Dietary habits in relation to breakfast consumption among adolescent males in New Zealand

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Abstract

Background: Adolescence is a vulnerable period of life whereby dietary habits are still being formed. These habits include regular breakfast consumption, which has been linked to several health benefits, including a lower body mass index and overall better diet quality. Previous literature identified that breakfast is a meal commonly skipped by adolescents. Breakfast consumption and associated dietary habits of adolescents have not been examined in New Zealand since the Adult Nutrition Survey 08/09, thus it is necessary to provide up to date data on this.

Objective: To assess the dietary habits of male adolescents, aged 15-18 years, in New Zealand. In particular, this thesis will investigate associations between breakfast consumption patterns and weight status and overall diet quality of these adolescents.

Design: The SuNDiAL (Survey of Nutrition, Dietary Assessment and Lifestyles) project is a nationwide, cross-sectional study focusing on male adolescents between the ages of 15-18 years in New Zealand. Six schools were recruited throughout New Zealand, with a total of 135 participants completing enrolment. Of these participants, 122 completed a dietary habits questionnaire, which was used to determine frequency of breakfast intake as well as food group intakes. Dietary data was also obtained through two 24-hour dietary recalls which was used to calculate energy, macronutrients and fibre intake via FoodWorks. Height and weight were measured and the World Health Organisation growth charts were used to determine Z-scores. Socioeconomic status was defined based on the 2018 New Zealand Deprivation Index, categorising the participants into low, medium or high deprivation categories depending on their corresponding scores. The prioritised ethnicity method was used to allocate participants into one of the following ethnic groups: Māori, Pacific, Asian, New Zealand European and Others.
Results: The current study found that 57.4% of participants consumed breakfast every day, while 9.8% reported not usually consuming breakfast. Of those consuming breakfast regularly (≥5 days a week), 69% were of a healthy weight status, compared to 63% of those who never/rarely consumed breakfast. There were a higher percentage of participants in the high deprivation category consuming breakfast never/rarely compared to that of regular breakfast eaters. Regular breakfast eaters had higher mean energy intakes (10343 kJ/day (95% CI: 9749-10937)), along with mean fibre intakes (25.7 g/day (95% CI: 24-28)), and a higher percentage of energy from carbohydrates (44% of energy from carbohydrates), compared to those consuming breakfast never/rarely. Forty-eight percent and 21% of regular breakfast eaters met the MOH guidelines for servings of fruits and vegetables, respectively, compared to 25% and 10% respectively, for those never/rarely consuming breakfast.

Conclusion: This study indicates that, in New Zealand adolescent boys, regular breakfast consumption promotes healthier overall eating habits and is associated with a healthy weight status. The results of this study also identify areas that need improvement in terms of the breakfast consumption and associated dietary habits in New Zealand male adolescents. More specifically, those in high deprivation areas were more likely to skip breakfast. Further research, with a larger and more representative population, is required to validate the findings of this study.
Preface

The data presented in this thesis was collected as a part of the larger SuNDiAL (Survey of Nutrition, Dietary Assessment and Lifestyle) project. It is a cross-sectional, nationwide survey conducted in the Department of Human Nutrition at the University of Otago, Dunedin New Zealand. The Candidate was supervised by Associate Professor Rachel Brown.

The co-Principal Investigators of the SuNDiAL project, Dr Jill Hazard and Dr Meredith Peddie, were in charge of designing the study, gaining access to funding and ethical approval, along with overseeing the data collection aspect of the study. The Project Coordinator for the SuNDiAL project was Tessa Scott, and Liz Fleming was responsible for overseeing the dietary data gathered. The data collectors consisted of Master of Dietetics (MDiet) students, which included the Candidate. They assisted in school and participant recruitment, coordinated data collection times, obtained dietary and physical activity data, anthropometric measurements, blood pressure readings and data entry.

The Candidate, alongside five other MDiet students who were based in Dunedin, were responsible for carrying out the following tasks:

- Visiting one school in Balclutha in-person to recruit them.
- Preparing a presentation given within the recruited schools to recruit participants.
- Organising appointments for data collection with the school representative and consented participants at the recruited Dunedin schools.
- Obtaining 24-hour dietary recall data, previous day activity recall data, and anthropometric data from participants.
• Entering anthropometric and activity recall data from participants into REDCap, and dietary data from the 24-hour recalls into FoodWorks.

• Statistical analysis with the help of the Biostatistician, Dr Jill Hazard, and interpretation and tabling of the data.

• The writing of this thesis.
Acknowledgements

I owe the following individuals a huge thank you for their support and guidance towards the completion of my thesis:

A sincere thank you to my primary supervisor, Associate Professor Rachel Brown. I would not have been able to write this thesis without all your help and guidance. You were very patient and always so quick to help and offer your support when I needed it.

I would like to thank the entire SuNDiAL team who helped to make this project run smoothly, even amongst the Covid-19 troubles. In particular, Dr Jill Haszard and Dr Meredith Peddie who have put an immense amount of time into the MDiet class and this project and offered continuous guidance throughout. This research would not be possible without you. Also, to the participants of this study - it would not have been possible without your participation and commitment.

Thank you to my MDiet class, many of whom have consistently been there for me and supported me without failure. Your encouragement and friendship is a huge part of the reason that I have found this process so enjoyable.

A final thanks to my partner, family and friends who continued to believe in me throughout the process and gave me confidence in my abilities.
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List of abbreviations

AI – Adequate Intake
AMDR – Acceptable Macronutrient Distribution Range
ANS 08/09 – 2008/09 Adult Nutrition Survey
BMI – Body Mass Index
Cm – centimetres
DHQ – Dietary Habits Questionnaire
g – grams
Kg - kilograms
kJ – Kilojoules
MDiet – Masters of Dietetics
MOH – Ministry of Health
NHANES – The National Health and Nutrition Examination Survey
NZDep18 – 2018 New Zealand Deprivation Index
NZEO – New Zealand European and Other
NZ – New Zealand
REDCap – Research Electronic Data Capture
SD – Standard Deviation
SuNDiAL – Survey of Nutrition, Dietary Assessment and Lifestyle.
Introduction

Adolescents are at a vulnerable age whereby many of their dietary habits are still in the process of being formed and are influenced by a combination of internal and external factors (1). Some of these factors include but are not limited to peers and parental influence, food availability and preference, as well as marketing of various food outlets (1, 2). Not only is this an age where lifelong habits are often being established, but it is also a period of which growth is still occurring (3). As a result, establishing healthy eating patterns at this age is important to ensure adequate growth and development, alongside forming healthy habits that may last throughout adulthood.

Research indicates that certain nutrients and food groups that are important for health are often lacking in the diets of male adolescents (4-6 ADD). Therefore, it is important to consider why these individuals may be consuming inadequate amounts of various food groups. Examining meal patterns/habits in male adolescents may provide insight into this. Breakfast habits in adolescents, in particular, have obtained a considerable amount of attention in the literature. This is likely due to the vulnerability of this life stage and associated health complications of skipping breakfast, that can carry through to adulthood.

Regular breakfast consumption is one dietary habit that has been suggested to have positive impacts on an individual’s overall diet (4-6), growth, body weight (4) and cognitive function (7, 8). Skipping breakfast frequently may lead to a reduction in consumption of specific nutrients or an entire food group (9, 10). This in turn, can ultimately have negative effects on cardiometabolic risk factors, growth and development, BMI and overall health of adolescents (4, 11). It is therefore concerning that breakfast is a meal that is frequently skipped (4). A total of 25.6% of adolescent males were found to frequently skip breakfast in an Australian
study (12), 54% in a United States study (13), 26% in a Canadian study (14), 23.6% in a study carried out in Taiwan (15) and 13.9% in New Zealand in 2008/9 (31 ADD).

There is some research available indicating that individuals who regularly skipped breakfast had poorer overall diets compared to those who consumed breakfast (16-18). However, there were many inconsistencies between studies in the way they defined breakfast, and how they assessed the overall quality of the participants diet. This thesis will assess participants diet quality by comparing intakes to the Ministry of Health healthy eating guidelines for young people (13-18 years of age) in New Zealand (19) where possible. Alongside this, weight status, energy and macronutrient intake will also be examined in relation to breakfast consumption. The findings will also help to provide more current data than is presently available for adolescents in New Zealand, which can help to guide health initiatives. The last extensive research completed that included adolescents aged 15 years and over in New Zealand, was the 2008/09 Adult Nutrition Survey (ANS 08/09), which was carried out over 10 years ago. It is possible that over this time, food patterns, habits and lifestyles could have changed considerably, thus creating the need for more recent data.

The aim of this thesis is to investigate the dietary habits of adolescent males, specifically breakfast consumption and associations with overall diet quality and weight status. This information will be gathered from the dietary habits questionnaire, alongside two 24-hour dietary recalls, and anthropometry measurements, as a part of the Survey of Nutrition, Dietary Assessment and Lifestyle (SuNDiAL) Project.
Literature Review

Methods

The objective of this literature review is to investigate the dietary habits of adolescent males, with a focus on breakfast consumption and the effect it has on overall diet quality. The databases used for searching purposes were Scopus, Web of Core Sciences, PubMed, Google Scholar, and Medline. Key words used to search the databases were as follows: dietary habits, diet, diet quality, adolescents, adolescence, breakfast, male(s), teenager(s).

Dietary habits

Dietary habits differ from person to person and influence behaviours that can either nourish and fuel an individual’s body or create unhealthy/obesogenic tendencies that can lead to a number of health complications later in life (20). Healthy dietary habits can be best described by the Ministry of Health, healthy eating guidelines, which recommends eating a variety of foods from each of the four food groups (fruits and vegetables, breads and cereals, milk and milk alternatives, and meat and meat alternatives) daily (19). These guidelines also encourage people to purchase and prepare foods with minimal sugar, fat and salt and recommend choosing unsaturated fats (among other recommendations) (19).

Lifestyle and dietary habits play a crucial role in the development of obesity, and chronic diseases including diabetes, coronary heart disease and stroke (20-22). Overweight and obesity prevalence has been increasing worldwide (22, 23), which raises health concerns for current, and more importantly future generations. Because dietary habits created during childhood and adolescence can influence behaviours into adulthood (1), adolescence is an imperative period to research.
Dietary habits of adolescents

Adolescence is a critical and vulnerable period between the ages of 10-19 years, as defined by the World Health Organisation (24) when physical, social, and developmental growth is still occurring (2, 3). As a result, establishing healthy eating patterns is essential to ensure adequate growth and development and in creating healthy habits later in life (3). Dietary habits at this stage of life are influenced by a complex combination of internal and external factors, including parental and peer influences (1).

Being overweight during adolescence is associated with being overweight as an adult (22, 25). A longitudinal study found that 100% of male participants that were overweight or obese between the ages of 7-18 years, remained overweight/obese in adulthood (when reassessed between the ages of 29-41 years) (25). The odds of becoming overweight or obese in adulthood were 6.2 (95% CI 2.2-17.2, p < 0.001) times greater for those who were overweight/obese in youth, compared with healthy weight youth, when adjusted for age and sex (25). Females had a lower risk of being overweight/obese in adulthood compared to males, regardless of age and weight status in youth (OR = 0.37; 95% CI 0.23-0.58, p <0.001) (25). This highlights the importance of creating an environment that encourages healthy behaviours, especially in males, and starting from a young age. However, it is important to note the relatively small sample size (n=372) is a limitation of this study as it may not be representative of the Canadian population (25, 26).

Given the finding that overweight in adolescence tracks into adulthood (26), it is important to examine the determinants of excess adiposity in adolescence. Several studies have shown associations between unhealthy eating habits in adolescents resulting in inadequate intakes of recommended food groups and nutrients, and increased risk of overweight and obesity (1, 27, 28). Of the recommended food groups, fruit and vegetables appear to be most commonly consumed in amounts below the recommended levels in adolescents (29-31). The ANS 08/09
illustrated that adolescents aged 15-18 years had the lowest prevalence of consuming three or more vegetables per day compared to all other age groups (with the exception of 19-30 year age range) (31). Additionally, only 50.9% of male adolescents consumed three or more vegetable servings per day compared with 61.5% of female adolescents (31). A diet low in fruits and vegetables may lead to an inadequate intake of nutrients that help the body function optimally (32). Fruit and vegetables have also been associated with having a protective effect against cardiovascular disease and high blood pressure, thus omission may lead to an increased risk of adverse health outcomes (32).

While many studies have focused on the consumption of various food groups in adolescents (29-32), it is also necessary to address the reasons why individuals may be lacking in some food groups and not others. An individual’s meal pattern could provide insight into this. For example, the frequent omission of breakfast could lead to reduced intake of a particular food group (e.g. dairy products) or nutrients (9, 10). This could reduce the overall quality of an individual’s diet. Based on this, the primary focus of this thesis will be on breakfast consumption and the effect it has on overall diet quality and lifestyle in adolescent males.

**Breakfast consumption**

Evidence suggests that adolescents and adults who regularly consume breakfast, have higher micro- and macro-nutrient intakes and an overall healthier diet, compared to those who regularly skip breakfast (4-6). One study identified that daily intakes of energy, dietary fibre, calcium, and potassium were significantly lower in the “rare breakfast eater group” compared with the “regular breakfast eater group” (6). Furthermore, there is growing evidence suggesting that breakfast consumption can have a positive impact on body weight (4) and cognitive function (7, 8). Nevertheless, breakfast continues to be one of the most commonly skipped meals, especially by adolescents (4).
Methodology used to measure breakfast consumption and breakfast definitions

Breakfast is defined in a variety of ways in the literature with regards to the frequency, time of day and type and amount of food (7). These have been summarised in Table 1. The most common definition was self-reported breakfast consumption obtained from questionnaire data. Other definitions included food and drink consumed before school, meals eaten before 9 am with a total intake of greater than or equal to 50 kcal, or 210 kJ, etc. There is evidence to suggest that the different definitions of breakfast amongst studies provide conflicting results, especially when assessing the association between breakfast consumption and obesity (33). One study demonstrated that there was a wide variation in the percentage of participants skipping breakfast (3.6%-74.6%) depending on how breakfast skipping was defined or the timing of the data collection (33). For example, significant associations were found between breakfast consumption and both BMI and overweight or obesity when these three variables were measured on the day of data collection (33). When assessing breakfast consumption in the previous week, however, few significant associations were found between these three variables (33). This could be due to recall error as the participants may have struggled to accurately recall the days they consumed or skipped breakfast in the previous week compared to the day of data collection (33).

Table 1 also demonstrates differences in the methods used to collect the information. For example, some studies were longitudinal in design (34), others were cross-sectional (9, 35, 36). Cross-sectional studies using a 24-hour recall to determine breakfast intake may provide conflicting results, as the reported breakfast intake on the day(s) of the recall may not be representative of habitual breakfast intakes and habits (37). As a result, challenges arise when evaluating the findings from these studies. Longitudinal studies provide evidence over a longer period of time (often years or decades) and thus may provide more reliable evidence.
for examining cause-and-effect relationships (e.g. between breakfast consumption and weight status) (37). Food frequency questionnaires and diet records completed on multiple occasions are methods of data collection commonly used in longitudinal studies (3, 38).
Table 1. Summary of assessment methods, questions asked to determine breakfast intake, and findings of various studies in adolescents.

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Study population</th>
<th>Study design and assessment method</th>
<th>Question asked and possible outcomes</th>
<th>Breakfast definition/ cut-off points</th>
<th>Findings</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keski-Rahkonen et al, 2003 (38)</td>
<td>5448 Finnish twins aged 15-18.5 years (2626 boys), and 4660 parents of the twins.</td>
<td>Longitudinal study. Questionnaire.</td>
<td><strong>Question</strong>: ‘How often do you eat breakfast (for example, sandwiches, milk, hot cereal, other similar food) before going to school or going to work?’ <strong>Outcomes</strong>: Every morning, a few times a week, about once a week, or less often Every morning, a few times a week, about once a week, or less often</td>
<td>Food/drink consumed before school/work</td>
<td>• 13% of adolescent boys ate breakfast ≤ once a week. • Parental breakfast consumption was found to be the most significant determinant of adolescent breakfast consumption. • Breakfast skipping was more common in the lower socioeconomic group than in the higher socioeconomic group, among adolescent boys (P= 0.013).</td>
<td>• Self-reported height and weight. • Overlooked important factors for regular breakfast eating such as, total daily energy intake, allocated breakfast time, and other dieting-related matters.</td>
</tr>
<tr>
<td>Sjo¨berg et al, 2003 (18)</td>
<td>611 boys, 634 girls aged 15-16 years in Sweden.</td>
<td>Cross-sectional study. Diet history, Questionnaire</td>
<td><strong>Question</strong>: Subjects were asked how often they ate breakfast in a week. <strong>Outcomes</strong>: Regularly (breakfast every day before school), irregularly (omitted breakfast once a week or more)</td>
<td>Intake in the morning before school containing a component of cereals and at least a milk product or a fruit/juice or a meat/fish/egg product.</td>
<td>• 12% of boys showed irregular breakfast eating patterns, related to negative lifestyle factors (such as smoking (OR: 3.8, 95% CI 2.6-5.4), and irregular intake of lunch and dinner. • Higher energy intakes from snack foods, lower intakes of micronutrients, but higher intakes of sucrose and alcohol were also associated with irregular breakfast eating,</td>
<td>• The study only included adolescents in 9th grade, aged 15-16 years, so may not be an accurate representation of all adolescents.</td>
</tr>
</tbody>
</table>
compared to groups with regular breakfast intakes.

**Videon et al, 2003 (3)**
18,177 adolescents (9270 boys), aged 11-21 years, in the United States. National longitudinal study. Dietary questionnaire

**Question:** Subjects were asked whether they ate something or nothing for breakfast.

**Outcomes:** Something, or nothing.

Self-reported breakfast consumption.

- One in five adolescents reported they usually skipped breakfast.
- Adolescents who perceived themselves to be overweight were more likely to usually skip breakfast (OR: 1.98, 95% CI 1.72-2.20, \( p < 0.001 \)), and more likely to report low intake of fruits, vegetables and dairy foods the previous day.

- Self-reported consumption of foods, which can lead to underestimation of nutrient intakes.
- Questionnaire did not specify whether fruit juice is included in the fruit group.

