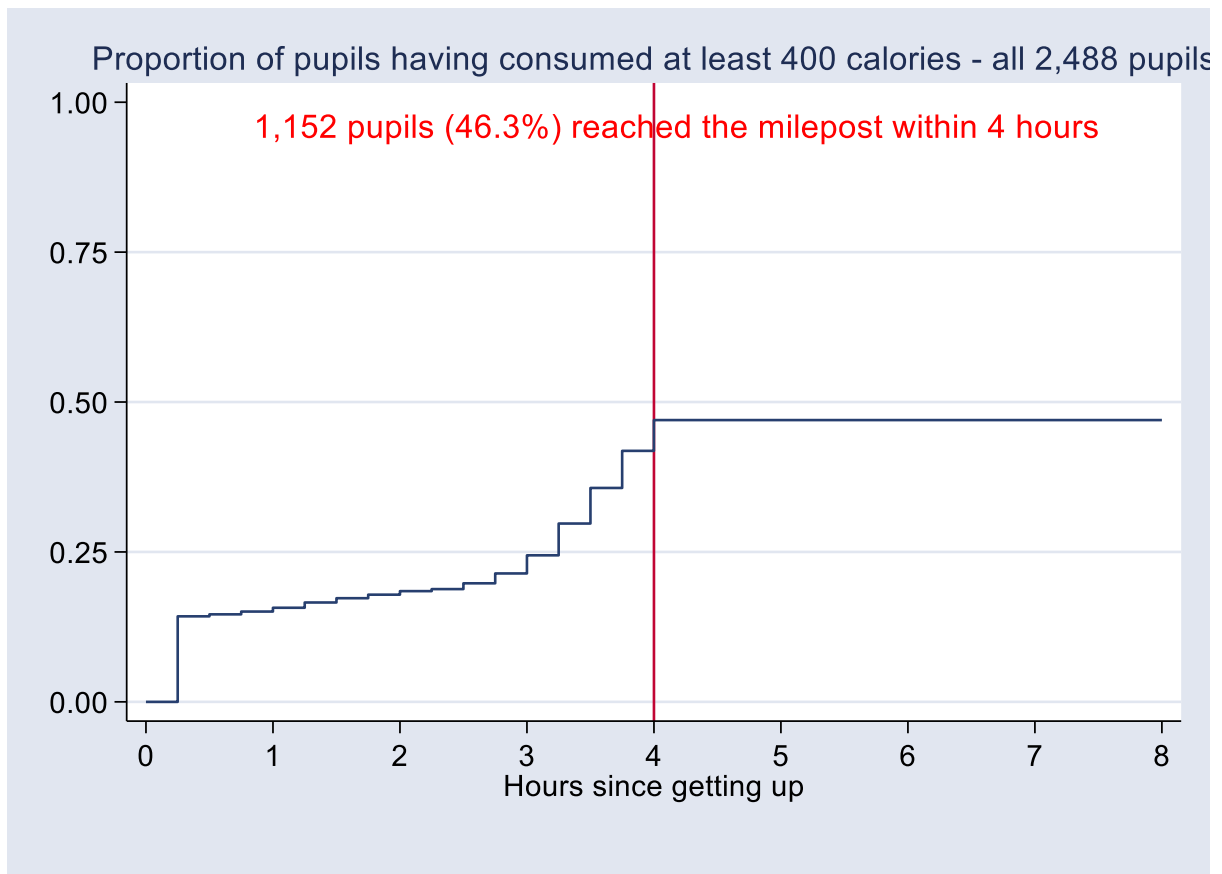
The Kaplan-Meier plot in **Figure 20** shows the same information as the histogram in **Figure 17** *(at least up to 4 hours since getting up)*. Nevertheless, most people would reckon that the Kaplan-Meier plot is more 'user friendly'. The superiority of Kaplan Meier plots becomes even

more apparent when we want to compare the breakfast habits of different sub-groups of pupils.

There was considerable variation in breakfast habits according to the school attended. **Table 14** summarises the findings.

Table 14: Percentage of pupils having consumed at least 400 calories within 4 hours of getting up

School Code	Milepost reached	Milepost not reached	Percentage reaching milepost	Rank
1	8	45	15%	18
2	99	31	76%	1
3	12	37	24%	17
4	35	23	60%	5
5	103	36	74%	2
6	37	48	44%	9
7	84	180	32%	16
8	45	90	33%	15
9	177	204	46%	7
10	54	97	36%	14
11	35	60	37%	13
12	22	29	43%	10
13	110	60	65%	4
14	52	80	39%	11
15	29	23	56%	6
16	63	32	66%	3
17	116	143	45%	8
18	71	118	38%	12
TOTALS	1,152	1,336	46%	

Figure 21 compares the Kaplan-Meier plot for the school with the highest rank *(School 2)* with the Kaplan-Meier plot for the lowest *(School 1)*.

Only 4 pupils out of 53 *(7.5%)* who attended School 1 had consumed 400 or more calories before leaving home in the morning. This compares with 35 pupils out of 130 *(25.9%)* who attended School 2.

Figure 21: Kaplan-Meier plots for schools with the 'best' and the 'worst' breakfast habits

Proportion of pupils having consumed at least 400 calories - best and worst schools

76% of pupils at the 'best' school had reached the milepost vs 15% of pupils at the 'worst' school

Hours since getting up

Worst school   Best school
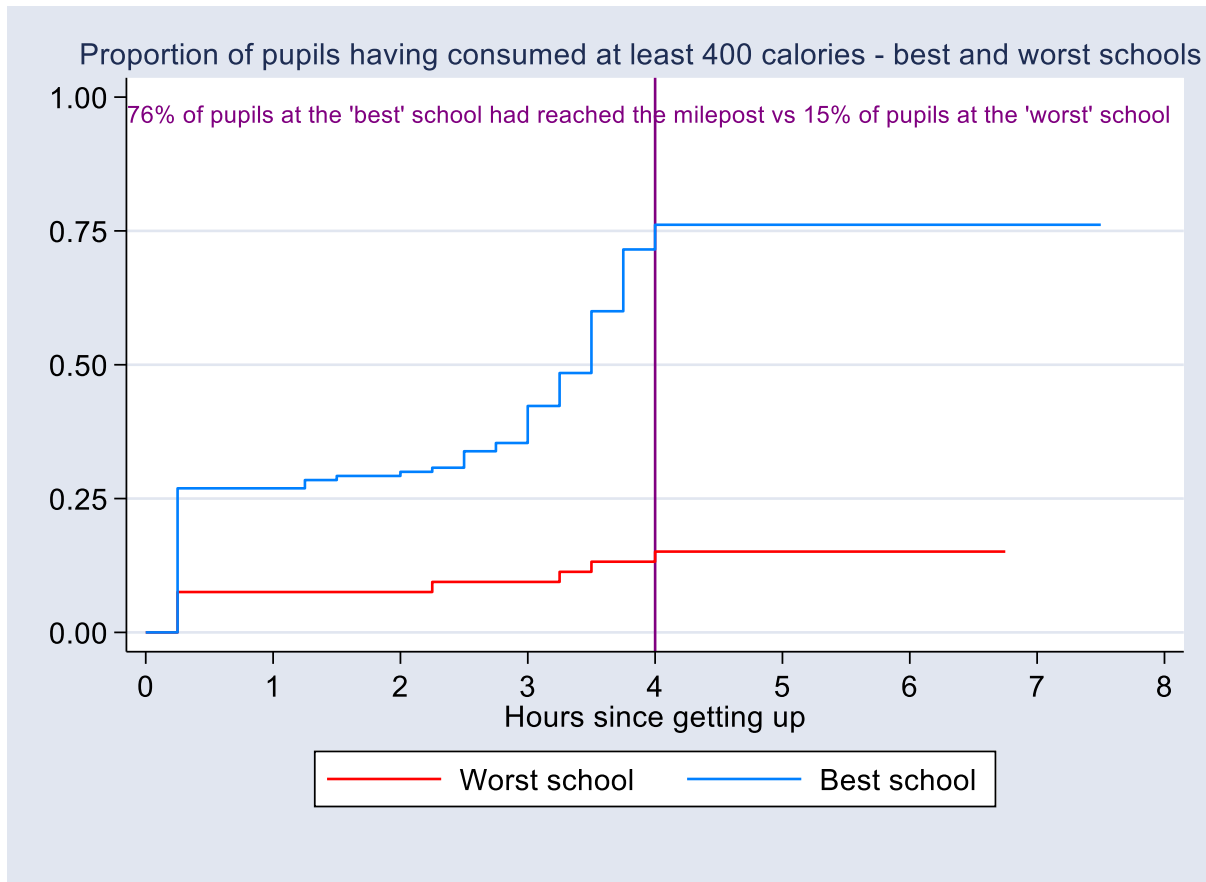
These Kaplan-Meir plots not only show what is happening at a single point in time; they also show what is happening over time. The poor breakfast habits of pupils attending School 1 *(and other schools with a low rank – such as School 3)* cause concern.

One obvious factor to examine is pupil gender – do boys and girls have different breakfast habits? Kaplan-Meier plots are an excellent means of exploring questions such as this. As we already know, the 2,488 pupils were classified as follows:

- 1,181 boys
- 1,196 girls
- 111 other *(including those who preferred not to say)*

The fact that there are almost equal numbers of boys and girls is very pleasing! **Figure 22** shows the Kaplan-Meier plots for the three gender groups.

Figure 22: Kaplan-Meier plots for the three gender groups
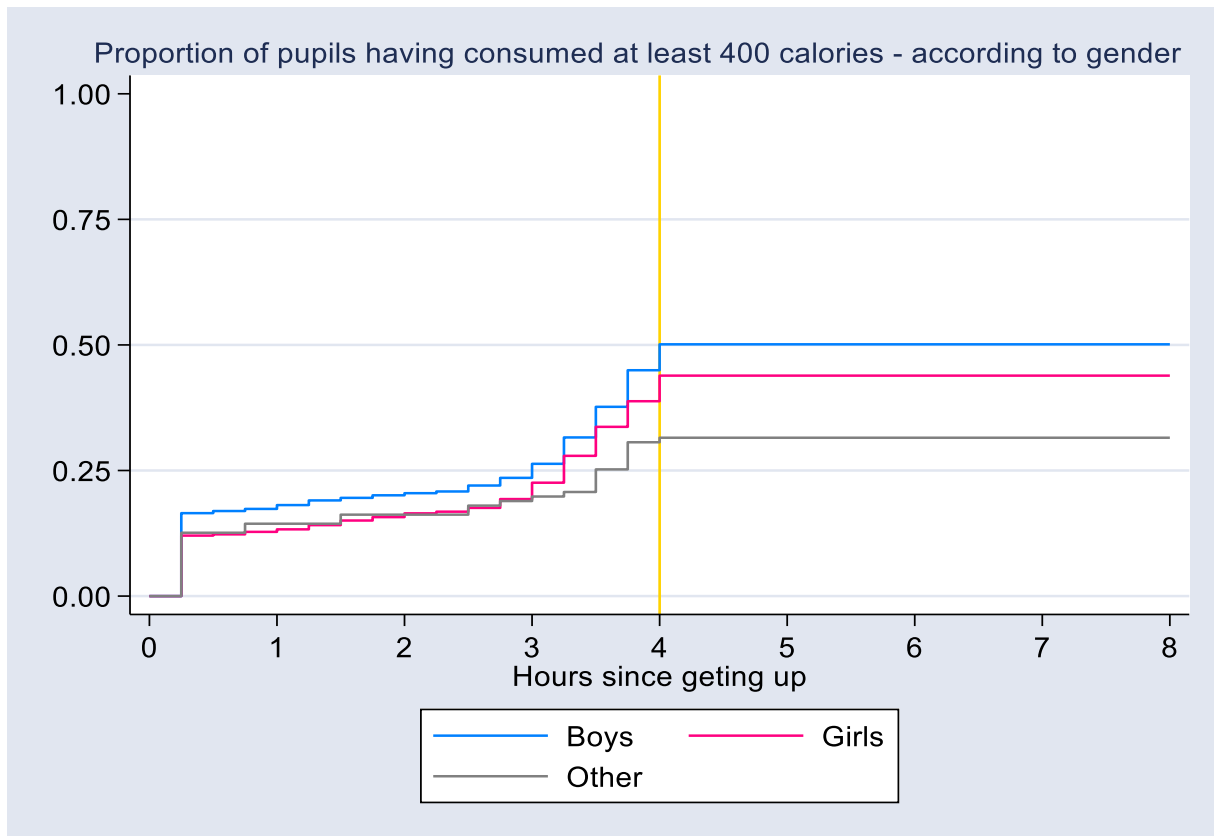
Tables 15 & 16 summarise some of the main results shown in **Figure 22**.

Table 15: Influence of gender on breakfast habits at home

Breakfast at home	Boys	Girls	Other
400 calories or more	196 (16.6%)	144 (12.0%)	14 (12.6%)
Fewer than 400 calories	985 (83.4%)	1,052 (88.0%)	97 (87.4%)
Totals	1,181	1,196	111

$\chi^2 = 10.36$; $p < 0.01$

Table 16: Influence of gender on eating habits within 4 hours of rising

Calories in first 4 hours	Boys	Girls	Other
400 calories or more	592 (50.1%)	525 (43.9%)	35 (31.5%)
Fewer than 400 calories	589 (49.9%)	671 (56.1%)	76 (68.5%)
Totals	1,181	1,196	111

$\chi^2 = 19.47$; $p < 0.01$

It is easy to compare the habits of boys and girls. **Tables 15 and 16** and **Figure 22** show that 'throughout the first 4 hours, the boys are always ahead of the girls by around 5%'. **It would appear (at first sight) that breakfast skipping is more prevalent in girls than boys.** *However, please note that this assertion will soon be shown to be too simplistic. It will need to be modified to take account of the pupil's age.*

It is not easy comparing the 111 pupils classified as 'other' with the 1,181 boys and the 1,196 girls. While these 111 pupils have similar breakfast habits to the 1,196 girls at home, by the end of 4 hours, they have a much higher propensity to skip breakfast.

In univariable analysis, there is a stable relationship in the breakfast habits of boys and girls over the first 4 hours since rising. Still, the non-stable relationship between the 'other' pupils' leads to 'statistical difficulties' when using multivariable methods. In the logistic regression analysis *(explained in the next section)*, I got some 'odd' estimates when I included the 111 'other' pupils. Some of the estimates conflicted with the observed data. When the analysis was restricted to the 1,181 boys and 1,196 girls *(omitting the 111 'other' pupils),* these 'inconsistencies' disappeared.

The 111 'other' pupils have different breakfast habits from the boys and girls, suggesting that this group is worthy of its own study. In particular, why is breakfast skipping *(defined at the end of 4 hours from rising)* so prevalent in these pupils?

Leaving the 111 'other' pupils out of the logistic regression analysis may seem controversial. However, it should be remembered that in HBSC, results of breakfast eating are only reported for boys and girls. Those pupils who did not wish to be classified as boys or girls were excluded.

The approach adopted in the current study is to **include** the 'other' category when the focus of analysis is not pupil gender. However, when a distinction between boys and girls is made, the investigation will be restricted to these two categories, and the 'other' category will be **excluded**.

To aid our understanding of the Wilcoxon rank-sum test, it is helpful to reproduce the Kaplan-Meier curves shown in **Figure 22**, omitting the 111 'other' pupils. The two remaining curves *(boys and girls)* are shown in **Figure 23**.

