Fibre intake and the main food sources of fibre in New Zealand female adolescents aged 15 – 18 years

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Abstract

**Background:** Dietary data from the 2008/9 New Zealand Adult Nutrition survey showed that the mean dietary fibre intake of New Zealanders was below the recommended dietary fibre adequate intake (AI). In particular, female adolescents were shown to be less likely to meet the AI compared with other demographic groups. It is unknown how these intakes have changed over time.

**Objectives:** The aim of this study is to assess the dietary fibre intake of New Zealand secondary schoolgirls aged 15-18 yrs and to determine the contributing food sources. The data presented in this thesis represent the first set of data to be collected as part of an ongoing larger project, the Survey of Nutrition Dietary Assessment and Lifestyle (SuNDial), that overall has been designed to be nationally representative.

**Method:** Schoolgirls aged 15-18 yrs attending secondary schools and meeting the criteria (English literate; able to complete questionnaires online; and not pregnant) were recruited from eight schools ranging from school decile 3 to 10. Recruitment was via power point presentations and information sheets provided to those schools. Consented participants completed demographic and health questionnaires online. Anthropometric measurements were completed onsite of which the averages were then calculated into BMI and BMI z-scores. Dietary intake information was collected using two 24-hour recalls (the first face-to-face, the second remotely by telephone or by video link) within two weeks. The collected dietary data were entered into a nutrient analysis software program (Foodworks 9, Xyris Software, Australia) to calculate energy and fibre intakes. The dietary fibre and energy intakes were adjusted for usual intakes in Stata.
15.1 (StataCorp, College Station, Texas) using the Multiple Source Method to adjust for usual intake. Descriptive statistics were undertaken using Microsoft Office Excel (2016). The mean fibre intake of the group was compared to the AI (22 g/d).

**Result:** The sample consisted of 145 schoolgirls self-identifying as New Zealand European or Other (NZEO; 72%), Māori (20%), with 8% from other ethnicities. The mean dietary fibre intake of the schoolgirls was 24 g/d (95% CI: 22.4, 25.9). The top five contributing food sources were fruits; vegetables; breads; grains and pasta; potato, kumara and taro. Dietary fibre intake was positively associated with energy intake although the energy density of foods was higher in foods without fibre compared with fibre-containing foods. The proportion of the schoolgirls classified as overweight was 32%.

**Conclusion:** Although the dietary fibre intake of this group of schoolgirls may not be nationally representative at this stage of the project, the data are indicative of low fibre intakes in this demographic. The girls are consuming some fibre-rich foods but in order for fibre intakes to increase, messages to consume more fibre-rich low energy-dense foods such as whole grains, vegetables, fruits, legumes and nuts in line with the Ministry of Health healthy eating guidelines, need to be emphasised.
Preface

This thesis is based on the data from the first component of the SuNDial project. The candidate’s supervisor for this thesis was Dr. Bernard Venn. The research team included the candidate, twenty-eight other MDiet candidates, one PhD candidate, and staff (two primary investigators, a coordinator and support staff) from the Dept HN. The primary investigators (Dr Jill Hazzard and Dr Meredith Peddie) conceived the research topic and were responsible for the final ethical approval, methodology and research protocols. The research candidates made contributions to the draft documents of the SuNDial. The primary investigators supervised the project, organised the phlebotomists, the accelerometers, and were responsible for the main statistical analysis of the data. The coordinator recruited the schools, organised required resources and equipment (e.g. registration forms, information sheets, mobile phones, anthropometric equipment, and 24-diet recall equipment), and set up the REDCap questionnaires. All candidates were responsible for the participant recruitment, data collection and data entry. The PhD candidate was responsible for checking all data entries and correcting discrepancies with support from the Dept HN staff.

Prior to data collection MDiet candidates underwent training sessions on anthropometry and dietary recall by highly trained Dept HN staff. Each MDiet candidate conducted at least five practice 24-hour dietary recall interviews and at least two anthropometric measurements with peers, friends and family members prior to the data collection phase.

The candidate and her research team were responsible for the following:

- Promote the study to the Dunedin participating schools.
- Recruit 32 of the total participants.
• Liaise with the school contacts about the details of the school visits and requirements.
• Set up the study equipment for the school visit appointments and clean up after.
• Conduct the 24-hour dietary recall interviews.
• Set up the appointments for phlebotomist and participants with regard to the blood and urine samples collection and assist the phlebotomist.
• Collect the used accelerometers and diaries from the school offices.
• Set up the appointments for the follow up dietary recalls and send reminder text messages to participants.
• Enter the collected dietary data into Foodworks.

The candidate was responsible for the following:

• Deliver five of the recruitment presentations with one other research team member.
• Conduct nine 24-dietary recall interviews, data collection and entries.
• Contact five participants for follow up appointments and reminders.
• Set up and assist phlebotomist with the blood and urine samples for 6 participants.
• Liaise with the Dunedin school contacts while at schools and for further information required.
• Carry out required tasks by the primary investigators and research teams (e.g. cart equipment to and from schools; collect forms from coordinators for the research team and participants).
• Compile the result data and use the Microsoft Office Excel (2016) to calculate mean, standard deviation, 95% confidence intervals and to analyse the food group sources of dietary fibre.
• Write this thesis.
# Table of Contents

Abstract ....................................................................................................................................................... ii

Preface .......................................................................................................................................................... iv

Table of Contents ........................................................................................................................................ vi

Acknowledgements ...................................................................................................................................... ix

List of Table ................................................................................................................................................ xi

List of Figures .............................................................................................................................................. xii

List of Abbreviations ................................................................................................................................. xiii

1. Introduction ............................................................................................................................................. 1

2. Literature Review .................................................................................................................................. 3
   2.1 Methodology ....................................................................................................................................... 3
   2.2 Background ....................................................................................................................................... 3
      2.2.1 Dietary fibre in health and disease ................................................................................................. 3
      2.2.2 Definition and classification of fibre ............................................................................................... 4
      2.2.3 Functions of fibre .......................................................................................................................... 6
      2.2.4 Food sources and current mode of use of fibre .............................................................................. 7
      2.2.5 History of fibre intakes ............................................................................................................... 7
2.2.6 Fibre intake recommendation

2.2.7 The need to assess fibre intake of female adolescents

2.2.8 Assessing fibre intake

2.2.9 Fibre intakes of female adolescents

2.3 Conclusion

3. Objective Statement

4. Methodology

4.1 Participants

4.2 School selection

4.3 Study procedure

4.4 Anthropometric measurement

4.5 24-hour food recalls

4.6 Nutrient analysis

4.7 Statistical considerations and data analysis

5. Results

5.1 Fibre intake

5.2 Food sources

5.3 Supplement use

6. Discussion

6.1 Conclusion
7. Application of Research to Dietetic Practice ................................................................. 42

8. References ......................................................................................................................... 44

9. Appendices ......................................................................................................................... 60

   Appendix A. Ethical approval letters .............................................................................. 61

   Appendix B. Anthropometric protocol ........................................................................... 66

   Appendix C. 24-hour food recall protocol ....................................................................... 69

   Appendix D. Supplement use questions ......................................................................... 75

   Appendix E. Food model photographs ........................................................................... 82

   Appendix F. Code book SuNDial 2019 S1 ................................................................... 96

   Appendix G. Data cleaning process ................................................................................. 106
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Research team, (Chaya, Emily, Nick and Syn Yun), thank you for the team spirit and fun during the data collection period. Sincere thank you to Chaya Ranasinghe for the hard work in checking and cleaning the data entries for analysis. MDiet candidates, thank you for the collective effort and the contributing data towards this thesis.

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My family, thank you for your unconditional love, patience, understanding, encouragements, and faith in me. You are my inspiration.

Once again, thank you everyone. May God continue to bless you all.

Malo ‘aupito.
List of Table

Table 1. Comparison of mean dietary fibre (DF) intakes between food recall and weighed record methods

Table 2. Fibre intakes of female adolescents from different countries’s national surveys with the top 5 food source of fibre

Table 3. Fibre intake of female adolescents from high schools and regional clusters in different countries with the top 5 food sources of fibre

Table 4. The characteristics of the participants by ethnicity, age, height, weight, BMI Z-score, and school decile status

Table 5. The mean fibre intakes of the participants by ethnicity, age, and school decile status

Table 6. The top 15 food group sources of dietary fibre intakes by contributing mean fibre proportion of fibre

Table 7. The foods included in some of the food groups

Table 8. Mean (95% CI) energy density (KJ/g) per thirds of dietary fibre intake (g)
List of Figures

Figure 1. The recruitment process of the participants ............................................. 26
Figure 2. The dietary fibre intake distribution of the participants ................................. 30
Figure 3. The percentage of the 24-hour recalls collected in each day .......................... 30
Figure 4. Correlation between the dietary fibre intakes and the energy intakes of the participants .................................................................................................................. 31
Figure 5. The number of participants taking supplements that may have contained fibre and the frequency of the consumption ........................................................................ 35
## List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAND</td>
<td>American Academy of Nutrition and Dietetics</td>
</tr>
<tr>
<td>AI</td>
<td>Adequate intake</td>
</tr>
<tr>
<td>ANS</td>
<td>Adult Nutrition Survey</td>
</tr>
<tr>
<td>AOAC</td>
<td>AOAC Internationals (used to be Association of Official Analytical Chemists)</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>CAC</td>
<td>Codex Alimentary Commission</td>
</tr>
<tr>
<td>CCNFSDU</td>
<td>Codex Committee on Nutrition and Food for Special Dietary Uses</td>
</tr>
<tr>
<td>Dept HN</td>
<td>Department of Human Nutrition</td>
</tr>
<tr>
<td>DF</td>
<td>Dietary fibre</td>
</tr>
<tr>
<td>DONALD</td>
<td>Dortmund Nutritional and Anthropometric Longitudinally Designed study</td>
</tr>
<tr>
<td>ENCAT</td>
<td>Evaluation of Nutritional Status in Catalonia</td>
</tr>
<tr>
<td>FFQ</td>
<td>Food Frequency Questionnaire</td>
</tr>
<tr>
<td>FSANZ</td>
<td>Food Standards Australia New Zealand</td>
</tr>
<tr>
<td>ID</td>
<td>Identification</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
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</tr>
<tr>
<td>IOM</td>
<td>Institute of Medicine</td>
</tr>
<tr>
<td>MDiet</td>
<td>Master of Dietetics</td>
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<tr>
<td>MoH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>MSM</td>
<td>Multiple Source Method</td>
</tr>
<tr>
<td>NHANES</td>
<td>National Health and Nutrition Examination Survey</td>
</tr>
<tr>
<td>NNPAS</td>
<td>National Nutrition and Physical Activity Survey</td>
</tr>
<tr>
<td>NZ</td>
<td>New Zealand</td>
</tr>
<tr>
<td>NZEO</td>
<td>New Zealand European and Other</td>
</tr>
<tr>
<td>PhD</td>
<td>Doctor of Philosophy</td>
</tr>
<tr>
<td>REDCap</td>
<td>Research Electronic Data Capture</td>
</tr>
<tr>
<td>SCAN</td>
<td>Scientific Advisory Committee of Nutrition</td>
</tr>
<tr>
<td>SD</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>SDT</td>
<td>Suggested Dietary Target</td>
</tr>
<tr>
<td>SuNDial</td>
<td>Survey of Nutrition Dietary Assessment and Lifestyle</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
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<tr>
<td>WHO</td>
<td>World Health Organisation</td>
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</table>
1. Introduction

Dietary fibre is an essential component of a healthy diet. Having a generous amount of fibre in the diet supports normal bowel function and regular laxation (1, 2) and is associated with reduced risk of obesity, type 2 diabetes, cardiovascular diseases and some cancers (3-11). Food Standards Australia New Zealand (FSANZ) defined dietary fibre as the non-digestible edible remnants of plant and their extracts or synthetic equivalents including lignin and resistant starch, which must promote one or more of: laxation, blood cholesterol reduction, or modulation of blood glucose (12). Various countries encourage consumption of fibre-rich foods by establishing dietary fibre intake recommendations based on the mean intake results from national nutritional and dietary surveys. The New Zealand (NZ) Ministry of Health (MoH) and the Australian National Health and Medical Research Council establish the fibre intake recommendations for NZ and Australia (13) combined with the NZ healthy eating guidelines which encourage the consumption of wholegrains, vegetables, fruits, nuts and legumes (14).

Fibre intake is usually estimated from assessing dietary intake and analysing for nutrient content using food composition tables (15). A method of dietary assessment commonly used for survey data is 24-hour food recall. This method is reflective of consumption over a pre-defined period and has been found to give a valid measure of the intake of a group or population (15-19).