- Potential for under- and over-reporting of dietary intakes due to social desirability bias.
- Self-selection bias.
- Does not differentiate between socioeconomic status or ethnicities.
- Reporting bias due to self-reported intakes.

**Stockman et al, 2005 (14)**
180 adolescent males aged 14-18 years, in Canada. Cross-sectional. 3x 24-hour recalls.

**Question:** Subjects were asked what they ate in a day (including time, type, quantity).

**Outcomes:** Consistent breakfast consumer i.e. consumed breakfast on all 3 occasions of completing the 24-hour recall; or inconsistent breakfast consumer i.e. skipped breakfast at least 1 of the 3 days

Self-reported breakfast consumption.

- 26% of participants skipped breakfast at least once during their three days of food records.
- Inconsistent breakfast consumers (skipped breakfast \( \geq 1 \) of the 3 days) had significantly higher BMIs \( (p < 0.0008) \), were more frequently classified as overweight and had lower iron intakes \( (p < 0.0041) \) compared to consistent breakfast consumers.

- Self-reported consumption of foods, which can lead to underestimation of nutrient intakes.
- Questionnaire did not specify whether fruit juice is included in the fruit group.

- Potential for under- and over-reporting of dietary intakes due to social desirability bias.
- Self-selection bias.
- Does not differentiate between socioeconomic status or ethnicities.
- Reporting bias due to self-reported intakes.
Sweeney et al, 2005 (13) 846 high-school students (399 boys) aged 13-19 years. Cross-sectional study. “Breakfast Survey” questionnaire

**Question:** “Did you eat breakfast today?”

**Outcomes:** Yes, or no.

Self-reported breakfast consumption.

- 54% of boys reported skipping breakfast on the day of the survey.
- 64% of participants reported not eating breakfast due to lack of time, 28% due to feeling ill when eating early in the morning, 3% due to not having food they wanted to eat, and 1% due to weight concerns.

Questionnaire was cross-sectional with no further questioning in order to clarify participants responses.

Reporting bias due to self-reported intakes.

Not representative of all adolescents as students were all from one high school.

Self-selection bias.

Yang et al, 2006 (15) 1609 adolescents aged 13-18 years, in Taiwan.

Cross-sectional, descriptive design. Self-administered questionnaire.

**Question:** “Generally speaking, how many days did you eat breakfast between Monday and Friday?”

**Outcomes:** Irregular breakfast eating if the answer was 3 days or fewer, and regular breakfast eating if the answer was four or five days.

“A meal taken before 9.00am each weekday (Monday to Friday).

- 23.6% of participants were classified as irregular breakfast consumers on school days.
- The odds of being overweight for irregular breakfast eaters was 51% (95% CI 1.12-2.04) greater than for regular breakfast eaters.

Questionnaire was cross-sectional with no further questioning in order to clarify participants responses.

Reporting bias due to self-reported intakes.

Not representative of all adolescents as students were all from one high school.

Self-selection bias.

Does not differentiate between genders.

Potential for under- and over-reporting of dietary intakes due to social desirability bias.

Breakfast consumption was only measured from Monday to Friday.

Breakfast quality and quantity was not measured.

Does not differentiate between SES or ethnicities.
Matthys et al, 2007 (10) 341 adolescents, aged 13-18 years from secondary schools in Ghent, Belgium. Cross-sectional study. 7-day (consecutive) food record

**Question:** Individual breakfast labels and scores were used

**Outcomes:** Individual breakfast label 1-5: 1: no or very limited breakfast (<400kJ), 2: breakfast including only energy-containing beverages, 3: breakfast including food items from one of the target food groups, 4: breakfast including food items from two of the target food groups, 5: breakfast including food items from the three target food groups. Individual breakfast scores: 1: never have breakfast, 2: usually do not have breakfast, 3: either usually have breakfast of low nutritional value or only occasionally have breakfast of higher nutritional value, 4: usually have breakfast of good/excellent nutritional value, 5: eat good-excellent-quality breakfast practically every day

The first eating/drinking occasion after waking greater than or equal to 400kJ.

- Breakfast consumption contributed to on average 15.7% of the daily energy intakes in male adolescents.
- 13.2% of boys had individual breakfast score < 3.
- Potential limitation of the breakfast score algorithm used is that a participant receives a lower score if they do not consume one of the selected foods.
- Sample population contained more girls than boys.

Vagstrand et al, 2007 (39) 474 participants (199 boys), aged 16-17 Cross-sectional study. Dietary questionnaire

**Question:** Subjects were asked how many times in a week would you normally eat breakfast.

No extensive definition of breakfast was provided; however examples of

- 3% of boys (p = 0.008). only had a beverage for breakfast or no breakfast at all
- Only includes adolescent boys aged 16-17 years.
- Reporting bias.
Timlin et al, 2008 (34)  
2216 participants (1007 boys), from high schools in the Minneapolis/St Paul, Minnesota, Metropolitan area. 
Longitudinal study. Project EAT-II survey. 
**Question:** “During the past week, how many days did you eat breakfast?” 
**Outcomes:** Never, 1-2 days, 3-4 days, 5-6 days or every day. 
Self-reported breakfast consumption. 
- Those who ate breakfast daily were more likely to be boys (37.9%) than girls (27.2%, p < 0.0001). 
- There was a 16.8% decrease in the number of boys consuming breakfast from time 1 to time 2 (5 year gap). 
- Those who ate breakfast daily were more likely to be white, come from a higher SES and take part in higher levels of PA. 
- Those who ate breakfast intermittently or never tended to have a higher BMI compared to daily breakfast eaters. 
- Reporting bias due to self-reported intakes. 
- Potential measurement error which may underestimate the true effect of breakfast habits on body weight. 

Storey et al, 2009 (40)  
2850 adolescents (1233 boys) aged 14-17 years, in Canada. 
Cross-sectional study. 24-hour dietary recall via web-based food behaviour questionnaire. 
**Question:** “How often do you usually eat breakfast?” 
**Outcomes:** Never, on weekends only, less than half the week (three or fewer days each week), more than half the week (four or more days each week), every day. 
Self-reported breakfast consumption. 
- Those with poor diet quality had a lower frequency of breakfast and lunch consumption than did those with average and superior (breakfast only) diet quality. 
- Reporting bias (social desirability, recall and response bias) due to self-reported intakes. 
- Validation of the web-based survey methodology was completed on a relatively small sample.
<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Question</th>
<th>Outcomes</th>
<th>Reporting bias (social desirability, recall and response bias) due to self-reported intakes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Health et al,</td>
<td>4,721 adults</td>
<td><strong>Question:</strong> “How many days in an average week do you have something to eat for breakfast? You may...</td>
<td>Daily, 3-6 times per week, less than 6 times per week.</td>
<td>Only 55.4% of male adolescents ate breakfast daily. 31% had breakfast 3-6 times/week and 14%...</td>
</tr>
<tr>
<td>2011 (31)</td>
<td>aged 15 years and over, in New Zealand.</td>
<td></td>
<td></td>
<td>reporting bias. (social desirability, recall and response bias) due to self-reported intakes.</td>
</tr>
<tr>
<td>Cross-sectional study.</td>
<td>Self-administered questionnaire</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Musaiger et al, 2011 (36)</td>
<td>735 adolescents (339 males), aged 15-18 years, in Bahrain.</td>
<td><strong>Question:</strong> Subjects were asked whether they were eating breakfast regularly.</td>
<td>Self-reported breakfast consumption.</td>
<td>37.2% of male participants did not consume breakfast regularly.</td>
</tr>
<tr>
<td>Cross-sectional study.</td>
<td>Self-administered questionnaire</td>
<td><strong>Outcomes:</strong> Yes, no</td>
<td></td>
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</tr>
<tr>
<td>Grieeger et al, 2012 (9)</td>
<td>781 boys aged 12-16 years, in Australia.</td>
<td>“Breakfast consumers were categorized as RTEC consumers; non-RTEC...</td>
<td>20% of participants skipped breakfast.</td>
<td></td>
</tr>
<tr>
<td>2007 Australian National Children's Nutrition and Physical Activity Survey, including 24-hour recalls.</td>
<td></td>
<td>and breakfast</td>
<td>Breakfast skippers had a higher BMI and waist circumference compared with ready-to-eat-cereal consumers (p ≤0.05).</td>
<td></td>
</tr>
<tr>
<td>2007 Australian National Children's Nutrition and Physical Activity Survey, including 24-hour recalls.</td>
<td></td>
<td>Food/drink (excluding water) consumed between 5am-9.30am on the day of the 24-hour recall.</td>
<td>24-hour dietary recalls may not be representative of participants habitual eating patterns.</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Sample Size</td>
<td>Methodology</td>
<td>Question</td>
<td>Outcomes</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>-------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Koca et al, 2017 (35)</td>
<td>7116 subjects (3671 boys), aged 6-18 years, from 10 schools in the region of Isparta in Turkey.</td>
<td>Cross-sectional study. Self-reported, semi-quantitative food frequency questionnaire.</td>
<td><strong>Question:</strong> How often do you have breakfast?</td>
<td><strong>Outcomes:</strong> (1) Every day and 4-6 times per week, (2) 1-3 times per week, and (3) Never.</td>
</tr>
</tbody>
</table>

- Only 52.1% of participants aged 12-18 years consumed breakfast daily ($p < 0.001$).
- 64.5% of all male participants ate breakfast every day ($p < 0.001$).
- The percentage of participants eating breakfast daily decreased with age, from 79.1% of participants aged 6-11 years to 52.1% of 12-18 year olds ($p < 0.001$) consuming breakfast daily.
- One in four overweight and obese subjects never ate breakfast and were significantly more likely to skip breakfast than their normal weight counterparts (3.8% vs 2.8%, $p < 0.05$).

- Reporting bias (social desirability, recall and response bias) due to self-reported intakes.
- Age range includes children and thus may not be an accurate representation of the adolescent population.
Smith et al, 2017 (12)  
1592 participants (824 boys) aged 2-17 years, in Australia.  
Longitudinal study.  
2011–12 National Nutrition and Physical Activity Survey, including two 24-hour recalls.  
**Question:** Subjects were asked what they ate on the days of the 24-hour recalls.  
**Outcomes:** If the subjects reported an eating occasion as “breakfast”, they were classified as breakfast consumers.  
Self-reported breakfast ≥210kJ. All food/drink consumed within 15 minutes of the reported breakfast time were combined as one meal. If food/drink was consumed more than 15 minutes apart, the meal with the highest energy content was counted as the breakfast.  
- 86.8% of boys ate breakfast on both days of the 24-hour recall, 11.8% skipped breakfast on one day, and 1.4% of boys skipped breakfast on both days.  
- Prevalence of skipping breakfast at least one of the two days increased with age, from 5.2% of boys aged 2-3 years to 25.6% of boys aged 14-17 years.

Drewnowski et al, 2018 (16)  
14,488 participants of which 1546 were adolescents aged 13-17 years, in the United States.  
Cross-sectional study.  
The first day of 24-hour diet recalls from the National Health and Nutrition Examination Survey.  
**Question:** Subjects were asked what they ate on the days of the 24-hour recalls.  
**Outcomes:** If the subjects reported an eating occasion as “breakfast/desayuno” and brunch they were classified as breakfast consumers. If they reported having no breakfast or less than 50kcal they were classified as breakfast skippers.  
Self-reported breakfast of ≥50kcal.  
- 3 out of 4 adolescents and young adults ate breakfast.  
- 17.68% of male children/adolescents skipped breakfast.  
- 24-hour dietary recalls may not be representative of participants habitual eating patterns.  
- Does not separate male adolescents from children.  
- Reporting bias (social desirability, recall and response bias) due to self-reported intakes.

Key: PA = physical activity, SES= socioeconomic status., RTEC= ready to eat cereal.
The effects of breakfast on diet quality

Many studies use various diet quality indices to assess the healthfulness and/or balance of an individual’s diet (16, 41). Generally speaking, markers of a healthy, balanced diet focus on adequate consumption of fruits, vegetables, wholegrain carbohydrates, milk/ milk alternatives, healthy fats, and meat/ meat alternatives (19, 41). Markers of an unhealthy diet include high consumption of sugary foods/drinks and processed foods high in saturated fat and sodium (19). Adequacy of intake can be assessed by comparing consumption against healthy eating recommendations for the target population (19). For male adolescents in New Zealand, the recommended food groups and amounts per day, based on the Ministry of Health Guidelines (19), are shown in Table 2.

Table 2. Ministry of Health Healthy Eating Guidelines for Young people (13-18 years of age) in New Zealand (19).

<table>
<thead>
<tr>
<th>Food group</th>
<th>Food included</th>
<th>Recommendation (per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit and vegetables</td>
<td>All vegetables and fruits, including starchy vegetables (e.g. kumara, potatoes) and fresh, frozen or canned.</td>
<td>At least 3 servings of vegetables and at least 2 servings of fruit. Only one serving of no-added-sugar fruit juice/ dried</td>
</tr>
</tbody>
</table>
fruit is counted as a serving per day.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Servings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breads and cereals</td>
<td>All breads, cereals, rice, and pasta. Wholegrain options recommended.</td>
<td>At least 6</td>
</tr>
<tr>
<td>Milk and milk products</td>
<td>Includes all milks, cheeses, and yoghurts, and calcium-fortified milk alternatives.</td>
<td>At least 3</td>
</tr>
<tr>
<td>Lean meat, poultry, seafood, eggs, legumes, nuts and seeds.</td>
<td>Lean meat, poultry, seafood, eggs, legumes (e.g. beans, lentils, peas), nuts and seeds.</td>
<td>At least 2</td>
</tr>
<tr>
<td></td>
<td>For vegetarians, at least 3 servings.</td>
<td></td>
</tr>
</tbody>
</table>

Several studies identified that breakfast consumers often made better food choices throughout the day compared with breakfast skippers (40-43). A study using the National Health and Nutrition Examination Survey (NHANES 2011-2014) data, assessed the effect of breakfast consumption on diet quality in children, adolescents, and adults (16). The macronutrient composition of those who regularly consumed breakfast was associated with overall better diet qualities (based on The Nutrient Rich Foods index), and consisted of less fat and added sugars, but more carbohydrate and protein (16). Higher-quality diets were comprised of higher intakes of citrus and other fruit, juice, wholegrains, milk and yoghurt, and lower intakes of breakfast meats, eggs, cheese, and refined grains during breakfast (16). Breakfast consumers also tended to have higher overall intakes of vegetables and milk, but lower intakes of soft drinks and fast food (17). Another study
found that adolescents (aged 15-16 years) with irregular breakfast intake (defined as omission of breakfast $\geq$ once a week) had significantly higher energy intakes derived from snack foods (26%, $P<0.001$) compared to regular breakfast consumers (18).

**Breakfast and body weight**

Many observational studies have assessed associations between skipping breakfast on an individual’s weight and BMI (18, 38, 44, 45). Resulting evidence is weak (due to the observational nature and cross-sectional design of many studies) but consistent, indicating that breakfast skipping can lead to unhealthy habits in adolescents, resulting in increased weight and subsequently a higher BMI (18, 38, 44). More specifically, a cross-sectional study involving 1609 Taiwanese adolescents found that the odds of being overweight were 51% (CI 1.12-2.04) greater for irregular breakfast consumers compared to regular breakfast eaters (15). However, the specific mechanisms linking breakfast and body weight are less clear. Several studies found that children and adolescents who eat breakfast have higher total daily energy intakes compared with those who skip breakfast (18, 46). Some of the rationale behind why those who eat breakfast regularly and have higher energy intakes, yet a lower risk of being overweight, is based on the theory that breakfast consumers are likely to make better food decisions throughout the day (e.g. not overcompensating later in the day) and less likely to snack as often and on high-fat foods (47). It is also possible that those who skip breakfast and snack more, under-report the food consumed due to difficulties in recalling it all or from social desirability bias (18, 38, 44, 47).

Another possibility is that obese individuals or those with a higher BMI are more likely to skip breakfast as a dieting technique (47). There is also some speculation around whether it is
the content of the breakfast that influences an individual’s BMI (for example, fibre and saturated fat content), rather than the act of eating or skipping breakfast (5).

Characteristics associated with breakfast skippers in adolescents

Several reoccurring associations between various characteristics and adolescent breakfast skippers have been identified. Lower socio-economic status (12, 16, 42, 48, 49), lack of parental presence during meal times (3, 48), poorer overall diet quality (4, 12, 16, 31, 34, 36, 42, 48), inadequate sleep (12, 50), being overweight/obese (4, 12, 14) and being female (12, 13, 49) were characteristics most commonly associated with breakfast skippers in adolescents. However, although these associations are common findings amongst observational studies, it is important to remember that correlation does not equal causation.

An association between breakfast consumption and depressive symptoms in adolescents has also been identified (51). At baseline, those who consumed breakfast less than or equal to one occasion per week were 3.78 (95% CI 1.71-7.87, p < 0.001) times as likely to experience depressive symptoms than those who consumed breakfast greater than or equal to six times per week (51). Several other cross-sectional studies assessing the relationship between breakfast consumption and depressive symptoms produced results that support the previously mentioned association (52, 53, 54, 55). This suggests that a greater frequency of breakfast consumption could potentially reduce the risk of depressive symptoms developing or progressing, although we must be mindful that these cross-sectional studies do not allow us to determine the direction of the relationship.

Variation in breakfast consumption amongst different ethnicities has also been identified (16). The NHANES 2011-2014 study found that Asian (87%, 95% CI 81.89-92.36), White
(83.53%, 95% CI 79.93-87.12) and Hispanic (83.54%, CI 80.08-87.00) children and adolescents were more likely to consume breakfast than Non-Hispanic Blacks (73.79%, 95% CI 69.43-78.14) (16).

The influence of parents on adolescent breakfast consumption appears to be multifactorial (3). A study examining eating patterns in 18,177 adolescents, found that those who ate six or seven meals a week with their parents were significantly less likely to skip breakfast (OR: 0.48, 95% CI 0.42-0.55, p < 0.001) (3). Parental rules around breakfast also affected the likelihood of adolescents consuming breakfast (3). Results indicated that adolescents who made their own decisions around breakfast consumption, were 25% more likely to skip breakfast (95% CI 1.06-1.46, p < 0.01) (3). Given this, adolescent autonomy regarding meal consumption, may not be beneficial in creating healthy habits for later in life (3). Parental breakfast eating has also been found to be the most statistically significant variable related to adolescent breakfast consumption (i.e. adolescents are more likely to eat breakfast when their parents also do) (38), thus suggesting that family interventions would be a preferable approach to improving breakfast consumption in adolescents.