Figure 23: Kaplan-Meier plots for boys and girls
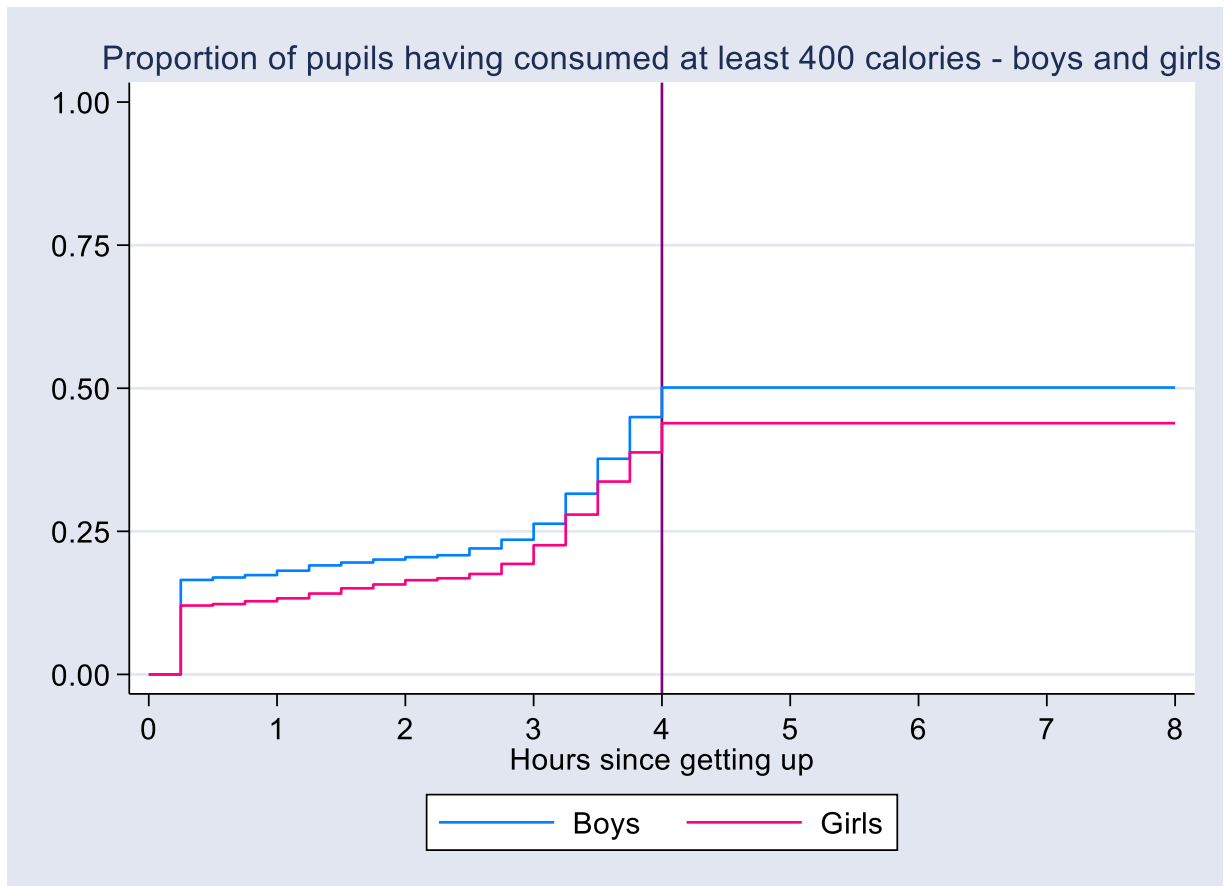
The plots shown in **Figure 23** are based on a **sample** of pupils. It is <u>possible</u> to draw 95% confidence intervals around these sample plots to get an idea of the likely ranges for all pupils (the **population**). Suppose there is little overlap between the 95% confidence interval plot for boys and the 95% confidence interval plot for girls. In that case, it can be concluded that the observed difference between boys and girls in the two samples is statistically significant. However, this method is rarely used, as confidence interval plots rarely look tidy.

The **Wilcoxon rank-sum test** *(Mann-Whitney U test)* can be used for a more formal analysis. This tests the **null hypothesis** that there is no difference between the two populations from which our samples are taken *(secondary school boys and secondary school girls)* in the probability of the event *(having consumed at least 400 calories since getting up)* at any time point up to 4 hours. For each point in time *(that is, for each 15-minute interval in the Kaplan-Meier survival function),* we count the **observed** number of pupils who have consumed at least 400 calories in our two groups *(boys and girls)*. We also calculate the number **expected** if there were, in reality, no difference between the two groups. The observed and

expected frequencies are compared in much the same way as in a chi-squared test. The **alternative hypothesis** is that there is a difference – **a two-tailed test**.[5] Below is the output from Stata 17 for this particular hypothesis test. It is largely self-explanatory.

```
. ranksum TimeH if PupilGender!=3, by(PupilGender)
```

Two-sample Wilcoxon rank-sum (Mann–Whitney) test

PupilGender	Obs	Rank sum	Expected
Boy	1181	1333068	1404209
Girl	1196	1493185	1422044
Combined	2377	2826253	2826253

```
Unadjusted variance    2.799e+08
Adjustment for ties   -1438357.4
                      _____
Adjusted variance      2.785e+08
```

H_0: TimeH(PupilG~r==Boy) = TimeH(PupilG~r==Girl)

$z = -4.263$

$\text{Prob} > |z| = 0.0000$

As there are almost equal numbers of boys and girls, if the null hypothesis were true, we would expect the sum of the ranks for the boys and girls to be almost equal *(1,404,209 and 1,422,044)*. In reality, the sum of the ranks for the boys is lower than expected *(1,333,068 vs 1,404,209); the sum of the ranks for the girls is higher than expected (1,493,185 vs 1,422,044).*

A low rank is considered preferable to a high rank, indicating that the 400 calorie milepost has been reached quicker. The difference between the observed and expected ranks is statistically significant ($p < 0.01$), so we conclude that boys and girls have different breakfast eating habits.

Age is a less controversial variable than gender. Although pupils were not asked directly about their age, they were asked to indicate their Year Group – and there was no opportunity to say, 'I prefer not to say'. As explained earlier, the 2,488 pupils can conveniently be divided into two relatively equal groups:

- 1,299 pupils in Years 8 or 9 *(Younger pupils)*
- 1,189 pupils in Years 10, 11, or 12 *(Older pupils)*

Figure 24 shows the Kaplan-Meier plots for these two age groups.

Figure 24: Kaplan-Meier plots for the two main age groups
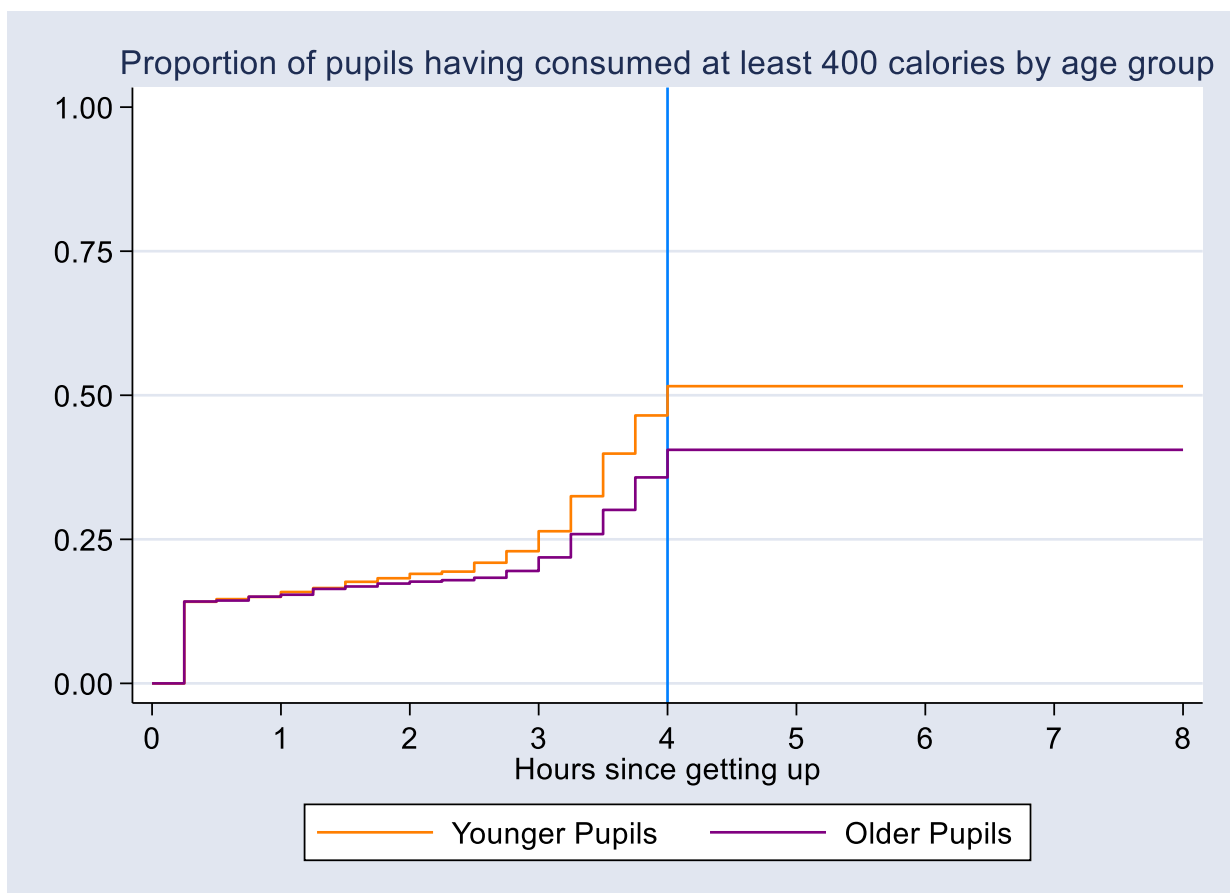
Tables 17 & 18 summarise some of the main results shown in **Figure 24**.

Table 17: Influence of age on breakfast habits at home

Breakfast at home	Younger pupils	Older pupils
400 calories or more	183 *(14.1%)*	171 *(14.4%)*
Fewer than 400 calories	1,116 *(85.9%)*	1,018 *(85.6%)*
Totals	**1,299**	**1,189**

χ^2 = 0.04; p = 0.83

Table 18: Influence of age on eating habits within 4 hours of rising

Calories in first 4 hours	Younger pupils	Older pupils
400 calories or more	670 *(51.6%)*	482 *(40.5%)*
Fewer than 400 calories	629 *(48.4%)*	707 *(59.5%)*
Totals	**1,299**	**1,189**

χ^2 = 30.43; p < 0.01

Figure 24 and **Tables 17 & 18** suggest that while age has little bearing on whether a pupil consumes at least 400 calories at home, it does have a bearing on calories measured at the end of 4 hours. **Breakfast skipping appears to be more prevalent among older pupils than younger pupils.**

The Wilcoxon rank-sum test enables us to test the relationship more formally. The output from Stata 17 is given below:

```
ranksum TimeH , by(Year2Cat)

Two-sample Wilcoxon rank-sum (Mann–Whitney) test
```

Year2Cat	Obs	Rank sum	Expected
Years 8/9	1299	1493060	1616605.5
Years 10/11/	1189	1603256	1479710.5
Combined	2488	3096316	3096316

```
Unadjusted variance    3.204e+08
Adjustment for ties   -1627477.2
                      _____
Adjusted variance      3.187e+08

H0: TimeH(Year2Cat==Years 8/9) = TimeH(Year2Cat==Years 10/11/12)
        z = -6.920
Prob > |z| = 0.0000
```

Stata 17 shows that the sum of ranks for the younger pupils is lower than expected *(1,493,060 vs 1,616,605.5),* and the sum of ranks for the older pupils is higher than expected *(1,603,256 vs 1,479,710.5).* These differences are statistically significant ($p < 0.01$), so it would appear that the prevalence of breakfast skipping varies with age *(2-tailed test).*

We can conclude that both gender and age have a bearing on breakfast habits, but could the relationship be different for boys and girls?

The statistical analysis so far has been **univariable** – we have altered just one variable *(gender or age)* at a time. It could be that this results in us making false conclusions. Perhaps age influences the breakfast habits of girls, but not boys? If that were true, we could still see a significant relationship between gender and breakfast habits and between age and breakfast habits. This possibility can be explored further if our 2,377 pupils *(excluding the 111 pupils classified as 'other')* are categorised by age <u>and</u> gender, as reported earlier in **Table 4**. This gives us four separate groups as follows:

- 659 younger boys
- 582 younger girls
- 522 older boys
- 614 older girls

Figure 25 shows the Kaplan-Meier plots for the 2,377 pupils classified by age <u>and</u> gender. This figure suggests that although breakfast skipping *(defined as <u>not</u> clearing the 400 calorie hurdle within 4 hours)* does not increase much with age in the case of boys, it does increase quite dramatically in the case of girls *(from 47% of younger girls to 65% of older girls).* Given that older girls require more calories than younger girls, this is cause for concern.

Figure 25: Kaplan-Meier plots by School Year and gender

Proportion of pupils having consumed at least 400 calories within 4 hours

Tables 19 to 22 summarise some of the main findings in **Figure 25**.

Table 19: Influence of age on breakfast habits at home – boys

Breakfast at home	Younger boys	Older boys
400 calories or more	97 (14.7%)	99 (19.0%)
Fewer than 400 calories	562 (85.3%)	423 (81.0%)
Totals	659	522

χ^2 = 3.79; p = 0.05

Older boys were **more** likely to have eaten a 'proper breakfast' at home than younger boys, though the difference in proportions **is not** statistically significant.

Table 20: Influence of age on breakfast habits at home – girls

Breakfast at home	Younger girls	Older girls
400 calories or more	79 (13.6%)	65 (10.6%)
Fewer than 400 calories	503 (86.4%)	549 (89.4%)
Totals	582	614

χ^2 = 2.51; p = 0.11

Older girls were **less** likely to have eaten a 'proper breakfast' at home than younger girls, though the difference in proportions **is not** statistically significant.

Tables 21 and 22 focus on the picture 4 hours after rising.

Table 21: Influence of age on food and drink consumption in the first 4 hours after rising – boys

Calories up to 4 hours	Younger boys	Older boys
400 calories or more	342 (51.9%)	250 (47.9%)
Fewer than 400 calories	317 (48.1%)	272 (52.1%)
Totals	659	522

χ^2 =1.86; p = 0.17

Although younger boys were more likely than older boys to reach the 400 calorie milepost within 4 hours, the difference in proportions **is not** statically significant.

Table 22: Influence of age on food and drink consumption in the first 4 hours after rising – girls

Calories up to 4 hours	Younger girls	Older girls
400 calories or more	308 *(52.9%)*	217 *(35.3%)*
Fewer than 400 calories	274 *(47.1%)*	397 *(64.7%)*
Totals	**582**	**614**

χ^2 = 37.49; p < 0.01

Older girls were less likely to have eaten at least 400 calories than younger girls. The difference in proportions **is** statistically significant.

To complete the picture, **Figure 26** shows the Kaplan-Meier plots for the 111 pupils who did not wish to be classified as a boy or a girl, again distinguishing between younger and older pupils.

Figure 26: Kaplan-Meier plots for the 111 pupils not identifying as a boy or girl
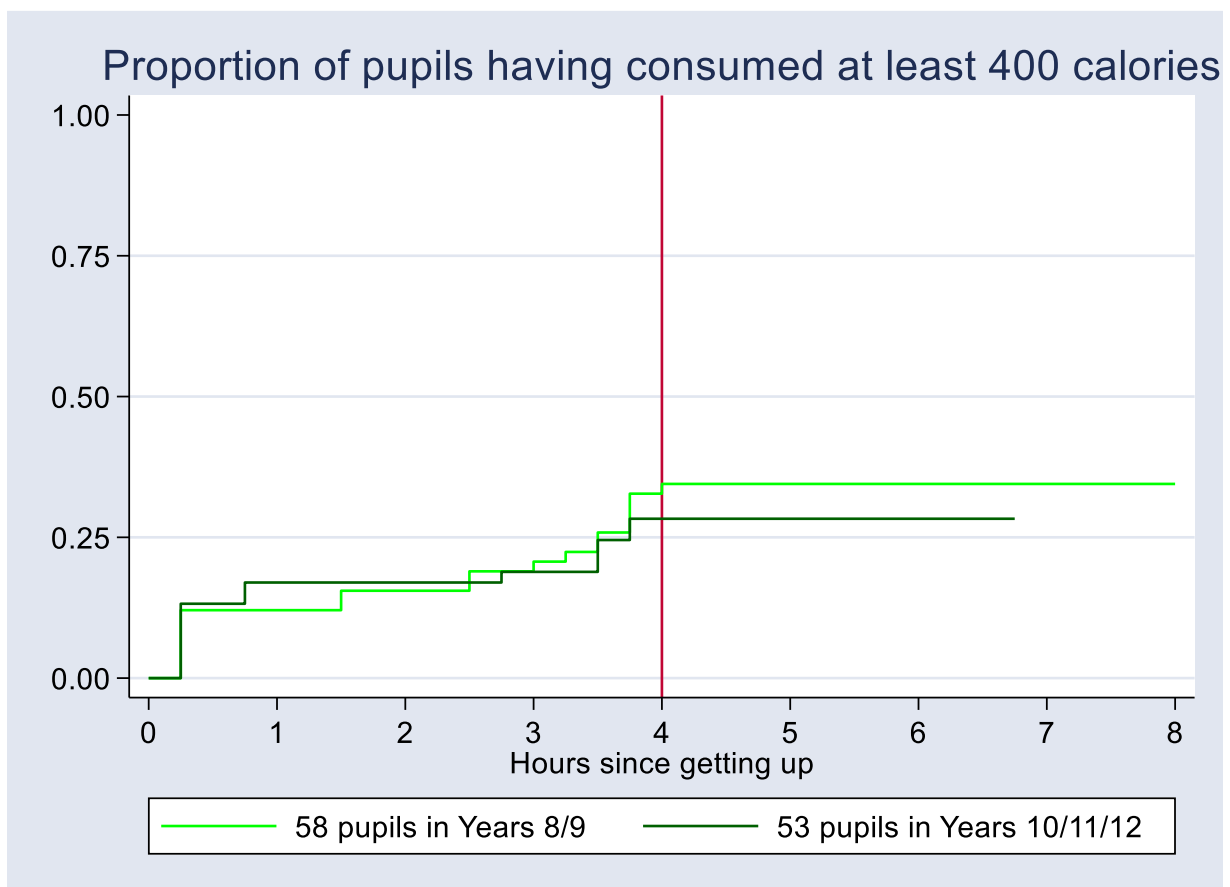
13% of the pupils had reached the 400 calorie milepost before leaving home, and 32% had reached it by the end of 4 hours. Not surprisingly, the observed differences between the younger and older pupils are not statistically significant with such small numbers.