Given the role of dietary fibre in health; the potential for intakes to change over time, for example trending vegetarianism (20); changes in food processing; and consumption of convenience food (21, 22); it is important that intakes are assessed on a regular basis. Assessment of young people’s patterns of fibre intake is particularly important, because
adolescence as a transitional phase from childhood to adulthood is a period in which young people are considered to be vulnerable to many factors that impact on their physical and mental health (23). Some of these factors often include the adoption of dietary patterns that may comprise low fibre processed foods (22). The findings from national surveys and observational studies in assessing fibre intake of female adolescents indicate that adolescents in westernised countries are likely to have diets low in dietary fibre (24). However, the existing data for NZ female adolescents is from the 2008/9 Adult Nutrition survey (ANS) (25), which is around 10 years old, shows fibre intakes were low and requires an update. Therefore, the aim of this study was to determine the dietary fibre intake of NZ female adolescents aged 15 - 18 yrs attending high schools and the contributing food sources.
2. Literature Review

2.1 Methodology

A literature search was conducted on Ovid Medline and Scopus databases using these terms: dietary fibre OR dietary fiber, fibre OR fiber, adolescents OR teenager OR teen*, intakes, food OR food sources; dietary fibre AND adolescents, intakes AND food sources, dietary fibre AND adolescents AND intakes AND food sources limiting to female. All published studies were identified and assessed for relevant to fibre intake in female adolescents. A search was also applied to the reference section of the selected articles to identify studies that had not been included in the electronic search.

2.2 Background

2.2.1 Dietary fibre in health and disease

Over the years the evidence of the health benefits of dietary fibre have become well established. People eating fibre-rich diets and having generous amounts of fibre are found to have reduced risk of obesity, diabetes, coronary heart diseases and certain cancers (3-11). Fibre-rich foods reduce the energy density of the foods, promote satiety and prevent constipation (1-3, 26, 27). Additionally, fibre-rich foods supply important nutrients including proteins, minerals, vitamins and other phytochemicals which are beneficial for health (28).
2.2.2 **DEFINITION AND CLASSIFICATION OF FIBRE**

Dietary fibre generally refers to plant remnants that resist hydrolysis by the human digestive enzymes (29-31). According to different regulatory organisations and researchers, the definition of dietary fibre varies based on either the physiological function of edible plant cell wall components (29) or, the material isolated and measured from plants food components according to plant remains by analytical methods (30, 32, 33).

Additionally, dietary fibre has been classified into soluble and insoluble fibres based on their solubility in water and fermentability properties (12, 34), and resistant starch. Soluble fibres can be viscous (e.g. gel forming fibres: β-glucan, psyllium and raw guar gum), non-viscous (e.g. inulin, fructo-oligosaccharides and wheat dextrin) or low viscous (e.g. Arabic/acacia gum). Soluble fibres are readily fermentable by colonic bacteria (35). Insoluble fibres have no significant reaction with water and are poorly fermentable (35). Resistant starch is defined as starch that escape digestion in the small intestines and reach the large intestine where it is either partially or completed fermented (36).

An agreed definition by the Codex Committee on Nutrition and Food for the Special Dietary Uses (CCNFSDU) encompasses features of the edible plant cell wall components and the undigestible materials from analytical methods including non-starch polymers, and having approved physiological benefits to health (31). Despite attempts for consistency in the definition, there is no agreed analytical approach by which to quantify dietary fibre and the two main testing methods, Englyst method and AOAC 985.29 (Englyst and Prosky) (30, 37), have been found to produce different proportions of insoluble to soluble fibre and resistant starch (36, 38). Nevertheless, the Codex Alimentary Commission (CAC) (39) adopted the CCNFSDU definition for food labelling and food composition tables, including all substances that behave
like fibre with beneficial physiological effects (laxation, blood cholesterol reduction, and modulation of blood glucose) regardless of how these substances are produced.

The CAC definition of dietary fibre (39) is carbohydrate polymers with 10 or more monomeric units, which are not hydrolysed by the endogenous enzymes in the small intestine of humans and belong to the following categories:

1. Edible carbohydrate polymers naturally occurring in the food as consumed.
2. Carbohydrate polymers, which have been obtained from food raw material by physical, enzymatic or chemical means and which have been shown to have a physiological effect of benefit to health as demonstrated by generally accepted scientific evidence to competent authorities.
3. Synthetic carbohydrate polymers, which have been shown to have a physiological benefit to health as demonstrated by generally accepted scientific evidence to competent authorities.

There is still dispute regarding the inclusion of the non-starch carbohydrates with 3-9 degree of polymerisation. The CAC thus includes footnotes in the definition to allow flexibility to suit the needs of different countries.

Footnote 1. “When derived from a plant origin, dietary fibre may include fractions of lignin and/or other compounds associated with polysaccharides in the plant cell walls. These compounds also may be measured by certain analytical method(s) for dietary fibre”.

Footnote 2. “The decision on whether to include carbohydrates of 3 to 9 monomeric units should be left up to national authorities.”
Currently in NZ, FSANZ (12) defines fibre as that segment of edible parts of plants and their extracts or synthetic equivalents, including polysaccharides, oligosaccharides (degree of polymerisation >2) and lignin that:

a. Resist digestion and absorption in the small intestines, usually with partial or complete fermentation in the colon.

b. Promote one or more of the following beneficial physiological effects of laxation, blood cholesterol reduction, and modulation of blood glucose.

The Institute of Medicine (IOM) of whom NZ’s definition is similar to, has a “total fibre” classification, which combines “dietary fibre” (non-digestible carbohydrates and lignin intrinsic and intact in plants) and “added fibre” (isolated, non-digestible carbohydrates with beneficial physiological effect in humans) (34). The IOM recommended replacing soluble and insoluble fibre classification with the standardised physicochemical properties. The use of fermentability to differentiate the types of fibres that regulate gastric and small bowel function from those that promote stool bulk reduces ambiguity provided by the terms soluble and insoluble (34). However, in NZ fibre is still classified as water soluble and water insoluble fibre, with the sum of the two referred to as total fibre (40).

2.2.3 FUNCTIONS OF FIBRE

It is challenging to generalise the functions of dietary fibre due to its diverse macromolecular structures and varying physiological and chemical properties. For example, soluble fibres react with water to produce different effects: viscous soluble fibres form gels thus slow digestion of foods while non-viscous soluble fibres have a limited interaction with water and a lesser effect on digestion (35). Dietary fibre is an important dietary requirement for normal bowel function, laxation and health (1, 2, 28, 41). Dietary fibre promotes faecal bulk, reduces faecal transit times,
encourages stool regularity (1, 2, 41, 42) and promotes prebiotic microflora activity (43, 44) hence reducing risk of constipation (45-47).

2.2.4 FOOD SOURCES AND CURRENT MODE OF USE OF FIBRE

Dietary fibre in the human diet is obtained from plant-based foods which are whole grains, legumes, nuts, vegetables and fruits. Dietary fibre can be naturally occurring, ‘intrinsic and intact’ fibre (29) or fibre can be isolated from food or synthesised (12, 39).

For years, food industries have been using “added fibres” to increase fibre content of processed foods in response to public health guidelines and consumer demand (48, 49). In NZ and Australia some common added fibres are inulin, oligofructose, polydextrose, psyllium and soy fibre (50). Manufacturing reasons for adding fibres to food include improving physical and structural properties for hydration, oil capacity, viscosity, texture, sensory characteristics and shelf life (51). Some added fibres (e.g. Psyllium and Metamucil) are used as prescribed treatments for constipation (45, 47).

2.2.5 HISTORY OF FIBRE INTAKES

Dietary fibre intake shows a declining trend over time (52, 53) associated with the general world-wide dietary changes from traditional plant-based diet to refined and convenience foods (52, 54, 55). The dietary change is influenced globally by the prevalence of modernisation, urbanisation, and changes to the food system due to global distribution, capital flow and mass media (54, 56). Changes to the food supply include a general shift to energy dense fibre-depleted diet, reduced complex carbohydrate intake, and reduced fruit and vegetable intake (54, 55).

The effects of the dietary change is reported to be worse in poor countries and the more deprived populations that face food security and malnutrition issues (55, 56). These changes have been
linked to the rising obesity and associated chronic diseases (55). In NZ, Māori, Pacific and low socio-economic populations are more affected by a high prevalence of obesity and chronic diseases compared to the NZ European counterparts (25).

2.2.6 **Fibre Intake Recommendation**

Scientists and regulatory agencies have established dietary fibre AI recommendations based on the mean intake results from national nutritional and dietary surveys over the years. The recommendations provide guidelines for people at different ages to have sufficient dietary fibre in their diet to meet their nutritional requirement consistent with reducing risk of chronic diseases. There is variation among countries in the fibre intake recommendations for female adolescents.

The American Dietetic Association recommends fibre intake of “age + 5” g/d for children and adolescents over the age range of 2-19 years (57). The Academy of Nutrition and Dietetics of the same country, recommends 14g fibre per 1000 kcal, or 26 g/d for female adolescents aged 14 – 18 years (58). In the UK and Canada, the recommended fibre intake for girls aged 14 - 18 yrs is 26 g/d (59). In 2014, the Scientific Advisory Committee on Nutrition (SCAN) in the UK recommended fibre intake of 25 g/d for adolescents aged 11 - 16 yrs and 30 g/d for aged 16 - 18 yrs (60). The fibre intake recommendation for girls aged 1 - 18 yrs by the European Food Safety Authority is 2 g fibre per 1000 KJ (59). The Nutrient Reference Values for Australia and NZ for dietary fibre Al of female adolescents aged 14 - 18 years is 22 g/d (13), the same as that recommended by the NZ Dietitian Board (61). The recommendation provides a base for suggested dietary target (SDT) for lowering chronic disease risk.
2.2.7 THE NEED TO ASSESS FIBRE INTAKE OF FEMALE ADOLESCENTS

Adolescents’ nutritional status is important because adolescence is a period of fast growth and development (physically, cognitively and emotionally) due to puberty (62) hence, nutritional intake requirement must meet these needs. Since obesity and non-communicable diseases are affecting people of all ages including adolescents, fibre intake in particular is important given the many health benefits associated with having adequate fibre in the diet (63). However, adolescents may have nutrient deficiencies (25, 64) which may include dietary fibre intake, due to replacing home-made meals with convenient foods, skipping meals, and eating on the run due to busy schedules with sports, hobbies, and part-time work (62).

Adolescence is a psychological and social transition period between childhood and adulthood where the search for independence increases (23, 65). This independence is often displayed by the adoption of lifestyle behaviours relating to diet, alcohol, smoking, exercise, sex, social media and self-management. (62). These behaviours can be contributing factors to the risk of obesity and non-communicable diseases which have similar risks associated with insufficient dietary fibre intake in the diet (63).

Females, in particular, tend to be more at risk for these factors and are often more susceptible to changes in dietary pattern and the influences of family, peers and social media (23, 65). Adolescent girls are more likely to be vulnerable to intense engagement with social media and are more likely to be sensitive about body image, adopt special diets, or have eating disorders (65-67). It is important therefore, to assess adolescent girls’ nutritional status and in particular, fibre intake given the described vulnerability and risks.
2.2.8 ASSESSING FIBRE INTAKE

There are various methods of collecting dietary data including weighed food record, food diary, 24-hour food recall, diet history and food frequency questionnaires (FFQ) (15). Deciding which method to use depends on the objectives of the study and a number of factors including cost, participant number and burden, study population, period over which the diet is representative for, and the assessors (15). Although a weighed food record gives a good estimate of one day’s consumption, this may not reflect habitual intake and asking for more days places a considerable burden on participants. For observational work in the community, researchers have typically used less burdensome methods for collecting dietary data including; diet histories, food recalls and FFQ. Of these methods, the 24-hour recall is one of the most commonly used in assessing dietary fibre intake in female adolescents because it can provide more accurate intake data; the time covered is short and limited, making measurement of food intake possible and practical (18); and usually has a high response and completion rate by respondents (68, 69). A strength of the recalls is that they are reflective of consumption over a pre-defined period that may range from one day, to weeks or months in the case of multiple recalls and can give a valid measure of the intake of a group or population (15, 16).