Breakfast in adolescent males

Although breakfast skipping is more common in female compared to male adolescents (4, 12, 16, 31, 34, 36), it is still important to research breakfast consumption in males. A relatively high proportion of New Zealand adolescent males were found to skip breakfast (31). International data also supports the commonalities of this behaviour, which are summarised in Table 1. The 2008/09 New Zealand ANS reported that only 55.4% of male adolescents aged 15-18 years, ate breakfast daily, 31% had breakfast three to six times a week and 14% consumed breakfast two or
fewer times per week (31). Alongside this, various studies in the United States show an increasing trend in the number of adolescents skipping breakfast (56, 57, 58). One study found that one in five adolescents reported they usually skip breakfast (3). This study also found that breakfast skipping was more common among those who perceived themselves to be overweight (3) (Table 1).

There is the potential for differences to occur with regard to the reasons for skipping breakfast between male and female adolescents. There is weak evidence suggesting that common reasons for male adolescents skipping breakfast is due to lack of time and accessibility, and less likely to be related to weight or body image concerns more commonly associated with females (38, 59). Only few studies appear to look at breakfast consumption and associated diet patterns solely in male adolescents and thus is a potential area for future research.

Gaps in the literature

The most recent data available on adolescent breakfast consumption in New Zealand is from the ANS 08/09 (31) and thus may not reflect current dietary habits of adolescents in New Zealand. Because dietary behaviours developed during adolescence influence future dietary habits into adulthood, it is an important age to focus on in order to improve their health outcomes later in life (22). Alongside this, parental habits influence the dietary and lifestyle habits of adolescents (1), and thus creating healthy habits in adolescence, leading to healthy parental habits, may increase the chances of having improved health outcomes in future generations. It would also be interesting to see if there is any correlation between breakfast consumption and a healthier overall diet in adolescent males in New Zealand. There is some speculation as to whether it is the content of the breakfast (e.g. cereal, vs other foods), that influences an
individual’s BMI, rather than the act of eating or skipping breakfast (5). This highlights an area that requires further investigation in future research.

Therefore, the aim of the present study is to investigate further whether breakfast consumption in adolescent males has an effect on the quality of their overall diet and associated weight status.
Objective statement

The aim of the SuNDiAL project was to assess the overall dietary habits of New Zealand adolescents, 15-18 years of age. The main focus of this thesis was to investigate breakfast consumption patterns and associations with weight status and overall diet quality in a subsample of participants from the SuNDiAL project (male adolescents only).

More specifically, the objectives of this thesis were to:

- Determine the frequency of breakfast consumption in male adolescents.
- Assess the frequency of breakfast consumption by weight status.
- Assess the associations between breakfast consumption and mean energy intake, macronutrients and fibre intake.
- Assess the associations between frequency of breakfast consumption and eating behaviours and food group intakes.
- Identify any possible correlations between breakfast consumption and quality of diet in relation to the Ministry of Health guidelines among male adolescents.
- Provide up to date data on breakfast consumption in adolescent males in New Zealand.
Methods

Overall Study Design

The data presented in this thesis was collected as a part of the larger SuNDiAL project. It is a cross-sectional, nationwide survey consisting of two sub-studies, involving female adolescents (Phase One 2019), and male adolescents (Phase Two 2020). The data presented in this thesis will focus primarily on the dietary habits of male adolescents aged 15 to 18 years.

The participants involved in this study completed two 24-hour dietary recalls, two previous day activity recalls, had their height, weight, ulna length and blood pressure measured. Those who consented also provided a blood sample to determine levels of cholesterol and HbA1c, along with a urine sample to identify iodine concentrations and wore an accelerometer 24-hours a day for seven days to obtain an estimate of their 24-hour activity. They also completed a series of online questionnaires using REDCap (Research Electronic Data Capture) software, assessing their dietary habits, screen time and attitudes and beliefs about the foods they choose to eat and/or avoid.

This study is registered with the Australian New Zealand Clinical Trials Registry: ACTRN12620000185965 (see Appendix A). Ethical approval was gained by the University of Otago Human Ethics Committee: H20/004 (see Appendix B), and Maori Consultation was carried out throughout the design of the study (see Appendix C)

The aim of the SuNDiAL project, Phase Two 2020, was to describe the dietary patterns, nutritional and health status, motivations, attitudes, 24-hour activity patterns, and screen time habits of adolescent males in New Zealand. This thesis describes breakfast consumption patterns and its effects on overall diet quality and weight status of adolescent males in a subsample of participants from the SuNDiAL project. Only the measurements reported in this thesis will be described in detail.
Participants and Recruitment

Study location

Data collection was carried out in six high schools in six locations across New Zealand, which are as follows: Auckland, Tauranga, Hawkes Bay, Wellington, Christchurch, and Dunedin. These locations were determined by where the data collectors (Masters of Dietetics Students) were based in Term One of the school year, 2020. Data collection in Term One of the school year was carried out between February to April, 2020.

Recruitment of schools

Emails for recruitment were sent by the SuNDiAL coordinator in October 2019, to all schools in the targeted areas that had male students enrolled, and had a total of more than 400 students at the school. The participating schools provided written consent to participate (signed by an appropriate representative from the school), following which, dates and times for student recruitment and data collection were organised. Additionally, as there were not enough responses via email, other schools were contacted for recruitment in-person by the data collectors who explained what was involved in the study.

Eligibility criteria

1.1.1.1 Inclusion criteria

Individuals eligible to participate in the study included those who were between 15 to 18 years of age, who self-identified as male, who were enrolled in one of the recruited high schools and who were able to speak and understand English, and were able to the complete necessary questionnaires online.
1.1.1.2 Exclusion criteria

Those who did not identify as male and were outside of the age range (15-18 years of age).

Recruitment of participants

The data collectors visited the schools that had agreed to participate early in term one (February), in order to commence recruitment of students within the schools. Presentations were given at the recruited High Schools during assemblies, providing an overview of the SuNDiAL project, including what and who would be involved, and how to participate. The schools were also provided with electronic copies and printed handouts about the study, that could be circulated in the school newsletters and on social media sites following the presentation.

At the end of the presentation, students were given the chance to sign up to participate in the study by recording their name, age and email address on the sign-up sheets provided. Alternatively, students were also given the opportunity to visit the study website (www.otago.ac.nz/sundial) at a later date where they could read more about the study and what was involved. Those interested could then sign up via the website by providing their name, age, email address and the high school they attend.

At this point, the interested students were assigned a study ID code and were directed to complete online consent (see Appendix D). Participants under the age of 16 were asked to provide the email address of a parent/guardian who then needed to provide consent for them to participate in the study. A link to the REDCap questionnaire was sent by the SuNDiAL coordinator to all interested students that had provided their details. The link to the questionnaire was only sent to participants under the age of 16 years once consent was gained by a parent/guardian.
Data Collection

After providing online consent, participants completed online questionnaires which included a series of questions on demographics and health. The interested students had the option of contacting investigators via phone or email at any point if they had questions about participating in the study. The participants had the option of answering the remaining questionnaires or finishing them at a later date. The additional questionnaires focused on dietary habits, attitudes and motivations for food choice, and weight loss intentions and methods. All of these questionnaires were administered via the web application REDCap.

The data collectors contacted the students and/or the school representative to schedule a time to be visited by the study investigators at school, in order to carry out the data collection. During the scheduled times, the participants completed a 24-hour dietary recall and a previous day activity recall with one of the data collectors face-to-face. Alongside this, height, weight, ulna lengths of the participants were measured in duplicate, and blood pressure was measured in triplicate. If measurements differed by 0.5, they were repeated until all values were within 0.5 of each other. This part of the data collection process took approximately 60 minutes per participant to complete.

Participants were given the option of wearing an accelerometer. Those who gave consent to wear one, were provided with an Actigraph GT3x+ accelerometer that was worn on an elasticated belt fitted over their right hip. This was worn continuously, 24 hours a day for seven days. The use of the accelerometer and other measures of physical activity will not be described in detail as they are out of the scope of this thesis.

A second 24-hour dietary recall and previous day physical activity recall were carried out by the data collectors either over the phone or by video-call. These took place the following weekend in order to get a more accurate representation of any changes in the
participants dietary habits and activity patterns between different days of the week. The second recalls took approximately 45 minutes per participant to complete.

Participants were also given the option of providing a blood sample. Those who consented to this, were appointed a time during which they had their blood sample taken by a trained phlebotomist/research nurse. Additionally, participants also had the option of providing a urine sample. Participants received a $5 supermarket voucher for each section of the study that they completed, with the potential to gain $30 total.

Due to the Coronavirus outbreak, data collection was not able to be completed at all schools. This meant that for some schools, both 24-hour recalls were achieved over phone call or video-call, and accelerometry data, along with blood and urine samples were not obtained.

Measurement procedures

Demographics and health status

A questionnaire, administered through REDCap, assessing demographics and health status (involving questions around food allergies and intolerances, medical history etc), was completed by the participants after consent was given. Contact details, age and ethnicity were also collected. The full questionnaire can be found in Appendix E. The 2006 New Zealand census question was used to determine participants ethnicity, which were categorised, as shown in Table 3. The participants were able to choose more than one ethnicity that they identified as, and the prioritised ethnicity method was used to allocate each person to a single ethnic group (60). The ethnicities of the participants are categorised in the following order of priority: Māori, Pacific, Asian, New Zealand European and Others (60). The New Zealand European and Other (NZEO) category included ethnicities that were too small to be analysed alone.
The participants home address was used to assign socioeconomic deprivation scores based on the 2018 New Zealand Deprivation Index (NZDep18) score. This provides deprivation scores for each geographical mesh-block in New Zealand, with one representing the lowest level of deprivation and 10 representing the highest level of deprivation (61). Those in mesh blocks corresponding to a deprivation score of one, two or three were categorised into the ‘low’ deprivation category, four, five, six and seven were considered ‘medium’ deprivation, and eight, nine and ten were categorised into the ‘high’ deprivation category (61).

Table 3. Ethnicity categories

<table>
<thead>
<tr>
<th>Ethnicity category</th>
<th>Ethnicities within category</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Zealand European and Others</td>
<td>New Zealand European, American, Afrikaans, Dutch, Ethiopian, German, Italian, Irish, Nicaraguan, Somali, South African.</td>
</tr>
<tr>
<td>Māori</td>
<td>Māori</td>
</tr>
<tr>
<td>Asian</td>
<td>Filipino, Japanese, Indian</td>
</tr>
<tr>
<td>Pacific</td>
<td>Cook Island, Fijian, Samoan, Tokelau.</td>
</tr>
</tbody>
</table>

Dietary habits questionnaire

Once consent had been given and the demographics and health status questionnaire had been completed, the participants gained access to the next questionnaire (also administered through REDCap). This questionnaire assessed their attitudes and motivations for food choice (shown in Appendix F).

The following questionnaire (Dietary Habits) was designed to provide insight into the participants habitual eating patterns. An example question was: “How many days in an
average week do you have something to eat for breakfast?”. The response options were as follows: “I don’t usually have breakfast, one day a week, two days a week, three days a week, four days a week, five days a week, six days a week, seven days a week.” Questions regarding the frequency and servings of fruits and vegetables, breads, milk, spreads and oils, nuts and nut butters, meat, dairy and eggs, legumes and other foods, that were consumed daily or weekly by the participants were also assessed. These questions provided examples of what a typical serving size of the food in question would be. Additionally, questions regarding the participants, snack, alcohol, fast food and sugar-sweetened beverage intake were also assessed. The questionnaire took approximately 20-30 minutes to complete. The participants were given the opportunity at the end of the questionnaire to provide any further information if necessary. The full questionnaire can be found in Appendix G.

Most of the questionnaires (of which includes the Dietary Habits Questionnaire (DHQ)), administered through REDCap, were based on questionnaires that have previously been validated in the United States (62-67) but contained some alterations to make it more appropriate for adolescent males in New Zealand.

24-hour Dietary Recall

Two multiple pass 24-hour recalls were completed with each participant in order to get an estimate of usual dietary intake. This involved a four-stage process (68). The first pass consisted of obtaining a list of all foods and beverages consumed from midnight to midnight the previous day (68). In the second pass, a more detailed list was obtained, which included the time of consumption, brands of food items, as well as cooking methods and recipes used (when possible) (68). In the third pass, food models, household measures and photographs of different portion sizes and amounts were provided to help participants estimate the quantity
of foods and beverages consumed more accurately (68). The fourth pass involved reviewing the previously recalled items to check that they are all correct (68).

This information was recorded by the data collectors and entered into FoodWorks 9 (Xyris Software Australia Pty Ltd) to calculate the participants total energy, and macro- and micro-nutrient intakes. FoodWorks software uses the most current and extensive food composition tables for New Zealand (FOODfiles 2018 (The New Zealand Institute for Plant & Food Research Limited)) which also includes the 2008/09 Adult Nutrition Survey (ANS 08/09) recipe calculated food. The second 24-hour recall was completed to obtain a more accurate representation of the participants usual dietary intake and to capture some of the day-day variation that may occur.

**Anthropometry**

Height, weight, and ulna length measurements were taken for each participant. Prior to this, each data collector was trained on how to appropriately take each measurement according to the study protocols, to ensure they results were as accurate as possible. These can be found in **Appendix H.** Before taking the participants anthropometric measurements, verbal consent was gained, and the procedure was explained in detail. These measurements were taken within the same time slot as the first 24-hour dietary recall for those that were conducted face-to-face.

Height was taken using one of two stadiometers available (Seca 213; and Wedderburn) on a hard floor surface. Each participant was asked to remove their shoes, as well as anything on/in their hair that may interfere with the height reading. Alongside this, their head was positioned in the Frankfort horizontal plane and their heels were touching, with their toes turned out in a 60-degree angle. The height was then recorded, to the nearest 0.1 cm. The participants weight was taken using one of four scales (Medisana PS420; Salter
9037 BK3R; Seca Alpha 770; or Soehnle Style Sense Comfort 400) which had been previously calibrated by the research team. Each participant was asked to remove any heavy items of clothing (such as shoes, jackets or heavy tops etc.) as well as items they may have in their pockets. Weight was measured to the nearest 0.1 kg.

The height, weight and ulna length were measured in duplicates, unless the two values did not fall within 0.5 units of each other. In this case, a third measurement was taken and the average of all three was used. The same equipment was used for the anthropometric measurements within each secondary school, but there was inter-school variation.

Data Entry/Processing

Anthropometric, activity recall data and 24-hour dietary recall data were all entered into REDCAP and FoodWorks by the MDiet students. The questionnaires were all completed online through REDCap by the participants, in their own time. REDCap is a web-based application that is used for creating and managing survey’s and databases online. This is where the data from the online questionnaires were stored and managed by the research assistants and statistician. No data cleaning was required as a result of using the REDCap software for the questionnaires (due to the inbuilt quality control measures).

Statistical Analysis

In order to determine mean nutrient intakes with a 95% precision interval, the number of participants required for this is 100 in order to give a precision level of +/- 0.2 standard deviations (SD). Microsoft Excel (Version 16.16.21 (200413)) was used for statistical analysis of the data, except for estimates of the participants usual dietary intake, which were determined using the Multiple Source Method (69). Stata 16.0 (StataCorp, Texas) was used for these calculations. This method was used to adjust for random measurement error (for
example day-day variation in nutrient intake) for participants with two days of diet recall data. This information was then applied to the entire dataset to provide an adjusted estimate of usual intake for all participants. These calculations were completed by the SuNDiAL project statistician (Jill Haszard). All baseline demographic statistics, such as descriptive analysis of age, New Zealand Deprivation score and category, BMI-for-age Z-score and categories, and ethnicity were calculated in Microsoft Excel. The World Health Organisation (WHO) growth charts were used to calculate BMI-for-age Z-scores (70). This system is standardised using Z-scores, which expresses the number of Z-scores, or standard deviations, an observed anthropometric measure is from the mean or median (71). The resulting values can then be used to compare against a reference population (71). The following formula is used to determine the BMI-for-age Z-score: Z-score = (observed value – median reference value)/ standard deviation of reference the population (71). The resulting BMI-for-age Z-score was then used to determine a weight category each participant was in. Weight categories were: underweight, BMI Z-score < -2, healthy weight is ≥ -2 to <1, overweight >1 & ≤2, and obese >2 (71).

Due to the small samples size of those who ‘do not usually eat breakfast’, this category was combined with those who eat breakfast ‘1-2 days/week’ and is labelled ‘Never/rarely’. Additionally, those who consumed breakfast three and four days a week were combined into one category (moderate consumption), and those who consumed breakfast five, six and seven days a week were also categorised together (regular breakfast eaters). Additionally, other questions that had multiple possible answers were also grouped together for ease of interpretation.

For energy and fibre, mean intakes per breakfast category were used. For carbohydrate, protein, fat and saturated fat intakes, the mean percentage of total daily energy from each of the macronutrients were used. These were determined in Excel using the mean
intakes for each macronutrient then converting it to a percentage of total energy intake per
breakfast category, by using the appropriate Atwater factor. The Atwater factors used are as
follows: for carbohydrate, it was 16 kJ/g, protein was 17 kJ/g and fat (including saturated fat)
was 37 kJ/g (72).
Results

Participant demographics

A total of 140 New Zealand secondary schools were identified as eligible to participate in the SuNDiAL project. The flow diagram, (Figure 1) outlines the school recruitment, with a total of six schools participating across New Zealand. The participant recruitment and selection process are outlined in Figure 2.