These examples concerning age and gender show the possible dangers of univariable analysis – just considering the effect of one variable at a time. **There is some interaction between gender and age, which a univariable analysis ignores.** What is clear from the four Kaplan-Meier plots shown in **Figure 25** and the results of the chi-squared tests is that one group is very different to the other three – and that is the **older girls**. They are the most likely pupils to be breakfast skippers – *as shown by HBSC data*. The Head of Year 10 needs to give a 'pep talk' to the girls in their care, not the Head of Year 8.

Multivariable analysis can get around this sort of problem *(where there is an interaction between some of the explanatory variables)*. It is the subject matter of the next section. However, before leaving univariable analysis, it is worth examining other results revealed when drawing Kaplan-Meier curves and using a Wilcoxon rank-sum test.

From my earlier career as an economist, I know that household income influences eating habits. **Engel's Law** states that as the income of a family increases, the proportion of income spent on food decreases, although the absolute level of expenditure on food is still increasing. This is nothing new – Engel's Law was first proposed in 1857![6] Perhaps the principle can be applied to breakfast? Schools that draw their pupils from relatively high economic prosperity will have a better breakfast eating pattern than schools that draw their pupils from areas of relatively low economic prosperity. In this study, the proportion of pupils entitled to free school meals was used as an indicator of the economic prosperity of the catchment area.

Figure 27 shows the Kaplan-Meier plots by the prosperity of the school catchment area. This indicates that breakfast skipping was more prevalent in the six schools serving less prosperous areas *(more than 40% free school meal entitlement)* than in the seven schools serving areas of high prosperity *(less than 20% free school meal entitlement)*. The 6 'low prosperity schools' had 703 pupils who completed the questionnaire, while the 7 'high prosperity schools' had 1,132 pupils who completed the questionnaire.

Figure 27: Kaplan-Meier plots by the prosperity of school catchment area
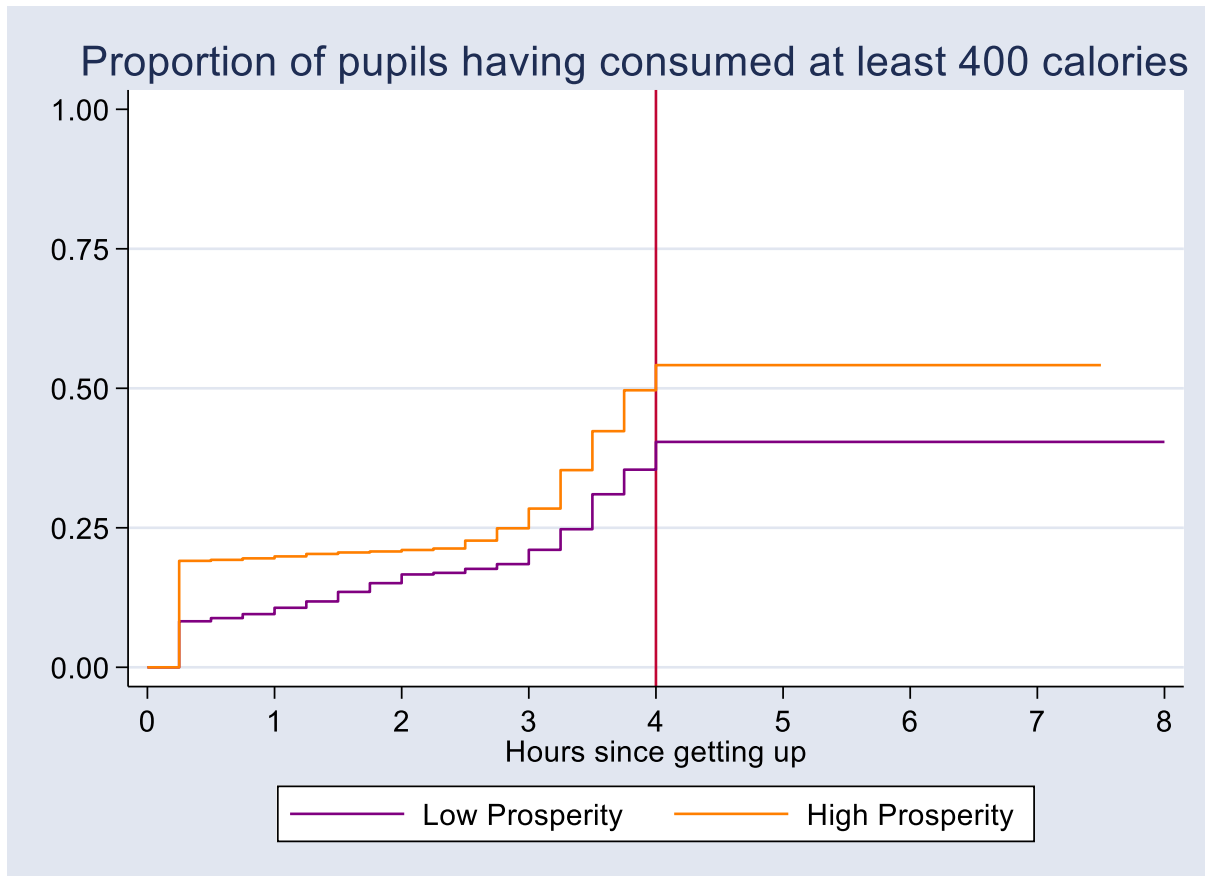
Proportion of pupils having consumed at least 400 calories

A Wilcoxon rank-sum test indicates that the difference between the two Kaplan-Meier plots is statistically significant (p < 0.01).

The Kaplan-Meier plot for the pupils from the five schools classified as 'medium prosperity' is similar to the 'low prosperity' group. Just 39% of the 653 pupils in this middle group reached the 400 calorie milepost within 4 hours. **Tables 23 & 24** summarise some of the main findings illustrated in **Figure 27**.

Table 23: Influence of economic prosperity on breakfast habits at home

Breakfast at home	Low prosperity	High prosperity
400 calories or more	58 *(8.3%)*	217 *(19.2%)*
Fewer than 400 calories	645 *(91.7%)*	915 *(80.8%)*
Totals	**703**	**1,132**

$\chi^2 = 40.59$ (p < 0.01)

The difference in proportions is statistically significant. **Perhaps low household income is a barrier to eating breakfast at home?**

Table 24: Influence of economic prosperity on eating habits during the first 4 hours since rising

Calories in first 4 hours	Low prosperity	High prosperity
400 calories or more	284 *(40.4%)*	613 *(54.2%)*
Fewer than 400 calories	419 *(60.3%)*	519 *(45.8%)*
Totals	**703**	**1,132**

χ^2 = 32.83 (p < 0.01)

At the end of 4 hours, a higher proportion of pupils attending schools in high prosperity catchment areas consumed at least 400 calories than the proportion attending schools in low prosperity catchment areas. The difference is statistically significant.

Classification of prosperity is based on the proportion of pupils entitled to free school meals. In reality, this is the proportion entitled to free school lunches. Perhaps one should ask whether these pupils should **be entitled to free school breakfasts and free school lunches?**

Figure 28 shows Kaplan-Meier plots distinguishing between schools that ran breakfast clubs in pre-COVID-19 days and schools which didn't. In December 2019, 130 out of 193 secondary schools offered breakfast before school – 63 schools didn't. In our sample of 18 schools, 14 had run breakfast clubs, and 4 hadn't. In March 2020, the school breakfast provision had to be suspended because of the pandemic. Summer Term 2021 started on 12 April, and some breakfast provision resumed, but this was patchy. Nevertheless, **Figure 28** shows that 'breakfast club schools' had a better record than 'non-breakfast club schools'. A total of 1,954 pupils who attended 'breakfast club schools' completed the survey; the other 534 attended 'non-breakfast club schools'.

Figure 28: Kaplan-Meier plots by breakfast club status
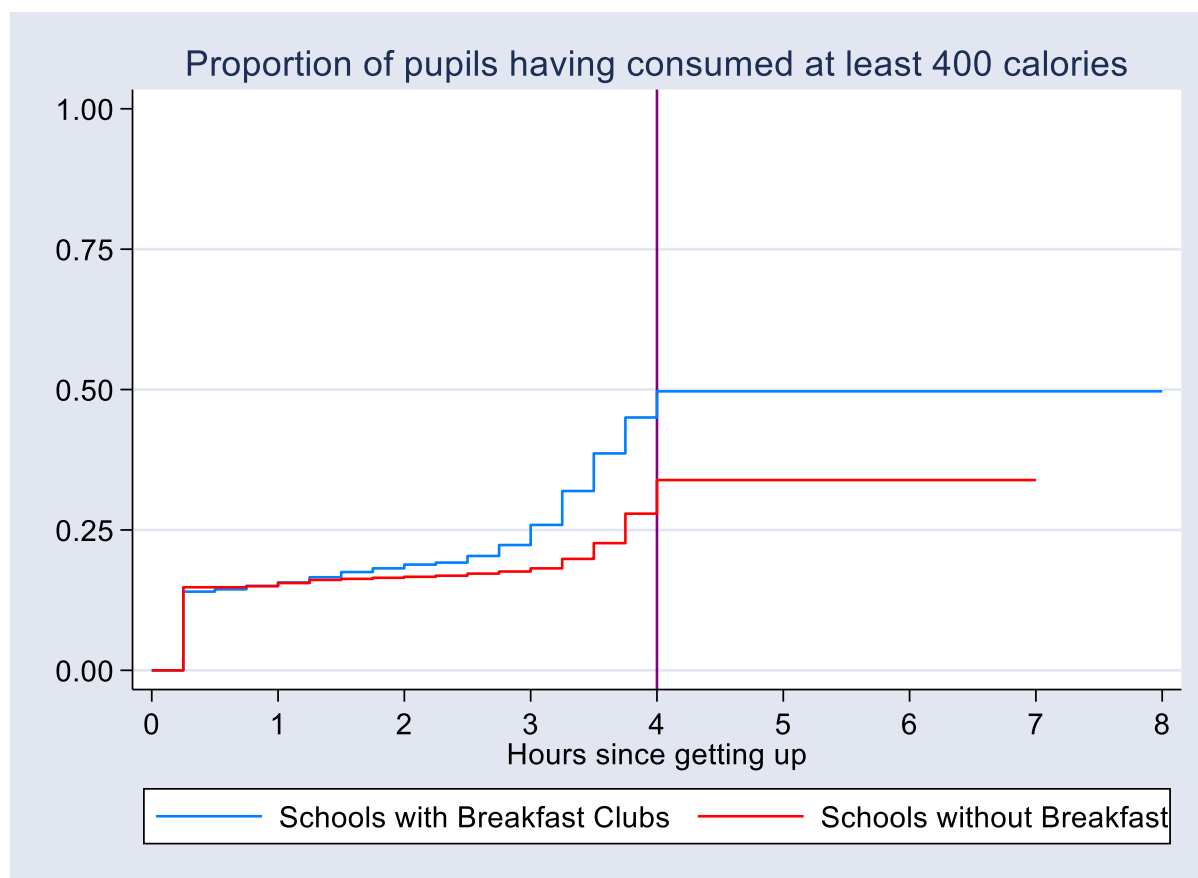
The Wilcoxon rank-sum test indicates that the difference between the two Kaplan-Meier plots is statistically significant (p < 0.01). The output from Stata 17 is given below.

```
. ranksum _t, by(SchBreakfast)

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

SchBreakfast |      Obs     Rank sum      Expected
-------------+-----------------------------------
 Breakfast Cl |     1954    2347980.5      2431753
  No Breakfast |      534     748335.5       664563
-------------+-----------------------------------
     Combined |     2488      3096316       3096316

Unadjusted variance     2.164e+08
Adjustment for ties    -1100791.1
                       _____
Adjusted variance       2.153e+08

H0: _t(SchBre~t==Breakfast Club) = _t(SchBre~t==No Breakfast Club)
        z = -5.709
Prob > |z| = 0.0000
```

Tables 25 & 26 summarise some of the main results illustrated in **Figure 28**.

Table 25: Influence of breakfast club status on breakfast habits at home

Breakfast at home	Breakfast club	No breakfast club
400 calories or more	275 *(14.1%)*	79 *(14.8%)*
Fewer than 400 calories	1,679 *(85.9%)*	455 *(85.2%)*
Totals	**1,954**	**534**

χ^2 = 0.18 (p = 0.67)

Around 14% of pupils ate a 'substantial' breakfast at home, and this was similar for those attending 'breakfast club schools' and those attending 'non-breakfast schools.' Not surprisingly, the observed difference is not statistically significant.

Table 26: Influence of breakfast club status on eating habits during first 4 hours

Calories in first 4 hours	Breakfast club	No breakfast club
400 calories or more	971 *(49.7%)*	181 *(33.9%)*
Fewer than 400 calories	983 *(50.3%)*	353 *(66.1%)*
Totals	**1,954**	**534**

χ^2 = 42.10 (p < 0.01)

By the end of 4 hours, the percentage who had reached the 400 calorie milepost had risen to almost 50% for those attending schools that usually ran breakfast clubs, compared to just under 34% for those attending other schools. The difference is statistically significant.

The two plots in **Figure 28** and the results shown in **Tables 25 & 26** suggest that breakfast provision at school only becomes relevant 2 - 3 hours after rising. This points to the potential role of food and drinks served during the morning break. Three possible explanations spring to mind:

- Perhaps 'breakfast club schools' feed a greater proportion of pupils at mid-morning break than 'non-breakfast club schools'.

- Perhaps 'breakfast club schools' offer more substantial food and drink options at mid-morning break.

- Perhaps 'breakfast club schools' have their mid-morning break earlier in the day than 'non-breakfast club schools'.

Of course, all three explanations may be valid.

There is little doubt that it is preferable for pupils to have consumed at least 400 calories before lessons begin rather than by the end of morning break. However, while serving breakfast at school during registration may be the **first-best policy**, having a more extended morning break earlier in the school day *(and enhancing the menu)* may be the **second-best policy**.

We now turn to the link between time spent in bed at night and breakfast habits. A typical 'grumble' among secondary school teachers is that their pupils are tired in class because they are not getting enough sleep. The 2,488 pupils in the survey provided information about their usual bedtimes on a school day *(Question 14)*, and the results were illustrated earlier in **Figure 6**.

- 547 (22%) of pupils went to bed before 10.00 pm;

- 922 (37%) went to bed between 10.00 pm and 10.59 pm;

- 1,019 (41%) went to bed at 11.00 pm or later. As pointed out previously, one suspects some pupils went to bed well after midnight.

Figure 29 shows the Kaplan-Meier plots for pupils in the above three categories.