The 24-hour recall has a good and acceptable relative validity in assessing fibre intake (17, 19). Different researchers reported agreement in the mean fibre intakes estimated in different populations between the 24-hour recall and weighed record methods. Some examples are included in Table 1.
Table 1. Comparison of mean dietary fibre (DF) intakes between food recall and weighed record methods

<table>
<thead>
<tr>
<th>Authors/year/Ref</th>
<th>Population (n)</th>
<th>Mean DF intake (SD) Food recall (g/d)</th>
<th>Mean DF intake (SD) Weighed record (g/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lafrenière, 2018 (70)</td>
<td>French Canadian adults 18-65yrs (147)</td>
<td>25.3 (8.6)</td>
<td>26.9 (8.7)</td>
</tr>
<tr>
<td>Frankenfeld, 2012 (17)</td>
<td>US university adults (93)</td>
<td>15.6 (8.0)</td>
<td>16 (6.6)</td>
</tr>
<tr>
<td>Bingham, 2007 (19)</td>
<td>Cambridge women 50-65yrs (160)</td>
<td>21 (10.0)</td>
<td>22 (7.0)</td>
</tr>
</tbody>
</table>

Despite good agreements in fibre intakes among the methods, there may be still errors in the estimates due to factors such as recall biases, interviewer biases, within-subject variation, unrepresentative days and season, unrepresentative study population, and food coding biases (15). For 24-hour food recall, overestimation of food consumed affecting fibre intake is reported in some studies (71, 72) and under reporting of foods is reported in others (73). Similarly, misreporting is reported in both the food diary and weighed record methods (74, 75). It is clear that not one method is completely without uncertainties in assessing fibre intake. Therefore, it is important to have standardised protocols within the studies and between the assessors for the collection of dietary intakes and the analysis and evaluation of nutrients intake data generated to minimise these errors.

2.2.9 FIBRE INTAKES OF FEMALE ADOLESCENTS

Three studies were identified in which the fibre intake of female adolescents aged 15 - 18 yrs were assessed. In twelve other studies, the 15 - 18 yrs age bracket were included within the intakes of a broader age range of female children/adolescents/adults. The findings from these studies are assumed to reflect that of the girls aged 15 - 18 yrs. The following tables: Table 2 and Table 3, show the identified studies and the contributing food sources of fibre.
<table>
<thead>
<tr>
<th>Author/Year/Ref</th>
<th>Country/Ethnicity (Age)</th>
<th>Sampling (n)</th>
<th>Dietary assessment method (#)</th>
<th>Mean DF intake g/d (SD or 95% CI)</th>
<th>Food sources of fibre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Government Department of Health and Ageing 2007 2008 (76)</td>
<td>Australia (14-16 yrs)</td>
<td>National survey (n = 500)</td>
<td>24 hr recall (AOAC)</td>
<td>21.5 *</td>
<td>cereal &amp; cereal products, vegetable products &amp; dishes, fruit products &amp; dishes, cereal-based products &amp; dishes, confectionery &amp; cereal bars</td>
</tr>
<tr>
<td>Fayet-Moore et al (2011-2012 NNPAS) 2018 (77)</td>
<td>Australia (14-18 yrs)</td>
<td>National survey (n=2812 for 2-18 yrs)</td>
<td>24 hr recall (AOAC)</td>
<td>19.3 (0.5)</td>
<td>Regular breads, cereal mixed dishes, potatoes, RTE breakfast cereals, pome fruit (78)</td>
</tr>
<tr>
<td>McGill et al (NHANES 2001-2010) 2015 (79)</td>
<td>US (4-18 yrs)</td>
<td>National survey (n= 14,973 male &amp; female)</td>
<td>2 x 24 hr recall (AOAC)</td>
<td>13.2 (0.1) 2001-10 13.9 (0.3) 2009-10</td>
<td>Vegetables, grain mixtures, other foods, fruits, yeast breads/rolls</td>
</tr>
<tr>
<td>Public Health England 2014-2016 2018 (80)</td>
<td>UK including 4 UK countries (11-18 yrs)</td>
<td>National survey (n= 272)</td>
<td>3 x 24 hr food diary (AOAC)</td>
<td>14.1 (4.8)</td>
<td>Cereals &amp; cereal products, vegetables/potatoes, meat &amp; meat products, fruits, savoury snacks</td>
</tr>
<tr>
<td>Author/Year/Ref</td>
<td>Country/Ethnicity(Age)</td>
<td>Sampling (n)</td>
<td>Dietary assessment method (#)</td>
<td>Mean DF intake g/d (SD or 95%CI)</td>
<td>Food sources of fibre</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>--------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------------------------------------</td>
<td>----------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Alexy et al - DONALD study 2006 (83)</td>
<td>German (14-18 yrs)</td>
<td>Dortmund longitudinal cohort study (125)</td>
<td>3 x 24 hr weighed record (AOAC)</td>
<td>20.1 (6.4)</td>
<td>Not given in the paper</td>
</tr>
<tr>
<td>Hoppu et al 2010 (84)</td>
<td>Finland (13.8 yrs)</td>
<td>Secondary school-based study (n=170)</td>
<td>2 x 24 hr recall (AOAC)</td>
<td>16.6 (7.6)</td>
<td>Not given in the paper. Suggestive - breads, vegetables, fruits, cereal bars</td>
</tr>
<tr>
<td>Park et al 2012 (85)</td>
<td>Korea (13.9 yrs)</td>
<td>2 middle school in Jeonju (n=213)</td>
<td>24 hr recall (measuring method not shown)</td>
<td>16.1 (7.1)</td>
<td>Grains and cereals, vegetables, seasonings, fruits, pulses</td>
</tr>
</tbody>
</table>

Table 3. Fibre intake of female adolescents from high schools and regional clusters in different countries with the top 5 food sources of fibre
<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Sample Size and Age</th>
<th>Methodology</th>
<th>Energy Values</th>
<th>Food Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Djuki et al 2009 (86)</td>
<td>Serbia (16-19 yrs)</td>
<td>Boarding school in Banat (n= 68 (30 females &amp; 38 males))</td>
<td>20 x 24 hr weighed record (10 in summer &amp; 10 in winter)</td>
<td>30.7 (12.2) for total sample 32.6 (13.7) summer 28.8 (10.9) winter</td>
<td>Vegetables (salads, soups, dishes), breads, pasta, bakery products, biscuits and starchy cakes.</td>
</tr>
<tr>
<td>De Carvalho et al 2006 (87)</td>
<td>Sao Paulo, Brazil (adolescents, no age given)</td>
<td>High schools (n=412) private = 178 public = 234</td>
<td>24 hr recall (AOAC)</td>
<td>21.8 (13.6) 19.1 (12.9) private 24.5 (14.3) public</td>
<td>Beans, fruits, bread, rice, vegetables</td>
</tr>
<tr>
<td>Hurson &amp; Corish 1997 (88)</td>
<td>Ireland (12-18 yrs)</td>
<td>Secondary school (n=224)</td>
<td>7 x 24 hr recall (Englyst)</td>
<td>17.0 *</td>
<td>Potatoes, breads, breakfast cereals, biscuits/cakes/pastries, vegetables,</td>
</tr>
<tr>
<td>Wuenstel et al 2016 (89)</td>
<td>Poland (13-18 yrs)</td>
<td>High school clustered (n=812)</td>
<td>Food questionnaire (AOAC)</td>
<td>18.7 (18.4-19.1)</td>
<td>Breads and rolls (white/dark), vegetables (fresh/other), potatoes, fruits, fruit juices</td>
</tr>
<tr>
<td>Sekgala et al 2018 (90)</td>
<td>South Africa (18-24 yrs)</td>
<td>22 government-subsidised schools (n =117)</td>
<td>2 x 24 hr recall (Englyst)</td>
<td>6.0 (6.0) median</td>
<td>Not given in the paper. Suggestive sources - cereals (maize), breads, grains, vegetables and fruits vegetables (91)</td>
</tr>
<tr>
<td>Harvey et al 2010 (92)</td>
<td>Uganda (15-49 yrs)</td>
<td>Clustered regions and households (n = 957)</td>
<td>24 hr recall &amp; 2 x 24hr for 10% subsample (AOAC)</td>
<td>29.1 – 54.4 *</td>
<td>Plantains, root/tubers, fruits, pulses, cereals.</td>
</tr>
</tbody>
</table>

*No Standard Deviation given in the paper. DF – dietary fibre. # Analytical method used in food composition tables*
Seven studies with dietary fibre intake of girls and the main food sources of fibre in different
countries were included in Table 2. The age range and fibre intake among the studies varied.
For the girls within an age range of 10 - 18 yrs, the intake ranged from 14.1 g/d (Pacific girls
living in NZ) to 24 g/d in German girls. In NHANES, the data were given across a wider age
range of 4 - 18 yrs with a mean fibre intake of 13.9 g/d (0.3). The main food sources of fibre for
the girls were cereals and cereal products, breads, and vegetables.

Table 3 includes, eight studies with dietary fibre intake of females from high schools and one
regional cluster, and the main food sources of fibre for the females. Again, the age and fibre
intake among the studies varied. For the girls within an age range of 12 - 19 yrs, the intake
ranged from 16.1 g/d (7.1) in Korea to 30.7 g/d (12.7) in Serbia. In Uganda, the data were given
across a wide age range of 15 - 49 yrs with mean intakes ranging from 29.1 - 54.4 g/d. In South
Africa, the age ranged from 18 - 24 yrs with a median fibre intake of 6.0 g/d (6.0). There was
also variation in the types of foods that comprised the main source of fibre intake. Cereals, grains
and breads were the main food sources of fibre for Korean, Irish and Polish girls; beans and
fruits were the main food sources for Sao Paulo girls; vegetables for Serbia; and plantain and
root/tubers were the main food sources for Ugandan girls.

There is clear evidence that dietary fibre intakes of many female adolescents world-wide were
below the NZ fibre intake recommendation of 22 g/d (13). The lowest intake was in South Africa
with a median intake of 6.0 g/d (6.0) and USA with a mean intake of (13.9 g/d (0.3). The NZ
mean fibre intake was also low at 16 g/d and lower for Māori and Pacific girls at 14.3 g/d and
14.1 g/d respectively. Fibre intake in German girls of 24 g/d was higher than the NZ
recommendation however, it was below the American Academy of Nutrition and Dietetics
(AAND) recommendation of 26 g/d (58). In NHANES, the fibre intake of 15 – 18 yrs girls may
be distorted because the average intake was calculated across girls aged 4 - 18 yrs, thus including children who are expected to have lower fibre intake. The NZ fibre intake recommendation for children 4 - 13 yrs is 18 - 20 g/d (13). Given the low fibre intake of many female adolescents world-wide, dietary changes associated with urbanisation and the global spread of westernisation (54, 55, 91) could be responsible. The effects of urbanisation and westernisation on dietary changes are assumed to be more pronounced in the lower socioeconomic and disadvantaged populations (55, 56, 91). This effect is perhaps reflected in the fibre intake of Māori, Pacific, and South African females. A potential explanation may be related to the types of foods accessibility for lower socioeconomic population, i.e. main food sources of cereals, breads and grains were potentially refined and lacking in fibre.

In contrast, fibre intakes in Uganda and Serbia were above the NZ and the AAND recommendations. The fibre intake of Ugandan girls 15 - 18 yrs could be assumed higher than other countries given the high intake across females aged 15 - 49 yrs of 29.1 - 54.4 g/d. The main food sources of plantain, root/tubers and fruits in this population suggest prevalence of traditional plant-based diet with sufficient fibre content. In Serbia, the high mean intake of 30.7 g/d (12.2) was across a small sample of 68 (girls and boys) from the same boarding school hence may not be a good representation of the general demographic.

2.3 Conclusion

Dietary fibre plays an important role in the human diet because of its varying physiological and chemical properties, providing many health benefits. Fibre occurs naturally in plant foods and manufacturers, have produced plant-extracted or synthetic products. The varying complexity of these properties makes fibre hard to define and measure hence giving rise to variation in the
definition and analytical methods. To promote consistency with respect to food labelling and food composition tables among countries, CAC and NZ adopted a definition that covers the indigestible component of plants from analytical methods coupled with a physiological function.

In many countries the dietary fibre intake of female adolescents is low. The low fibre intake is suggestive of dietary changes from traditional diets comprising of fibre-rich whole complex carbohydrates to refined fibre-depleted carbohydrates due to global modernisation and urbanisation.

Whilst the data from national surveys and studies of high school and regional clusters provide good representation of female adolescents’ fibre intakes, the majority of data were out of date, including the 2008/9 data from NZ from the most recent nutrition survey. Furthermore, there is limited data from longitudinal studies for comparison. The lack of recent data warrants the need to update the nutritional intake of New Zealanders.
3. Objective Statement

Inadequate dietary fibre intake is considered to increase the risk of obesity and non-communicable diseases (63, 93). Adolescents are more likely to adopt dietary habits which comprise of convenience and processed foods (94) and which tend to be low in fibre content. These dietary habits may continue into adulthood (95). Adolescence is a period of rapid growth and development from childhood to adulthood in which adolescents tend to seek autonomy in decision making (65, 96) including food choice. Some studies have been conducted to evaluate fibre intake in various countries, however, the majority of data on fibre intake and the contributing food sources for female adolescents relate to data that were collected from seven years to more than a decade ago. In NZ, the existing data are provided from the ANS that was conducted in 2008/2009. The burden of obesity and related health conditions (97, 98); the potential of fibre intakes to be negatively affected by food processing; and an increasing consumption of convenience and fast foods (99); provide a strong drive for updating the dietary fibre intake of NZ adolescents.