From the six participating schools, there were 1664 eligible participants, of which 334 responded. Data collection was fully completed at two of the six schools, however due to the COVID-19 outbreak, only partial data collection was carried out at the remaining four schools. A total of 146 participants, consented and completed enrolment; however, 11 of these did not complete any of the online questionnaires or 24-hour recalls; and so, were excluded from the study. Of the 135 remaining participants, 122 completed the dietary habits questionnaire. The completion of this questionnaire was essential to this thesis, and thus a total of 122 participants were included in this study (Figure 2).
Phase Two
February – April 2020

140 eligible schools
140 invited by email

8 schools consented to participate
• 10 schools declined
• 122 schools did not respond
• 2 schools did not participate due to COVID-19

6 schools total participated

Figure 1. School recruitment process.
Phase Two
February – April 2020

6 Schools recruited
- 1664 Eligible participants
- 334 responded

• 101 did not give consent
• 76 had no parental consent
• 10 did not complete enrolment
• 1 was 19 years old and was excluded

146 participants both consented and enrolled
11 did not complete any questionnaire or 24-hour recall

135 participants included

128 completed online questionnaires
- 128 completed demographics & health
- 124 completed attitudes & motivations
- 122 completed dietary habits

102 completed a 24-hour recall
- 72 completed a second 24-hour recalls

109 completed anthropometric measurements

122 participants in total included in data analysis

Data collection was fully completed at 2 of these schools.

Figure 2. Participant recruitment process.
The baseline characteristics of the study population are presented in Table 4. The mean (SD) age of the participants was 16.6 (0.7) years. Over half of the participants were of New Zealand European/Other ethnicity (58.2%), and nearly one-third (30.3%) were of Asian ethnicity. The proportion of those identifying as Māori and Pacific Islander were 9.8% and 1.6%, respectively. The highest proportion of adolescent males in the study were in the moderate category for household deprivation (41.8%), with the lowest proportion being from the category representing the most deprived households (21.3%). Although the average BMI-for-age- Z-score was 0.4 (indicating a healthy weight) for this sample population, 27.6% were overweight \((n=27)\), and 6.1% were obese \((n=6)\).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Participants (n=122)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years [mean (SD)]</td>
<td>16.6 (0.7)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
</tr>
<tr>
<td>New Zealand European/ Other</td>
<td>71 (58.2)</td>
</tr>
<tr>
<td>Asian</td>
<td>37 (30.3)</td>
</tr>
<tr>
<td>Māori</td>
<td>12 (9.8)</td>
</tr>
<tr>
<td>Pacific</td>
<td>2 (1.6)</td>
</tr>
<tr>
<td>Household Deprivation Category(^2)</td>
<td></td>
</tr>
<tr>
<td>1-3 (low)</td>
<td>45 (36.9)</td>
</tr>
<tr>
<td>4-7 (moderate)</td>
<td>51 (41.8)</td>
</tr>
<tr>
<td>8-10 (high)</td>
<td>26 (21.3)</td>
</tr>
<tr>
<td>Weight Status (^3)</td>
<td></td>
</tr>
<tr>
<td>Underweight(^4)</td>
<td>1 (1.0)</td>
</tr>
<tr>
<td>Healthy(^5)</td>
<td>64 (65.3)</td>
</tr>
<tr>
<td>Overweight(^6)</td>
<td>27 (27.6)</td>
</tr>
<tr>
<td>Obese(^7)</td>
<td>6 (6.1)</td>
</tr>
</tbody>
</table>

Abbreviations: SD, standard deviation; BMI, body mass index

\(^1\) Data is shown as number (percentage) unless otherwise stated and is for participants who had available data.

\(^2\) Determined using the NZDep18 Index of Deprivation with decile 1 representing areas with the least deprivation and decile 10 presenting areas with the most deprivation (61).

\(^3\) Only 98 out of 122 participants had available data for these variables.


\(^5\) BMI z-score \(\geq -2 \& \leq 1\) using World Health Organisation Growth Standard reference data (70).
Breakfast consumption among participants

Participants were asked in the Dietary Habits questionnaire how frequently they eat breakfast. The largest proportion of participants (57.4% (95% CI: 44-71)) reported they consumed breakfast seven days a week, whereas 9.8% (95% CI: 4.2-15.4) said they don’t usually have breakfast (as shown in Table 5).

Table 5. Frequency of breakfast consumption among participants who completed the Dietary Habits Questionnaire.

<table>
<thead>
<tr>
<th>Breakfast consumption frequency</th>
<th>Participants (% (95% CI))¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don’t usually have breakfast</td>
<td>9.8 (4.2-15.4)</td>
</tr>
<tr>
<td>One day a week</td>
<td>2.5 (-0.3-5.3)</td>
</tr>
<tr>
<td>Two days a week</td>
<td>4.1 (0.5-7.7)</td>
</tr>
<tr>
<td>Three days a week</td>
<td>4.1 (0.5-7.7)</td>
</tr>
<tr>
<td>Four days a week</td>
<td>4.9 (1.0-8.8)</td>
</tr>
<tr>
<td>Five days a week</td>
<td>7.4 (2.6-12.2)</td>
</tr>
<tr>
<td>Six days a week</td>
<td>9.8 (4.2-15.4)</td>
</tr>
<tr>
<td>Seven days a week</td>
<td>57.4 (44.0-70.8)</td>
</tr>
</tbody>
</table>

¹ Total n=122

Breakfast consumption by weight category, ethnicity and socioeconomic status

The characteristics of those who regularly consumed breakfast (five or more times per week) and those who never/rarely consumed breakfast (those who don’t usually at breakfast combined with those who reported consuming breakfast 1-2 days a week) were assessed (Figure 3). The results for the ‘never/rarely’ breakfast category need to be interpreted with
caution given the small numbers (n=20). These two categories were assessed by weight status, ethnicity and socioeconomic status (based on NZDep18 categories). Sixty-three percent of those consuming breakfast ‘never/rarely’ were a healthy weight versus 69% of participants in the ‘≥5 days/week’ category. In the obese weight category, 12.1% of those consuming breakfast ‘never/rarely’ were obese versus 4.1% of regular breakfast eaters. There was a higher percentage of participants who consumed breakfast five or more times per week in both the NZEO and Asian ethnicity categories (60.4% and 30.8% respectively) compared to the ‘never/rarely’ breakfast category. In contrast, 15% of the ‘never/rarely’ breakfast category identified as Māori, compared to 8.8% in the ‘≥5 days/week’ category. Among those consuming breakfast never/rarely, 30% were in the lowest deprivation, whereas 40% were in the highest level of deprivation. Among those who consumed breakfast ‘≥5 days per week’ only 16.5% were in the high deprivation category compared to 40.7% in the low and 42.9% in the medium categories.
Figure 3. Percentage of participants\(^1\) that do not consume breakfast versus those that do five or more times a week, by weight status, ethnicity and socioeconomic status\(^2\).

\(^1\)Total ‘never/rarely: \(n=20\), except for weight status where there was only data for 16 of these participants. Total \(\geq \) 5 days/week: \(n=91\), except for weight status where there was only data for 73 of these participants. Total underweight \(n=1\), total healthy weight \(n=60\), total overweight \(n=23\), total obese \(n=5\), total New Zealand European and Other (NZEO) \(n=66\), total Asian \(n=32\), total Maori \(n=11\), total Pacific \(n=2\), total low deprivation \(n=43\), total medium deprivation \(n=45\), total high deprivation \(n=23\).

\(^2\)Socioeconomic status is defined by the participants NZDep18 category.
Breakfast consumption, and energy and macronutrient consumption

The average amount of energy consumed based on frequency of breakfast consumption is shown in Figure 4. This data is based on adjusted results from the two 24-hour dietary recalls. There is evidence of a trend whereby energy intake increased with more frequent breakfast consumption. Those who reported ‘never/rarely’ consuming breakfast had an average energy intake of 7350 kJ/day (95% CI: 6273-8427), compared to 10343 kJ/day (95% CI: 9749-10937) for those who reported consuming breakfast ‘≥5 days/week’.

There appears to be no consistent trend in percentage of mean energy intake from carbohydrates with increasing frequency of breakfast consumption (Figure 5). The only breakfast categories that consumed the recommended amount of carbohydrates based on total energy intake (between 45-65% of total energy (74)) were those who consumed breakfast ‘3-4 times/week’ (45%). Those who consumed breakfast ‘≥5 days a week’ were nearly within the acceptable macronutrient distribution range (AMDR) (44% of energy from carbohydrates). Those who consumed breakfast ‘never/rarely’ had the lowest percentage of energy from carbohydrates (39%).

Participants consuming breakfast ‘never/rarely had the highest percentage of energy from protein (21%), whereas those consuming breakfast ‘3-4 days a week’ had the lowest percentage of energy from protein (17.5%) (Figure 5). All values amongst the different breakfast categories fell within the AMDR for protein intake (10-25% of total energy (74)). All breakfast categories had a percentage of energy from fat that exceeded the upper limit of the AMDR for this macronutrient (20-35% of total energy (74)). Those who consumed breakfast ‘never/rarely’ had the highest percent energy from fat (39.8%), and those who consumed breakfast regularly (≥5 days/week) had the lowest percent energy from fat (36.5%). Both the percentage of energy from fat and saturated fat decreased with increasing frequency of breakfast consumption. All breakfast categories also exceeded the AMDR for
saturated fat intake (≤10% of total energy). Those consuming breakfast ‘never/rarely’ had the highest percent energy from saturated fat (14.6%) and those who consumed breakfast regularly had the lowest percent energy from saturated fat (13.6%).

**Figure 6** presents the mean fibre intake (g/day) of the participants based on the three breakfast categories. A pattern is evident whereby the average fibre intake increased with increasing breakfast consumption frequency. The regular breakfast eaters (≥5 days/week) had the highest average fibre intake of 25.7 g/day (95% CI: 24-28). Those who consumed breakfast ‘never/rarely’ had the lowest fibre mean fibre intake (15.1 g/day, 95% CI: 12-19).
Figure 4. Mean energy (kJ) consumed per day, categorised by frequency of breakfast consumption, based on 24-hour recall data\textsuperscript{1}.

\textsuperscript{1}Never/ rarely includes those who do not usually consume breakfast and those that do 1-2 days a week.
Figure 5. Mean percentage of mean carbohydrate, protein, fat and saturated fat from mean daily energy intake categorised by frequency of breakfast consumption, based on 24-hour recall data\(^1\).

\(^1\) *Never/rarely* includes those who do not usually consume breakfast and those that do 1-2 days a week.
Figure 6. Mean fibre intake (g/day) by breakfast category\textsuperscript{1}.

\textsuperscript{1} Never/rarely $n=13$, 1-2 days/week $n=6$, 3-4 days/week $n=9$, $\geq$5 days/week $n=67$. Total $n=89$. 
Breakfast consumption and food groups

Participants fruit and vegetable intakes (from the DHQ) by breakfast category were compared in Table 6. The consumption of fruit and vegetables was fairly similar amongst the various breakfast categories. The ‘≥5 days/week’ category was the only breakfast subgroup that had participants consuming more than three servings of fruit per day (9.9%), and had the smallest proportion of individuals consuming less than one serving of vegetables per day (27.5%). The highest proportion of participants consuming more than three servings of vegetables per day was present in the ‘3-4 days a week’ breakfast category (18.2%).

Table 6. Number of participants\(^1\) consuming various servings of fruit and vegetables per breakfast consumption frequency category.

<table>
<thead>
<tr>
<th>Breakfast category</th>
<th>Never/rarely(^2) (n=20)</th>
<th>3-4 days/week (n=11)</th>
<th>≥5 days/week (n=91)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fruit intake:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 serving/day</td>
<td>12 (60.0)</td>
<td>4 (36.4)</td>
<td>35 (38.5)</td>
</tr>
<tr>
<td>1 serving/day</td>
<td>3 (15.0)</td>
<td>2 (18.2)</td>
<td>12 (13.2)</td>
</tr>
<tr>
<td>2 servings/day</td>
<td>5 (25.0)</td>
<td>3 (27.3)</td>
<td>26 (28.6)</td>
</tr>
<tr>
<td>3 servings/day</td>
<td>0 (0.0)</td>
<td>2 (18.2)</td>
<td>9 (9.9)</td>
</tr>
<tr>
<td>&gt;3 servings/day</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>9 (9.9)</td>
</tr>
<tr>
<td><strong>Vegetable intake:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 serving/day</td>
<td>10 (50.0)</td>
<td>5 (45.5)</td>
<td>25 (27.5)</td>
</tr>
<tr>
<td>1 serving/day</td>
<td>4 (20.0)</td>
<td>2 (18.2)</td>
<td>25 (27.5)</td>
</tr>
<tr>
<td>2 servings/day</td>
<td>4 (20.0)</td>
<td>1 (9.1)</td>
<td>22 (24.2)</td>
</tr>
<tr>
<td>3 servings/day</td>
<td>2 (10.0)</td>
<td>1 (9.1)</td>
<td>8 (8.8)</td>
</tr>
<tr>
<td>&gt;3 servings/day</td>
<td>0 (0.0)</td>
<td>2 (18.2)</td>
<td>11 (12.1)</td>
</tr>
</tbody>
</table>

\(^1\) Data is shown as number (percentage) unless otherwise stated
\(^2\) Never/ rarely includes those who do not usually consume breakfast and those that do 1-2 days a week.
Figure 7 presents the percentage of individuals who meet the MOH healthy eating recommendations for fruit (19), based on categorised frequency of breakfast consumption. The results need to be interpreted with caution, given the low numbers in the categories who consumed breakfast less than five times a week. There is a trend towards increasing percentage of participants meeting the MOH fruit recommendations with increasing frequency of breakfast consumption. The ‘≥5 days a week’ breakfast category had the highest percentage of individuals consuming two or more servings of fruit per day (48.3%).

Figure 8 presents the percentage of individuals that meet the MOH healthy eating recommendations for vegetables (19), based on categorised frequency of breakfast consumption. The largest percentage of participants consuming three or more servings of vegetables per day also consumed breakfast ‘3-4 days/week’ (27.3%). Much like the results for fruit intakes, those who consumed breakfast ‘≥5 days/week’ had a higher percentage of participants eating three or more servings of vegetables per day compared to those who ‘never/rarely’ consume breakfast (20.9 and 16.7% respectively).

The frequency of milk and dairy product consumption per breakfast category is presented in Table 7. The majority of participants consumed both milk and dairy products less than once a day, except for those consuming breakfast ‘≥5 days a week’. There also appears to be a decrease in those consuming milk and dairy products less than once a day with increasing consumption of breakfast. Those consuming breakfast ‘never/rarely’ had a higher percentage of individuals consuming both milk and dairy products less than once a day (55% and 80% respectively) compared to those eating breakfast ‘≥5 days a week’ (29.7% and 57.1% respectively). The ‘never/rarely’ and ‘≥5 days/week’ breakfast categories were the only two subgroups in which participants reported consuming milk and dairy products more than three times a day (milk: 5% and 5.5%, respectively; dairy: 5% and 3.3% respectively).
Those who consume breakfast ‘3-4 days a week’ have the highest percentage of participants consuming processed meats one or more times per day (18.2%) compared to all other breakfast categories as shown in Table 8. Regular breakfast eaters (≥5 days a week) have fewer participants consuming processed meats ‘5-6 times a week’ and ‘≥once a day’ compared to those consuming breakfast ‘never/rarely’. There appears to be an increase in the percentage of participants consuming red meat ‘≥ once a day’ with increasing frequency of breakfast consumption, although the numbers are small. The majority of participants consumed pork less than two times a week across all breakfast categories. Both the ‘never/rarely’ and ‘≥5 days a week’ breakfast categories show a decrease in percentage of participants with increasing frequency of poultry consumption. For fish, seafood, legumes, tofu/tempeh, vegetarian meat alternatives and other vegetarian ingredients, majority of participants across all breakfast categories, consumed these products less than two times a week. Regular breakfast eaters had the highest percentage of participants consuming eggs ‘5-6 times a week’ and ‘≥ once a day’ compared to all other breakfast categories.
Figure 7. Percentage of participants consuming two or more servings of fruit per day based on frequency of breakfast consumption categories$^1$.

$^1$ Never/rarely includes those who do not usually consume breakfast and those that do 1-2 days a week.
Figure 8. Percentage of participants consuming three or more servings of vegetables per day based on frequency of breakfast consumption categories\(^1\).

\(^1\) Never/rarely includes those who do not usually consume breakfast and those that do 1-2 days a week.
Table 7. Frequency of milk and dairy product consumption based on breakfast category.

<table>
<thead>
<tr>
<th>Breakfast category</th>
<th>Never/rarely&lt;sup&gt;1&lt;/sup&gt; (n=20)</th>
<th>3-4 days/week (n=11)</th>
<th>≥5 days/week (n=91)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Milk Products</strong>&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; once a day</td>
<td>11 (55.0)</td>
<td>4 (36.4)</td>
<td>27 (29.7)</td>
</tr>
<tr>
<td>Once a day</td>
<td>3 (15.0)</td>
<td>3 (27.3)</td>
<td>39 (42.9)</td>
</tr>
<tr>
<td>2-3 times a day</td>
<td>5 (25.0)</td>
<td>4 (36.4)</td>
<td>20 (22.0)</td>
</tr>
<tr>
<td>&gt; 3 times a day</td>
<td>1 (5.0)</td>
<td>0 (0.0)</td>
<td>5 (5.5)</td>
</tr>
<tr>
<td><strong>Dairy products</strong>&lt;sup&gt;3&lt;/sup&gt;:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; once a day</td>
<td>16 (80.0)</td>
<td>7 (63.6)</td>
<td>52 (57.1)</td>
</tr>
<tr>
<td>Once a day</td>
<td>1 (5.0)</td>
<td>3 (27.3)</td>
<td>22 (24.2)</td>
</tr>
<tr>
<td>2-3 times a day</td>
<td>2 (10.0)</td>
<td>1 (9.1)</td>
<td>14 (15.4)</td>
</tr>
<tr>
<td>&gt; 3 times a day</td>
<td>1 (5.0)</td>
<td>0 (0.0)</td>
<td>3 (3.3)</td>
</tr>
</tbody>
</table>

<sup>1</sup> Never/rarely includes those who do not usually consume breakfast and those that do 1-2 days a week.
<sup>2</sup> Milk products include cow’s milk or plant milk
<sup>3</sup> Dairy products include foods such as cheese and yoghurt.

Table 8. Frequency of meat/meat alternative<sup>1</sup> consumption based on breakfast category.