Figure 29: Kaplan-Meier plots by usual bedtime on school nights

Proportion of pupils having consumed at least 400 calories
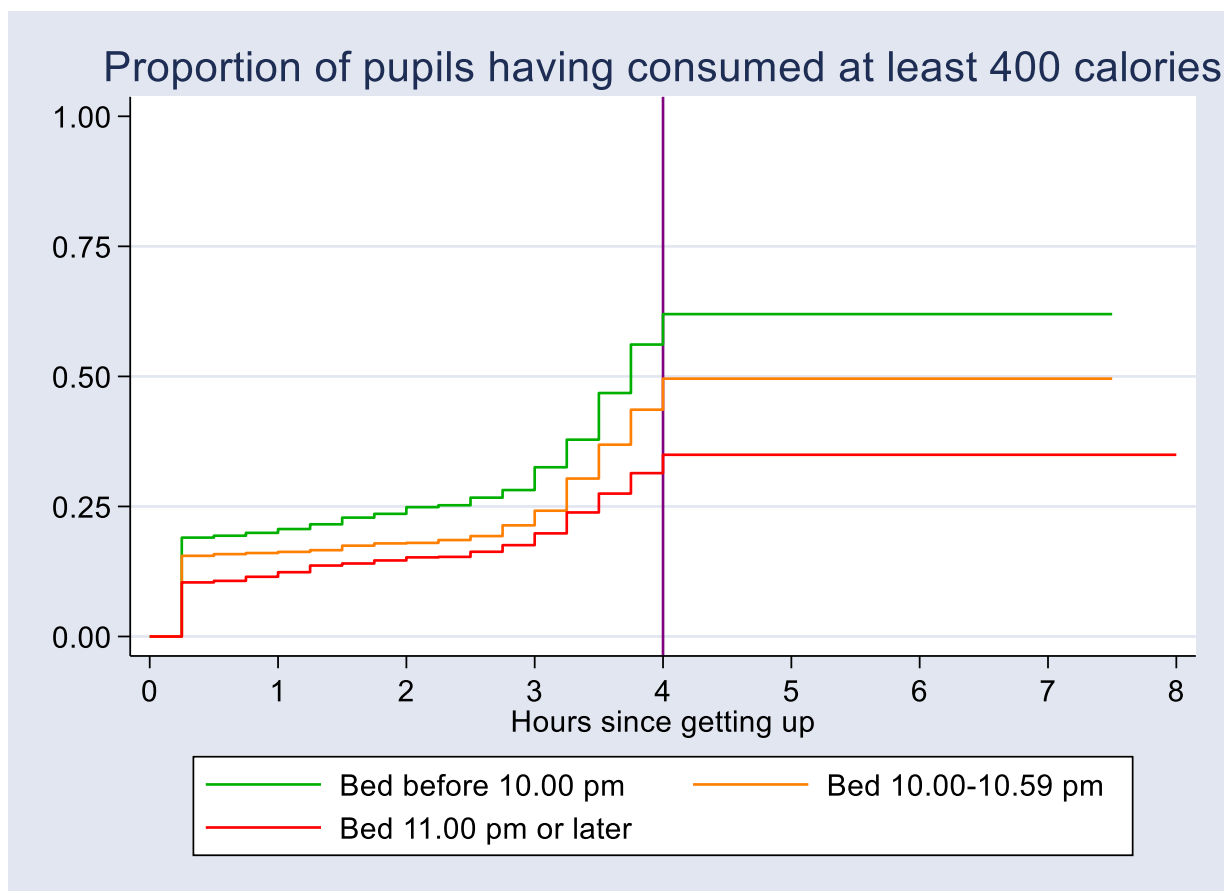
Some of the main results in **Figure 29** are summarised in **Tables 27 & 28** below:

Table 27: Impact of bedtime on breakfast habits at home

Calories at home/Bedtime	Bed before 10.00 pm	Bed 10.00 – 10.59 pm	Bed 11.00 pm or later
400 or more	104 (19.0%)	143 (15.5%)	107 (10.5%)
Fewer than 400	443 (81.0%)	779 (84.5%)	912 (89.5%)
Totals	**547**	**922**	**1,019**

χ^2 = 23.10 (p < 0.01)

Table 28: Impact of bedtime on eating habits during the first 4 hours

Calories within 4 hours/Bedtime	Bed before 10.00 pm	Bed 10.00 – 10.59 pm	Bed 11.00 pm or later
400 or more	339 *(62.0%)*	457 *(49.6%)*	356 *(34.9%)*
Fewer than 400	208 *(38.0%)*	465 *(50.4%)*	663 *(65.1%)*
Totals	**547**	**922**	**1,019**

χ^2 = 110.93 (p < 0.01)

It would appear that usual bedtime may be quite a good predictor of breakfast habits. Those who go to bed early are more likely to reach the 400 calorie milepost within 4 hours of rising, but they are also more likely to have eaten a 'full' breakfast at home before leaving for school. There is probably a link between bedtime and the time of getting up in the morning. Those who retire early may be early risers and may have time to eat a full breakfast at home. The familiar adage, *'Early to bed and early to rise, makes a man **healthy, wealthy, and wise'**,* springs to mind!

As we already know, in addition to being asked about their usual bedtime, pupils were asked to provide information about their usual time of getting up in the morning. The data (shown in **Figure 1**) indicates that many pupils got up too late to leave sufficient time to eat a 'proper breakfast' at home. Over 30% of pupils got up at 7.30 am or later. Linking the answers to the questions about bedtime and rising time, it is possible to calculate the maximum hours of sleep a pupil had. I say 'maximum', as it is unlikely that pupils slept for 100% of this time. **Figure 30** shows the distribution of hours in bed at night. **The mean time was 8 hours and 24 minutes**.

Figure 30: Histogram of usual hours in bed at night
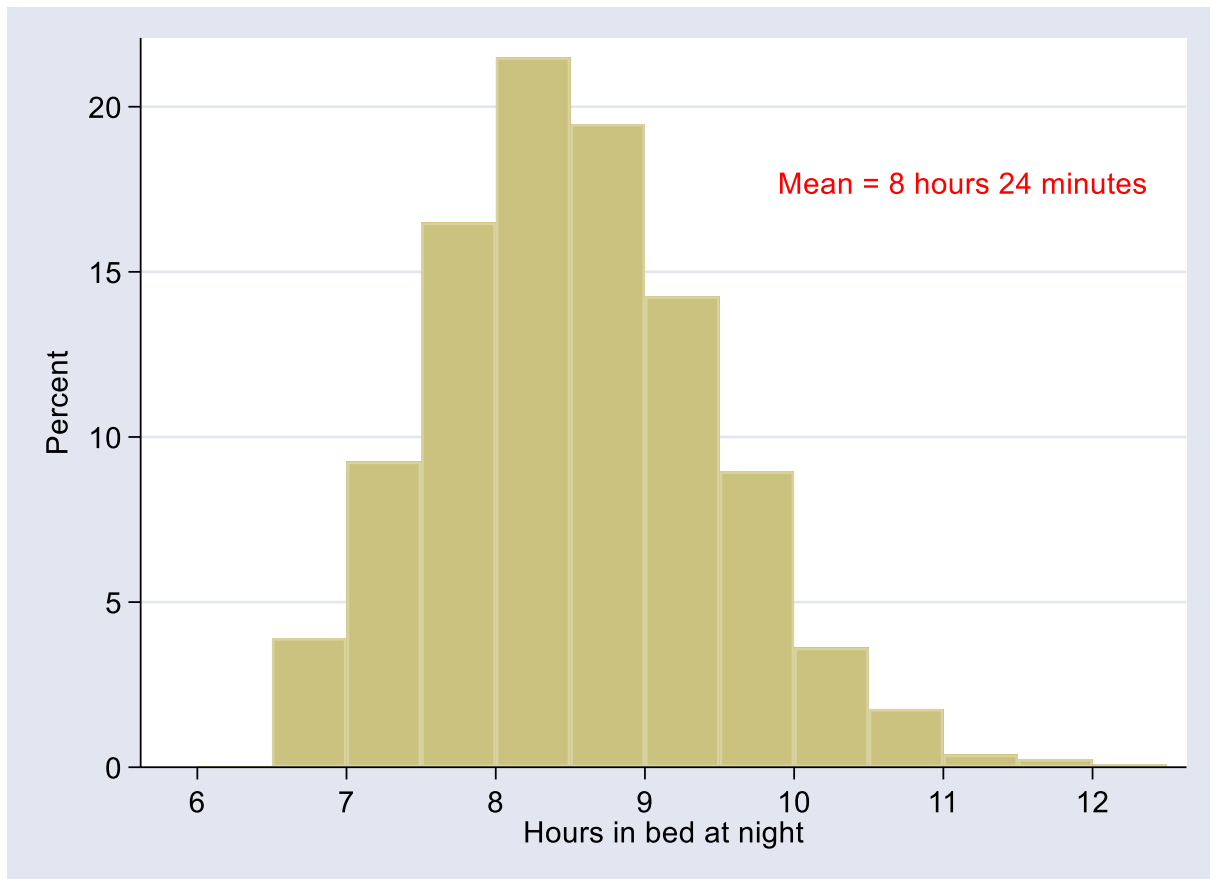
- 774 pupils *(31.1%)* spent fewer than 8 hours in bed

- 1,009 pupils *(40.6%)* spent between 8 and 8.99 hours *(inclusive)* in bed

- 705 pupils *(28.3%)* spent 9 hours or more in bed

The Kaplan-Meier plots in **Figure 31** illustrate how breakfast habits varied for these three groups.

Figure 31: Kaplan-Meier plots by hours in bed at night

Proportion of pupils having consumed at least 400 calories
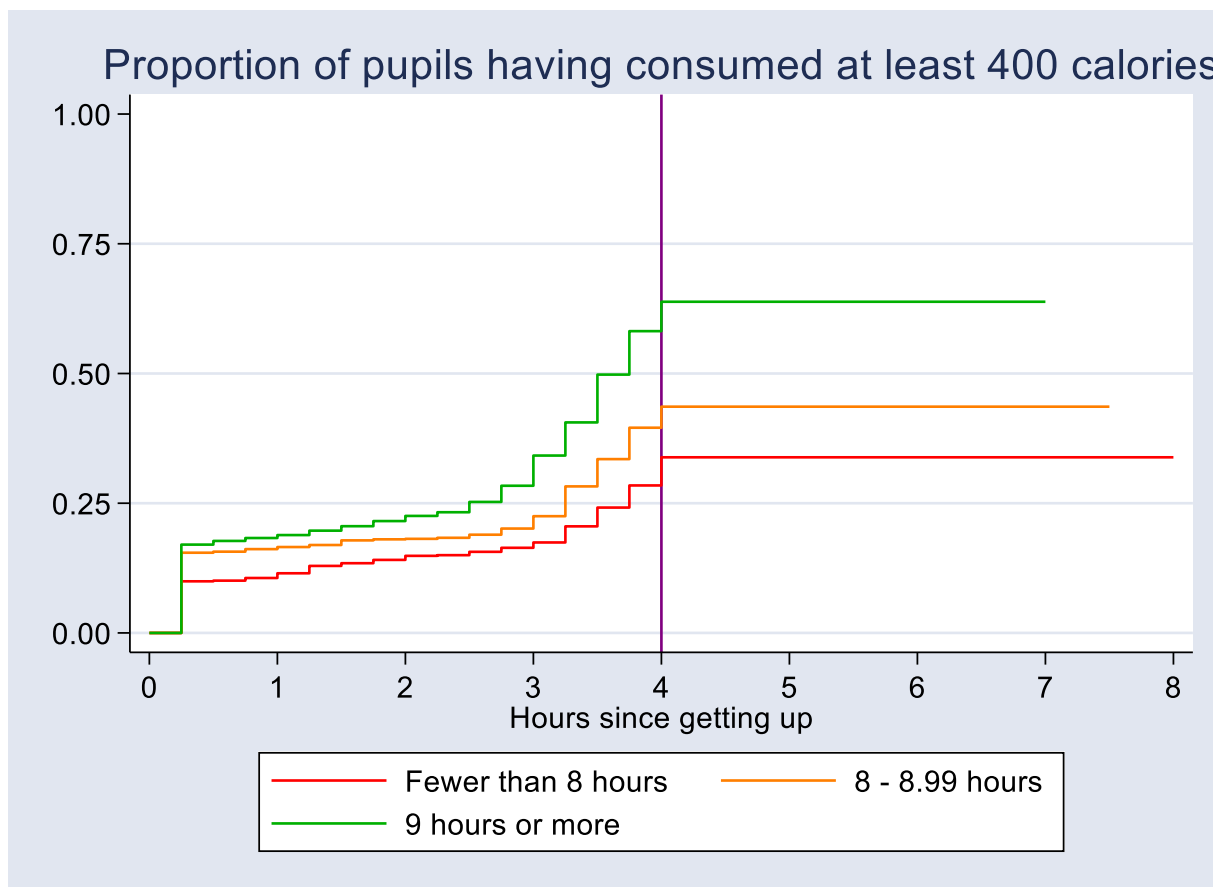
In this case, we cannot perform a Wilcoxon rank-sum test, as the test is based on just two groups – not three.

Tables 29 & 30 summarise some of the main results in **Figure 31**.

Table 29: Impact of hours in bed on breakfast habits at home

Calories at home/Hours in bed	Fewer than 8 hours	8 – 8.99 hours	9 hours or more
400 or more	77 (9.9%)	157 (15.6%)	120 (17.0%)
Fewer than 400	697 (90.1%)	852 (84.4%)	585 (83.0%)
Totals	774	1,009	705

χ^2 = 17.59 (p < 0.01)

Table 30: Impact of hours in bed on eating habits during first 4 hours

Calories within 4 hours/Hours in bed	Fewer than 8 hours	8 – 8.99 hours	9 hours or more
400 or more	262 *(33.9%)*	440 *(43.6%)*	450 *(63.8%)*
Fewer than 400	512 *(66.1%)*	569 *(56.4%)*	255 *(36.2%)*
Totals	**774**	**1,009**	**705**

χ^2 = 138.33 (p < 0.01)

Although the effect of hours in bed on breakfast habits at home is not all that dramatic, it has a very significant impact at the end of 4 hours.

Hours in bed are more meaningful than bedtime because a pupil who lives very close to school may be able to get up later than a pupil who has a long journey to school. Therefore, although they may go to bed later, they may get more sleep. In addition, not all school days start at the same time.

The NHS recommends 9-12 hours' sleep a night for children aged 6-12 years old and 8-10 hours for teenagers aged 13-18 years old.[1] **In the present survey, younger pupils *(Years 8 and 9)* spent on average 8 hours 39 minutes in bed, while older pupils *(Years 10-12)* spent on average 8 hours 06 minutes in bed.** One girl from Year 10 spent just 6 hours 15 minutes in bed.

According to the **British Nutrition Foundation** (www.nutrition.org.uk), a healthy lifestyle includes getting enough sleep. Chronic lack of sleep can affect health, increase vulnerability to colds and infections, and is linked to severe health conditions such as obesity in children and adolescents. A lack of sleep can also harm mood. Sleep is essential for cognitive skills such as communicating well, memory and creative thinking.

Not getting enough sleep has been linked to a higher energy intake, eating more snacks, and snacking on less healthy foods. Being sleep-deprived can also change levels of hormones involved in appetite, which might increase feelings of hunger and lead to the consumption of more food than the body needs.'

Given that many pupils have late bedtimes, it may not be sensible to suggest they get up earlier to have a 'proper' breakfast at home. **Breakfast at school may be wiser.**

Most schools with breakfast clubs serve breakfast in the canteen before the formal school day. One wonders whether a simple breakfast served in the classroom during morning registration may be a better idea. This would enable pupils to spend longer in bed at night. I shall say more about this when I make some policy recommendations.

11. Logistic regression analysis – basic principles

Kaplan-Meier plots and the Wilcoxon Rank-Sum test are very much in the realms of **univariable analysis**. Here we consider the effect of one independent variable *(alone)* on our dependent variable. However, this can lead to problems.

As explained in the previous section, a univariable analysis may suggest a significant relationship between gender and breakfast habits <u>and</u> between age and breakfast habits. It may fail to reveal only a significant relationship between gender and breakfast habits for a particular age group. For other ages, there may be no significant relationship. This is where **multivariable analysis** comes into its own – it can deal with several predictor variables simultaneously and allow for interrelationships between these variables.