**Aim:** To determine the dietary fibre intake and the main food sources of fibre in NZ female adolescents aged 15 – 18 yrs attending high schools.

**Objective one:** To determine whether the mean dietary fibre intake of NZ adolescent girls meets the NZ adequate intake (AI) recommendation of 22 g/d.

**Objective two:** To identify the main food sources of fibre for the NZ female adolescents.
4. Methodology

The SuNDial project: Survey of Nutrition Dietary Assessment and Lifestyle, is a cross-sectional study of NZ female adolescents with the purpose of comparing the nutritional status, dietary habits, health status, attitudes and motivations for food choice of vegetarians and non-vegetarian schoolgirls. The project is being undertaken by MDiet candidates and a PhD candidate with the support of staff at the Dept HN. Each MDiet candidate has conducted interviews with a small number of schoolgirls (typically 5-10 each). The data collected by all MDiet candidates involved in the project to date have been pooled such that the work described herein relates to an analysis of dietary fibre intake of the whole sample.

The Human Ethics Committee (Health) from the University of Otago granted ethical approval prior to the survey with reference code H19/004 (Appendix A). The study is registered with the Australian New Zealand Clinical Trials Registry: ACTRN12619000290190.

4.1. Participants

The target recruitment for the study as a whole was 300 girls aged 15 - 18 yrs recruited from secondary schools nation-wide between February and October 2019. The data included in this thesis represent approximately half of the target population (n = 145) who were recruited during the first three months of the project (February to April). The project was promoted via power point presentations and information sheets given to students at their high schools. The inclusion criteria were: females or those who self-identified as females between age 15 and 18 yrs enrolled
in one of the recruited high schools; able to speak and understand English and to complete required questionnaires online. Pregnancy excluded participation. Those schoolgirls interested in participating were asked to write their name, age and email address on study forms that were subsequently collected by the investigators. If an interested schoolgirl was under 16 yrs of age, she was asked to provide the email address of a parent/guardian in order for parental consent to be obtained. Following recruitment, an identification (ID) number was assigned to each student and a link to an online questionnaire was emailed to her by the study coordinator. The questionnaire was created and managed using REDCap electronic data capture tools hosted at the University of Otago, Dunedin (100). REDCap is a secure web-based application designed to support data capture for research studies. Students were instructed to click on the link and to confirm eligibility. Validation within the software enabled students who complied with the eligibility criteria to complete online consent and to answer a series of questions about demographics (including self-reported main ethnic background that the participant identifies with) and health. Participants were invited to contact investigators at any time via phone or email to ask questions about participation. A total of 263 interested girls were sent the link to enrolment, of which 153 consented and 145 went on to complete the enrolment process.

4.2. SCHOOL SELECTION

The schools were selected by taking into account decile representation (e.g. decile 1 has the highest proportion of students from low socio-economic communities whereas decile 10 has the lowest proportion of these students), the female roll number (a preference for schools with higher rolls: >400 for co-educational or >200 for girls only), and at locations accessible to MDiet candidates. There were 25 schools invited to participate by the coordinators via email in
November 2018. Schools that did not respond within two weeks were sent a second email and a follow-up phone call. When targeted schools did not respond or declined, convenient schools that were not initially selected were recruited by the research team (either by word of mouth or because a school staff member was known to the research team) to meet the targeted number of schools (n = 14). The interested schools were contacted via phone to provide information about suitable dates and times for the research teams to conduct data collection at the schools. The participating schools for this part of the project were: Tauraroa Area School (Whangarei), Mt Maunganui College, Spotswood College (New Plymouth), St Catherine’s College (Wellington), Waimea College (Nelson), Hornby High School (Christchurch), Columba College (Dunedin) and Kaikorai Valley College (Dunedin).

4.3. STUDY PROCEDURE

Consented participants were asked to complete 6 components of the study as follows: fill in a demographic and health questionnaire and a questionnaire about attitudes, beliefs and motivations towards food choice online; undertake a 24-hour diet recall and anthropometric measurements at school; undertake a follow-up diet recall within two weeks; donate blood samples; donate urine samples; and wear an accelerometer for seven days. Participants were given a $5 grocery voucher for the completion of each component.

The data from the blood, urine, accelerometers, and most of the food choice motivation questionnaire, were not included in this thesis. This thesis reported on the data from the anthropometric measurement and 24-hour dietary recall. See Appendix B and Appendix C for the detailed data collection protocols. The supplement use questions in the online motivations
towards food choice questionnaire were checked for any fibre-containing supplements. The online supplement use questions are given in Appendix D.

4.4. **Anthropometric Measurement**

Height was measured to the nearest 0.1 cm using a portable stadiometer (Seca 213, Hamburg, Germany). Weight was recorded to the nearest 0.1 kg using one of four sets of scales (Medisana, PS 420; Salter, 9037 BK3R; Seca Alpha 770; and Soehnle, Style Sense comfort 400) on participants with jackets, jerseys, and heavy tops removed. The procedure was then repeated to generate a second set of data. When any of the duplicate measurements were more than 0.5 units apart, a third set of measurements were taken. The PhD candidate compiled the recorded measurements on excel and calculated the average height and weight for each participant from the two closest measurements. The average data were then loaded onto the REDCap to calculate the participants’ body mass index (BMI). BMI was compared to the World Health Organisation (WHO) age and sex specific growth charts to calculate the BMI z-scores.

4.5. **24-Hour Food Recalls**

Two 24-hour recalls were undertaken by trained researches. The first recall interview was conducted doing face to face interviews at school. The second recall was administered over the telephone or by video-link on a weekend day or on a different weekday to the first recall convenient to the participant, at least eight days but less than 14 days after the first recall interview.
The interview followed 3 multiple-pass steps. Participants were asked to recall everything they ate and drank from midnight to midnight the previous day. A quick list of all foods and beverages consumed were recorded first. Then detailed descriptions of the foods including brands, amounts, cooking and preparation methods were collected. Participants were prompted to recall the detail (Appendix C). For example, “Was the food item fresh, canned, frozen or rehydrated?” If canned, “What is the brand name? What is the size of the can? Was it in syrup or juice? Was the liquid drained? How much did you eat?” For each food item, participants were asked to estimate as accurately as possible the quantity consumed by estimating their recalled intake against resources provided by the Dept HN. These were household items (four measuring cups, three measuring spoons, a 500 ml measuring jug, two mugs, one wine glass, one dessert bowl, and one dinner plate); food models (three wooden spheres, eight rectangles, and two plastic containers of dried beans); and photographs (Listed in Appendix E). The measuring cups range in volume from 62.5 ml to 250 ml, the spoons from 5 ml to 15 ml, and the mugs from 250 ml to 400 ml. The wooden spheres ranged in diameter from 4 cm (the size of a small tomato) to 8 cm (the size of a large apple). The eight rectangles were each 0.3 cm thick, 2.5 cm wide and 7.5 cm long. They were used to estimate the thickness and longitudinal dimensions of food (e.g. cheese and meat) by stacking them and by placing them side-by-side. The photographs depicted foods and beverages in a number of portion sizes. For example, photographs of fizzy drinks and hot beverages ranged in images of containers of volume 250 ml to 500 ml; chocolate sweets ranged in portion sizes from 4g to 250g; cereals from 25g to 100g; bread spread from 4g to 35g; vegetables from 17g to 137g; and sliced meat from 25g to 204g.
4.6. **Nutrient Analysis**

The food consumption data collected from participants were entered into a commercial nutrient analysis program, Foodworks 9 (Xyris Software, Australia). The food composition database contained within Foodworks was a combination of the 2016 NZ Food Composition data (101) and data generated in-house by the Dept HN whilst undertaking the NZ ANS. Foods which were not present in the Foodworks database were either entered as a new recipe (provided the recipe or ingredients were known) or substituted with a similar food. The steps used for food substitution:

1. Look at the Countdown website or purchase food item for nutritional information, portion size, weight and ingredients.
2. Match food to a similar food in Foodworks with similar nutritional information.
4. If still no match, make up recipe using the nutritional information on food package or Countdown website allowing up to 10% difference in macronutrients content of carbohydrate, protein, sugar, total fat, saturated fat, and the closest match to fibre content.
5. Last resort is to send food item to PhD candidate to find a suitable match.

Some substituted food items followed procedures given in the "Code book SuNDial 2019 S1- default foods and food substitutions" *(Appendix F)*. As a check on the accuracy of food coding, all the Foodworks entries followed the cleaning data process given in *Appendix G*.

The Dietary fibre intake was calculated from fibre values in Foodworks that were determined using AOAC analytical method (102). In addition, intakes of the soluble and insoluble portions
of the non-starch polysaccharide (NSP) fibres, were calculated from Foodworks values determined using the Englyst method (30, 37).

4.7. STATISTICAL CONSIDERATIONS AND DATA ANALYSIS

Statistical analyses were carried out using Stata 15.1 (StataCorp, College Station, Texas). Dietary intake data were adjusted for usual intake using the Multiple Source Method (MSM) (103). This estimates the day-to-day variation in nutrient intake using those participants with two days of diet recall data and applies this information to the whole dataset to give an adjusted estimate of usual intake for each participant. The estimates of dietary fibre intakes prevalence and means were reported with 95% confidence intervals. The correlation and regression analyses between dietary fibre intakes, energy intakes and energy density of consumed foods were also carried out using Stata. The food groups were selected based on those used in the 2008/9 NZ ANS. The main data management and statistical analysis were overseen by the study biostatistician, Dr Jill Haszard.

The method used to find the top contributing food sources of dietary fibre intake was:

- The proportion of the total dietary fibre intake from each of the 33 food groups was calculated for each participant using Stata.
- The sum of the total dietary fibre content of each food group, the mean and 95% confidence intervals of these proportions were calculated for the whole group using the Microsoft Office Excel (2016).
5. Results

The recruitment process of the participants is given in Figure 1. 

![Flowchart of recruitment process]

- The total roll of potential girls in the consented schools: $n = 1882$
- Available potential students who attended the recruitment drives: $n = 806$
- Interested students who were sent link to enrolment: $n = 263$ (33%)
- Consented to participate: $n = 153$ (20%)
- Potential girls who were not available to attend the recruitment drives: $n = 1076$
- Approached girls who did not register interest: $n = 543$ (67%)
- Did not respond to link: $n = 110$ (14%)
- Did not complete enrolment: $n = 9$ (1%)

Data available for analysis:
- 145 completed enrolment and 133 attended school visits appointments
- 131 had anthropometric measures (2 missing due to technical issues)
- 132 completed first 24 hr recall
- 113 completed repeat 24 hr recall
- 19 refused repeat 24 hr recall

Figure 1. The recruitment process of the participants

---

1 Percentages are in respect of the 806 schoolgirls approached
Of the 806 schoolgirls approached, 18% completed the enrolment process. The analysed data comprised the following enrolled participants: 91% completed a 24-hour diet recall; 78% completed a repeat recall; and 90% had anthropometric measurements taken.
Table 4 shows the characteristics of the participants.

### Table 4. The characteristics of the participants by ethnicity, age, height, weight, BMI Z-score, and school decile status

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N (%) or Mean (SD)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 145</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>NZEO</td>
<td>104 (71.7)</td>
</tr>
<tr>
<td>Māori</td>
<td>29 (20.0)</td>
</tr>
<tr>
<td>Other</td>
<td>12 (8.3)</td>
</tr>
<tr>
<td><strong>Age (yrs)</strong></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>28 (19.3)</td>
</tr>
<tr>
<td>16</td>
<td>54 (37.2)</td>
</tr>
<tr>
<td>17</td>
<td>60 (41.4)</td>
</tr>
<tr>
<td>18</td>
<td>3 (2.1)</td>
</tr>
<tr>
<td><strong>School decile</strong></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>14 (9.7)</td>
</tr>
<tr>
<td>5</td>
<td>29 (20.0)</td>
</tr>
<tr>
<td>6</td>
<td>35 (24.1)</td>
</tr>
<tr>
<td>7</td>
<td>21 (14.5)</td>
</tr>
<tr>
<td>8</td>
<td>28 (19.3)</td>
</tr>
<tr>
<td>10</td>
<td>18 (12.4)</td>
</tr>
<tr>
<td><strong>Height (cm)</strong></td>
<td>165.8 (6.7)*</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>65.3 (12.8)*</td>
</tr>
<tr>
<td><strong>Overweight (BMI Z-score &gt;1 &amp; &lt;=2)</strong></td>
<td>46 (31.7)</td>
</tr>
<tr>
<td><strong>BMI Z-score</strong></td>
<td>0.7 (1.0)*</td>
</tr>
</tbody>
</table>

*Mean (Standard deviation)

The mean age of the schoolgirls was 16.7 yrs (0.8). The mean body mass index (BMI) was 23.7 kg/m² (4.4)
5.1 FIBRE INTAKE

Table 5 shows the mean AOAC dietary fibre intakes of the participants.  