<table>
<thead>
<tr>
<th>Breakfast category</th>
<th>Never/rarely&lt;sup&gt;2&lt;/sup&gt; (n=20)</th>
<th>3-4 days/week (n=11)</th>
<th>≥5 days/week (n=91)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Processed meats</strong>:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2 times a week</td>
<td>8 (40.0)</td>
<td>4 (36.4)</td>
<td>29 (31.9)</td>
</tr>
<tr>
<td>2-4 times a week</td>
<td>6 (30.0)</td>
<td>2 (18.2)</td>
<td>33 (36.3)</td>
</tr>
<tr>
<td>5-6 times a week</td>
<td>3 (15.0)</td>
<td>3 (27.3)</td>
<td>12 (13.2)</td>
</tr>
<tr>
<td>≥ Once a day</td>
<td>3 (15.0)</td>
<td>2 (18.2)</td>
<td>17 (18.7)</td>
</tr>
<tr>
<td><strong>Red meat</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2 times a week</td>
<td>3 (15.0)</td>
<td>0 (0.0)</td>
<td>14 (15.4)</td>
</tr>
<tr>
<td>2-4 times a week</td>
<td>11 (55.0)</td>
<td>5 (45.5)</td>
<td>33 (36.3)</td>
</tr>
<tr>
<td>5-6 times a week</td>
<td>4 (20.0)</td>
<td>4 (36.4)</td>
<td>23 (25.3)</td>
</tr>
<tr>
<td>≥ Once a day</td>
<td>2 (10.0)</td>
<td>2 (18.2)</td>
<td>21 (23.1)</td>
</tr>
<tr>
<td><strong>Pork</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2 times a week</td>
<td>13 (65.0)</td>
<td>6 (54.5)</td>
<td>66 (72.5)</td>
</tr>
<tr>
<td>2-4 times a week</td>
<td>5 (25.0)</td>
<td>3 (27.3)</td>
<td>16 (17.6)</td>
</tr>
<tr>
<td>5-6 times a week</td>
<td>1 (5.0)</td>
<td>2 (18.2)</td>
<td>5 (5.5)</td>
</tr>
<tr>
<td>≥ Once a day</td>
<td>1 (5.0)</td>
<td>0 (0.0)</td>
<td>4 (4.4)</td>
</tr>
<tr>
<td>Ingredient</td>
<td>&lt;2 times a week</td>
<td>2-4 times a week</td>
<td>5-6 times a week</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td><strong>Poultry</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2 times a week</td>
<td>8 (40.0)</td>
<td>1 (9.1)</td>
<td>26 (28.6)</td>
</tr>
<tr>
<td>2-4 times a week</td>
<td>6 (30.0)</td>
<td>7 (63.6)</td>
<td>41 (45.1)</td>
</tr>
<tr>
<td>5-6 times a week</td>
<td>4 (20.0)</td>
<td>2 (18.2)</td>
<td>13 (14.3)</td>
</tr>
<tr>
<td>≥Once a day</td>
<td>2 (10.0)</td>
<td>1 (9.1)</td>
<td>11 (12.1)</td>
</tr>
<tr>
<td><strong>Fish</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2 times a week</td>
<td>20 (100.0)</td>
<td>9 (81.8)</td>
<td>71 (78.0)</td>
</tr>
<tr>
<td>2-4 times a week</td>
<td>0 (0.0)</td>
<td>2 (18.2)</td>
<td>11 (12.1)</td>
</tr>
<tr>
<td>5-6 times a week</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>5 (5.5)</td>
</tr>
<tr>
<td>≥Once a day</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>4 (4.4)</td>
</tr>
<tr>
<td><strong>Seafood</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2 times a week</td>
<td>20 (100.0)</td>
<td>11 (100.0)</td>
<td>87 (95.6)</td>
</tr>
<tr>
<td>2-4 times a week</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>3 (3.3)</td>
</tr>
<tr>
<td>5-6 times a week</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>≥Once a day</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td><strong>Legumes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2 times a week</td>
<td>18 (90.0)</td>
<td>8 (72.7)</td>
<td>72 (79.1)</td>
</tr>
<tr>
<td>2-4 times a week</td>
<td>1 (5.0)</td>
<td>1 (9.1)</td>
<td>15 (16.5)</td>
</tr>
<tr>
<td>5-6 times a week</td>
<td>1 (5.0)</td>
<td>2 (18.2)</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>≥Once a day</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>3 (3.3)</td>
</tr>
<tr>
<td><strong>Tofu/tempeh</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2 times a week</td>
<td>20 (100.0)</td>
<td>11 (100.0)</td>
<td>88 (96.7)</td>
</tr>
<tr>
<td>2-4 times a week</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>3 (3.3)</td>
</tr>
<tr>
<td>5-6 times a week</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>≥Once a day</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Vegetarian meat alternatives</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2 times a week</td>
<td>19 (95.0)</td>
<td>11 (100.0)</td>
<td>90 (98.9)</td>
</tr>
<tr>
<td>2-4 times a week</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>5-6 times a week</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>≥Once a day</td>
<td>1 (5.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Other vegetarian ingredients:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2 times a week</td>
<td>20 (100.0)</td>
<td>11 (100.0)</td>
<td>89 (97.8)</td>
</tr>
<tr>
<td>2-4 times a week</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>2 (2.2)</td>
</tr>
<tr>
<td>5-6 times a week</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>≥Once a day</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Eggs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2 times a week</td>
<td>15 (75.0)</td>
<td>4 (36.4)</td>
<td>38 (41.8)</td>
</tr>
</tbody>
</table>
Breakfast consumption and sweet drink, snacks and fast food consumption

To create a better overall picture of participants’ eating habits, we also assessed their frequency of consumption of sweet drinks, snack foods and fast-food. The results are presented in Table 9 based on their frequency of breakfast consumption. A higher percentage of those consuming breakfast ‘never/rarely’ consumed fizzy drinks ‘≥2 days a week’ (10%) compared to regular breakfast eaters (≥5 days a week) who had no participants consuming fizzy drinks this often. All participants consuming breakfast ‘3-4 days a week’ consumed fizzy drinks ‘<5 days a week’. One-hundred percent of those eating breakfast five or more times a week, consumed energy drinks less than five days a week, and in the ‘never/rarely’ category, all but one person consumed energy drinks once a day.

The majority of all participants consumed lollies, cakes and savoury snacks less than five days a week (Table 9). Those consuming breakfast ‘3-4 days a week’ had a higher percentage of participants consuming lollies, cakes and savouries once a day (9.1%, 18.2% and 18.2% respectively) compared to all other breakfast categories.

Of those consuming breakfast ‘never/rarely’, 35% consumed fast food from outlets, and 50% consumed ready-to-eat fast foods, monthly or less; a slightly higher percentage than regular breakfast eaters (≥5 days a week) (33% and 48.4% respectively). Regular breakfast eaters had a lower percentage of participants consuming fast food ‘2-4 times a week’ and ‘≥5 times a week’ compared to those consuming breakfast ‘never/rarely’ for both types of fast

---

<table>
<thead>
<tr>
<th>Frequency</th>
<th>2-4 times a week</th>
<th>5-6 times a week</th>
<th>≥Once a day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 (15.0)</td>
<td>5 (45.5)</td>
<td>25 (27.5)</td>
</tr>
<tr>
<td></td>
<td>1 (5.0)</td>
<td>1 (9.1)</td>
<td>10 (11.0)</td>
</tr>
<tr>
<td></td>
<td>1 (5.0)</td>
<td>1 (9.1)</td>
<td>18 (19.8)</td>
</tr>
</tbody>
</table>

1 Meat/meat alternative products include: processed meat (e.g. ham, bacon, sausages, luncheon, canned corned beef, pastrami, salami), red meat (including beef, lamb, venison etc), pork, poultry (including chicken, turkey etc), fish, other seafood/shellfish (eg prawns, squid, crab), eggs, legumes, tofu/tempeh products, and vegetarian "meat alternatives" (like chicken-free chicken, vegetarian chicken schnitzel, meat-free bacon rashers etc), vegetarian ingredients (like quorn, nut meat, vegetarian mince).

2 Never/rarely includes those who do not usually consume breakfast and those that do 1-2 days a week.
food. For regular breakfast consumers there is a pattern whereby the prevalence of fast food consumption decreases with increasing frequency of fast food consumption.

Table 9. Frequency of sweet drink, snack and fast food consumption for ‘non-consumers’ of breakfast and regular breakfast eaters (≥5 days/week)¹.

<table>
<thead>
<tr>
<th>Breakfast category</th>
<th>Never/rarely² (%) (n=20)</th>
<th>3-4 days/week (%) (n=11)</th>
<th>≥5 days/week (%) (n=91)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sweet Drink Consumption</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fizzy drinks³:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 days a week</td>
<td>16 (80.0)</td>
<td>11 (100.0)</td>
<td>88 (96.7)</td>
</tr>
<tr>
<td>5-6 days a week</td>
<td>2 (10.0)</td>
<td>0 (0.0)</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>Once a day</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>2 (2.2)</td>
</tr>
<tr>
<td>≥2 times a day</td>
<td>2 (10.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Juice drinks⁴:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 days a week</td>
<td>16 (80.0)</td>
<td>9 (81.8)</td>
<td>84 (92.3)</td>
</tr>
<tr>
<td>5-6 days a week</td>
<td>2 (10.0)</td>
<td>1 (9.1)</td>
<td>3 (3.3)</td>
</tr>
<tr>
<td>Once a day</td>
<td>2 (10.0)</td>
<td>0 (0.0)</td>
<td>3 (3.3)</td>
</tr>
<tr>
<td>≥2 times a day</td>
<td>0 (0.0)</td>
<td>1 (9.1)</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>Energy drinks:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 days a week</td>
<td>19 (95.0)</td>
<td>10 (90.9)</td>
<td>91 (100.0)</td>
</tr>
<tr>
<td>5-6 days a week</td>
<td>0 (0.0)</td>
<td>1 (9.1)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Once a day</td>
<td>1 (5.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>≥2 times a day</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Snack Consumption⁵:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lollies:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 days a week</td>
<td>16 (80.0)</td>
<td>8 (72.7)</td>
<td>82 (90.1)</td>
</tr>
<tr>
<td>5-6 days a week</td>
<td>2 (10.0)</td>
<td>2 (18.2)</td>
<td>3 (3.3)</td>
</tr>
<tr>
<td>Once a day</td>
<td>1 (5.0)</td>
<td>1 (9.1)</td>
<td>5 (5.5)</td>
</tr>
<tr>
<td>≥2 times a day</td>
<td>1 (5.0)</td>
<td>0 (0.0)</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>Cakes:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 days a week</td>
<td>16 (80.0)</td>
<td>7 (63.6)</td>
<td>68 (74.7)</td>
</tr>
<tr>
<td>5-6 days a week</td>
<td>1 (5.0)</td>
<td>1 (9.1)</td>
<td>9 (9.9)</td>
</tr>
<tr>
<td>Once a day</td>
<td>2 (10.0)</td>
<td>2 (18.2)</td>
<td>11 (12.1)</td>
</tr>
<tr>
<td>≥2 times a day</td>
<td>1 (5.0)</td>
<td>1 (9.1)</td>
<td>3 (3.3)</td>
</tr>
<tr>
<td>Savoury:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 days a week</td>
<td>16 (80.0)</td>
<td>8 (72.7)</td>
<td>73 (80.2)</td>
</tr>
<tr>
<td>5-6 days a week</td>
<td>1 (5.0)</td>
<td>1 (9.1)</td>
<td>7 (7.7)</td>
</tr>
<tr>
<td>Once a day</td>
<td>3 (15.0)</td>
<td>2 (18.2)</td>
<td>9 (9.9)</td>
</tr>
<tr>
<td>≥2 times a day</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>2 (2.2)</td>
</tr>
<tr>
<td><strong>Fast Food Consumption⁶:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fast food outlets:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ monthly</td>
<td>7 (35.0)</td>
<td>5 (45.5)</td>
<td>30 (33.0)</td>
</tr>
<tr>
<td>2-3 times a month</td>
<td>4 (20.0)</td>
<td>2 (18.2)</td>
<td>30 (33.0)</td>
</tr>
<tr>
<td>Once a week</td>
<td>4 (20.0)</td>
<td>2 (18.2)</td>
<td>23 (25.3)</td>
</tr>
<tr>
<td>2-4 times a week</td>
<td>5 (25.0)</td>
<td>1 (9.1)</td>
<td>6 (6.6)</td>
</tr>
</tbody>
</table>

¹ For those who do not consume breakfast (non-consumers).
² For those who never/rarely consume breakfast (less than 5 times a week).
³ Fizzy drinks: includes diet and energy drinks.
⁴ Juice drinks: includes fruit juices, sports drinks and vitamin drinks.
⁵ Lollies: includes chocolate, sweets, and confectionery.
⁶ Fast food outlets: includes fast food restaurants, cafes and vending machines.

40
<table>
<thead>
<tr>
<th>Frequency</th>
<th>0 (0.0)</th>
<th>1 (9.1)</th>
<th>2 (2.2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥5 times a week</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Fast food ready-to-eat:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>≤ monthly</td>
<td>10 (50.0)</td>
<td>5 (45.5)</td>
<td>44 (48.4)</td>
</tr>
<tr>
<td>2-3 times a month</td>
<td>2 (10.0)</td>
<td>3 (27.3)</td>
<td>22 (24.2)</td>
</tr>
<tr>
<td>Once a week</td>
<td>2 (10.0)</td>
<td>1 (9.1)</td>
<td>16 (17.6)</td>
</tr>
<tr>
<td>≥5 times a week</td>
<td>2 (10.0)</td>
<td>1 (9.1)</td>
<td>9 (9.9)</td>
</tr>
</tbody>
</table>

1 Data is shown as number (percentage) unless otherwise stated
2 Never/rarely includes those who do not usually consume breakfast and those that do 1-2 days a week.
3 Fizzy drinks do not include the diet varieties.
4 Juices include: Fruit juices, drinks or cordials (e.g. Just Juice, Fresh-up, Keri, Golden Circle, Ribena, Charlie’s, Raro).
5 Snacks include lollies, chocolate or confectionary, biscuits, cakes, slices, muffins, sweet pastries, muesli bars (nut and other sweet bars), and savoury snacks such as crisps and crackers.
6 Fast food includes fast food or takeaways from places like McDonalds, KFC, Burger King, Pizza shops or fish and chip shops, as well as pies and other hot food that you buy ready-to-eat.
Discussion

This thesis presents an overview of the dietary habits in relation to breakfast consumption, in New Zealand (NZ) adolescent males, aged 15-18 years. Overall, more than half of the participants consumed breakfast every day of the week, with 9.8% reporting they do not usually consume breakfast. A higher percentage of participants with a healthy weight status consumed breakfast greater than or equal to five days a week compared to those who ‘never/rarely’ consumed breakfast. Although regular breakfast eaters had the highest mean daily energy intake, their fat and saturated fat intake (as a percent of total energy) was the lowest amongst all breakfast categories. There was no consistent pattern between breakfast consumption and consumption of the major food groups, although there was a trend for greater fruit and vegetable intake among regular breakfast consumers. The results provide up to date data on the dietary habits of adolescents in NZ in regards to breakfast consumption. However, due to the small total population size, along with small sample sizes of various subgroups (e.g. n=20 in the ‘never/rarely’ breakfast category), the results should be interpreted with caution.

Breakfast consumption

Over half (55%) of participants in the present study reported consuming breakfast every day, which is similar to the 2008/09 New Zealand Adult Nutrition Survey (57%) (31). The percentage of adolescents consuming breakfast less than or equal to two days a week in this study was also similar compared with the ANS 08/09 (16.4% vs 13.9%) (31). It is difficult to compare the prevalence of breakfast consumption with other studies as different questions and definitions were used to determine breakfast consumption (9, 10, 15). Overall, the percentage of New Zealand male adolescents consuming breakfast daily in this study appears to be less than that found internationally. For example, Koca et al. (2017) found that 64.5%
of male adolescents living in Turkey consumed breakfast daily (35), while Keski-Rahkonen et al. (2003) found that 73.5% of male adolescents living in Finland were daily breakfast consumers (38). However, the prevalence of those consuming breakfast ≤1 day a week in this study (12.3%) were similar to the global findings of other studies. For example, 13% of Finnish adolescents (38) and 15% of Swedish male adolescents (18) consumed breakfast ≤1 day per week.

**Breakfast consumption and weight status**

This study found that among those who consumed breakfast regularly (i.e. ≥5 days a week), there was a higher percentage of participants with a healthy weight status (69%), compared to those consuming breakfast ‘never/rarely’ (63%). This finding is consistent with other studies that found an association between regular breakfast consumption and a healthier weight status (15, 34, 75, 76), however, the difference is less pronounced in the present study. In agreement with other studies (15, 34, 75, 76), there was a higher percentage of ‘never/rarely’ breakfast consumers in the overweight and obese categories combined.

Due to the observational nature of these studies, it is difficult to determine the mechanism for this. One study suggested that breakfast consumption may reduce total daily energy intake by preventing overeating during the day (77). However, the results of this current study do not support this statement. Average energy consumption was lower in adolescents who ‘never/rarely’ consumed breakfast compared to those who ate breakfast regularly (7350 vs 10343 kJ/day). Several other studies have also found that breakfast skippers tend to have lower average energy intakes despite often having higher BMIs (18, 75). One explanation, is that those who frequently skip breakfast may snack more often throughout the day, but under-report their intakes due to difficulties in recalling all snacks (18, 38). Alternatively, this finding may be due to the behaviour whereby those who are
already overweight/obese use breakfast skipping as a diet technique to try and control or lose weight (75).

There was a larger percentage of participants who were obese that did not consume breakfast (12.5%), compared to those who were obese and regularly ate breakfast (4.1%). Providing more education on the importance of regular breakfast consumption could decrease this behaviour and potentially reduce the risk of continuing into adulthood (34).

Due to the observational nature of this study, the results cannot determine the temporal nature of the relationship between skipping breakfast and body weight. However, in general, this study is in agreement with previous research, that suggest there is a pattern towards healthier eating behaviours and weight status when breakfast is consumed regularly (17, 18).

Breakfast consumption in relation to ethnicity and socioeconomic status

Our findings suggest that breakfast consumption is related to socioeconomic status, whereby those who are from the least deprived areas are more likely to consume breakfast than those from the highest deprivation areas. Those in the most deprived areas were also more likely to be breakfast skippers compared to those in the least deprived areas. These results align with the findings of several other studies (12, 48, 49). Previous research has suggested that a potential reason is the higher cost of healthy food habits such as breakfast consumption (78-80). Breakfast consumption among Māori and Pacific participants cannot be reported on due to these two groups having an insufficient sample size.