In general terms, **interaction** *(or **effect modification**, as it is sometimes called)* refers to the situation where the association between an exposure and an outcome varies according to the level of a third factor. Effect modification may help us understand an association better, and we should aim to detect and report it.

Logistic regression is used where the response variable is a binary categorical variable, i.e., taking only two values. In our case, an individual pupil has consumed a minimum of 400 calories within 4 hours of rising – or they haven't.

If they have consumed at least 400 calories, the dependent variable is given the value '1'; if they have not, it is given the value '0'.

The **odds** of an event occurring is the probability of the event occurring (denoted as π) divided by the probability of the event not occurring ($1 - \pi$).

When the odds equal 1, the event of interest is just as likely to happen as not to happen (π = 0.5). When it is greater than 1, it implies that the probability of the event occurring is greater than the probability of the event not occurring (π > 0.5); similarly and conversely, when the odds are smaller than 1 (π < 0.5).

The **odds ratio** is the odds of an event in one group divided by the odds of the event in a second group. So, one possible odds ratio will be the odds of a boy having consumed at least 400 calories divided by the odds of a girl having consumed at least 400 calories.

Interaction allows for the possibility that *(for example)* the odds ratio between boys and girls differs with age. So, although it may be close to 1.00 for all ages combined, it may be less than 1.00 for younger ages but greater than 1.00 for older ages.

If the odds ratio is 1.20 (*for a particular age range)*, it will imply that *(within this age range)* the odds of a boy having consumed at least 400 calories is 20% higher than the odds of a girl having consumed at least 400 calories.

Odds refer to a ratio of probabilities, while odds ratios refer to a ratio of odds.

Although our sample of 2,488 pupils may seem impressive, it is only a sample. We are only interested in our sample results to the extent that they allow us to draw inferences about the likely results in the population (68,392 pupils). For example, our sample odds ratio enables us to:

1. Test hypotheses concerning the value of the population odds ratio.

2. Calculate 95% *(or whatever)* confidence intervals for the value of the population odds ratio.

To calculate a 95% confidence interval for the actual *(population)* odds ratio, the logarithm *(natural – to base e)* is better approximated by a normal distribution than the odds ratio itself. Stata 17 makes 'light work' dealing with natural log odds ratios and standard errors. After the estimates have been made, Stata 17 can exponentiate the 95% confidence interval *(for the natural log of the odds ratio)* to give us the corresponding interval for the true odds ratio.

Epidemiologists are well-used to working with odds ratios, but this idea can seem odd *(sorry!)* to others.[7]   The danger with simple linear regression when the dependent variable is a probability *(the probability of a pupil reaching the 400 calorie milepost)* is that the estimates *(predictions)* made by the analysis can easily be 'ridiculous' *(impossible)* values. Probabilities must lie between 0 and 1, but we could find that our predicted probabilities were either less than 0 or greater than 1.

Dealing with log odds gets around this problem. While probabilities must lie between 0 and 1, odds can lie anywhere between 0 and infinity. Log odds can lie anywhere between minus infinity and plus infinity – that is, they can take any value – there are no 'impossible' values.

Once a log odds ratio has been estimated, it can be converted to an odds ratio. If we know the 'baseline' odds *(the odds in a reference group)*, we can then calculate the odds in the group of individuals that interest us. Once the odds are known, it is a simple calculation to work out the estimated probability.

This is put into practice in Section 14 *(predictions of the multiple regression model),* and the results are shown in **Tables 33 – 38**. It will be noticed that none of the estimated probabilities is 'ridiculous' *(the lowest is 0.12, and the highest is 0.71).*

Given all this background, logistic regression is a mathematical modelling approach used to describe the relationship between several predictors and a binary dependent variable. Of course, the simplest logistic regression model has just one predictor variable *(univariable analysis),* but a multivariable analysis *(with several predictors)* is more common.

For logistic regression to be a valid analysis method, certain assumptions should *(ideally)* be met.[5] These are:

- The predictor variables included in the model are independent of each other.

- There is a linear relationship between the predictor variables and the logit function of the outcome.

- There is no multicollinearity.

- The data contains no enormously influential observations.

Fortunately, it seems likely that these four conditions will be broadly satisfied in our study.

The **first criterion** concerns the **independence of predictor variables**. As the results section *(Section 13)* will show, the five predictor *(explanatory)* variables used were:

- Gender *(boy or girl)*

- Age *(Year Group – younger or older)*

- Economic prosperity *(low, medium, or high)*

- Usual time in bed on a school night *(short, medium, or long)*

- Breakfast club status *(school usually offers breakfast; school doesn't offer breakfast)*

The following variables were <u>not</u> used in making the estimates shown in **Tables 33 – 38**:

- Location of school *(such as Co. Antrim or Co. Down)*

- School size *(small, medium, or large)*

- Type of area *(rural or urban)*

- Type of school *(boys only, girls only, or co-ed)*

- Educational attainment *(Grammar or Secondary School)*

- Religious affiliation of school *(Catholic, Protestant, or Integrated)*

These last six variables were <u>not</u> irrelevant in the study because they were used to help ensure the 18 schools sampled represented all 193 secondary schools.

It seems reasonable to assume that the five predictor variables listed above are independent. There is some dependence between age and time in bed, but *(as already shown)*, the dependence is far less than expected. It is unlikely to invalidate the statistical methods.

The **second criterion** concerns **linear relationships**. Suppose pupils from areas of high economic prosperity are less likely to skip breakfast than pupils from areas of low economic prosperity. In that case, it seems likely that the figure for pupils from areas of medium prosperity will lie somewhere between the two. If pupils who have less than 8 hours in bed are more likely to skip breakfast than pupils who have 9 or more hours in bed, it seems likely that the figure for pupils who have between 8 and 8.99 hours in bed will lie somewhere between the two.

The **third criterion** concerns **multicollinearity**. Multicollinearity occurs when a predictor variable can be estimated as a linear function of one or more other predictors with some accuracy. This can cause problems in interpretation and produce misleading or invalid results. It is sometimes surprising that a high correlation between variables does not necessarily indicate multicollinearity. There is no 'obvious' reason why multicollinearity should be a problem in this study.

The **fourth criterion** concerns **outliers**. As with simple linear regression, observations far from the general data pattern can disproportionately impact the fitted model. Observations with a high level of influence should be further investigated, and sensitivity analysis should be carried out to find the effect of these individuals. A quick look at the student questionnaire suggests outliers should not be a significant problem in this study. The questionnaire was designed to keep answers 'within bounds'!

Appendix 4 contains a brief note on Cox regression, which is sometimes used instead of logistic regression.

Appendix 5 contains a brief note about multilevel models in logistic regression analysis – these are sometimes used when the data is 'nested'.

12. Goodness of fit in logistic regression analysis – basic principles

After fitting a valid model to a set of data, it is natural to enquire how much the fitted *(predicted)* values of the response variable in the model compare with the observed values. The model may be acceptable if the agreement between the observations and the corresponding fitted values is good. If not, the model will not be accepted and will need to be revised. Goodness of fit is the name given to this aspect of the adequacy of a model. An ill-fitting model is said to display lack-of-fit.

There are several ways in which a fitted model may be inadequate. For example:

- The model may exclude explanatory variables that should have been in the model.

- The data may contain particular observations *(termed – outliers)* that are not well-fitted by the model.

- A variable may have been specified wrongly *(for example, confusing the area of a circle – πr^2 with the corresponding circumference – $2\pi r$).*

The techniques used to examine the adequacy of a fitted model are known as **diagnostics**. In simple linear regression, such diagnostic procedures involve calculating residuals – the distances between the observed and fitted values under the assumed model. The ordinary least squares (OLS) method minimises the sum of the squared residuals. In this simple model, it is sometimes helpful to examine plots of residuals against explanatory variables. However, plots of residuals in logistic regression are not of much help and are not generally used.

Several numerical methods exist for assessing the goodness of fit of a logistic model. One of them is the **deviance (D)** measurement. D can be thought of as representing the extent to which the **current fitted model** deviates from the **full model**. The full model is the model that contains a parameter for every observation in the dataset so that the data are fitted perfectly. It can be considered as the difference between the observed and expected values. In mathematics, D is equal to (-2 x log-likelihood). Stata 17 calculates the log-likelihood, and the deviance can be obtained from this.[4]

Large D values indicate that the fitted model is poor *(as there is large deviance from the 'perfect' model)*, whereas small D values suggest that the model is good. D values are not very informative in isolation but can be used to compare **nested models**. A model is nested if it is a subset of another model.

For example, a model investigating the relationship between breakfast skipping and gender is nested in another investigating the relationship between breakfast skipping and gender and age. However, a model investigating the relationship between breakfast skipping and gender is <u>not</u> nested in a model investigating the relationship between breakfast

skipping and age. Nested models can be compared using the model deviances. This is known as the **likelihood ratio test** and is based on the chi-square distribution.

A model with lower deviance fits the data better than a model with higher deviance. However, we should also consider how many independent variables are included when interpreting deviance. If the amount of deviance change is small when independent variables are added, these additional variables do not add significantly to the model fit and may reasonably be excluded.

What we have is a sort of cost-benefit analysis. The model that fits the data better has more independent variables but is more complicated than the more straightforward, less accurate model. Goodness of fit is a benefit, while many variables making for a complicated model is a cost. Sometimes, the predictions made by a simple model are almost as accurate as those made by far more complicated models.

Fortunately, a hypothesis test exists that compares model deviances and determines whether additional predictors sufficiently increase the model's fit.

The null hypothesis being tested is that the simpler model *(the model with the fewer predictor variables)* is not significantly different to the more complex one. The test assumes that the difference in deviances follows a chi-squared distribution with k *(the difference in the number of parameters)* degrees of freedom. **Table 31** shows the minimum deviance needed for each additional parameter to improve fit significantly and for us to reject the simpler model.

Table 31: Minimum difference in deviance required to accept additional parameters

Number of additional parameters	Difference in deviance needed for $p < 0.05$	Difference in deviance needed for $p < 0.01$
1	3.84	6.63
2	5.99	9.21
3	7.81	11.34
4	9.49	13.28
5	11.07	15.09
6	12.59	16.81

The 'basic' model contains the one predictor variable with the lowest deviance. Stata 17 can 'automatically' add other predictor variables in a method known as **'stepwise regression'**. This needs to be used with care, as automatic methods don't consider the scientific or practical reasons for including/excluding certain variables. Automated methods are no substitute for common sense!

Stepwise regression is a combination of forward and backward searches. Forward searches add variables to the model until there is no significant decrease in the deviance. Backward searches remove variables from a model until there starts to be a substantial increase in deviance.

The underlying principle is that the more variables included, the better the model fit and the lower the deviance. However, small changes will not warrant the inclusion of the additional variables. Model selection aims to find the subset of covariables that produces the most parsimonious model, i.e., achieves 'a lot' with 'relatively few' variables.[8]

The **Wald test** is similar to the likelihood ratio test but is based on the value of the fitted quadratic approximation to the log-likelihood ratio at the null value of the parameter of interest rather than the actual value of the log-likelihood ratio at this point. **The Wald and likelihood ratio tests often yield very similar results.**

More commonly, the Wald test is carried out as a z-test, using the square root of the likelihood ratio statistic. The Wald statistic follows a standard normal distribution – since a x^2 distribution with 1 d.f. is equivalent to the square of a standard normal distribution.

13. Multivariable analysis – results

So much for the theory – let's now put it into practice! Five explanatory variables were chosen for possible inclusion in the logistic regression analysis:

1. Pupil gender *(0 for boys; 1 for girls; 2 for other)*
2. Year at school *(0 for Years 8 & 9; 1 for Years 10-12)*
3. Prosperity of catchment area *(0 for low; 1 for medium; 2 for high)*
4. Hours in bed at night *(0 for less than 8 hours; 1 for 8-8.99 hours; 2 for 9 hours or more)*
5. School breakfast provision *(0 if breakfast not usually served; 1 if breakfast usually served)*

An initial run of the analysis *(using the 'inclusion method' of stepwise regression)* revealed some 'statistical problems.' For example, the constant term *(which estimates the baseline odds)* differed from what one would have expected *(looking at the results of the univariable analysis)*, and there was lack-of-fit.

The 'issue' appeared to be the 111 pupils *(out of 2,488 – 4.5%)* who did not wish to be classified as 'boy or girl'. It was therefore decided to re-run the model excluding these 111 pupils and just including the 1,181 boys and the 1,196 girls. This resulted in a much better 'fit' as shown by the likelihood ratio test.

This idea of restricting the logistic regression analysis to the 2,377 pupils identified as boys or girls has already been mentioned. Perhaps the primary justification is that it follows the decision to present the HBSC results in this way. *Again, I should point out that pupils who did not wish to be classified as boys or girls are worthy of further study, but we will not get very far when we have only 111 such pupils.*

As we know, the univariable analysis had suggested an interaction between pupil gender and age. So, it was decided to re-run the stepwise regression, including the possibility of an interaction term. This showed that **pupil gender was a significant determinant of breakfast habits – though it needed to be considered with age – not on its own.**

The stepwise regression was also performed 'the other way round', starting with a complete model *(with all variables included)* and excluding any variable with $p > 0.05$ using the Wald test.[4] **This resulted in identical results to the 'inclusion method'.**

The Stata output for the fitted model is shown below. The p-value for pupil gender *(without reference to age)* was 0.1386 (>0.05), and so this explanatory variable was removed from the complete model *(and not added to the primary, simpler model)*. Although pupil gender was **excluded** for the 1,241 younger boys and girls, it was **included** in the case of 1,136 older boys and girls. Indeed, it was the most critical variable in the stepwise regression for these pupils.

```
Wald test, begin with full model:
p = 0.1386 >= 0.0500, removing LRPupilGender

Logistic regression                              Number of obs =  2,377
                                                 LR chi2(5)    = 226.08
                                                 Prob > chi2   = 0.0000
Log likelihood = -1529.1163                      Pseudo R2     = 0.0688
```

Milepost	Odds ratio	Std. err.	z	P>|z|	[95% conf. interval]	
LRPupilGender#Year2Cat						
0#Years 10/11/12	1.446984	.1835043	2.91	0.004	1.128537	1.85529
LRYear2Cat	.6694855	.072927	-3.68	0.000	.540779	.8288243
LRProsperity	1.372028	.0715112	6.07	0.000	1.23879	1.519596
LRSchBreakfast	2.231682	.242616	7.38	0.000	1.803409	2.761659
LRSleepCat	1.73275	.1029277	9.25	0.000	1.542316	1.946697
_cons	.2046755	.0298293	-10.88	0.000	.1538198	.2723452

Note: **_cons** estimates baseline odds.

Table 32 summarises the results of the stepwise logistic regression. **The five explanatory variables are shown in the order indicated** (1. 2. 3. 4. & 5.) **by the Wald test** *(and the likelihood ratio test)*.

Table 32: Results of the logistic regression analysis

Explanatory Variable	Odds Ratio	p value*	95% confidence interval
1. Pupil Gender for boys in Years 10 - 12 *categorical*	1.45	0.004	1.13 to 1.86
2. School Year *categorical*	0.67	<0.001	0.54 to 0.83
3. Economic Prosperity *categorical*	1.37	<0.001	1.24 to 1.52
4. School Breakfast *categorical*	2.23	<0.001	1.80 to 2.76
5. Hours in bed *categorical*	1.73	<0.001	1.54 to 1.95
Baseline Odds	**0.20**	**<0.001**	**0.15 to 0.27**

*The p-value indicates the probability of observing the sample odds ratio *(or baseline odds)* if the actual *(population)* odds ratio *(or baseline odds)* is, in fact, 1.00

The baseline refers to:

- A boy or girl in Year 8 or 9;

- Who attends a school with a low prosperity catchment area;

- Which never runs a breakfast club;

- Who spends less than 8 hours in bed at night.

The predicted odds are 0.20, giving an estimated probability of such a pupil having eaten at least 400 calories within 4 hours of rising, equal to 0.17. *(0.20 / 1.20 = 0.17)* – as shown in **Table 33**.

14. Predictions of the multiple logistic regression model

Equivalently to simple logistic regression *(which involves only one explanatory variable)*, a prediction can be made where more than one predictor has been considered. By substituting the specific values of the set of predictors into the model, the estimated odds of the event are computed.   We can then use the estimated parameters to predict the likely effect on breakfast habits if, say:

- all secondary schools in Northern Ireland were required to offer breakfast at the start of the school day

- all school pupils were to have 9 hours or more in bed at night.