Table 5. The mean fibre intakes of the participants by ethnicity, age, and school decile status

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>DF (g)</th>
<th>Mean (SD)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘n’ = 132</td>
<td>24.1</td>
<td>(10.2)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZEO</td>
<td>24.5</td>
<td>(9.4)</td>
</tr>
<tr>
<td>Māori</td>
<td>23.9</td>
<td>(11.8)</td>
</tr>
<tr>
<td>Others</td>
<td>22.1</td>
<td>(12.8)</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>24.4</td>
<td>(10.9)</td>
</tr>
<tr>
<td>16</td>
<td>21.8</td>
<td>(8.9)</td>
</tr>
<tr>
<td>17</td>
<td>26.0</td>
<td>(10.8)</td>
</tr>
<tr>
<td>18</td>
<td>24.1</td>
<td>(8.2)</td>
</tr>
<tr>
<td>School decile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>16.4</td>
<td>(7.6)</td>
</tr>
<tr>
<td>5</td>
<td>20.1</td>
<td>(8.6)</td>
</tr>
<tr>
<td>6</td>
<td>27.3</td>
<td>(10.0)</td>
</tr>
<tr>
<td>7</td>
<td>21.8</td>
<td>(6.3)</td>
</tr>
<tr>
<td>8</td>
<td>26.1</td>
<td>(12.3)</td>
</tr>
<tr>
<td>10</td>
<td>29.4</td>
<td>(8.3)</td>
</tr>
</tbody>
</table>

*Standard deviation unless otherwise stated. DF- dietary fibre


3 Other refers to Asian, Pacific and no known ethnicity

4 Dietary fibre values based on AOAC analytical method
Overall, the participants’ mean dietary fibre intake based on the AOAC analytical method was 24.1g (95% CI: 22.4, 25.9). Using data for the Englyst method, the mean non-starch polysaccharide intake was 17.8g (16.8, 19.9) of which 44% (43, 45) was soluble fibre.

Figure 2 displays the participants’ dietary fibre intake distribution

![Figure 2. The dietary fibre intake distribution of the participants](image)

Figure 3 gives the percentage of the 24-hour recalls collected in each day for the repeat recalls.

![Figure 3. The percentage of the 24-hour recalls collected in each day](image)
The mean energy intake was 8066 kJ (95% CI: 7755, 8378). There was a positive correlation (Pearson correlation coefficient $r=0.63$) between the energy intakes and the dietary fibre intakes (Figure 4). The more the energy intakes the higher the dietary fibre intakes.

![Figure 4. Correlation between the dietary fibre intakes and the energy intakes of the participants](image)

5.2 **FOOD SOURCES**

The 15 food groups contributing 95% of the dietary fibre intake are given in Table 6. The remaining food groups contributing 5% of dietary fibre intake are savoury sauces and condiments; confectionary; soups and stocks; sausages and processed meat; milk; pudding and desserts; meat and seafood; dairy products; and egg and egg dishes.
Table 6. The top 15 food group sources of dietary fibre intakes by contributing mean fibre proportion of fibre

<table>
<thead>
<tr>
<th>Food group</th>
<th>DF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>17.7</td>
</tr>
<tr>
<td>Vegetable</td>
<td>14.6</td>
</tr>
<tr>
<td>Bread</td>
<td>13.6</td>
</tr>
<tr>
<td>Grains and pasta</td>
<td>9.2</td>
</tr>
<tr>
<td>Potatoes, kumara and taro</td>
<td>7.9</td>
</tr>
<tr>
<td>Snacks</td>
<td>5.9</td>
</tr>
<tr>
<td>Breakfast cereals</td>
<td>4.8</td>
</tr>
<tr>
<td>Bread based dishes</td>
<td>4.8</td>
</tr>
<tr>
<td>Nuts and seeds</td>
<td>4.0</td>
</tr>
<tr>
<td>Legumes</td>
<td>3.4</td>
</tr>
<tr>
<td>Biscuits</td>
<td>2.2</td>
</tr>
<tr>
<td>Pies and pastry</td>
<td>2.0</td>
</tr>
<tr>
<td>Cakes and muffins</td>
<td>2.0</td>
</tr>
<tr>
<td>Supplements providing energy</td>
<td>1.8</td>
</tr>
<tr>
<td>Non-alcoholic beverages</td>
<td>1.6</td>
</tr>
</tbody>
</table>

DF - dietary fibre
The foods contained within some of the food groups are given in Table 7.

**Table 7. The foods included in some of the food groups**

<table>
<thead>
<tr>
<th>Food group</th>
<th>Foods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breads</td>
<td>Regular breads and bread rolls; flat bread, pita bread, tortillas (plain), pizza bases; speciality breads, sweet yeast buns, English muffins; and bagels</td>
</tr>
<tr>
<td>Snacks</td>
<td>Corn snacks (corn chips and popcorn; grain, kumara and other crisps except potatoes); other snack mixes (e.g. pretzels, Bombay mix: fried noodles and chickpea, or oriental mix, rice based or scroggin trail mix); and sweet snacks (e.g. muesli bars, fruit break/bars, nuts and /or seeds bars, mixed grain bars, puffed cereal bars of other breakfast cereal-based bars).</td>
</tr>
<tr>
<td>Bread-based dishes</td>
<td>Sandwiches, filled rolls and filled pita breads; pizzas; burgers and hot dogs; tortilla, tacos, doner kebabs, burritos, nachos; bread-based batters (e.g. dim sims, spring rolls, wontons); bread-based stuffing; and pancakes.</td>
</tr>
<tr>
<td>Supplements providing energy</td>
<td>Meal replacement (meal replacement bars and drinks); protein supplements; and carbohydrate supplements</td>
</tr>
<tr>
<td>Non-alcoholic beverages</td>
<td>Hot beverages (e.g. coffee, tea, hot chocolates, milo); fruit and vegetable juices; powdered, cordial and fruit drinks; soft, sports and energy drinks and water.</td>
</tr>
<tr>
<td>Savouries sauces and condiments</td>
<td>Gravies and savoury sauces (dry mixes and commercial sauces), condiments, salt and other flavouring, tomato sauce, other sauces (e.g. steak sauce, fruit (e.g. plum/apricot/apple), mustard and mustard sauces, hollandaise and bernaise sauces, soy/worcestershire/oyster/chilli), roux, salad dressings, pickles and chutneys, yeast and vegetable extracts.</td>
</tr>
<tr>
<td>Meat and seafood</td>
<td>Beef and veal, lamb, pork, poultry, other meat, fish and seafood dishes including stews/casseroles, stir-fries, and processed.</td>
</tr>
<tr>
<td>Sausages and processed meat</td>
<td>All types of sausages, luncheon, frankfurters, salamis, saveloys/cheerios; meat loaf, and meat patties</td>
</tr>
</tbody>
</table>
The mean energy density per thirds of the participants’ dietary fibre intakes is shown in Table 8.

**Table 8. Mean (95% CI) energy density (KJ/g) by tertile of dietary fibre intake (g)**

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Mean fibre content of foods (g)</th>
<th>Mean energy density (KJ/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower third</td>
<td>0 - 0.1561</td>
<td>10.8 (10.2, 11.4)</td>
</tr>
<tr>
<td>Mid third</td>
<td>0.01562 - 1.6792</td>
<td>8.3 (7.7, 8.9)*</td>
</tr>
<tr>
<td>Upper third</td>
<td>&gt;1.6793</td>
<td>8.9 (8.3, 9.5)*</td>
</tr>
</tbody>
</table>

*Regression of energy density with thirds of fibre intake with participant id as a random effect; significantly different from the lower third*

The food groups represented by the lower third of fibre intake were fats and oils, sugar-sweetened beverages, animal products (meat, dairy, eggs), alcoholic beverages, and plain sugar or sugar sweets. The food groups represented by the upper third of fibre intake were fruits, vegetables, bread, grains and pasta, and potatoes, kumara and taro. The mid third included snacks, breakfast cereals, bread-based dishes, nuts and seeds and legumes.
5.3 SUPPLEMENT USE

Twenty nine percent of the schoolgirls reported taking a dietary supplement, but none were specifically taking fibre supplements. However, 35 girls reported the use of products derived from plants, seeds and fruits. Figure 5 shows the number of schoolgirls who took supplements that may have contained fibre and the frequency of the consumption. The range of products is given in Figure 5. Although these products may have contained fibre, the amounts were not listed, and no allowance has been made to the diet recalls.56

For the frequency of supplement consumption: 1 means daily, 2 more than once a week, 3 once a week, 4 means monthly, 5 regularly but for a limited time, and 6 not very often.

Figure 5. The number of participants taking supplements that may have contained fibre and the frequency of the consumption

5 Suggestive fibre-containing supplements included those that contain plant extracts, herbs, fruits bits or flavour, seeds, and/or made from plants as shown in the ingredients list. Oils and supplements that none of the girls consumed except for bran supplement were not included.
6. Discussion

The mean dietary fibre intake based on the AOAC method of determination was 24.1 g/d (22.4,25.9). Of the foods in the composition data that had non-starch polysaccharides values using the Englyst method, 56% of the fibre was classified as insoluble and 44% soluble. The food groups contributing the majority of the dietary fibre were fruits; vegetables; breads; grains and pasta; potato, kumara and taro; snacks; breakfast cereals; and bread-based dishes. The proportion of fibre intake from these foods ranged from 5-18%. Dietary fibre intake was positively associated with energy intake although the energy density of foods was higher in foods without fibre compared with fibre-containing foods.

From the national surveys reviewed, the mean dietary fibre intakes of female adolescents ranged from 13 – 24 g/d (25, 76, 77, 79-82). The main contributing food sources to the intakes from these national surveys were cereals and cereal products, breads, vegetables, potatoes and fruits. From the studies of high school survey data, the mean dietary fibre intake of female adolescents ranged from 16 – 31 g /d (83-89). The top contributing food sources of the high school samples, breads, cereals, vegetables and grains were similar to reports from other countries except for the Brazilian girls for whom beans was the top contributing food source of dietary fibre (87). For Serbian schoolgirls the contributing food sources of dietary fibre were similar to other countries yet they had the highest dietary fibre intake of 31 g/d (86). A possible explanation is that these girls were accommodated in boarding schools with meals provided. The lowest intake of 13 g/d came from the NHANES data that included children from the age of 4yrs upwards (79).
From these results the mean dietary fibre intake of the SuNDial participants is either similar to or higher than most of the reported intakes of female adolescents in other countries. Having whole fruit as the top contributing food source is different to that found in the other countries in which breads and cereals generally topped the list. The NZ Health Survey 2016/17 reported that NZ females 15+ years were more likely to consume the recommended servings of fruits (2+ servings a day) with 56.8% (95% CI: 53.1 - 60.5) of females aged 15-24 yrs meeting the recommended fruit intake (104). This may explain fruit being the top contributing food source of fibre for the participants in the present study.

The resulting fibre intake in the SuNDial girls may be attributable to a recent trend towards plant-based or vegetarian diets, due to sustainability concerns, and moral or ethical reasons towards the environment (105-107). A commercial research poll carried out on vegetarianism in NZ in 2016 found that 10.3% of New Zealanders described themselves as vegetarians, representing a 2.2% rise over the preceding four years with vegetarianism being more common in the younger age group (108). The current data may have captured this trend to vegetarianism whereas the data from the 2008/9 ANS of 16 g/d mean fibre intake, may have been collected before the trend. Moreover, the fibre content of processed foods (e.g. breads, pasta, snacks and breakfast cereals) may have increased over the years because of the ongoing reformulation by food industries to meet consumer demands and public health guidelines (48, 49).

The positive association between fibre intakes and energy intakes shows that schoolgirls with high energy intakes are more likely to have high dietary fibre intakes than those who have low energy intakes. A similar association has been reported in the 2012 Australian National Nutrition and Physical Activity Survey (NNPAS) (76). Achieving recommended fibre intakes needs to be done by consuming fibre-rich, low energy-dense foods such as fruits and vegetables rather than by over-consuming food in general. Moreover, some high energy dense foods were
fibre-rich because of added fibres (e.g. snacks, biscuits, cakes and muffins, which contain bran and grains). These foods tend to be processed convenience foods high in fat, sugar and energy. It is important therefore, to reduce the consumption of these foods to occasionally whilst focusing on increasing the consumption of wholesome foods which usually have low energy density. Many of the SuNDial participants were potentially overconsuming, as evidenced by 32% of the sample being classified as overweight.