Breakfast consumption, macronutrients and fibre

There were no obvious trends evident for carbohydrate and protein intakes (as a percentage of total energy) with increasing frequency of breakfast. There was however, a decrease in percentage of fat and saturated fat intake with increasing frequency of breakfast consumption.
Of particular interest, is the saturated fat intake. Consistent evidence suggests that lower intakes of saturated fat can reduce the risk of cardiovascular disease (81). Although the percentage of energy from saturated fat was above the recommended levels for all breakfast categories, regular breakfast eaters had the lowest average intake of saturated fat (13.6% of energy). Fibre intakes were higher with increasing breakfast consumption, with regular breakfast eaters having the highest mean fibre intake of 25.7g/day. The adequate intake (AI) for fibre for adolescent boys is 28 g/day (74). However, none of the breakfast categories had a mean intake that met the AI for fibre. Positive associations between breakfast consumption and fibre intake have been found in previous studies (in both adults and adolescents) (9, 82, 83), with findings more pronounced in those consuming ready-to-eat- breakfast cereal (9, 82). Additionally, those who consumed ready-to-eat-cereals, consumed less energy from fat and more energy from carbohydrate and consumed a fibre-dense diet (83). Higher fibre intakes have been negatively associated with BMI (84), thus may in part, explain the difference in weight status between breakfast skippers and regular breakfast consumers. Fibre is also necessary for adequate bowel function, and is associated with a reduced risk of diseases such as cardiovascular disease, diabetes and potentially colorectal cancer (19).

Although the average intake for regular breakfast eaters did not fall within the AMDR for carbohydrate and fat intake, or the AI for fibre, their mean intake was closer to these recommendations than those consuming breakfast ‘never/rarely’. This indicates an association between regular breakfast consumption and overall healthier eating behaviours.

**Breakfast consumption and food groups**

There was a trend towards an increase in the percentage of participants eating the recommended servings of fruits per day (as per the MOH guidelines (19)) with increasing frequency of breakfast consumption. Also, those who consumed breakfast three to four days
per week, and greater than or equal to five or more days, had the highest percentage of participants (27.3% and 20.9%, respectively) meeting the MOH healthy eating recommendations for vegetables (three or more servings per day) (19). Only 16.7% of participants in the breakfast skipping category met these recommendations for vegetables. These results align with the findings of previous studies whereby regular breakfast consumption is associated with better overall diet quality (often characterised by adequate intakes of nutrient dense foods like fruits and vegetables) (16, 17). Due to the health benefits associated with frequent consumption of fruits and vegetables, including a protective effect against cardiovascular disease and high blood pressure (33), lower intakes increase the risk of adverse health outcomes.

The MOH recommendations for milk/dairy products for adolescents, are at least 3 servings per day. Although those consuming breakfast ‘never/rarely’ had a slightly higher percentage of participants consuming milk products ‘2-3 times a day’ (25%), regular breakfast eaters have a higher percentage of participants consuming milk products ‘>3 times a day’ (5.5%), as well as ‘2-3 times a day’ (15.4%) for dairy product consumption, compared to breakfast skippers. Adequate consumption of this food group is essential for adolescents to ensure they consume enough calcium, as they are at a critical period in life for achieving peak bone mass (85). Additionally, adolescence and infancy are the two stages of life with the highest calcium requirements, thus it is especially important that they are consuming adequate amounts of milk/dairy products (85). Although the content of breakfast was not assessed in this thesis, in New Zealand breakfast can be a common occasion for consuming milk and dairy products (such as milk and yoghurt with cereal), thus again highlighting the importance of eating breakfast.

Other common indicators of diet quality are the frequency of consumption of sweet drinks (e.g. fizzy and energy drinks), snack foods and fast food. Previous studies found an
association between breakfast skippers and increased frequency of snacking, soft drink and fast food consumption, compared to regular breakfast eaters (17, 18). The results of the present study are consistent with the previously mentioned associations, with the exception of snacking, where there was no apparent association between frequency of consumption and consumption of breakfast. This inconsistency with the results for snacking compared to other studies may be due to the fact that the sample size of those consuming breakfast ‘never/rarely’ was very small (n=20) and thus may not be an accurate representation of all breakfast skippers.

**Strengths and limitations**

There are a number of limitations of this study that need to be considered when interpreting the results. The total sample size is small (n=122), and the proportion of each ethnicity reported (in comparison to the New Zealand 2018 consensus (73)), indicates the sample is not representative of the male adolescents population in New Zealand. Compared to the New Zealand population 2018 consensus, this study had a lower percentage of NZEO (58.2% vs 70.2%), Māori (9.8% vs 16.5%), and Pacific (1.6% vs 8.1%), but a higher percentage of Asian (30.3% vs 15.1%) (73). Additionally, there were very small numbers in various subgroups (such as those consuming breakfast ‘never/rarely’ and ‘3-4 days a week’, n=20 and n=11 respectively) meaning our estimates are less precise. Consequently, this reduces the generalisability of our findings and does not allow for definitive conclusions to be reached. Another limitation is with the design and questions asked in the DHQ. Due to the self-reported intakes, under- and/or over-reporting is likely. Furthermore, the questionnaire did not ask questions regarding the content of the participants breakfast, making it more difficult to assess what aspects of breakfasts were contributing to the various results. The DHQ assessed the intake of fruit and vegetables in servings per day, however for milk/alternative
and meat/alternative products, it assessed frequency of consumption rather than servings. This made it difficult to compare participants intake with the MOH recommendations to assess their overall diet quality in relation to breakfast intake. It also did not assess the reasons for skipping breakfast which could provide insightful information for future research. Lastly, the participants weight status and BMI do not reflect their body composition, which can vary substantially in adolescent boys, thus reducing the accuracy of the results.

This study also has a number of strengths. Although the population size was small, the participants were recruited from across New Zealand making it more representative than regional studies. The questionnaires were administered through an online database, which allowed participants to complete them in their own time and by themselves, which may have reduced participant burden and approval bias. This may have led to more truthful and accurate answers, thus decreasing the likeliness of under/over reporting.

Conclusions

This study has provided relevant and up-to-date data on adolescent males in New Zealand, in regards to breakfast consumption and associated eating behaviours. It is the first nationwide study completed on adolescents in New Zealand since the ANS 08/09 (31) and therefore adds value for informing public health initiatives. Potential areas that need to be addressed in future research in New Zealand, include reasons for skipping breakfast. This can provide valuable information for designing schemes to reduce the number of adolescents skipping breakfast. It would also help identify areas that need the most attention. Additionally, content of breakfast should also be examined as this could explain some of the potential associations between breakfast consumption and diet quality in more detail. Future research should aim to have a larger sample that is more representative of the population than that of the present study in order to have more reliable and conclusive results.
Application of Research to Dietetic Practice

General application

The results of this study identify areas where improvements can be made in the dietary habits of adolescent males in New Zealand, specifically in regards to irregular breakfast consumption. It may be due to lack of knowledge of the importance of breakfast, parental influence, socio-economic status or increased autonomy at this time. Adolescence is a vulnerable period, when growth and development is still occurring and dietary habits are being formed (3). This underscores the importance of establishing healthy eating patterns at this age, such as regular consumption of breakfast. This study found that breakfast consumption was associated with healthier eating patterns and weight status in male adolescents. The findings of this study provide useful information for dietitians for creating public health initiatives to educate parents and adolescents on the importance of breakfast consumption. Additionally, this could also be used to help educate groups on recommended amounts of saturated fat intake, as all breakfast categories had intakes above recommended levels. Health initiatives should particularly focus on communities in high deprivation areas in New Zealand, and among Māori and Pacific Islander ethnicities. This is due to poorer dietary habits and associated outcomes often being more prevalent in these communities (86), which is also noticeable in the results of this study. Education could include how to eat healthy on a budget, and hands on experience through available school programmes, such as plant to plate.

The observations from this study could also be used to guide individual and population level nutrition interventions and dietary guidelines, which has the potential to further raise awareness of healthy eating behaviours and influence adolescents’ dietary habits.
Individual application and reflection

The creation of this thesis allowed for the development of several essential skills for becoming and practicing as a competent dietitian. One of these is communication, both written and verbal. This was an essential part of the entire research process, with the schools, participants, the research team, academic supervisors and the writing of the thesis (among others). More specifically, clear and tailored communication was key to obtaining accurate results from the participants. This included building rapport with the individuals and interacting in a way that made them feel comfortable enough to share their diet. This highlighted the importance of clear and effective communication in order to get the desired results, and has subsequently helped me to progress in this area. It is also a skill that is highly transferrable to all areas of dietetics, whether in a group setting, or one-on-one.

This research project also helped me to improve my research skills. It helped me to better understand and interpret previous research, alongside teaching me the importance of consistently keeping up to date with the latest research. Additionally, it also allowed me to develop a better understanding of what is involved in the research process. My improved ability to interpret and translate research findings should improve the advice I provide to future patients, and help me to form new health initiatives. Thus, I have developed many highly transferrable skills that I will use in dietetics practice.
References

Appendices

Appendix A: Australian New Zealand Clinical Trials Registry
Appendix B: Ethical Approval Letter
Appendix C: Maori Consultation Letter
Appendix D: SuNDiAL Study Consent and Eligibility
Appendix E: SuNDiAL Health and Demographics Questionnaire
Appendix F: SuNDiAL Attitudes and Motivations for Food Choice Questionnaire
Appendix G: SuNDiAL Dietary Habits Questionnaire
Appendix H: Protocol for Anthropometric Measurements
Appendix A: Australian New Zealand Clinical Trials Registry

Trial registration 2019: ACTRN12619000290190

Trial registration 2020: ACTRN12620000185965
Appendix B: Ethical Approval Letter

Dr J Haszard
Department of Human Nutrition
Division of Sciences

4 February 2019

Dear Dr Haszard,

I am writing to let you know that, at its recent meeting, the Ethics Committee considered your proposal entitled “SuNDIAL Project 2019: Survey of Nutrition Dietary Assessment and Lifestyle Phase 1: Adolescent Females”.

As a result of that consideration, the current status of your proposal is: Approved

For your future reference, the Ethics Committee’s reference code for this project is: H19/004.

The comments and views expressed by the Ethics Committee concerning your proposal are as follows:

While approving the application, the Committee would be grateful if you would respond to the following:

Information Sheet
A typing error was noted on the Information Sheet, under the heading “Is there any risk of discomfort or harm from participation?”, line 3, “some” should read “someone”.

Consent Form
Please amend the Consent Form to include an option for participants to indicate whether they would prefer for their blood samples to be disposed of using standard methods or with a Karakia.

Please provide the Committee with copies of the updated documents, if changes have been necessary.

The standard conditions of approval for all human research projects reviewed and approved by the Committee are the following:

Conduct the research project strictly in accordance with the research proposal submitted and granted ethics approval, including any amendments required to be made to the proposal by the Human Research Ethics Committee.
Inform the Human Research Ethics Committee immediately of anything which may warrant review of ethics approval of the research project, including: serious or unexpected adverse effects on participants; unforeseen events that might affect continued ethical acceptability of the project; and a written report about these matters must be submitted to the Academic Committees Office by no later than the next working day after recognition of an adverse occurrence/event. Please note that in cases of adverse events an incident report should also be made to the Health and Safety Office:

http://www.otago.ac.nz/healthandsafety/index.html

Advise the Committee in writing as soon as practicable if the research project is discontinued.

Make no change to the project as approved in its entirety by the Committee, including any wording in any document approved as part of the project, without prior written approval of the Committee for any change. If you are applying for an amendment to your approved research, please email your request to the Academic Committees Office:

gary.witte@otago.ac.nz

jo.farrondediaz@otago.ac.nz

Approval is for up to three years from the date of this letter. If this project has not been completed within three years from the date of this letter, re-approval or an extension of approval must be requested. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing.

The Human Ethics Committee (Health) asks for a Final Report to be provided upon completion of the study. The Final Report template can be found on the Human Ethics Web Page http://www.otago.ac.nz/council/committees/committees/HumanEthicsCommittees.html

Yours sincerely,

Mr Gary Witte  
Manager, Academic Committees  
Tel: 479 8256  
Email: gary.witte@otago.ac.nz

c.c. Assoc. Prof. L Houghton  
Department of Human Nutrition
Dear Dr Peddie,

I am again writing to you concerning your proposal entitled "SuNDiAL Project: Survey of Nutrition Dietary Assessment and Lifestyle 2020: Adolescent males.", Ethics Committee reference number H20/004.

Thank you for your email of 5th February 2020 with response attached addressing the issues raised by the Committee.

On the basis of this response, I am pleased to confirm that the proposal now has full ethical approval to proceed.

The standard conditions of approval for all human research projects reviewed and approved by the Committee are the following:

Conduct the research project strictly in accordance with the research proposal submitted and granted ethics approval, including any amendments required to be made to the proposal by the Human Research Ethics Committee.

**Final report**: A Final Report is required by the Committee upon completion of the study. The Final Report template can be found on the Human Ethics Web Page

https://www.otago.ac.nz/council/committees/committees/HumanEthicsCommittees.html

**Adverse or unforeseen events**: Inform the Human Research Ethics Committee immediately of anything which may warrant review of ethics approval of the research project, including: serious or unexpected adverse effects on participants; unforeseen events that might affect continued ethical acceptability of the project; and a written report about these matters must be submitted to the Academic Committees Office by no later than the next working day after recognition of an adverse occurrence/event. Please note that in cases of adverse events an incident report should also be made to the Health and Safety Office:

http://www.otago.ac.nz/healthandsafety/index.html
Discontinuation: Advise the Committee in writing as soon as practicable if the research project is discontinued.

Amendments: Make no change to the project as approved in its entirety by the Committee, including any wording in any document approved as part of the project, without prior written approval of the Committee for any change. If you are applying for an amendment to your approved research, please email your request to the Academic Committees Office:

gary.witte@otago.ac.nz

jo.farrondiaz@otago.ac.nz

Locality authorisation: Studies requiring locality authorisation, i.e. permission from the organisations at which the study is taking place or from which participants are being accessed, must be confirmed before the study commences.

Approval period: Approval is for up to three years from the date of this letter. If this project has not been completed within three years from the date of this letter, re-approval or an extension of approval must be requested. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing.

Yours sincerely,

[Signature]

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz

cc. Assoc. Prof. L Houghton Department of Human Nutrition
Appendix C: Maori Consultation Letter

Monday, 17 December 2018

Dr Meredith Peddie
Department of Human Nutrition

Tēnā Koe Dr Meredith Peddie

The SuNDiAL Project 2019: Survey of Nutrition, Dietary Assessment and Lifestyle.

The Ngāi Tahu Research Consultation Committee (the Committee) met on Tuesday, 11 December 2018 to discuss your research proposition.

By way of introduction, this response from The Committee is provided as part of the Memorandum of Understanding between Te Rūnanga o Ngāi Tahu and the University. In the statement of principles of the memorandum it states “Ngāi Tahu acknowledges that the consultation process outline in this policy provides no power of veto by Ngāi Tahu to research undertaken at the University of Otago”. As such, this response is not “approval” or “mandate” for the research, rather it is a mandated response from a Ngāi Tahu appointed Committee.

This process is part of a number of requirements for researchers to undertake and does not cover other issues relating to ethics, including methodology they are separate requirements with other Committees, for example the Human Ethics Committee, etc.

Within the context of the Policy for Research Consultation with Māori, the Committee base consultation on that defined by Justice McGechan:

"Consultation does not mean negotiation or agreement. It means: setting out a proposal not fully decided upon; adequately informing a party about relevant information upon which the proposal is based; listening to what the others have to say with an open mind (in that there is room to be persuaded against the proposal); undertaking that task in a genuine and not cosmetic manner. Reaching a decision that may or may not alter the original proposal."

The Committee considers the research to be of importance to Māori health.

As this study involves human participants, the Committee strongly encourages that ethnicity data be collected as part of the research project as a right to express their self-identity.

The Committee suggests researchers consider the Southern District Health Board's Tikaka Best Practice document, in particular patient engagement. The document also covers the collection, storage and disposal of blood and tissue samples. This document is available on the Southern District Health Board website. The Committee also refers researchers to Te Mana Raraunga Māori Data Audit Tool, which gives an overview of key Māori Data Sovereignty terms and principles.
We wish you every success in your research and the Committee also requests a copy of the research findings.

This letter of suggestion, recommendation and advice is current for an 18-month period from Tuesday, 11 December 2018 to 3 June 2020.

The recommendations and suggestions above are provided on your proposal submitted through the consultation website process. These recommendations and suggestions do not necessarily relate to ethical issues with the research, including methodology. Other Committees may also provide feedback in these areas.

Nāhaku noa, nā

Claire Porima
Kaiwhakahaere Pūtere
Senior Project Manager
Office of Māori Development
Te Whare Wānanga o Otāgo
Ph: +64 3 479 7461
Email: claire.porima@otago.ac.nz
Web: www.otago.ac.nz
Wednesday, 12 February 2020

Dr Meredith Peddie
Department of Human Nutrition

Tēnā Koe Dr Meredith Peddie,

SuNDiAL Project: Survey of Nutrition Dietary Assessment and Lifestyle 2020: Adolescent males

The Ngāi Tahu Research Consultation Committee (the Committee) met on Tuesday, 11 February 2020 to discuss your research proposition.

By way of introduction, this response from the Committee is provided as part of the Memorandum of Understanding between Te Rūnanga o Ngāi Tahu and the University. In the statement of principles of the memorandum it states “Ngāi Tahu acknowledges that the consultation process outline in this policy provides no power of veto by Ngāi Tahu to research undertaken at the University of Otago”. As such, this response is not “approval” or “mandate” for the research, rather it is a mandated response from a Ngāi Tahu appointed committee. This process is part of a number of requirements for researchers to undertake and does not cover other issues relating to ethics, including methodology they are separate requirements with other committees, for example the Human Ethics Committee, etc.

Within the context of the Policy for Research Consultation with Māori, the Committee base consultation on that defined by Justice McGeachan:

“Consultation does not mean negotiation or agreement. It means: setting out a proposal not fully decided upon; adequately informing a party about relevant information upon which the proposal is based; listening to what the others have to say with an open mind (in that there is room to be persuaded against the proposal); undertaking that task in a genuine and not cosmetic manner. Reaching a decision that may or may not alter the original proposal.”