We can use the fitted model to estimate the chance that a pupil with specific characteristics will have reached the milepost.

If our 'baseline' pupil had between 8 and 8.99 hours in bed a night, the estimated odds would increase to 0.35 *(0.20 x 1.73)*, which gives a probability of consuming at least 400 calories within 4 hours or rising of 0.26

If the pupil had nine or more hours in bed at night, the estimated odds would increase to 0.60 *(0.20 x 1.73 x 1.73)*, which gives a probability of 0.38

If the pupil had nine or more hours in bed <u>and</u> their school started offering breakfast, the estimated odds would rise to 1.33 *(0.20 x 1.73 x 1.73 x 2.23)*, which gives a probability of 0.57

As a final example, the estimated odds of a boy in Years 10, 11, or 12; who attends a school in an area of high prosperity; that offers breakfast; and who spends nine or more hours in bed at night passing the 400 calorie

milepost within 4 hours is 2.43 *(0.20 x 1.45 x 0.67 x 1.37 x 1.37 x 2.23 x 1.73 x 1.73)*, which gives a probability of 0.71 (2.43 / 3.43 = 0.71) – as shown in **Table 38.**

With two gender categories *(for pupils in Years 10-12)*; two school year categories; three economic prosperity categories; two school breakfast categories; and three hours in bed categories, there are **54 categories** in total. The estimated probabilities for each are shown in **Tables 33 – 38. No distinction is made between boys and girls in Years 8 or 9.**

The calculation of the five probabilities in purple has been shown above.

Table 33: Year 8-9 pupils attending school in a low prosperity area
Boys and girls have the same estimated probabilities

Hours in bed / Breakfast Club	No breakfast club	Breakfast club
Fewer than 8 hours	0.17	0.31
8 – 8.99 hours	0.26	0.44
9 or more hours	0.38	0.57

Table 34: Year 10-12 pupils attending school in a low prosperity area ***Boys and girls have different estimated probabilities***

Hours in bed / Breakfast club / Pupil Gender	No club Boys	B'fast club Boys	No club Girls	B'fast club Girls
Fewer than 8 hours	0.16	0.30	0.12	0.23
8 – 8.99 hours	0.25	0.43	0.19	0.34
9 or more hours	0.37	0.56	0.29	0.47

Table 35: Year 8-9 pupils attending school in a medium prosperity area ***Boys and girls have the same estimated probabilities***

Hours in bed / Breakfast club	No breakfast club	Breakfast club
Fewer than 8 hours	0.22	0.38
8 – 8.99 hours	0.32	0.51
9 or more hours	0.45	0.65

Table 36: Year 10-12 pupils attending school in a medium prosperity area *Boys and girls have different estimated probabilities*

Hours in bed / Breakfast club / Pupil Gender	No club Boys	B'fast club Boys	No club Girls	B'fast club Girls
Fewer than 8 hours	0.21	0.37	0.16	0.29
8 – 8.99 hours	0.32	0.51	0.26	0.41
9 or more hours	0.44	0.64	0.35	0.55

Table 37: Year 8-9 pupils attending school in a high prosperity area *Boys and girls have the same estimated probabilities*

Hours in bed / Breakfast club	No breakfast club	Breakfast club
Fewer than 8 hours	0.27	0.46
8 – 8.99 hours	0.39	0.59
9 or more hours	0.53	0.71

Table 38: Year 10-12 pupils attending school in a high prosperity area *Boys and girls have different estimated probabilities*

Hours in bed / Breakfast club / Pupil Gender	No club Boys	B'fast club Boys	No club Girls	B'fast club Girls
Fewer than 8 hours	0.27	0.45	0.20	0.36
8 – 8.99 hours	0.39	0.58	0.30	0.49
9 or more hours	0.52	0.71	0.43	0.63

It should be remembered that these estimated probabilities are based on the results of a logistic regression model using data from 2,377 *pupils (not 2,484 pupils).* 1,117 *(47.0%)* had reached the 400 calorie milepost within 4 hours of rising.

There is considerable variation in the 54 estimated probabilities around this figure of 0.47. The lowest probability is 0.12 *(Table 34),* and the highest probability is 0.71 *(Tables 37 and 38).* By any standards, our five explanatory variables significantly affect breakfast habits.

A few observations can be made:

❖ School Year Group is <u>not</u> relevant in the case of boys.

- ❖ School Year Group is relevant in the case of girls. Older girls are more likely to skip breakfast *(not reach the 400 calorie milepost within 4 hours)* than younger girls.

- ❖ Gender is not relevant in the case of younger pupils. The probabilities for boys and girls are the same.

- ❖ Gender is relevant for older pupils. Breakfast skipping is more prevalent in older girls than older boys.

- ❖ The economic prosperity of the school catchment area is relevant. As prosperity increases *(other things equal),* the probability of breakfast skipping falls.

- ❖ Hours spent in bed at night are relevant. As hours increase, the probability of skipping breakfast falls.

- ❖ Whether the school *(usually)* runs a breakfast club is relevant. Schools that run breakfast clubs have lower probabilities of breakfast skipping *(other things equal)* than schools that don't.

The exact extent to which the 54 predicted probabilities lie above or below 0.47 is more challenging to comment on, as any judgement will be largely subjective.

Although the relevance of age *(for girls)*, gender *(for older pupils)*, and economic prosperity did not surprise me, I was surprised by how much hours in bed and school breakfast provision were important. **The predictions shown in the tables suggest that increasing hours in bed from fewer than 8 hours to 9 hours or more can raise the estimated probability of passing the milepost by 20% or more *(in absolute terms)*. Increases of up to 20% can also be achieved by a non-breakfast club school starting to offer breakfast.** I shall have more to say about this later.

15. Goodness of fit – results

Unfortunately *(unlike in simple linear regression)*, there is no simple measure of goodness of fit *(such as R^2 – the coefficient of determination).* The more sophisticated measures for multivariable logistic regression are of limited value in our case because the estimates of calorie intake in this study have been somewhat 'rough and ready'. There is no claim that the

calorie counts are accurate at the individual pupil level – they could well be out by a margin as large as 50%. What is claimed is that by the time we move to school-level statistics *(where the minimum sample size is 49 pupils – Dundonald High School)*, the mean calorie counts are reasonably accurate. Suppose an individual pupil's estimated calorie count is 50% above *(or below)* the actual count. In that case, there is no reason to believe they are more likely to attend one particular school than any other.

Some of the 'simpler' measurements of the goodness of fit *(such as areas under ROC curves)* refer to the **predictions' sensitivity and specificity**. Sensitivity measures how good the model predicts that a pupil who passes the milepost did pass it. It penalises false negatives.   Specificity estimates how good the model predicts that a pupil who didn't reach the milepost failed to achieve it. It penalises false positives. The basic idea is illustrated in **Table 39**.[7]

Table 39: Measuring the validity of a predicted result

Prediction/Fact	Fact – did reach milepost	Fact – didn't reach milepost
Prediction – Did reach milepost	True positive – A	False positive – B
Prediction – Didn't reach milepost	False negative – C	True negative – D
Totals	**A + C**	**B + D**

❖ **Sensitivity = A / (A + C)** *(also called the true positive rate - TPR)*

❖ **Specificity = D / (B + D)**

❖ **1 – specificity = B / (B + D)** *(also called the false positive rate - FPR)*

We used stepwise regression *(using both the Wald test and likelihood ratio test)*. Therefore, we can be reasonably confident that our fitted model is the best when using logistic regression. However, **how good is the best?** This is where the **ROC curve** can be of use.

ROC stands for 'Receiver Operating Characteristic'. Technically speaking, a receiver operating characteristic curve is a graphical plot that illustrates the diagnostic ability of a binary system of classification. The method was initially developed during World War II for operators of military radar receivers, which led to its name. The ROC curve is created by plotting the true positive rate (TPR) against the false positive rate (FPR) at various threshold levels.[9]

The log-likelihood statistic has little meaning to anyone not involved in the study. The log-likelihood for our 'best-fit' model is -1529, but an independent observer would have no idea of whether this is 'impressive' or 'shameful'. In contrast, the area under the ROC curve does have a meaning that an independent observer can appreciate.

The area under a ROC curve has a maximum value of 1.00. If perfect discrimination between breakfast eaters and breakfast skippers were achievable, it would be possible to have no false positives and no false negatives. In that case, the ROC curve would go across the top of the grid area in **Figures 32 and 33** and yield an area of 1. The ROC curve will be the straight diagonal line if the fitted model cannot discriminate between breakfast eaters and breakfast skippers. This line shows sensitivity = 1 – specificity *(or the true positive rate = the false positive rate)*, and **the area under this curve is 0.5 *(the minimum possible value)*.**[5]

The ROC curve imagines changing our 'milepost' from a fixed value of 400 calories and allowing it to move up and down. If it were set at zero calories, we would correctly predict that everyone had reached the milepost. There would be no false negatives, and so sensitivity would be 1. On the other hand, if the milepost were set at 2,000 calories *(more than the maximum observed in any of the 2,377 pupils),* we would correctly predict that nobody had reached the milepost. There would be no false positives, and so specificity would be 1.

As a 'gentle' introduction to ROC curves in practice, we might consider an economics undergraduate who has studied Engel's Law and wants to examine the link between economic prosperity and breakfast habits. They construct a simple logistic regression model with just **one** explanatory categorical variable:

- Economic prosperity of catchment area *(low, medium, or high)*

Using the data in the current study for the 2,377 boys and girls, they would obtain the following output from Stata 17:

```
. logistic _d LRProsperity if LRPupilGender!=2
```

```
Logistic regression                                    Number of obs =   2,377
                                                       LR chi2(1)    =   35.27
                                                       Prob > chi2   =  0.0000
Log likelihood = -1625.6713                            Pseudo R2     =  0.0107
```

_d	Odds ratio	Std. err.	z	P>|z|	[95% conf. interval]	
LRProsperity	1.340278	.0665322	5.90	0.000	1.21602	1.477233
_cons	.6257412	.0453568	-6.47	0.000	.5428696	.7212635

Note: **_cons** estimates baseline odds.

Figure 32 shows the ROC curve associated with this estimated model.

Figure 32: ROC curve with ONE explanatory variable (Prosperity of catchment area)

Area under ROC curve = 0.5683
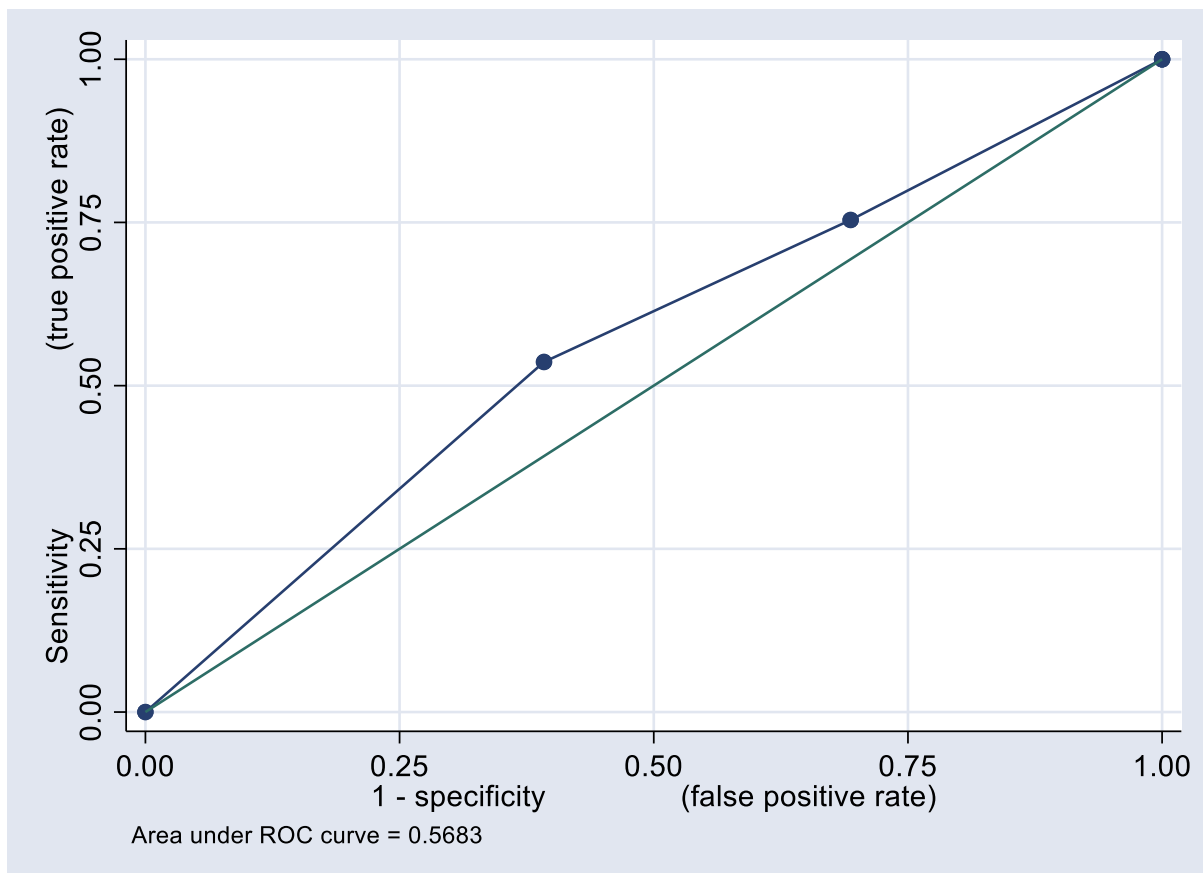
The area under this ROC curve is 0.57.

Let's compare this simple model with the model that we have fitted. This model includes **five** explanatory categorical variables:

- Gender *(for pupils in Years 10-12; boy or girl)*

- School Year *(Years 8 and 9, or Years 10, 11, and 12)*

- Economic prosperity of catchment area *(low, medium, or high)*

- Breakfast provision at school *(yes or no)*

- Time in bed *(less than 8 hours; 8-8.99 hours; 9 or more hours)*

It will be recalled that the Stata 17 output for this model was as follows:

```
Wald test, begin with full model:
p = 0.1386 >= 0.0500, removing LRPupilGender
```

Logistic regression   Number of obs = 2,377
                                                       LR chi2(5)   = 226.08
   Prob > chi2   = 0.0000
Log likelihood = -1529.1163   Pseudo R2   = 0.0688

Milepost	Odds ratio	Std. err.	z	P>|z|	[95% conf. interval]	
LRPupilGender#Year2Cat						
0#Years 10/11/12	1.446984	.1835043	2.91	0.004	1.128537	1.85529
LRYear2Cat	.6694855	.072927	-3.68	0.000	.540779	.8288243
LRProsperity	1.372028	.0715112	6.07	0.000	1.23879	1.519596
LRSchBreakfast	2.231682	.242616	7.38	0.000	1.803409	2.761659
LRSleepCat	1.73275	.1029277	9.25	0.000	1.542316	1.946697
_cons	.2046755	.0298293	-10.88	0.000	.1538198	.2723452

Note: **_cons** estimates baseline odds.

It is interesting to note that the estimated odds ratio for the explanatory variable – prosperity, is almost identical in both the univariable and multivariable models.