In our dataset, foods in the lowest third of fibre content had a higher energy density compared to foods with more fibre. Fibre-rich foods tend to be plant foods high in water content and low in fat content (e.g. fruits and vegetables) (109). Water has no energy density despite adding weight to food, and fibre contributes a relatively small amount of energy compared with the macronutrients, particularly fat (109). An energy dense, high fat and low-fibre diet is associated with higher fat mass in childhood which may increase adiposity in adolescence (110, 111) and may therefore continue on to obesity in adulthood. In contrast, high fibre, low energy dense diets have been found to promote satiety and to decrease hunger, leading to reduced calorie intake and better weight control (3, 26, 27). It is important that any guidelines and public health initiatives to increase fibre intake for this group should address high-fibre low energy dense foods. There should be supportive policies in the NZ schools to reinforce messages to increase consumption of fruits, vegetables, and whole grains whilst reducing consumption of low-fibre fatty and sugary foods and drinks. Promoting appropriate fibre-rich foods that comply with the guidelines for healthy eating for New Zealanders (14) would be a worthwhile intervention to reduce the likelihood of this population becoming overweight.

Establishing supportive policies in the NZ schools to target the reduction of low-fibre energy dense foods whilst increasing high-fibre low energy dense foods could be achieved by a
coordinated approach between the Ministries of Health and Education. There are current initiatives to increase consumption of fruits and vegetables in schools including the ‘Fruits in Schools’ programme by the MoH (112) and the ‘Health and Nutrition’ guideline by the Ministry of Education (113). Despite the positive impact reported from the ‘Fruits in School’ programme, it is limited to low decile primary schools. The Health and Nutrition guideline gives practical advice for food policy in all schools but without any measures of compliance. It is clear that attempts to promote healthy eating in this population are not new. However, the 32% of our sample classified as overweight, the overall DF intake results (despite the mean DF meeting the AI) and the positive correlation between DF intakes and energy intakes, indicate that these initiatives need to be more effectively implemented.

In the USA, a National School Lunch Program and School Breakfast Program has been introduced to schools (114). The nutrition standards for these initiatives are regulated with support from policy memoranda and other guidelines to encourage healthy eating, including advice to consume whole grains, vegetables and fruits (114). In addition to the nutrition standards, certification of compliance in these North American schools is required, a requirement that may be lacking in NZ. A similar approach in NZ schools coordinated between the two governmental ministries above would surely have a positive impact in meeting the dietary fibre intake targets and overall good health of the schoolgirls.

A strength of this first tranche of the SuNDial project has been the collection of two days of food recall data using MSM (103) which allows for the adjustment to estimate for usual intakes. Another strength has been the pairing of the fibre content of foods with energy density. This is a novel approach that may be useful in the identification of suitable low energy fibre-rich foods.
A major limitation of the project has been the low number of schools recruited (8 out of 28) and the low recruitment rate within those schools (145 girls out of 1882). Hence, this relatively small convenience sample may not provide representative data on the dietary fibre intake of all NZ adolescent schoolgirls. Additionally, the uneven distribution of represented days from the 24-hour dietary recall collection is another limitation.

This study on the other hand, is part of the national SuNDial project and so the sample representation with regard to school decile, ethnicity, age groups and days of the week is expected to improve with the recruitment of more participants. At this stage however, statistical analysis with respect to ethnicity, age, socioeconomic status, and BMI status has not been carried out.

The lack of information of the fibre content of supplements derived from plants was a limitation, potentially leading to an underestimation of fibre intake. The Dietary Supplement Regulations (1985 reprinted 2016) does not regulate for fibre content (115). Given that fibre intake is low, it may be of benefit to consumers to have the fibre content of botanical supplements quantified on the ingredients list, allowing for incorporation of this fibre content to the dietary intake assessment.

Looking ahead, the Englyst method of NSP determination is being discontinued (116). This means that the soluble and insoluble fractions of dietary fibre will only be available for some older entries in the database. Already a limitation in our dataset, the data on soluble/insoluble NSP does not reflect the entire diets of the schoolgirls. Soluble fibre is associated with health effects which include lipid control (5, 8) thereby reducing the risks of cardiovascular diseases; improved blood glucose from cereal fibres which comprised of soluble and insoluble fibres (4, 7) thus reduce risks of type 2 diabetes; improving satiety and weight loss (3, 4, 7, 26, 27); having
probiotic effects (117); and improving symptoms of irritable bowel syndrome (118). Insoluble fibre is associated with adding bulk to stools and promoting normal laxation (1, 2, 42); and reducing the risks of some cancers (9, 11). Knowing the proportions of soluble and insoluble fibre in foods could be useful for targeting recommendations, although our ability in NZ to do this will be hampered by an ongoing lack of data. Nevertheless, it is important that fibre-rich diets are promoted to schoolgirls and to the NZ population.

6.1 CONCLUSION

The dietary fibre intake and contributing food sources of the schoolgirls in this component of the SuNDial project may not have been representative of the NZ situation. However, the relationship between dietary fibre and energy intake, as well as an association between the fibre content of foods and energy density were highlighted. This is important not only for public health advocates but the country as a whole because of the reported association of high density low-fibre diets with fat mass and adiposity. The low energy dense character of fibre and water makes fruits, vegetables and plant-based diets recommended food sources in line with the types and amounts of food given in the NZ healthy eating guidelines (14). For future research, an intervention to increase the amount of fibre-rich low energy dense foods in the diets of NZ schoolgirls to assess practicality, acceptability and effectiveness in raising fibre intakes is suggested.
7. Application of Research to Dietetic Practice

In common with many dietary surveys conducted around the world, the DF intakes of these schoolgirls are suggested to be low despite their mean fibre intake meeting the Al recommendation. This finding reinforces the importance of dietetic practice to encourage the consumption of wholesome fibre-rich foods (whole grains, vegetables, fruits, legumes and nuts), an approach in line with nutritional advice from the MoH (14).

For those who are overweight/obese and those with related health issues (e.g. type 2 diabetes, high blood pressure), consuming wholesome fibre-rich foods and complying with the MoH guideline (14) to lose/control weight and improve symptoms of health issue would be the recommended advice. Awareness needs to be directed to fibre-rich processed and convenience foods and foods that may be perceived healthy (due to claims on packet as a good source of fibre) that may be misleading. These foods tend to be high in fat and sugar, thus contribute high calories. Therefore, it is important to address consumption of these foods as “occasional foods” in small portions size.

As dietitians, encouraging daily consumption of whole grains, vegetables, fruits, legumes and nuts that comply with the healthy guideline whilst reducing consumption of low-fibre processed convenience fatty, sugary foods and beverages to:

- achieve adequate fibre intake recommended in the Nutrient Reference Values for Australians and New Zealanders (13);
- provide protein, minerals and vitamins;
- promote normal bowel function and laxation;
would be a sustainable guideline for overall good health, thus reduce the risks of obesity and related health issues. Furthermore, asking about supplement use in all patient consultations is important for appropriate dietary advice.

The importance of the practical approach of the dietetic practice in regard to ongoing competence development was also highlighted by the different research components: data collection, data entry, data analysis, and thesis writing. Collecting relevant dietary data and interpreting these data is a typical practice of a dietitian. Required professional attributes for dietitians (e.g. communication, collaboration, critical thinking and documentation) (119), were practiced many times resulting in increased confidence and skill level.
8. References


7. InterAct C. Dietary fibre and incidence of type 2 diabetes in eight European countries: The European Prospective Investigation into Cancer and Nutrition (EPIC)-
InterAct study and a meta-analysis of prospective studies. Diabetologia. 2015;58(7):1394-408.


119. New Zealand Dietitians Board. Professional standards and competencies for dietitians [Internet]. Wellington: Dietitian Board; 2017 [cited 2019 23 April]. Available from:
9. Appendices

Appendix A. Ethical approval letter including the Māori consultation approval letter

Appendix B. Anthropometric measurements protocol

Appendix C. 24-hour dietary recall protocol

Appendix D. Supplement use question section of the REDCap motivations to food choice online questionnaire

Appendix E. Food model photographs – estimation of food portion sizes

Appendix F. Code book SuNDial 2019 S1– default foods and food substitutions

Appendix G. Data cleaning process
APPENDIX A. ETHICAL APPROVAL LETTERS
Dr J Haszard  
Department of Human Nutrition  
Division of Sciences

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,

[Signature]

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8258
Email: gary.witte@otago.ac.nz

c.c. Assoc. Prof. L Houghton Department of Human Nutrition
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 outlined 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 bases 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 Raranga 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 Perima
Kaiwhakahaere Pūtere
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Office of Māori Development
Te Whare Wānanga o Otago
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APPENDIX B.  ANTHROPOMETRIC PROTOCOL
ANTHROPOMETRIC MEASUREMENTS

Gain verbal consent from the participant for each measurement and explain fully what you will do to obtain them. Before beginning, gain consent from the participant to use non-permanent pen for marking anatomical landmarks.

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

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 (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 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.

![Fig 2: Ulna Length Measurement](image)

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 no tell participant measurements).

CHECK: are any of the 1st and 2nd measurements are more than 0.5 units apart? If so take a third measurement where required.
APPENDIX C. 24-HOUR FOOD RECALL PROTOCOL


24 Hour Recall

Introduce yourself to the participant, thank them for participating in the sundial project and ask them to take a seat.

“I am going to ask you about everything that you ate and drank yesterday. Please try to recall, and tell me about everything that you had to eat or drink, whether it be at home, or away from home, including snacks, drinks and water.”

Stage One – Quicklist
“First, we will make a quick list of all the things you ate and drank, and then we will go back over this list and I will ask you more details about the specific foods and drinks, and the amounts.”

“It might help you remember what you ate by thinking about where you were, who you were with, or what you were doing yesterday; like going to school, eating out, or watching TV. Feel free to keep these activities in mind and say them aloud if that helps.”

“So starting from midnight the day before yesterday, what was the first thing you remember eating?”

Start recording quick list – keep prompting until finished

“That’s great. Sometime people forget to tell us about drinks, particularly water when we do this list.”

“How much water do you remember drinking yesterday?” (record)

“Did you have any other drinks you might have forgotten about?” (record)

Stage two – Collect more information
“I am now going to ask you some more specific questions about each food. We also need to work out how much of each food that you ate or drank”

“Lets start at the beginning – the first thing you remember eating was xxxx” (record)

What time did you eat/drink that? (record)

Go on to collect specific information that is relevant to each food based on the tips provided on the tip sheet. Record as much specific information as you can. Record each food item in a different row.

Use the photos and measurement aids to help the participant estimate the portion size. Remember that brand and package size will always give you the most accurate information.
Before you go onto the next food on the quick list be sure to ask if they added anything to the food they have just described.

Stage 3 – check for any further additions

“Ok, thanks for working with me to provide all of that detail. We are now going to do one more check to make sure there isn’t anything else that should be on this list. I am going to read this list back to you. If you remember anything else that you ate while I am reading it back to you please interrupt me and we will record in”

Read through with the participant all the food and drink they have listed

“Is there anything you can think of that we need to add in?” (record as necessary)

“Last Question: Do you know if the salt you use at home contains iodine?” (tick appropriate box)

“Great thank you again. If it is ok with you one day in the next week I would like to ring you and go through this process again on a different day, so that we can get an idea of how the foods you eat change from day to day. What time of the day (outside of school time) would suit you for me to ring you?”

Record preferred times - remember, ideally this second 24 h recall will occur on a randomly selected day, but that might not always be possible (at the very least it should be a different day of the week than today)
Tips Sheet

Remember that the more information you can obtain about each food the more accurate the data is going to be. Please keep in mind that some of your fellow MDiet students are writing their thesis on nutrients (like Folate) that will vary from brand to brand depending on fortification so please be as careful and accurate as possible.

You need to gather more information about each food identified on the Quicklist. Below are some prompts that might help you do this.

Where possible for packaged foods collect the brand name

Potential questions to consider asking (depending on the food reported)
- What is the brand name?
- Was it fresh, canned, frozen or rehydrated?
- Was it home made? Do they know the recipe? If they do record on the recipe sheet) – this is more important for savory foods than baking (as the basic composition of a biscuit or a cake varies much less than the composition of, for example, a stir fry)
- How was it cooked? Was it baked, fried, or boiled
- Was the item coated before cooking, if so what it with flour, batter, eggs, or breadcrumbs etc?
- Was it standard, low fat, low sugar caffeine free?