The Committee is aware of the researcher’s experience in similar studies that have been referred to this Committee. As in the past, the Committee encourages the collection of ethnicity data as part of the research project as a right of participants to express self-identity. The Committee also supports the analysis of cultural perspectives on diet, nutrition and social activities such as screen time which may have an impact on the research findings.

The Committee acknowledges the aims and outcomes of this research project, and wishes to advise that further consultation is not required.

This letter of suggestion, recommendation and advice is current for an 18-month period from Tuesday, 11 February 2020 to 11 August 2021. The Committee would...
appreciate receiving a copy of the research findings.

The recommendations and suggestions above are provided on your proposal submitted through the consultation website process. These recommendations and suggestions do not necessarily relate to ethical issues with the research, including methodology. Other committees may also provide feedback in these areas.

Nāhaku noa, nā

Claire Porima
Manager, Māori Research Consultation; Senior Project Manager
Office of Māori Development
Te Whare Wānanga o Otākou
Ph: +64 3 4798081
Email: claire.porima@otago.ac.nz
Web: www.otago.ac.nz
Appendix D: SuNDiAL Study Consent and Eligibility

Confidential

Study Consent & Eligibility

Thank you for showing an interest in this project. Please read the information about the SuNDiAL project carefully. This can be found on our website www.otago.ac.nz/sundial. Take time to think about it and talk with family or friends before you decide whether to take part or not. If you decide to take part we thank you. If you decide not to take part that won’t disadvantage you and we thank you for considering our request.

What is the aim of this research project?

The food and activity patterns of teenage boys probably influence their health and wellbeing. However, we don’t know much about teenage boys’ food intakes and physical activity patterns in New Zealand. Teenagers often make their own decisions about what foods to eat, but why they choose the foods they do is not well known. Last year we conducted a similar study in teenage girls. To get a more complete picture of what the teenagers of New Zealand eat and how they spend their time the SuNDiAL project is now going to investigate the food intakes and physical activity of adolescent males (aged 15-18 years), and why they choose to eat the way they do.

Who is funding this project?

This project is funded by the Department of Human Nutrition, University of Otago.

Who are we seeking to take part in the project?

We are looking for at least 150 male high school students who are between 15 to 18 years old. To be eligible to take part, your high school must have agreed to take part in the study, you must speak and understand English, and be able to complete the questionnaires.

If you take part, what will you be asked to do?

If you agree to take part in this study you will be asked to do three things:

1) Complete an online questionnaire

After you have completed the consent process you will be asked to complete an online questionnaire that asks questions about your health and some general questions such as what ethnicity you identify with. This online questionnaire also asks you about your overall eating habits, and why you choose to eat the foods that you do. It should take about 30 minutes to complete.

2) Attend a session at your school with our research team

This visit will take about 60 minutes during the school day and you will be asked to:

Complete a face to face interview with one of our research team where you will be asked to recall everything you ate and drank the day before. They will also ask you to recall how you spent your time during that day.

At this session one of our research team will also measure your blood pressure, height, weight and the length of your lower arm. Blood pressure will be measured three times, and the other measurements will be taken twice to make sure they are as accurate as possible. This will be done in a private space and you won’t be told these measurements unless you ask for them.
3) Complete a second interview about the food you have eaten and your physical activity on another day

Sometime in the 2 weeks after you have finished the session at school you will be contacted by the research team and asked to complete a second interview where you will be asked to recall everything you ate and drank and how you spent your time on a different day of the week than the first interview. This is important because sometimes you can eat quite differently or do different activities from one day to the next. This interview will be performed over Facetime or Zoom, at a time that is convenient for you.

Any questions?

Contact Meredith or Tessa (ph 03 479 8157) or Jill (ph 03 479 5683) or email us on: sundial@otago.ac.nz

This study has been approved by the University of Otago Human Ethics Committee (Health) reference number H20/004. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (phone +64 3 479 8256 or email gary.witte@otago.ac.nz). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

Electronic consent

Click on the “agree” button below if:

You have read the information about the study and understand the aims of the study

You have had all your questions answered about the study and understand that you can ask for more information at any stage

You are a young male who is 15 to 18 years old

You have chosen to take part, but you know you can pull out of the study anytime before it finishes in October 2020

You know that as a participant you will be asked to complete questionnaires about why you choose to eat the foods that you do, and have your blood pressure, height, weight and the length of your forearm measured, and complete interviews about the food that you eat and how you spend your time over two different 24 h periods

You know that the responses you provide to the questionnaires in this study will be recorded against an ID number, not your name. The information linking you to this ID number will be destroyed once all the data has been collected and you have been given the opportunity to request your individual information. The remaining data, which will not be able to be linked back to you in anyway, will be placed in secure storage and kept for at least ten years

You understand the results of the project may be published and be available from the University of Otago

You know that no commercial use will be made of this data

You know that for each component of the study you complete you will receive a $5 voucher (up to a possible total of $30)

Agreeing to this part of the study does not mean that you have agreed to give a blood sample, a urine sample or to wear an accelerometer (you will be asked about those bits separately)
If you don’t want to take part in the SuNDiAL project, please click on the “DISAGREE” button.

☐ AGREE
☐ DISAGREE
Thank you for agreeing to taking part in the SuNDiAL project! If you are male and aged 15-18 years of age, please answer the following questions:

<table>
<thead>
<tr>
<th>What age are you as of today?</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>None of the above</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>What high school do you attend?</th>
<th>Macleans College</th>
<th>John Paul College</th>
<th>Papamoa College</th>
<th>Catholic Cathedral College</th>
<th>South Otago High School</th>
<th>St Patrick's College Silverstream</th>
<th>Wesley College</th>
</tr>
</thead>
</table>
Thank you! You are eligible to take part in the SuNDIAL project!

There are three other parts to the SuNDIAL project that are optional. Please read the following information carefully before you decide whether to take part in these optional bits of the study. For each one of these that you do, you will receive a $5 gift voucher from New World or PaknSave.

If you agree to do these, but change your mind later, that’s OK - there is no disadvantage to you if you decide not to do these.

Once all of the analysis has been completed the samples will be disposed of using standard biohazard protocols.

Electronic consent:

Click on the "AGREE" button below if:
- You have read the information on the website
- You want to take part in these parts of the study

If you don’t want to take part in these parts of the study, please click on the "DISAGREE" button.

---

**BLOOD SAMPLE:**

We would like you to provide a blood sample (which would be collected by someone with extensive training in how to take a blood sample), but we understand that not everyone feels comfortable about this so it is entirely up to you if you do this. You can still take part in the rest of the study even if you don’t do this bit.

Click on the "AGREE" button below if:

You agree to have a blood sample collected by a phlebotomist (someone with special training in how to take a blood sample) You understand the possible risk and discomfort involved in providing a blood sample You understand that your blood sample will be analysed locally for concentrations of cholesterol and HbA1c You know that the concentrations of things measured in your blood will be recorded against an ID number The information linking you to this ID number will be destroyed once all the data has been collected and you have been given the opportunity to request your individual information. The remaining data, which will not be able to be linked back to you in any way, will be placed in secure storage and kept for at least ten years You will receive an additional $5 voucher if you provide a blood sample. If you do not wish to provide a blood sample, please click the ‘DISAGREE’ button.

- [ ] AGREE
- [ ] DISAGREE

---

**URINE SAMPLE:**

We would also like you to give a urine sample ("pee or wee") - which is easy for you collect yourself with the equipment we give you. You can still take part in the rest of the study even if you don’t do this bit.

Click on the "AGREE" button below if you are ok with providing a urine sample:

You agree to provide a urine sample You understand that your urine sample will be frozen and transported to the University of Otago where it will be stored until it is analysed for iodine concentrations You understand that your urine sample will only be analysed for iodine concentrations You know that the concentrations of iodine measured in your urine will be recorded against an ID number. The information linking you to this ID number will be destroyed once all the data has been collected and you have been given the opportunity to request your individual information. The remaining data, which will not be able to be linked back to you in any way, will be placed in secure storage and kept for at least ten years. You will receive an additional $5 voucher if you provide a urine sample. If you do not wish to provide a urine sample, please click the ‘DISAGREE’ button.

- [ ] AGREE
- [ ] DISAGREE
ACCELEROMETER:

We would also like you to wear a small red box called an accelerometer on an elastic belt 24 hours a day for seven days. This will tell us how much time you spend sitting down, moving around, and sleeping. If you choose to wear the accelerometer you will be asked to complete a little diary about the times you took the device off, and what time you went to bed each night on the days that you wear it.

One of our research team will return to your school the week after this visit to collect the accelerometer. You can still take part in the rest of the study even if you don't do this bit.

Please click the 'AGREE' button below if:

You agree to wear an accelerometer for 24 hours a day for seven days. You understand that during this time you will be asked to record in a diary provided to you when you take the accelerometer on and off, and when you go to bed each night. You know that amount of time you spend sleeping and moving will be recorded against an ID number. The information linking you to this ID number will be destroyed once all the data has been collected and you have been given the opportunity to request your individual information. The remaining data, which will not be able to be linked back to you in any way, will be placed in secure storage and kept for at least ten years. You will receive an additional $5 voucher if you wear the accelerometer for seven days and return it to the research team when they visit your school. If you do not wish to wear an accelerometer, please click the 'DISAGREE' button.

☐ AGREE
☐ DISAGREE

Please let us know which type of gift card you would prefer:

☐ New World
☐ PaknSave
Please answer the following questions:

What is your first name?

What is your last name?

What is your date of birth?

Today's date for age calculation

Age

What is your phone number (mobile would be best - so we can text you reminders)?

What is your email address?

Thank you for enrolling in the SuNDIAL project!

What happens next?

We are now going to ask you to complete a health and demographic questionnaire. If you want to complete it at a later time, please click the "Save and Return" button at the bottom of this page (if you click this button you will be given a code which you will need to write down and which you will need to use to return to and continue this survey). Or, click the "Submit" button to continue.

You will also get an email and/or text to tell you when you can visit the SuNDIAL clinic at your school to complete the other measurements, a food recall and an activity recall.
Appendix E: SuNDiAL Health and Demographics Questionnaire

**Confidential**

**Health & Demographics**

Please answer the following questions:

<table>
<thead>
<tr>
<th><strong>We need a bit more information about you.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Please provide an address where we can send your voucher:</strong></td>
</tr>
<tr>
<td>Street address:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Suburb:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>City:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Post code:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Is this your home address?</td>
</tr>
<tr>
<td>☐ Yes</td>
</tr>
<tr>
<td>☐ No</td>
</tr>
<tr>
<td>If no, please put your home address:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Do you live at this address during school term?</td>
</tr>
<tr>
<td>☐ Yes</td>
</tr>
<tr>
<td>☐ No</td>
</tr>
<tr>
<td>Do you live in a boarding house during school term? (Don’t include private boarding)</td>
</tr>
<tr>
<td>☐ Yes</td>
</tr>
<tr>
<td>☐ No</td>
</tr>
<tr>
<td>Please put the name and/or address of the boarding house</td>
</tr>
<tr>
<td>(number &amp; street, suburb, city, postcode)</td>
</tr>
<tr>
<td>What is the address that you live at during school term?</td>
</tr>
<tr>
<td>(number &amp; street, suburb, city, postcode)</td>
</tr>
</tbody>
</table>
**Please tell us about your ethnicity:**

<table>
<thead>
<tr>
<th>Ethnic Group</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Zealand European</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td></td>
</tr>
<tr>
<td>Samoan</td>
<td></td>
</tr>
<tr>
<td>Cook Island Māori</td>
<td></td>
</tr>
<tr>
<td>Tongan</td>
<td></td>
</tr>
<tr>
<td>Niuean</td>
<td></td>
</tr>
<tr>
<td>Chinese</td>
<td></td>
</tr>
<tr>
<td>Indian</td>
<td></td>
</tr>
<tr>
<td>Other such as Dutch, Japanese, Tokelauan</td>
<td></td>
</tr>
</tbody>
</table>

Other: please state

______________________________

20-04-2020 11:05am
### Health Information

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you ever been told by your doctor that you have high blood pressure?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you on any medication for high blood pressure?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you been diagnosed with diabetes?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If so, which type?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you avoid eating gluten?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you been diagnosed with either coeliac disease or gluten intolerance?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you been diagnosed with a food allergy or intolerance? (not gluten)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Which foods are you allergic or intolerant to?**
(Select as many as apply)

- Eggs
- Dairy
- Nuts
- Shellfish
- Other

**Other: please specify**

---

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you vegetarian or vegan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which foods do you eat? (Select as many as apply)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you vegan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How long have you been following this way of eating?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Less than a month
- Between 1 and 6 months
- Between 6 months and 1 year
- Between 1 and 2 years
- More than 2 years
- My whole life
How many times per week do you usually have a bowel movement (poop)?

Please look at the picture below and select the number that corresponds to your usual and most common bowel movement (poop) type:

- Type 1
- Type 2
- Type 3
- Type 4
- Type 5
- Type 6
- Type 7

**Bristol Stool Chart**

- **Type 1**: Separate hard lumps, like nuts (hard to pass)
- **Type 2**: Sausage-shaped but lumpy
- **Type 3**: Like a sausage but with cracks on its surface
- **Type 4**: Like a sausage or snake, smooth and soft
- **Type 5**: Soft blobs with clear-cut edges (passed easily)
- **Type 6**: Fluffy pieces with ragged edges, a mushy stool
- **Type 7**: Watery, no solid pieces. Entirely Liquid
Thank you for completing your health and demographic information.

What happens next?

We are now going to ask you to complete a questionnaire about why you eat the food you do. If you want to complete it at a later time, please click the “Save and Return” button at the bottom of this page (if you click this button you will be given a code which you will need to write down and which you will need to use to return to and continue this survey). Or, click the “Submit” button to continue.
# Attitudes and Motivations for Food Choice

Please choose how important it is to you that the food you eat on a typical day:

<table>
<thead>
<tr>
<th></th>
<th>Not at all important</th>
<th>A little important</th>
<th>Moderately important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contains a lot of vitamins and minerals</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Helps me relax</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Is cheap</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Is what I usually eat</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Has been produced in a way that animals have not experienced pain</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>Not at all important</td>
<td>A little important</td>
<td>Moderately important</td>
<td>Very important</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----------------------</td>
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<td>----------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Is not forbidden in my religion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has been prepared in an</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>environmentally friendly way</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is easy to prepare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is low in calories</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smells nice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Please choose how important it is to you that the food you eat on a typical day:</td>
<td>Not at all important</td>
<td>A little important</td>
<td>Moderately important</td>
<td>Very important</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Keeps me healthy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Makes me feel good</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has been produced in a way that animals’ rights have been respected</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has been packaged in an environmentally friendly way</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helps me control my weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not at all important</td>
<td>A little important</td>
<td>Moderately important</td>
<td>Very important</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----------------------</td>
<td>--------------------</td>
<td>----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Is familiar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Looks nice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is easily available in shops and supermarkets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is high in fibre</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheers me up</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not at all important</td>
<td>A little important</td>
<td>Moderately important</td>
<td>Very important</td>
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<tr>
<td>--------------------------------------</td>
<td>----------------------</td>
<td>--------------------</td>
<td>----------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Is not expensive</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Has a pleasant texture</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Is low in fat</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Contains natural ingredients</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Helps me cope with life</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>Not at all important</td>
<td>A little important</td>
<td>Moderately important</td>
<td>Very important</td>
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<tr>
<td>-----------------------------------------</td>
<td>----------------------</td>
<td>--------------------</td>
<td>----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Is in harmony with my religious views</strong></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td><strong>Is nutritious</strong></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td><strong>Can be cooked very simply</strong></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td><strong>Tastes good</strong></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td><strong>Helps me cope with stress</strong></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>Not at all important</td>
<td>A little important</td>
<td>Moderately important</td>
<td>Very important</td>
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<tr>
<td>----------------------</td>
<td>----------------------</td>
<td>--------------------</td>
<td>----------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Takes no time to prepare</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Contains no artificial ingredients</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Is like the food I ate when I was a child</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Is high in protein</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Is good value for money</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>Not at all important</td>
<td>A little important</td>
<td>Moderately important</td>
<td>Very important</td>
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<tr>
<td>------------------------------------------------</td>
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<td>----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Can be bought in shops close to where I live</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Is good for my skin/teeth/hair/nails etc</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Has been produced in a way which has not shaken the balance of nature</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Contains no additives</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Keeps me awake/alert</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Statement</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Somewhat disagree</td>
<td>Neither agree nor disagree</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>It is only natural to eat meat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>It is necessary to eat meat in order to be healthy</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Not eating meat is socially unacceptable</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Meat is delicious</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>It is unnatural to eat an all plant-based diet</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Please let us know how strongly you agree or disagree with the following statements about eating meat:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Somewhat disagree</th>
<th>Neither agree nor disagree</th>
<th>Somewhat agree</th>
<th>Agree</th>
<th>Strongly agree</th>
<th>I would prefer not to answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>You cannot get all the protein, vitamins and minerals if you need on an all plant-based diet</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>It is abnormal for humans not to eat meat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Meat adds so much flavour to a meal it does not make sense to leave it out</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Our human ancestors ate meat all the time</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Human beings need to eat meat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Statement</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Somewhat disagree</td>
<td>Neither agree nor disagree</td>
<td>Somewhat agree</td>
<td>Agree</td>
<td>Strongly agree</td>
<td>I would prefer not to answer</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
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<td>-----------------------------</td>
<td>----------------</td>
<td>-------</td>
<td>----------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Most people I know eat meat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>The best tasting food is normally a meat based dish (e.g. steak, chicken breast, grilled fish)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Human beings naturally crave meat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>A healthy diet requires at least some meat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>It is normal to eat meat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Meals without meat would just be bland and boring</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Please answer the following questions:

Are you currently trying to do any of the following?  
☐ Lose weight  
☐ Stay the same weight  
☐ Gain weight  
☐ No, not trying to do anything about my weight  

What are you doing to try and gain weight?  