Figure 33 shows the ROC curve associated with the multivariable model. **The area under the ROC curve is 0.67.**

Figure 33: ROC curve with FIVE explanatory variables (Gender; School Year; Economic Prosperity; School Breakfast provision; and Hours in bed)

Area under ROC curve = 0.6729
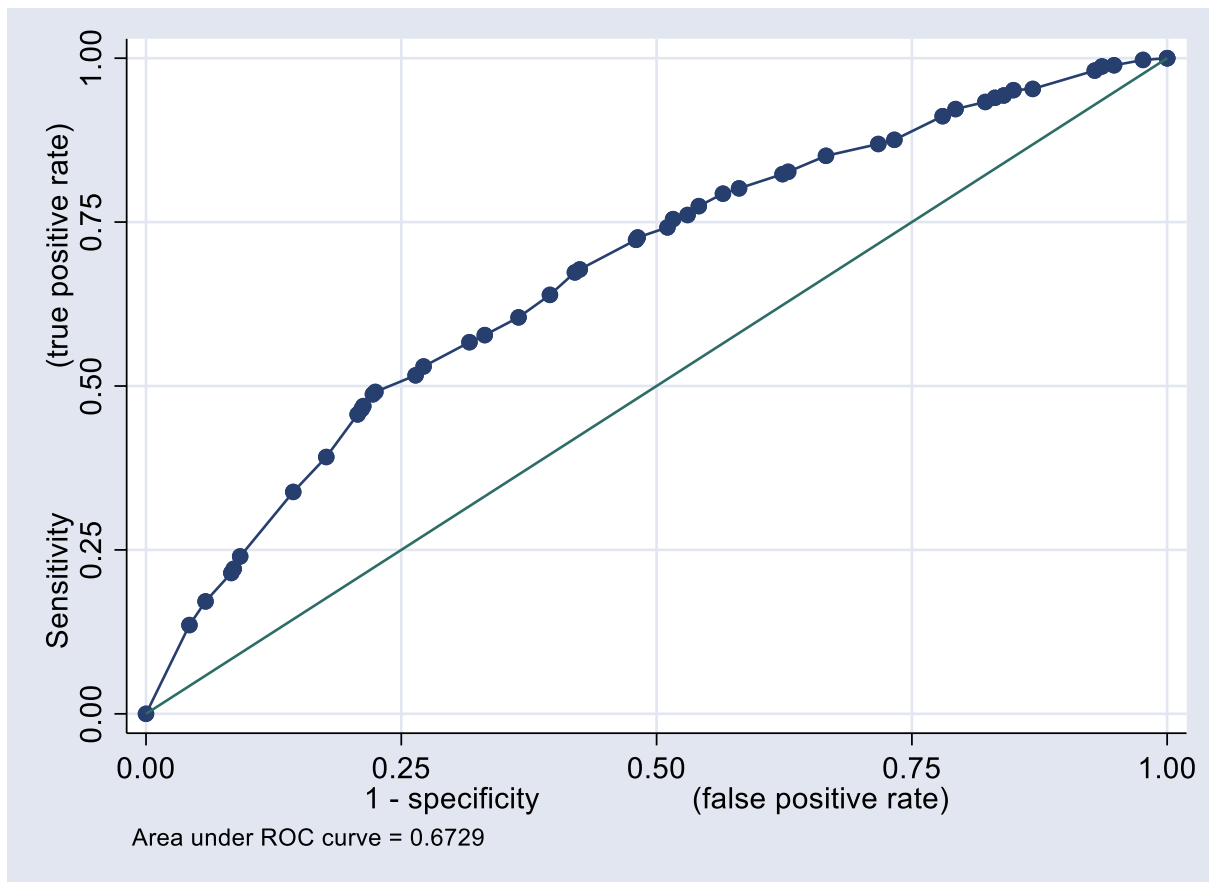
The increase in area from 0.57 to 0.67 (0.10) measures the superiority of the more complex model – the improvement in fit.

The multivariable model has four more parameters than the univariable model, and as a consequence, the log-likelihood increases from -1625.67 to -1529.12. This is an increase of 96.55. **Table 31** shows that the difference in deviance needed for p<0.01 with four additional parameters is 13.28. Our difference is 96.55 is well over 13.28. This confirms the superiority of the more complex model.

To give some sense of proportion to the area under the ROC curve of 0.67, I will quote a value from a completely different study. In the textbook 'Statistics in Medicine' by Riffenburgh and Gillen, the authors refer to extensive research conducted into the validity of the PSA test in predicting whether a man has prostate cancer. They consider the truth of the test result as indicated by a biopsy. The area under the resultant ROC curve was 0.71. The study concluded that the PSA test is far from perfect but

worth doing. There is, however, room for improvement. Reported values of around 0.70 are common in the published literature.[9] Our value of 0.67 is 'quite respectable.'

In reality, we are <u>not</u> particularly interested in knowing how accurate our model is at predicting whether an INDIVIDUAL pupil passes the 400 calorie milepost or not. ROC curves can be valuable diagnostic techniques in clinical settings such as cancer screening, where sensitivity and specificity have more concrete meanings. However, in our case, are false negatives that lower sensitivity any worse than false positives that lower specificity?[10] False negatives arise when we fail to predict a pupil has reached the milepost when they have. False positives occur when we expect a pupil has reached the milepost when they haven't.

Our concern is more at the SCHOOL LEVEL. How good is the model at predicting the <u>proportion</u> of pupils who reach the milepost? We can claim that our model has a good fit if it gives accurate predictions at the whole-school level. If it predicts that 75% of the pupils at a school will reach the milepost when in fact, 75% do, we will be impressed – even if it has made some wrong predictions at the individual pupil level.

A more rough and ready method of assessing goodness of fit seems called for. **We are attempting to decide 'should a school offer breakfast to ALL its pupils', not 'should it offer breakfast to a SPECIFIC pupil'?**

One possible approach is to go back to our observed data at the school level and consider how well it ties in with the predictions shown in **Tables 33-38**. Do the predictions fit the school-level data well?   Data at the school level *(for the 2,377 pupils classified as boy or girl)* is given in **Table 40.** It differs from **Table 14** because it excludes the 111 pupils who did not wish to be classified as boy or girl.

Table 40: Proportion of pupils reaching milepost by school – 2,377 pupils *(only boys and girls – not 'other')*

School Code Number and Name	Yes	No	Proportion Yes
1. Aughnacloy College	8	44	0.15
2. Bangor Grammar School	99	31	0.76
3. Dundonald High School	11	34	0.24
4. Edmund Rice College	35	23	0.60
5. Friends' School, Lisburn	101	33	0.75
6. Kilkeel High School	36	44	0.45
7. Killicomaine Junior High	81	170	0.32
8. Larne High School	45	82	0.35
9. Loreto College, Coleraine	172	195	0.47
10. Malone Integrated College	50	87	0.36
11. Methodist College, Belfast	34	57	0.37
12. Oakgrove Integrated College	22	28	0.44
13. Our Lady & St Patrick's	108	55	0.66
14. Portadown College	49	79	0.38
15. St Fanchea's College	29	21	0.58
16. St Joseph's Grammar	61	31	0.66
17. St Louise's Comprehensive	112	132	0.46
18. St Mary's Christian Brothers'	64	114	0.36
All 18 schools	1,117	1,260	0.47

The proportion of pupils reaching the milepost at the 18 schools ranged from a minimum of 0.15 to a maximum of 0.76. The lowest estimated proportion is 0.12 (see **Table 34**), and the highest estimated proportion is 0.71 (see **Tables 37 & 38**). This indicates that the estimated proportions reported in **Tables 33-38** are in keeping with the observed proportions – **the range is about right.**

Table 41 ranks the 18 schools from the lowest *(just 15% reached the 400 calorie milepost)* to the highest *(76% of pupils achieved the milepost).* It also shows:

1. Which prosperity group the school is in

2. Whether the school usually offers breakfast

3. Whether *(on average)* the pupils at the school had more or less time in bed than the average for all 2,377 pupils *(8 hours 24 minutes)*

Table 41: Proportion of pupils reaching milepost and information on three predictors

School No.	Prosperity	Breakfast	Time in bed	Proportion Yes
1	Medium	No	More	0.15
3	Low	Yes	Less	0.24
7*	Medium	No	More	0.32
8	Low	Yes	Less	0.35
18	Medium	Yes	Less	0.36
10	Low	Yes	Less	0.36
11	High	Yes	Less	0.37
14*	High	No	Less	0.38
12	Low	Yes	Less	0.44
6	High	No	More	0.45
17	Low	Yes	Less	0.46
9**	High	Yes	Less	0.47
15	Medium	Yes	More	0.58
4	Low	Yes	More	0.60
13	High	Yes	More	0.66
16	Medium	Yes	More	0.66
5	High	Yes	More	0.75
2	High	Yes	More	0.76

It should be remembered that School 7 (Killicomaine Junior High) only taught younger pupils in Years 8 to 10, so it is hardly surprising that they spent more time in bed on average. Conversely, School 14 (Portadown College) only had Year 12 pupils completing the questionnaire, so it is not surprising that they spent less time in bed on average. These reduced age ranges may also have affected the proportion of 'yeses.'

**It should also be remembered that no pupils in Years 11 or 12 completed the questionnaire at School 9 (Loreto College, Coleraine). Given the tendency for older girls to skip breakfast, perhaps the proportion of 'yeses' would have been less than 0.47 if all year groups had participated. Following this comment, the relatively low time spent in bed is perhaps more surprising than it first appears.*

The estimated model suggests that the proportion of pupils at a school who reach the 400 calorie milepost should increase:

- As the economic prosperity of the catchment area improves from low to medium to high.

- As the school moves from not serving breakfast to serving breakfast.

- As the pupils at the school spend more hours in bed at night.

The data in **Table 41** offers some support for these suggestions – it does not point in the opposite direction. The actual ranking of schools is not all that different from what we would expect based on the predictions.

In conclusion, it is appropriate to state that the estimated logistic regression model is the best that can be achieved using this type of analysis. **It is not unreasonable to claim that the fit is 'quite good.'**

16. Policy recommendations

There is nothing we can do about an **(i) pupil's age** *(indicated by their School Year Group)* or **(ii) gender**, and not a great deal we can do *(in the short term)* about **(iii) the economic prosperity of the school catchment area** *(indicated by entitlement to free school meals)*. However, we can say something about the amount of **(iv) time spent in bed at night** and something we can do about **(v) breakfast availability at school**.

When it comes to time in bed and sleep, we can draw attention to the recommendations given on the NHS website.   Many secondary school pupils in Northern Ireland are not getting enough sleep and would benefit from more time in bed. While the Principal of a boarding school *(of which there are only six in Northern Ireland)* will be able to act here, there is nothing much they can do with pupils who live at home – other than pleading to parents and reasoning with pupils at a school assembly.

Over recent years, there has been a tendency *(at least in England)* to start the school day earlier. As an example, I taught at Latymer Upper School in Hammersmith, London, between 1990 and 2008. We had an eight-period day, and while in the 1990s, this was split five/three between morning and afternoon, by the 2000s, the split had become six/two. This move was not unique to Latymer; it was matched in many other independent day schools. With increased pressure on public exam results, one could see the attraction of a weekly games afternoon only taking up two periods rather than three. The start of Period 1 was moved from 9.00 am to 8.30 am, and the twice-weekly assembly was moved from the beginning of the school day to just before lunch. The following is taken from the school website in March 2022.

The school day at Latymer starts with lessons at 8.30 am. An hour and 45-minute lunch break gives pupils plenty of time for dedicated tutor time,

extra-curricular clubs, and sports. Co-curricular sports training, drama and music rehearsals run after the school day has finished at 4.00 pm.

Given many pupils at Latymer have long journeys from home, I imagine many will not be spending enough time in bed *(according to NHS guidelines)*. This is likely to have a detrimental effect on breakfast eating habits, impacting pupils' health, learning, and behaviour. Although Latymer serves breakfast *(continental in the Bistro from 7.30 am, and cooked in the Canteen from 7.45 am)*, perhaps it should consider offering a simple breakfast to **all** its pupils at 8.30 am, starting lessons at 8.45 am, and reducing the lunch break to 90 minutes. This would still allow the school day to finish at 4.00 pm.

According to the **US National Sleep Foundation**, later school start times support the biological needs of adolescents and increase the amount of sleep they get. Other benefits of later school start times include:

- Improved attendance at school.

- Decreased tardiness.

- Better student grades.

- Fewer occurrences of falling asleep in class.

- Reduced irritability and depressive symptoms.

- Fewer disciplinary issues.[11]

On breakfast availability, we can appeal to the Department of Education to insist that **all** secondary schools in Northern Ireland offer breakfast to their pupils before starting the school day. We can also request that public funds be provided where necessary *(such as hardship in paying)*.

Perhaps individual schools should go further. Principals and governors should consider the wisdom of making breakfast part of the regular school day. A 'grab-and-go' breakfast could be introduced where pupils pick up a bag of essential food items *(such as a bagel, a yoghurt, and a carton of fruit juice)* when they arrive at school. These items are then consumed during morning registration and form tutor time. **It would be helpful if a few secondary schools in Northern Ireland were to trial this idea so that it can be appropriately evaluated.**

17. Epilogue

Some people may think that this is all very well in theory but is not realistic in practice. I conclude by quoting an email sent to me on 21 September 2021 by Mrs Annette McGleenan, Vice-Principal of St Joseph's Grammar School, Donaghmore, Co Tyrone *(School Code 16).*

"Thank you for sending me a copy of your research findings – they have resulted in us bringing in some changes this year. Over the coming weeks, we hope to have a 'grab and go' healthy breakfast facility for pupils so that they can purchase something quickly and bring it to registration, where they will be able to eat. We have re-established our breakfast facility in the canteen, and lots of pupils are availing of it. The food on offer is more nutritious, and I hope that the food offer will expand. Please do not hesitate to send me other good practices that you are aware of in other schools."

I hope it will not be long before I have other examples to refer to and that the Northern Ireland Government takes swift action.   It could be money well spent.

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Appendices

The first three appendices are sample 'recruitment' letters for this part of the research:

- **Appendix 1** – Sample letter to Schools Principals

- **Appendix 2** – Letter to Parents

- **Appendix 3** – Letter to Pupils

Appendix 1 – Letter to Schools

UNIVERSITY OF LEEDS

Woodhouse Lane, Leeds LS2 9JT

March 2021

Mr Jeffrey Reid
Principal
Aughnacloy College
23 Carnteel Road
Aughnacloy BT69 6DX

Dear Jeffrey

BREAKFAST ON SCHOOL DAYS – STUDENT QUESTIONNAIRE

I appreciate that due to COVID-19, school time is even more precious than ever. However, because things are currently moving very fast in England concerning breakfast provision in secondary schools, it seems prudent to make this request now. **I hope you will agree to all your Year 8, 10, and 12 students being invited to complete an online questionnaire entitled 'BREAKFAST ON SCHOOL DAYS.'** The survey received approval from the University of Leeds Research Ethics Committee on 14 July 2020 and was pre-tested on 235 students attending a secondary school in Leeds during November 2020. Any problems that the pre-test revealed have been 'ironed out', and the revised questionnaire is highly effective at providing the required information. **The average time taken to complete the questionnaire is 4 minutes, and it may be completed by students either at home or school on any convenient date before 1 July 2021.** If completed at home, the school will need to send the students a link to the survey and keep a copy of their receipt number *(as evidence that the student has completed the questionnaire.)* Here is the link:

[Breakfast on school days - student questionnaire (Northern Ireland Schools) (onlinesurveys.ac.uk)](onlinesurveys.ac.uk)

I invite you *(or any other member(s) of staff you wish to nominate)* to try the questionnaire out – though you will need to pretend that you are a student! I shall know that any responses received before 1 April have not come from students and will delete them before the 'real survey' commences. The questions can be answered on an iPad/tablet or smartphone – in addition to a laptop or PC.

Much of the background research has already been completed – I sent you a copy of our initial report in February 2020. For your convenience, I have provided a further copy as an attachment to my email. The school used in the pilot study asked me to provide information letters *(which were distributed electronically)* for both parents/guardians and students. These have been suitably adapted for use in schools in Northern Ireland and are also included as attachments. Of course, these letters are 'optional' and can be modified to comply with your usual procedures.

You may be aware that The School Breakfast Bill *(currently proceeding through the Westminster Parliament)* will require all schools in England to provide breakfast club facilities. The proposal has been costed, and possible sources of funding have been identified. It is likely that some of this funding *(such as that from 'Magic Breakfast')* will be available to **all** parts of the UK, so it is vital to gather the information now.

There are 193 secondary schools in Northern Ireland, and 20 schools have been chosen to provide a representative sample. **Aughnacloy College is one of them.** Although a distinction will be made between those schools that currently run breakfast clubs and those that don't, the findings will be written up so that no individual school can be identified. Eight of the chosen schools are located in Belfast, and the other twelve are situated around the six counties. Because it is unlikely that neighbouring schools have been selected, your school's participation really matters.

Most of the analysis will focus on the effects of age and gender on breakfast eating habits. Therefore, it should be possible to fill in the missing data from the WHO *(World Health Organisation)* Study entitled 'Health Behaviour in School-aged Children' *(HBSC)*. Again, I attach a copy of the most recent data. I'm sure you will agree that it is regrettable that data from Northern Ireland is absent. Hopefully, you will welcome this opportunity for your school to help complete the picture – and, of course, due recognition will be given.