Do not
- Collect information about herbs and spices that are used in very small quantities
- Ask leading questions
- Ask for recipes for traditional home baking, but do note if it is gluten free.
- Make assumptions

Do
- Keep your prompts neutral
- Ask about cooking method and the type of fat used in cooking e.g. if they say baked, ask what with?
- Collect brand names for margarine, butter, juices/fruit drinks, breakfast cereals, energy drinks, breads, dairy alternatives (e.g. almond milk) as the micronutrient content of these products can vary considerably from brand to brand.
- Ask for the recipe for less traditional home baking (e.g. brownies made with black beans, raw caramel slice etc)
Useful Prompts for Specific Food Groups

FRUIT
- Peeled or unpeeled
- Colour? – e.g. red/green apple
- Tinned? – if so was it tinned in syrup or juice, how much of the syrup/ juice did they have
- Use photos of tinned peaches, wooden balls, cups or beans to help estimate portion sizes

VEGETABLES
- Fresh, frozen or Tinned (if tinned were they tinned with flavoured sauce/syrup/ juice)
- Cooking method – boiled, baked (with fat/oil – what type and how much?), microwaved, steamed etc
- Colour – e.g. red/green capsicums
- Potatoes – with or without skin, if mashed what was added and how much?
- Quantities could be recorded in cups (sliced/whole/mashed/diced) or how much of a whole vegetable (e.g. ½ a medium capsicum)
- Use photos to help estimate portion size for similar vegetables not shown in pictures (e.g. broccoli can be used to estimate cauliflower, peas can be used for corn or bean etc). Use thickness guides and rulers to help estimate sliced vegetables (e.g. cucumber).

DAIRY
- Milk – brand name and fat content (show picture of bottle tops)
- Yoghurt – brand and with fruit or plain/natural or vanilla, reduced fat, low fat
- Ice cream – brand, any additions? If in a bowl use pictures to help estimate amounts.
- Cheese - - type (e.g. Edam, Colby, Feta), brand, grated (in cups or use pictures) or sliced (thickness guides)

NUTS
- Roasted, raw, salted, other favouring, blanched
- Whole, chopped, slivered
- Mixed – with or without peanuts
- How many cups or how many whole nuts? or can use beans to estimate handful size

BREAD
- White, wholemeal, wholegrain, light or dark rye (use photos to help with identification)
- Brand name (important for fortification)
- Toast or sandwich slice (thick or thin)
- For buns – any toppings (don’t worry about small amounts of seeds, but do record cheese, bacon etc)

MARGARINE/BUTTER/TABLE SPREAD
- People often use the term butter and margarine interchangeably so collect the brand name (do not comment on the fact they might not have used the correct description)
- Low fat or standard
- Phytosterols (cholesterol reducing)
- Use pictures to help indication of thickness of spread
DRINKS
- Juices/Fruit Drinks
  - Terms used interchangeably so always collect brand information if possible
  - 100% juice or fruit drink
  - No sugar added or sweetened?
  - Added vitamins
  - Commercial or freshly squeezed
  - Did they dilute with water, is so how much
  - Use cups or pictures of cans and bottles to help estimate portion size

- Fizzy drinks
  - Brand
  - Flavour
  - Diet, standard, zero sugar, type of sweetener
  - Caffeinated
  - Use cups or pictures of cans and bottles to help estimate portion size

- Made from liquid (cordial) or powdered concentrate (raro)
  - Brand and flavour details of concentrate
  - Standard or low energy/ low sugar version
  - How much concentrate?
  - Did they make it with water or something else?
  - How much water or other substance was added?

PACKAGED FOODS
- Brand and package size most important
- Did they consume everything in the packet?

MIXED DISHES
- Try and record recipe if possible
- If recipe unavailable try and get as much detail as possible
- Check any protein ingredients, starchy ingredients, vegetables, sauces
- Use photos, cups, plates and bowls to estimate portion size
APPENDIX D. SUPPLEMENT USE QUESTIONS
## 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 mineral
- [ ] Single vitamin or mineral
- [ ] Oil
- [ ] Bran
- [ ] Lecithin
- [ ] LSA
- [ ] Kelp
- [ ] Spirulina
- [ ] Glucosamine and/or chondroitin
- [ ] Echinacea
- [ ] Ginkgo
- [ ] Hypericum (St John’s Wort)
- [ ] Sports supplement
- [ ] Other (please specify)

**Multivitamin and/or mineral: How long 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 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.

**Multivitamin and/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.

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

**Single vitamin or mineral: How long 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.

Please specify the type of oil:

Oil: How long 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

Oil:

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.

Oil:

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.

Bran: How long 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

Bran:

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.

Bran:

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>Supplement</th>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecithin</td>
<td>How long did you take the supplement in the last 12 months?</td>
<td>Daily, More than once a week, Once per week, Monthly, Regularly but for a limited time, Not very often</td>
</tr>
<tr>
<td>Lecithin</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>LSA</td>
<td>How long did you take the supplement in the last 12 months?</td>
<td>Daily, More than once a week, Once per week, Monthly, Regularly but for a limited time, Not very often</td>
</tr>
<tr>
<td>LSA</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>LSA</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Kelp</td>
<td>How long did you take the supplement in the last 12 months?</td>
<td>Daily, More than once a week, Once per week, Monthly, Regularly but for a limited time, Not very often</td>
</tr>
<tr>
<td>Kelp</td>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>
Kelp:
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.

| Spirulina: How long 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 |

Spirulina:
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.

Spirulina:
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.

| Glucosamine and/or chondroitin: How long 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 |

Glucosamine and/or chondroitin:
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.

Glucosamine and/or chondroitin:
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>Supplement</th>
<th>Frequency Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Echinacea</td>
<td>Daily, More than once a week, Once per week, Monthly, Regularly but for a limited time, Not very often</td>
</tr>
<tr>
<td>Echinacea</td>
<td>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.</td>
</tr>
<tr>
<td>Ginkgo</td>
<td>Daily, More than once a week, Once per week, Monthly, Regularly but for a limited time, Not very often</td>
</tr>
<tr>
<td>Ginkgo</td>
<td>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.</td>
</tr>
<tr>
<td>Hypericum</td>
<td>Daily, More than once a week, Once per week, Monthly, Regularly but for a limited time, Not very often</td>
</tr>
<tr>
<td>Hypericum</td>
<td>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.</td>
</tr>
</tbody>
</table>
Hypericum (St John's Wort):

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.

Sports supplement: How long 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

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 long 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

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.
APPENDIX E. FOOD MODEL PHOTOGRAPHS
Margarine/butter

Honey

Jam

Peanut butter
Comparative images of spaghetti, rice, noodles, and spiral pasta, showing the amount of each food on the plate at different weights.
**SQUARE OR RECTANGLE**
(3 Dimensions required)
L=length
W=width
H=height

**CYLINDER**
(2 Dimensions required)
D=diameter
L=length

**WEDGE**
(3 Dimensions required)
L=length
W=width
H=height/thickness
APPENDIX F.  CODE BOOK SuNDIal 2019 S1
Codebook Instructions

Default foods: Default food items: to be used when insufficient food information is provided to determine exact food code OR when no exact match is present in FoodWorks but a closely related food is available. We need to be consistent about the food that is selected: the default foods used in the BLISS and SWIFT studies are on separate sheets. A new sheet has been created for the SunDial study. When you use a default from either the BLISS or SWIFT study please copy that food in to the SunDial study Default foods page.

Substitutions: SUBSTITUTIONS are to be used when there is no exact or close match to the diary food item in FoodWorks (e.g. chicken bacon is not present in FOODfiles and so would require a substitute such as pork bacon, muffin muesli bars would need a substitute and so on) There are some listed in the Substitutions BLISS and SWIFT sheet

Food weight estimation rules: to be used when the food weight is not provided

Food weight estimation defaults: to be used when the food weight is not provided

Cooking method rules: When no cooking method has been specified for foods

Fruit When no cooking method is specified for fruits (including apple, pear and tomato) assume that it was offered fresh and use the appropriate default options listed on the "default foods" sheet
<table>
<thead>
<tr>
<th>Vegetables (non starchy vegetables)</th>
<th>When no cooking method is specified for vegetables (such as carrots, broccoli, cauliflower etc) assume that it was offered steamed/microwave or boiled and use the appropriate default options listed on the &quot;default foods&quot; sheet. For green peas assume that they have been boiled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starchy vegetables</td>
<td>When no cooking method has been specified for starchy vegetables (including potatoes, kumara/sweet potatoes, pumpkin) assume that it was offered steamed/microwave or boiled and use the appropriate default options listed on the &quot;default foods&quot; sheet. However, if the meat accompanying vegetables is roasted then vegetables may have been as well. If meat is stirfried vegetables may be stir fried. For green peas assume that they have been boiled Use meat with no fat removed or add fat additionally</td>
</tr>
<tr>
<td>Meat, fat or skin not</td>
<td>Choose milk first, then drink type next, don’t worry too much about shot amount Look up nutrient profile, then choose a similar match (don’t worry about brand) if type not available, match energy, sugar and fat.</td>
</tr>
<tr>
<td>Other:</td>
<td>Coffee pre made (cafe) Data that is not in FoodWorks eg edamame beans, look up nutrient profile and match data with similar</td>
</tr>
<tr>
<td></td>
<td>Chocolate Milk Data that is not in FoodWorks eg edamame beans, look up nutrient profile and match data with similar Use type and brand if available or if brand not available use composition data for a trim version or std version - don’t use Nov/May data</td>
</tr>
</tbody>
</table>
When an overall amount for combined foods has been given and there are no amounts for the individual foods making up the combined offering (e.g. toast with margarine and jam) the amounts of the individual ingredients have to be estimated.

- for foods that have default weight estimations available in the "food weights estimation DEFAULTS" page (e.g. bread/toast and marg/butter etc) use the "food weights estimation DEFAULTS" page weights to guide estimation of the individual food weights
- for foods that do not have default food amounts/weights (e.g. potato/carrots/chicken etc with no other serving size guidance) assume that equal proportions of each of the individual items were consumed (e.g. chicken + potato + peas + corn (total amount/weight of food offered = 2 cups (or 300g) - assume 0.5 cup (or 75g) of each item.

When dimensions of food (e.g. 5cm x 1cm x 1cm) have been given instead of weights OR household measures (e.g. 1/4 cup or 1TBsp) OR food unit sizes (e.g. medium carrot or a toast slice of bread) use Kai-culator to convert the dimensions to a weight estimate.

If a participant says there were leftovers record the weight or volume of the left overs or a fraction/proportion (i.e. 10% or 1/10) left over. If a word description is given use the following proportions to estimate the amount of food leftover: Used in the BLISS study but could apply to adult diets as well.

"almost all" = 90%
"most" = 75%
"some" = 50%
"a little bit / tiny bit" = 25%
"almost none" = 10%

Adults handful = 8.4cm 11.5cm 2cm - used in the BLISS study
Fluids

Coffee ground = 1 tsp if not specified
Tea = use Indian infused tea or black tea both are liquid, do not use 'Tea, Indian, leaves' as we do not usually consume the leaves.
Espresso shot = 25 ml

Record water/liquid when it as it is consumed. If liquid is recorded at the end of recall record as a whole amount, add to the last entry (eg: 20:00)
Used 180ml for a glass of water when not specified amount

Used mug (240ml) if size of tea or coffee not specified

Milk for coffee or tea not specified amount use 20mls or guideline amount per 1 ml of beverage

Milk for porridge or cold cereal if not specified (guideline amount per cup hot or cold cereal)

Glass of wine - If amount not specified, use Kai-culators guide for a glass of wine e.g. 149 g for wine, white, dry - Rose
Alcoholic cocktail = 150 ml - Michelle

Pint of beer: In New Zealand, there is no legal requirement for beer to be served in standard measures; in pubs, the largest size of glass, which is referred to as a pint, usually contains 450ml.
Vegetables
Roast vegetable salad with dressing: 1 cup = 200 g (Salad, veg, w/salad cream dressing, canned R149) - Liz

1 "bunch" of asparagus = 11 spears (counted from the bunch in my fridge) - Rose

1/4 head of cabbage (average) = 128 g (taken from info found on two sites on internet - Rose

1 "stock pot" (~28 g) is dissolved in 500 mL of water, therefore = 528 g stock. Reduce the water content of recipe accordingly. - Rose

cake - small slice = 65 g

Herbs or spices do not need to be included unless they are large quantities

Oil spray → ¼ tsp

If they don’t specify size, always assume medium

Egg, Size 6 unless specified

Used 1 cup for premade meals such as curry if not specified

Soy sauce if not specified 1Tbsp

Ice cream not specified 1 Scoop
Food weight estimation defaults: to be used when the food weight is not provided NB: this file was used for the BLISS study - obvious references to baby foods have been removed but all other foods remain - the amounts may/may not be suitable for SuNDial. If in doubt check!