Have you followed any of these types of diet to try to lose weight or keep from gaining weight DURING THE PAST YEAR? Select ALL that you have tried:

☐ Paleo  
☐ Low-fat  
☐ Low-carb  
☐ Low-sugar  
☐ Ketogenic  
☐ Vegetarian  
☐ Vegan  
☐ Gluten-free  
☐ Intermittent fasting (e.g. the 5:2 diet)  
☐ Time restricted eating (e.g. only eating between 10am and 7pm)  
☐ Mediterranean  
☐ Other (please specify)  

If other, please specify:  

Have you done any of the following to try to lose weight or keep from gaining weight DURING THE PAST YEAR? Select ALL that you have tried:

☐ Exercised  
☐ Skipped meals  
☐ Ate more fruit and/or vegetables  
☐ Used a food substitute (e.g. powder or special drink)  
☐ Made yourself throw up (vomit)  
☐ Ate very little food  
☐ Smoked cigarettes  
☐ Ate smaller portions of my usual food  
☐ Ate less sugary food or drinks  
☐ Ate less high-fat foods  
☐ Other (please specify)  

If other, please specify:
At the moment do you feel that you are...

- Very underweight
- A bit underweight
- About the right weight
- A bit overweight
- Very overweight
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
</table>
| I would like to have broader shoulders      | - Definitely
                                              - Possibly yes
                                              - No I'm happy with them
                                              - Maybe not
                                              - Definitely not |
| I would like to have bigger muscles         | - Definitely
                                              - Possibly yes
                                              - No I'm happy with them
                                              - Maybe not
                                              - Definitely not |
| I would like to be heavier                  | - Definitely
                                              - Possibly yes
                                              - No I'm happy with my weight
                                              - Maybe not
                                              - Definitely not |
| I would like to be taller                   | - Definitely
                                              - Possibly yes
                                              - No I'm happy with my height
                                              - Maybe not
                                              - Definitely not |
### Please answer the following questions:

**How often do you usually brush your teeth?**
- [ ] More than 3 times a day
- [ ] 3 times a day
- [ ] Twice a day
- [ ] Once a day
- [ ] 3-6 times a week
- [ ] 1-2 times a week
- [ ] Less than once a week
- [ ] Less than once a month
- [ ] Never

**How often do you use dental floss?**
- [ ] More than 3 times a day
- [ ] 3 times a day
- [ ] Twice a day
- [ ] Once a day
- [ ] 3-6 times a week
- [ ] 1-2 times a week
- [ ] Less than once a week
- [ ] Less than once a month
- [ ] Never

**When you brush your teeth, how much toothpaste do you use? (see image below)**
- [ ] I don’t use toothpaste when I brush my teeth
- [ ] A smear
- [ ] A pea-sized amount
- [ ] More than a pea-sized amount
After you brush your teeth, do you:

☐ Spit into the basin, then swallow (straightaway or later on)
☐ Spit into the basin, rinse with water, and then spit into the basin again, then swallow (straightaway or later on)
☐ I don’t spit into the basin

What brand of toothpaste do you use?

☐ Colgate
☐ Macleans
☐ Aquafresh
☐ Oral B
☐ Ecostore
☐ Red Seal
☐ Sensodyne
☐ Other

If other, please specify: ____________________________
### Please answer the following questions:

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you take PE or Outdoor Education as a subject at school?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you play a school sport?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you play a sport out of school?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the most common way that you get to and from school?</td>
<td>Car</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bus or train</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bike</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scooter/skateboard</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Walk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other (please specify)</td>
<td></td>
</tr>
</tbody>
</table>

If other, please specify: ____________________________


Do you have any comments about the questions in the previous section?

Please add any comments you may have here:

What happens next?

We have one more online questionnaire for you to complete about your dietary habits. If you would like to take a break, please click the "Save & Return Later" button (if you click this button you will be given a code which you will need to write down and which you will need to use to return to and continue this survey). Or, if you would like to continue, please click the "Submit" button.

You're nearly there!
Appendix G: SuNDiAL Dietary Habits Questionnaire

Confidential

Dietary Habits Questionnaire

Fruit

On average how many servings of fruit - fresh, frozen, canned or stewed - do you eat per day or per week?
Do not include fruit juice or dried fruit.

A serving is the same as a medium piece of fruit like an apple or two small pieces of fruit like two apricots, or half a cup of stewed or canned fruit.

☐ Never I don’t eat fruit
☐ Less than 1 serving a week
☐ 1 serving a week
☐ 2-4 servings a week
☐ 5-6 servings a week
☐ 1 serving a day
☐ 2 servings a day
☐ 3 servings a day
☐ More than 3 servings a day
Vegetables

On average how many servings of vegetables - fresh, frozen or canned - do you eat per day or per week?
Do not include vegetable juices.

A serving is the same as one potato, half a cup of peas or a cup of salad.

☐ Never I don't eat vegetables
☐ Less than 1 serving a week
☐ 1 serving a week
☐ 2-4 servings a week
☐ 5-6 servings a week
☐ 1 serving a day
☐ 2 servings a day
☐ 3 servings a day
☐ More than 3 servings a day
### Bread

On average how often do you eat bread?

Include slices of bread, rolls, bagels, wraps, and gluten-free bread.

- [ ] Never I don’t eat bread
- [ ] Less than once a week
- [ ] Once a week
- [ ] 2-4 times a week
- [ ] 5-6 times a week
- [ ] Once a day
- [ ] Twice a day
- [ ] 3 times a day
- [ ] More than 3 times a day

What type of bread, rolls or toast do you eat most of the time?

- [ ] White
- [ ] Wholemeal (brown colour)
- [ ] Light grain - has some grains but soft to eat (eg honey grain)
- [ ] Heavy grain - has some grains and a bit chewier (eg Vogels)
- [ ] Other (please specify):

If Other, please specify:
**Milk**

How often do you have milk (cow’s milk or plant milk)?

- I do not have any milk
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day

What type of milk do you use the most of?

- None
- Cow’s milk
- Plant-based milk (eg soy, rice, almond, coconut)
- Other (such as goat or sheep milk)

What kind of milk do you usually have?

- Whole or standard milk (Dark blue or silver)
- Reduced fat (light blue)
- Skim or trim (green or yellow)
- Other (please specify)

If Other, please specify:

What kind of milk do you usually have?

- Regular
- Lite
- Sweetened or flavoured
**Spreads and Oils**

What type of spread do you use the most of?

- None
- Butter (including semi soft)
- Margarine (eg canola, sunflower, olive oil based, or table spread)
- Other (eg avocado, cream cheese), please specify
- I don’t know

If other, please specify:

______________________________

What type of fat or oil is used most often in cooking in your household?

- None
- Butter
- Coconut oil
- Margarine
- Oil (eg olive, canola, or one in a bottle)
- Dripping or lard
- I don’t know
# Nuts

**How often do you eat the following types of nuts? (Include nuts in cooked foods, bars, cereals etc but don’t include peanut butter or other nut butters)**

<table>
<thead>
<tr>
<th></th>
<th>More than 3 times a day</th>
<th>2-3 times a day</th>
<th>Once a day</th>
<th>3-6 times a week</th>
<th>2-4 times a week</th>
<th>Once a week</th>
<th>2-3 times a month</th>
<th>Monthly</th>
<th>Rarely</th>
<th>I do not eat these</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almonds</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Brazil</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Cashew</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Hazelnut</td>
<td>○</td>
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<tr>
<td>Macadamia</td>
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<td>○</td>
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<tr>
<td>Peanut</td>
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<tr>
<td>Pecan</td>
<td>○</td>
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<tr>
<td>Pine nut</td>
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<td>○</td>
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<tr>
<td>Pistachio</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Walnut</td>
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<tr>
<td>Other</td>
<td>○</td>
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<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
### How often do you eat nut butters?

<table>
<thead>
<tr>
<th></th>
<th>More than 3 times a day</th>
<th>2-3 times a day</th>
<th>Once a day</th>
<th>5-6 times a week</th>
<th>Once a week</th>
<th>2-3 times a month</th>
<th>Monthly</th>
<th>Rarely</th>
<th>I do not eat these</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almond butter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cashew butter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazelnut butter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Peanut butter</td>
<td></td>
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<td></td>
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<tr>
<td>Walnut butter</td>
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<td></td>
<td></td>
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<tr>
<td>Other</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Meat, Dairy and Eggs

How often do you eat each of the following foods:

<table>
<thead>
<tr>
<th>Food Description</th>
<th>More than 3 times a day</th>
<th>2-3 times a day</th>
<th>Once a day</th>
<th>5-6 times a week</th>
<th>2-4 times a week</th>
<th>Once a week</th>
<th>2-3 times a month</th>
<th>Monthly</th>
<th>Rarely</th>
<th>I do not eat these</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>Cow’s milk</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
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</tr>
<tr>
<td>Dairy products excluding milk (eg cheese, yoghurt - don’t include plant based)</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
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<td>☒</td>
</tr>
<tr>
<td>Processed meat (eg ham, bacon, sausages, luncheon, canned corned beef, pastrami, salami)</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
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</tr>
<tr>
<td>Other red meat (including beef, lamb, venison etc don’t include processed meat)</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
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<tr>
<td>Pork</td>
<td>☒</td>
<td>☒</td>
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<td>☒</td>
<td>☒</td>
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<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>Poultry (including chicken, turkey etc)</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
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<td>☒</td>
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<td>☒</td>
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<td>☒</td>
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<tr>
<td>Fish</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
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<td>☒</td>
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<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>Other seafood/shellfish (eg prawns, squid, crab)</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
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</tr>
</tbody>
</table>
**Legumes**

How often do you eat lentils, chickpeas, kidney beans or baked beans? (Don’t include peas or peanuts)

- I do not eat legumes
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day
Other Foods
How often do you eat tofu, tempeh and tofu products?
- I do not eat these
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day

How often do you eat vegetarian ingredients (like quorn, nut meat, vegetarian mince) that are used in other dishes?
- I do not eat these
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day

How often do you eat vegetarian sausages, nuggets, patties etc?
- I do not eat vegetarian meat alternatives
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day

How often do you eat vegetarian "meat alternatives" (like chicken-free chicken, vegetarian chicken schnitzel, meat-free bacon rashers etc)?
- I do not eat these
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day
### Sweet Drinks

How often do you drink diet drinks or drinks labelled "sugar-free"?

- I do not drink diet or sugar-free drinks
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day

How often do you drink fizzy drinks? Don’t include diet varieties (eg Coca-cola, Pepsi, lemonade)

- I do not drink fizzy drinks
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day

How often do you drink fruit juices, drinks or cordials? (eg Just Juice, Fresh-up, Kerl, Golden Circle, Ribena, Charlie’s, Raro).

Don't include diabetic, diet or sugar-free varieties.

- I do not drink juice or cordial
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day

How often do you drink energy drinks? (eg V, Lift plus, Red Bull, Powerade)

- I do not drink energy drinks
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day
### Alcohol

How often do you have a drink containing alcohol?

- Never
- Monthly or less
- 2 to 3 times a month
- Once a week
- 2 to 3 times a week
- 4 or more times a week

---

How many drinks containing alcohol do you have on a typical day when you are drinking?

- 1 or 2
- 3 or 4
- 5 or 6
- 7, 8 or 9
- 10 or more
### Snacks

How often do you eat lollies, sweets, chocolate or confectionary?

- I do not eat these
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day

---

How often do you eat biscuits, cakes, slices, muffins, sweet pastries or muesli bars?

Include nut and other sweet snack bars.

- I do not eat these
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day

---

How often do you eat savoury snacks such as chips (crisps not hot chips) and crackers?

- I do not eat these
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day
**Fast Food**

How often do you eat fast food or takeaways from places like McDonalds, KFC, Burger King, Pizza shops or fish and chip shops?

- I do not eat fast food
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day

How often do you eat pies and other hot food that you buy ready-to-eat?

- I do not eat these
- Rarely
- Monthly
- 2-3 times a month
- Once a week
- 2-4 times a week
- 5-6 times a week
- Once a day
- 2-3 times a day
- More than 3 times a day
<table>
<thead>
<tr>
<th>Breakfast Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>How many days in an average week do you have something to eat for breakfast?</td>
</tr>
<tr>
<td>☐ I don't usually have breakfast</td>
</tr>
<tr>
<td>☐ 1 day a week</td>
</tr>
<tr>
<td>☐ 2 days a week</td>
</tr>
<tr>
<td>☐ 3 days a week</td>
</tr>
<tr>
<td>☐ 4 days a week</td>
</tr>
<tr>
<td>☐ 5 days a week</td>
</tr>
<tr>
<td>☐ 6 days a week</td>
</tr>
<tr>
<td>☐ 7 days a week</td>
</tr>
</tbody>
</table>
Supplement Use

Did you take any supplements during the last year?  
☐ Yes  
☐ No

What type of supplement was it? (Select as many as apply)

☐ Multivitamin and/or multimineral  
☐ Single vitamin or mineral  
☐ Sports supplement (including protein powders or shakes)  
☐ Other (please specify)

Multivitamin and/or multimineral:
How often did you take the supplement in the last 12 months?  
☐ Daily  
☐ More than once a week  
☐ Once per week  
☐ Monthly  
☐ Regularly but for a limited time  
☐ Not very often

Multivitamin and/or multimineral:
If you know the brand name and/or the product name please write them here. Please provide as much information about the product as possible.

Multivitamin and/or multimineral:
If you are able to take a photo of your supplement packaging, please do so and upload here (you can complete the questionnaire and come back to upload a photo at a later time).

When taking a photo (or two), please make visible the brand and the list of contents.

Single vitamin or mineral:
Please tell us what vitamin or mineral it was:

Single vitamin or mineral:
How often did you take the supplement in the last 12 months?  
☐ Daily  
☐ More than once a week  
☐ Once per week  
☐ Monthly  
☐ Regularly but for a limited time  
☐ Not very often

Single vitamin or mineral:
If you know the brand name and/or the product name please write them here. Please provide as much information about the product as possible.

Single vitamin or mineral:
If you are able to take a photo of your supplement packaging, please do so and upload here (you can complete the questionnaire and come back to upload a photo at a later time).

When taking a photo (or two), please make visible the brand and the list of contents.
<table>
<thead>
<tr>
<th>Sports supplement (including protein powders or shakes):</th>
<th>Daily</th>
<th>More than once a week</th>
<th>Once per week</th>
<th>Monthly</th>
<th>Regularly but for a limited time</th>
<th>Not very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often did you take the supplement in the last 12 months?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sports supplement:**

If you know the brand name and/or the product name please write them here. Please provide as much information about the product as possible.

**Sports supplement:**

If you are able to take a photo of your supplement packaging, please do so and upload here (you can complete the questionnaire and come back to upload a photo at a later time).

When taking a photo (or two), please make visible the brand and the list of contents.

**If Other, please specify:**

**Other:**

How often did you take the supplement in the last 12 months?

<table>
<thead>
<tr>
<th>Daily</th>
<th>More than once a week</th>
<th>Once per week</th>
<th>Monthly</th>
<th>Regularly but for a limited time</th>
<th>Not very often</th>
</tr>
</thead>
</table>

**Other:**

If you know the brand name and/or the product name please write them here. Please provide as much information about the product as possible.

**Other:**

If you are able to take a photo of your supplement packaging, please do so and upload here (you can complete the questionnaire and come back to upload a photo at a later time).

When taking a photo (or two), please make visible the brand and the list of contents.
Do you have any comments about this survey?

Please add any comments you may have about this questionnaire here:

____________________________
Appendix H: Protocol for Anthropometric Measurements

Anthropometric Measurements

To complete anthropometric measurements you will need:

- This protocol
- A stadiometer that has been assembled correctly, and positioned appropriately against a straight wall
- A set of body weight scales
- A steel anthropometric measuring tape
- The blood pressure and anthropometry recording sheet

Make sure you have taken the ID number from the name & ID spreadsheet and written it correctly on the blood pressure and anthropometry recording sheet.

Gain verbal consent from the participant for each measurement and explain fully what you will do to obtain them, specifically asking them if it is ok to touch the top of their head with the stadiometer when doing the height measurement. Before beginning, gain consent from the participant to use non-permanent pen for marking anatomical land marks.

**HEIGHT**

1. Ask the participant to remove their shoes, as well as any hair ornaments or buns/braids on the top of the head.
2. If the participant is taller than the investigator, use a step tool to take the measurements. Errors can be minimised by the investigator being parallel to the participant and the headpiece.
3. Tell the participant to stand with their heels together and toes apart pointing outward at approximately a 60-degree angle.
4. Make sure the back of the head, shoulder blades, buttocks, and heels of the participant are touching the backboard/stadiometer.

5. Make sure the participant’s head is aligned in the Frankfort horizontal plane, where a horizontal line connects from the ear canal to the lower border of the orbit of the eye.

6. Lower the headpiece to rest firmly on the top of the participant’s head and ask the participant to stand as tall as possible and take a deep breath.

7. Record the result to the nearest 0.1 cm in the HEIGHT 1 box on the recording sheet without informing the participants.

**WEIGHT**

1. Ask the participant to remove any heavy clothing (such as jackets, heavy tops, boots etc). As the participant would have just had their height measurement done, they should not be wearing shoes.

2. Turn on the scales, ensure they are switched on to metric (kg).

3. Ask the participant to step on to the scales so that they are facing away from the display (to prevent seeing the weight) cautioning them that they need to step up onto the scales.

4. Wait for the scales to read or come to a stable number.

5. Record the participant’s weight to the nearest 0.1 kg in the WEIGHT 1 box on the recording sheet without informing the participant.

**ULNA LENGTH:**

Ulna length is measured between the point of the elbow and the midpoint of the prominent bone of the wrist using an anthropometric steel tape. This value is then compared with a standardized height conversion chart. Participants should be dressed in light clothing with no wrist watch or other jewellery on the arm that is to be measured.
1. Measure between the point of the elbow and the midpoint of the prominent bone of the wrist (non-dominant side).

2. Read and accurately record the measurement to the nearest 0.1 cm in the UNLA LENGTH 1 box on the recording sheet without informing the participants.

NB: anthropometry tapes have a blank lead before measurement markings start - consider this when reading a measurement.

**REPEAT ALL MEASUREMENTS**

Repeat all three measurements again, in the same order, entering the measurements in the HEIGHT 2, WEIGHT 2 and ULNA LENGTH 2 box as appropriate (do not tell participant measurements).

CHECK: are any of the 1st and 2nd measurements more than 0.5 units apart? If so take a third measurement where required.

Anthropometric measurements will need to be entered into REDCap (see REDCap data entry protocol)