Assuming you agree to participate, I shall be happy to share my overall findings with your students. Hopefully, this will provide them with a practical example of data collection and analysis and show how academic research can aid policymaking in the real world. I shall try and ensure that my report is pitched at the level a 'typical' 13-year-old can understand.

With all good wishes

Yours sincerely

Reverend Peter Simpson

Appendix 2 – Letter to Parents

UNIVERSITY OF LEEDS

Woodhouse Lane, Leeds LS2 9JT

April 2021

Dear Parent(s)/Guardians(s)

I am researching breakfast eating habits among secondary school students in Northern Ireland. In particular, I hope to evaluate the role that schools might play in ensuring that students consume a healthy, nutritious breakfast each school day

Not surprisingly, I am only sampling a few schools, but I hope you will be pleased to know that your son's/daughter's school/college has been chosen. I very much hope you will want them to receive an invitation to take part. Of course, it is entirely up to you, but the more students who participate, the more worthwhile will be the research. Your son/daughter will be free to decline the invitation without any need to explain.

The survey takes the form of an on-line questionnaire which can be answered either at home or at school. The questions are easy to answer, and students automatically pass to the next relevant item. Most questions simply involve 'clicking' or 'tapping' the appropriate box. If more information is requested, students are never asked to write more than a few words. Pre-testing has shown that the majority of students complete the questionnaire in around 4 minutes. The questions can be answered using an iPad/tablet or smartphone, in addition to a laptop or PC.

You may be assured that I will not be asking for your son's/daughter's name or address and that all responses are anonymous. I shall use the information for statistical purposes only, and I will not share individual replies with the school authorities. It will be impossible to identify any particular student when the report is written up.

The research is being conducted according to The University of Leeds Research Participant Privacy Protocol. I have supplied the Principal with the formal notice of this protocol and requested that they provide you with a copy – if requested. A link to the Privacy Notice is also provided as part of the on-line questionnaire. The School Principal has been supplied with a copy of all the questions and invited to answer them should they so wish.

This study received Ethical Approval from the University of Leeds Food Science & Nutrition, Engineering and Physical Sciences joint Faculty Research Ethics Committee (Ethics reference number MEEC 19-038) on 14 July 2020.

Should you **not** wish your son/daughter to receive an invitation to participate in this research, will you please ensure that the School receives the tear-off slip below within seven days of the receipt of this letter.

Yours sincerely

Reverend Peter Simpson

Nutritional Epidemiology Group – School of Food Science and Nutrition   **Email: fsprs @leeds.ac.uk**

✂ -

University of Leeds Breakfast Survey

I do not wish my son/daughter _____ (name) of Year _____ to receive an invitation to take part in this research project.

Signed: _____ Name: _____ (please print)

Appendix 3 – Letter to Pupils

UNIVERSITY OF LEEDS

Woodhouse Lane, Leeds LS2 9JT

April 2021

Dear Student

I am researching breakfast eating habits among secondary school students in Northern Ireland. In particular, I am attempting to evaluate the role that schools might play in ensuring that their students are offered a nutritious breakfast every school day.

Not surprisingly, I am only sampling a few schools, but I hope you will be pleased to know that your school/college has been chosen. I very much hope **you** will want to take part. Of course, it is entirely up to you, but the more students who agree, the more worthwhile will be the research. Your Principal has informed your parent(s)/guardian(s) about this research, and they have not asked for you to be excluded. **I plan to share my findings with you later, and I hope my report will be of some use in your studies.**

Previous studies have suggested that age and gender are two factors that influence breakfast habits, and that is why I will be asking you about these. When you go to bed and the length of time spent in bed are also relevant, so I shall seek some basic information about these.

However, you may be assured I will not be asking for your name or home address, and your responses will be anonymous. I shall use the information for statistical purposes only and not share individual replies with your school authorities. It will not be possible to identify any student when I write up my report. Please only answer the questions asked and do not provide any information that is not requested.

The questions will be answered on-line, either at home or at school. The questions are easy to answer, and you will automatically pass to the next relevant item. Most questions simply involve 'clicking or tapping' the appropriate box. If more information is requested, you will never be asked to write more than a few words. I have provided your Principal with a copy of the questions. When you have completed the questionnaire, you will receive a unique receipt number. If you complete the survey at home, your school may ask you for the last eight digits so that they can record that you have completed the task. **This number will not give the school access to your replies, and your school will <u>not</u> inform me of your name.**

Assuming you are happy to take part, I hope you will answer all the questions - it won't take long. A pilot study conducted at a school in Yorkshire showed that most students could complete the questionnaire *(on an iPad/Tablet, smartphone, laptop, or PC)* in approximately 4 minutes.

Best wishes

Reverend Peter Simpson

Nutritional Epidemiology Group – School of Food Science and Nutrition   Email: fsprs@leeds.ac.uk

The multivariable analysis outlined in Sections 11 to 15 was carried out using logistic regression. Concerning the methods' appropriateness, I have been asked two questions that I will address in **Appendix 4** and **Appendix 5**. The questions are as follows:

1. Why did I not use Cox regression?

2. Given that I chose to use logistic regression, should I not have used multilevel modelling?

Appendix 6 shows an attempt to compare the findings of this survey with the HBSC data.

Appendix 7 includes some additional material sent to me by one of the participating schools – St Mary's Christian Brothers' Grammar School, Belfast. This may help explain the importance of Breakfast Clubs, even when attendance is low.

Appendix 4: A brief note about Cox regression

Cox regression is sometimes used in preference to logistic regression when analysing survival *(time-to-event)* data. There usually needs to be a clear distinction between the two groups being compared – for example, those exposed to a risk factor and those not exposed. The various groups being compared in the breakfast study *(such as boys vs girls; or Years 8/9 vs Years 10/11/12)* are not different in terms of whether this should influence the probability of consuming breakfast.

Cox regression is most useful when rates vary quickly with time. Hence, it is used chiefly to examine incidence or survival following a well-defined event, e.g., a surgical procedure, starting a new drug treatment etc.

In the case of breakfast habits, the results suggest a steady increase in the proportion of pupils having eaten at least 400 calories since rising as we move to the 4-hour milepost. Rates do not vary quickly with time – the Kaplan-Meier curves show few noticeable 'jumps'.

Just for the record, the reason that Cox regression is so helpful in circumstances such as a surgical procedure or the start of drug treatment is that the rates in the unexposed and exposed groups are allowed to vary with time, with the only restriction being that the ratio remains constant through time. This is known as the **proportional hazards assumption**

(the hazard is the rate at a given moment in time, i.e., the instantaneous rate). This explains why Cox regression models are also known as proportional hazards models.

Appendix 5: A brief note about multilevel models in logistic regression

Logistic regression is a natural choice for modelling when the outcome *(dependent)* variable is binary. Traditional logistic regression is *(in multilevel terms)* single-level. This is not always appropriate when the data is nested.[12]

With the analysis in this study, the level of interest is **either**:

- **Individual pupils** (e.g., hours of sleep at night; or age - *as indicated by the year group at school*)

  or

- **School-level** (e.g., whether the school offers breakfast; economic prosperity of catchment area)

There is no apparent third level that might call for multilevel modelling.

A simple example should illustrate the point. Suppose we were interested in the probability of pupils volunteering to sing in the school choir. We could ask pupils at a sample of schools to complete an online questionnaire. Our outcome variable would be binary – they either sing in the choir or don't. Our analysis could be carried out to make predictions at both the individual pupil and whole-school levels.

However, there is likely to be a 'third level' that may be relevant – the pupils' class/form. Pupils are both class members *(8A or 8B)* and school members. Class membership is nested within school membership.

Three sorts of factors may influence the probability of a pupil singing in the school choir:

- **Individual factors** – such as their age and gender.

- **Class factors** – whether their friends in the same class sing in the choir; whether their form tutor actively encourages them to join the choir.

- **School factors** include how good the choir is; the type of music they sing; whether the choir sings on TV; whether they go on exciting tours.

In this situation, we may get unreliable estimates if the logistic regression analysis ignores the class factors. It could be that a pupil is far more likely to sing in the choir if they are in Form 8A than if they are in Form 8B. Forms 8A and 8B are part of Year 8 at the school, and the statistical analysis should distinguish between them. This is where multilevel models are more appropriate than single-level models.

In the case of the current breakfast study, there is no obvious 'third level.' The single-level model seems to fit the data well *(and produces some realistic predictions)*, and there is little point in making the analysis more complicated just for the sake of it. Indeed, there is a danger that the message will be 'blurred' in the process.

All we know about the 2,488 pupils *(other than their breakfast habits and opinions; and the length of time in bed)* is the name of their school, their year at school, and *(in the case of 2,377 pupils)* their gender. We have no idea which form they belong to or how their school selected them to participate in the research.

Appendix 6: A comparison of the NI survey data with the HBSC data

As explained in Section 4, one of the aims of the Northern Ireland study was to 'fill in the gaps' in the WHO HBSC survey. One of the many things examined in this survey is the breakfast habits of children of secondary school age. However, although most European countries are included, Northern Ireland is excluded.

Table 42 shows breakfast eating habits in ten countries as reported in the 2014 and 2018 surveys. The next survey will be conducted in 2022.

Table 42: World Health Organisation – Health Behaviour in School-aged Children (HBSC) Survey. Percentage of pupils eating breakfast* every school day – 2018 *(2014 in italics)*

Country	11-year-old boys	13-year-old boys	15-year-old boys
England	77% *(83)*	64% *(71)*	63% *(64)*
Scotland	77% *(79)*	68% *(68)*	55% *(57)*
Wales	69% *(70)*	60% *(61)*	53% *(59)*
Austria	54% *(62)*	48% *(51)*	42% *(52)*
France	75% *(76)*	69% *(72)*	57% *(64)*
Germany	66% *(72)*	60% *(65)*	55% *(59)*
Greece	54% *(56)*	49% *(54)*	52% *(54)*
Irish Republic	83% *(82)*	75% *(74)*	73% *(73)*
Italy	65% (69)	67% *(67)*	57% *(61)*
Netherlands	91% *(92)*	83% *(87)*	80% *(81)*

Country	11-year-old girls	13-year-old girls	15-year-old girls
England	67% *(74)*	52% *(51)*	48% *(48)*
Scotland	74% *(75)*	51% *(53)*	45% *(43)*
Wales	61% *(62)*	42% *(43)*	35% *(44)*
Austria	47% *(62)*	38% *(47)*	33% *(42)*
France	72% *(76)*	58% *(58)*	49% *(46)*
Germany	65% *(68)*	51% *(54)*	42% *(52)*
Greece	48% *(57)*	43% *(43)*	43% *(47)*
Irish Republic	80% *(79)*	67% *(67)*	59% *(62)*
Italy	59% *(58)*	49% *(52)*	52% *(50)*
Netherlands	88% *(90)*	75% *(78)*	67% *(71)*

* Breakfast is defined as anything more than a glass of milk or fruit juice consumed before the start of the formal school day

Three main things stand out from the data in **Table 42**:

1. There is much variation between countries. For example, breakfast eating is far more prevalent in the Netherlands than in Austria.

2. The prevalence of breakfast eating falls with increasing age.

3. The prevalence of breakfast eating is higher in boys than in girls.

The definition of breakfast eating used in the HBSC study would seem far less satisfactory than the definition used in the present study *(at least 400 calories within 4 hours of rising)*. Nevertheless, using the answers to Questions 6, 8, and 10, it is possible to see the percentages if our sample of 2,377 pupils *(excluding the 111 pupils whose gender was classified as 'other')* had taken part in the HBSC survey.

Before presenting the results analysed by age and gender, it is worth reporting that using the HBSC definition of breakfast skipper, 714 of our 2,377 NI pupils (30%) would have been classified as breakfast-skippers, 1,663 (70%) would have been classified as breakfast-eaters.

In the case of the 111 pupils who did not wish to be classified as boy or girl, 44% would have been classified as breakfast-skippers, and 56% would have been classified as breakfast-eaters.

Of course, we should bear in mind that the NI survey was carried out in 2021, not 2018 *(or 2014)*; that our pupils were asked about their breakfast habits on a 'typical' school day, not every day; and that our age ranges are broader than those used in HBSC. Also, of course, the COVID-19 pandemic may have had a significant effect.

Nevertheless, using the HBSC definition of breakfast, **Table 43** shows the results for Northern Ireland school children.

Table 43: Proportion of pupils eating breakfast* on a typical school day in Northern Ireland – 2021

Gender	Years 8 – 9 *(Age 11 – 13)*	Years 10 – 12 *(Age 13 – 16)*
Boys	77%	75%
Girls	70%	58%

* Breakfast is defined as anything more than a glass of milk or fruit juice consumed before the start of the formal school day

The statistics for Northern Ireland appear 'better' than those for England, Wales, and Scotland; but are not as good as those for the Irish Republic. The fact that the breakfast habits of secondary school pupils in Northern Ireland lie somewhere between their contemporaries in Great Britain and the Republic of Ireland is not entirely surprising.

Appendix 7: A comment on the importance of Breakfast Clubs, even if few pupils attend

At the end of Section 14, I commented that I was surprised by how significant the breakfast provision at school was. Although 14 out of 18 schools offered breakfast, take-up rates tended to be low. So why should it have such a significant effect?

Not surprisingly, due to many phone calls and emails, I got to know some of the staff at the 18 schools quite well. Mr Donagh Finnegan is the Bursar at **St Mary's Christian Brothers' Grammar School** in Belfast *(School Code 18)*, and he informed me that the Principal, Mrs Siobhan Kelly, took a very dim view of her pupils skipping breakfast. He shared with me a letter that was sent to all parents/guardians at the start of Autumn Term 2019 *(shortly before the beginning of the COVID-19 pandemic).* Although attendance at the Breakfast Club was relatively low *(fewer than 10% of pupils)*, the effect of the letter on breakfast habits could well have been significant. One could hardly imagine the Principal of a school that didn't offer breakfast issuing such a strongly worded document. If the Principal feels so strongly, parents will probably think, why don't they do something about it and start offering breakfast themselves? It is easier for staff to show concern about pupils skipping breakfast if they run a breakfast club.

St Mary's also sent me a photo taken on Leavers' Day 2021. The final day of term for Year 14 pupils started with Mass in the School Chapel, followed by a Leavers' Breakfast in the school canteen.

An 'Ulster Fry' might not be the most nutritious food to serve – though, I suppose an exception can be made on a 'rite of passage' occasion such as this! From Mrs Kelly's letter, it is reassuring to note that this type of breakfast is the exception – not the rule.

St. Mary's Christian Brothers' Grammar School
Scoil Mhuire na mBráithre Críostaí

Edmund Rice Schools Trust

147a Glen Road, Belfast, BT11 8NR   147a Bóthar an Ghleanna, Béal Feirste, BT11 8NR
Telephone: (028) 9029 4000   Fax.: (028) 9029 4009
Website: www.stmaryscbgs.com

'Nurturing faith, promoting partnership, excelling in teaching and learning, creating a caring school community and inspiring transformational leadership.'

September 2019

Dear Parent /Guardian

I would like to make you aware of the **Breakfast Club** we have on offer each morning in school. This is available between the times of **8.10am and 8.45am** a breakfast meal deal for the cost of £1.00.

The menu for the Breakfast club is as follows:

1 Cereal – Weetabix or Cornflakes
1 Glass of pure orange
Scrambled eggs
2 Slices of toast
1 Cup of tea.

As you will be aware break time is now scheduled at the later time 11.10 am this year. It is therefore imperative that your son has a substantial meal at the start of the day so that he can engage fully in the classroom. We would encourage you to ensure that your son avails of a proper breakfast at home or what we have on offer in school at our Breakfast Club.

I want to also draw your attention to our Code of Conduct, published in your son's Home School diary. In particular, I want to highlight to you that stimulant drinks are not permitted on the school campus and any pupil found with these will have them confiscated. A number of these drinks have a very high sugar content. Research indicates that regular digestion of these could have an adverse effect on your son's health and behaviour. These concerns are clearly outlined on the NHS website. Potential risks associated with energy drink consumption include:
High blood pressure, type 2 diabetes, neurological and cardiovascular system effects in children and adolescents, poor behaviour, poor dental health, obesity and may lead to dependence on other harmful substances. I have included the link for your reference.

https://www.nhs.uk/news/food-and-diet/warnings-issued-over-energy-drinks/

We would ask you to support us to ensure that your son starts the day with a healthy breakfast and makes good dietary choices.

Yours faithfully

Siobhan Kelly
Principal