<table>
<thead>
<tr>
<th>Unspecified food item</th>
<th>Default food description and code number</th>
<th>Record ID</th>
<th>Portion size information (g)</th>
<th>Default when no size is specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>green bean, boiled</td>
<td>Beans, green, boiled</td>
<td>X140</td>
<td>1 = 6.4g</td>
<td></td>
</tr>
<tr>
<td>&quot; A spoonful&quot; - in an adult recipe</td>
<td></td>
<td></td>
<td>15mL liquid or flat</td>
<td></td>
</tr>
<tr>
<td>1 cup cooked = 184g</td>
<td>(from packet information)</td>
<td>L212</td>
<td>30mL scooped/rounded (e.g.</td>
<td>Medium</td>
</tr>
<tr>
<td>Apples</td>
<td>Apple, flesh, fresh</td>
<td></td>
<td>2 rusk = 4.2g</td>
<td></td>
</tr>
<tr>
<td>apricot</td>
<td>Apricot, flesh &amp; skin, fresh</td>
<td>L23</td>
<td>Small = 86g</td>
<td></td>
</tr>
<tr>
<td>avocado</td>
<td>Avocado, assorted</td>
<td>L1017</td>
<td>Medium = 133</td>
<td></td>
</tr>
<tr>
<td>baking powder</td>
<td>Baking powder</td>
<td>P1</td>
<td>Large = 169</td>
<td></td>
</tr>
<tr>
<td>Baking soda</td>
<td>Baking soda</td>
<td>P62</td>
<td>slice = 7g</td>
<td></td>
</tr>
<tr>
<td>Banana raw</td>
<td>Banana, flesh, fresh</td>
<td>L32</td>
<td>1 apricot = 56g</td>
<td>Medium</td>
</tr>
<tr>
<td>Barbecue sauce (condiment)</td>
<td>Sauce, barbecue</td>
<td>W72</td>
<td>1 avocado = 242g</td>
<td></td>
</tr>
<tr>
<td>Beef</td>
<td>Beef, composite cuts, lean, cooked</td>
<td>M542</td>
<td>1 teaspoon = 3.4g</td>
<td></td>
</tr>
<tr>
<td>Blueberries</td>
<td>Blueberries, jersey, unsweetened, fr</td>
<td>L39</td>
<td>1 cut round = 3g</td>
<td></td>
</tr>
<tr>
<td>boiled/steamed broccoli</td>
<td>Broccoli, microwaved</td>
<td>X1021</td>
<td>1 cup mashed = 238g</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 linear cm = 6g</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 cut round = 3g</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 cup = 264g</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 TBsp = 15.8g</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 thin slice = 22g</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 medium slice = 44g</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 thick slice = 67g</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 berry = 1.2g</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 floret = 10</td>
<td></td>
</tr>
<tr>
<td>Brand name</td>
<td>Code link (Abbey)</td>
<td>Foodfiles match</td>
<td>LINZ match</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>------------------</td>
<td>----------------------------------------------------------------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>MILL MIXED GRAIN MEDIUM SLICE</td>
<td>500000313</td>
<td>Bread, multi-grain light</td>
<td>R4659</td>
<td></td>
</tr>
<tr>
<td>BAKERS DELIGHT BROWN BRE</td>
<td>800000392</td>
<td>BREAD,WHOLEMEAL,SLICED &amp; UNSLICED</td>
<td>A23</td>
<td></td>
</tr>
<tr>
<td>BAKERS DELITE TIGER BREAD, LOW G</td>
<td>500000342</td>
<td>Bread, multi-grain heavy with seeds</td>
<td>LZ_R4855</td>
<td></td>
</tr>
<tr>
<td>BIG VALUE GIANT MULTIGRAIN TOAST</td>
<td>500000313</td>
<td>Bread, multi-grain light</td>
<td>R4659</td>
<td></td>
</tr>
<tr>
<td>TOAST SLICE</td>
<td>500000313</td>
<td>Bread, multi-grain light</td>
<td>R4659</td>
<td></td>
</tr>
<tr>
<td>BREADMAN PUMPERNICEL BREAD 700G</td>
<td>600391980</td>
<td>BREAD,PUMPERNICEL</td>
<td>A120</td>
<td></td>
</tr>
<tr>
<td>BRUMBY'S ANCIENT GRAIN, 700G</td>
<td>500000342</td>
<td>Bread, multi-grain heavy with seeds</td>
<td>LZ_R4855</td>
<td></td>
</tr>
<tr>
<td>BUDGET MULTIGRAIN BREAD, TOAST 600 G</td>
<td>500000356</td>
<td>Bread, multi-grain light, with folate</td>
<td>R5111</td>
<td></td>
</tr>
<tr>
<td>BUDGET MULTIGRAIN BREAD, SANDWICH 600 G</td>
<td>500000356</td>
<td>Bread, multi-grain light, with folate</td>
<td>R5111</td>
<td></td>
</tr>
<tr>
<td>BUDGET SANDWICH BREAD, WHEATMEAL 600 G</td>
<td>500000315</td>
<td>Bread, wheatmeal</td>
<td>R4661</td>
<td></td>
</tr>
<tr>
<td>BUDGET TOAST BREAD, WHEATMEAL 600 G</td>
<td>500000315</td>
<td>Bread, wheatmeal</td>
<td>R4661</td>
<td></td>
</tr>
<tr>
<td>BUDGET WHOLEMEAL</td>
<td>500000315</td>
<td>Bread, wheatmeal</td>
<td>R4661</td>
<td></td>
</tr>
<tr>
<td>BURGEN BARLEY &amp; SUNFLOWER 720G (HH)</td>
<td>600392023</td>
<td>FOLDFE OVERWRITE (BREAD)</td>
<td>LZ_A212</td>
<td></td>
</tr>
<tr>
<td>(HH)</td>
<td>600392023</td>
<td>FOLDFE OVERWRITE (BREAD)</td>
<td>LZ_A212</td>
<td></td>
</tr>
<tr>
<td>BURGEN MIXED GRAIN 720G (HH)</td>
<td>600391781</td>
<td>BREAD,MULTI-GRAIN,BURGEN</td>
<td>A1020</td>
<td></td>
</tr>
<tr>
<td>BURGEN MIXED GRAIN TOAST 700G (HH)</td>
<td>600391781</td>
<td>BREAD,MULTI-GRAIN,BURGEN</td>
<td>A1020</td>
<td></td>
</tr>
<tr>
<td>BURGEN OATBRAN &amp; HONEY 720G (HH)</td>
<td>500000341</td>
<td>Bread, multigrain medium with seeds</td>
<td>R4854</td>
<td></td>
</tr>
<tr>
<td>BURGEN ORIGINAL FRUIT 700G (HH)</td>
<td>800003449</td>
<td>BREAD,CURRANT,SLICED,PREPACKED</td>
<td>A206</td>
<td></td>
</tr>
<tr>
<td>BURGEN SWISS RYE LOAF 720G (HH)</td>
<td>800003447</td>
<td>BREAD,WHEAT/RYE,SLICED &amp; UNSLICED</td>
<td>A47</td>
<td></td>
</tr>
<tr>
<td>(</td>
<td>800003392</td>
<td>BREAD,WHOLEMEAL,SLICED &amp; UNSLICED</td>
<td>A23</td>
<td></td>
</tr>
<tr>
<td>CONNONS WHOLEMEAL SLICED 750G (ML)</td>
<td>800000392</td>
<td>BREAD,WHOLEMEAL,SLICED &amp; UNSLICED</td>
<td>A23</td>
<td></td>
</tr>
<tr>
<td>COUNTRY SPLIT SOFT RYE</td>
<td>500000353</td>
<td>Bread, rye, with seeds</td>
<td>R5096</td>
<td></td>
</tr>
<tr>
<td>SANDWICH</td>
<td>800000392</td>
<td>BREAD,WHOLEMEAL,SLICED &amp; UNSLICED</td>
<td>A23</td>
<td></td>
</tr>
<tr>
<td>'SOUTHERN PLAINS'</td>
<td>600391262</td>
<td>BREAD,WHITE,SLICED, PREPACKED</td>
<td>A1007</td>
<td></td>
</tr>
<tr>
<td>SLICE</td>
<td>500000313</td>
<td>Bread, multi-grain light</td>
<td>R4659</td>
<td></td>
</tr>
<tr>
<td>COUPLANDS DAILY GRAIN 600G</td>
<td>500000313</td>
<td>Bread, multi-grain light</td>
<td>R4659</td>
<td></td>
</tr>
</tbody>
</table>
Default foods BLISS study

**Default food items: to be used when insufficient food information is provided to determine exact food code OR when no exact match is present in FoodWorks but a closely related food is available**

<table>
<thead>
<tr>
<th>Unspecified/unmatched food item</th>
<th>Comments about FOODfiles food choice match</th>
<th>FOODfiles food description</th>
<th>Record ID</th>
<th>Portion size info (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almond butter</td>
<td></td>
<td>Peanut butter, smth &amp; crh, no sug salt add</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Almond milk - not specified sweetend or sweetened</td>
<td>New foods will be added for SunDial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal biscuits</td>
<td></td>
<td>Biscuit, semi-sweet</td>
<td></td>
<td>A10</td>
</tr>
<tr>
<td>Select - Honey Teddy bears</td>
<td></td>
<td>Apple, flesh, fresh</td>
<td></td>
<td>L212</td>
</tr>
<tr>
<td>Apple (type unspecified - flesh and NO skin)</td>
<td>i.e. use for peeled apples</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apple (type unspecified - flesh and skin)</td>
<td>i.e. use for unpeeled apples</td>
<td></td>
<td></td>
<td>L1014</td>
</tr>
<tr>
<td>baked beans - wight watchers</td>
<td></td>
<td>Baked beans, canned, in tomato sauce</td>
<td></td>
<td></td>
</tr>
<tr>
<td>barkers raspberry jam</td>
<td></td>
<td>Jam, berry frt, asst berries, premium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef - roast</td>
<td>combination of fat and no fat</td>
<td>Roast beef (cut unspecified) for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef (panfried/grilled) - type unspecified</td>
<td></td>
<td>Beef, steak, rump, fat trimmed, pan fried/stir fried/sautéed, with oil - peanut, olive, canola, rice bran (monounstaturated)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef (stewed etc) - type unspecified</td>
<td></td>
<td>Beef, steak, stewing cuts, fat trimmed, stewed/boiled/simmered/poach, with no fat</td>
<td></td>
<td>R1890</td>
</tr>
</tbody>
</table>
Default foods SWIFT study

**Default food items: to be used when insufficient food information is provided to determine exact food code OR when no exact match is present in FoodWorks but a closely related food is available**

<table>
<thead>
<tr>
<th>Unspecified/unmatched food item</th>
<th>Comments about FOODfiles food choice match</th>
<th>FOODfiles food description</th>
<th>Record ID</th>
<th>Portion size info (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almond ground, slices, dry roasted</td>
<td></td>
<td>Almonds raw</td>
<td>Q1</td>
<td></td>
</tr>
<tr>
<td>Almond slivered</td>
<td></td>
<td>Almonds,dried,blanched</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMARANTH</td>
<td></td>
<td>Oats,rolled,raw</td>
<td>Q45</td>
<td></td>
</tr>
<tr>
<td>Animal biscuits</td>
<td></td>
<td></td>
<td>E25</td>
<td></td>
</tr>
<tr>
<td>Select - Honey Teddy bears</td>
<td></td>
<td>Biscuit,semi-sweet</td>
<td>A10</td>
<td></td>
</tr>
<tr>
<td>Apple (type unspecified - flesh and NO skin)</td>
<td>i.e. use for peeled apples</td>
<td>Apple,flesh,fresh</td>
<td>L212</td>
<td></td>
</tr>
<tr>
<td>Apple (type unspecified - flesh and skin)</td>
<td>i.e. use for unpeeled apples</td>
<td>Apple,assorted variety,flesh&amp;skin,fresh</td>
<td>L1014</td>
<td></td>
</tr>
<tr>
<td>Artichoke heart marinated</td>
<td></td>
<td>Artichoke,jerusalem,flesh,boiled,d</td>
<td>X3</td>
<td></td>
</tr>
<tr>
<td>Asian Home gourmet indian</td>
<td></td>
<td>Curry paste eg rogan josh,butter chicken paste</td>
<td>R1240</td>
<td></td>
</tr>
<tr>
<td>butter chicken spice paste</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX G. DATA CLEANING PROCESS
Data cleaning process.

1. Check the diet recall hard copy with the data entry in FW, checked 100% of records
   • check that all entries are completed
   • check for entry of water
   • check for milk entry as Liz wanted 'composite milk' to be entered unless a brand is specified
   • check on butter, PB default is added
   • check on the quality of foods entered in FW other than 'pear shape' - crosscheck with Kaiculator
   • check for grams/ml/tsp/tbsp conversions and entries
   • Check on recipes/ some weren’t mentioned in the recall sheet - most recipes didn’t have moisture factor
   • 1 cup of cornflakes is 30g not 250g, pop corn 1 cup, coffee instant powder 1 tsp not 90g, etc
   • check on cooked and uncooked food entry
   • Make logical recipes as some diet recalls had no amounts mentioned
   • Note down all the bread, cereal and milk entered for fortification

2. Dept HN support staff rechecked 10% of the entries with PhD candidates and tried to get a best match for some of the foods as staff had a better understanding about the FW database/NZ food
   • For this 10% recipes were rechecked

3. Sort the foods based on energy, carbohydrate, protein and fats and check the top and bottom 10% outliers followed up by correction