A web-based dietary assessment method for exploring iron bioavailability: developing a food list and pretesting

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Abstract

Iron deficiency is the most common nutrient disorder worldwide. To assess intake in a population, food frequency questionnaires (FFQs) are commonly used as a low-burden, cost-effective method of dietary assessment. However, most FFQs measure intake by day, and do not account for nutrient or food component interactions when eaten as a meal. This is important for non-haem iron which has absorption modifiers (e.g., vitamin C and phytate) that affect its bioavailability. The Web–Meal-Based Intake Assessment Tool (Web–MBIAT) assesses iron intake by meal, potentially allowing for these interactions to be taken into account.

The first aim of this study was to generate a food list for the Web–MBIAT program that estimates the intake of iron and its absorption modifiers in premenopausal adult women (aged 19-50y) living in New Zealand. The second aim was to assess the usability of the Web–MBIAT program from the perspective of the interviewer.

FOODfiles 2010 version 2.0 and literature on the phytate content of foods were used to generate two food lists. Cut-offs were set using the literature or observing a natural break in the nutrient content of foods in FOODfiles. Cut-offs for the ‘main’ food list were: iron (≥2mg/100g); vitamin C (≥7mg/100g, except ≥10mg/100g for non-alcoholic beverages); meat, fish and poultry (≥30g/100g); and phytate (≥50mg/100g). The Adult Nutrition Survey 2008/09 was used to identify food groups that contributed ≥4% to iron and ≥10% to vitamin C intake in the target population. Reasons for exclusion such as ‘similar item already in food
list’, were developed to limit the food list length. Cut-offs for the ‘short’ food list were: iron (≥8mg/100g), vitamin C (≥80mg/100g) and phytate (≥750mg/100g).

Staff (who were Dietitians or Nutritionists) and graduate students were recruited by email from the Department of Human Nutrition, University of Otago, as interviewers to pretest the Web–MBIAT and user’s manual. Interviewers conducted the FFQ with a standardized diet and were timed. Interviewers’ characteristics and audio recordings of their feedback were gathered, and a list of issues and suggestions were categorized for analysis.

The main iron food list contained 420 items, (16% of the total number of foods in FOODfiles). The most common reason for inclusion and was meeting a specific food component cut-off (97% of inclusions). The most common reason for exclusion was a ‘similar food item already in food list’ (47% of exclusions). The short food list contained 24 items.

A total of 10 interviewers were recruited. In pretesting, most interviewers were positive about the Web–MBIAT program and user’s manual. However, the main issues identified by both groups concerned the Web–MBIAT’s ‘logic and navigation’ — particularly searching food items — and the lack of colour in the user’s manual. Proposed modifications include removing case-sensitive searching of food items, assessing supplement use, and having more prompts to guide the interviewer. The next step is to modify and validate the Web–MBIAT (against weighed diet records), before future use.

**Key words:** Web–MBIAT, Web–Meal Based Intake Assessment Tool, Food frequency questionnaire, iron, pretesting
Preface

Earlier versions of the Meal-Based Intake Assessment Tool (MBIAT) were published in 2000 and 2005 (Heath et al., 2005; Heath et al., 2000). This study assesses the usability of the web-based version (Web–MBIAT), programmed by Charlie Blakey in 2012. The project was conceived, designed and supervised by Dr Anne-Louise Heath from the Department of Human Nutrition, University of Otago. The data used to create the iron food lists was from FOODfiles 2010 version 2.0, generated by the New Zealand Institute for Plant & Food Research Limited. Data for grams of meat, fish and poultry in foods from FOODfiles were obtained from Ashleigh Barris’ Masters of Dietetics project completed in 2012 (Barris, 2013).

As part of this thesis, the candidate:

- Gained Category B ethical approval from the Head of Department of the Department of Human Nutrition
- Created the main and short iron food lists. These were later combined with respective food lists that assessed zinc intake that were created by Catherine Luey, another Masters of Dietetics candidate. The combined main and short food lists were used in the pretesting phase of this project
- Carried out the descriptive statistical analysis of the main iron food list
- In collaboration with Catherine Luey, developed a user’s manual for the Web–MBIAT program
- Developed recruitment and interview protocols
- Developed questions to collect interviewers’ characteristics and feedback on the usability of the Web–MBIAT and user’s manual
• Recruited 10 interviewers from the Department of Human Nutrition, University of Otago, New Zealand

• Pretested the Web–MBIAT program and user’s manual with the interviewers

• Transcribed audio recordings of interviewers’ feedback

• Proposed several modifications to improve the usability of the Web–MBIAT and user’s manual.
Acknowledgements

I would like to thank many people for their help and support during my thesis project.

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Thank you to Charlie Blakey for your expertise, patience and support with the Web–MBIAT program. I deeply appreciate your prompt effort to fix program issues as I discovered them. Thank you to Liz Fleming and Ashleigh Barris for your advice and support with FOODfiles, phytate data and Kai-culator. Also, thank you to the interviewers who took part in the study, my thesis would not be complete without your feedback.

A special thank you to my dear parents Hassan and Azhar for your continuing support and encouragement, and the many Skype sessions to keep me motivated during difficult times. Your own struggles with completing a Masters and PhD degree inspired me to persevere to my own finish line. I will forever be indebted to you, and I hope that I have made you proud. Also, a special thank you to my brothers and sister-in-law for your tough-love, advice and motivation; often forced upon me in humorous ways.
Also, many thanks to Jannie and the girls in the office; you gave me wonderful support and entertainment during times of stress or lulls in the thesis process. I will miss you all during the next phase of our Masters degree and I wish you the very best with your dietetic careers.

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1 Introduction

According to the World Health Organization (WHO), iron deficiency is the most common nutrient disorder in the world (World Health Organization, 2013). It is not confined to poverty-stricken populations, with a surprisingly high prevalence in both developing and developed countries; and New Zealand is no exception (University of Otago & Ministry of Health, 2011a). Among those most vulnerable to iron deficiency are females of child-bearing age (MacPhail, 2007; Ministry of Health, 2003). In fact, the Adult Nutrition Survey (ANS) 2008/09 reported that 6.4% and 18.4% of women aged 19-31y and 31-50y, respectively, were iron deficient (University of Otago & Ministry of Health, 2011a). This is considered to be a result of two factors: having higher iron requirements from iron loss during menstruation and pregnancy; and having inadequate iron intake from the diet (MacPhail, 2007; University of Otago & Ministry of Health, 2011a). Therefore, measuring dietary iron intake is essential to understanding the reasons for deficiency in this population.

Food frequency questionnaires (FFQs) are commonly used dietary assessment tools. They measure usual intake; can rank individuals into low, medium or high intakes; are cheap, and have lower respondent burden than other methods (Gibson, 2005; Heath et al., 2005; Heath et al., 2000). However, the majority of FFQs estimate nutrient intake by day, and not by meal (Heath et al., 2000). They do not consider the interactions with other nutrients or food components, typical of a complex meal, that may affect a nutrient’s bioavailability (Reddy et al., 2000). This is particularly important for iron because the non-haem portion of iron intake is subject to influences from a range of nutrients and food components. Enhancers of non-haem iron absorption, such as vitamin C, and ‘meat, fish, and poultry’, must be factored in
when assessing dietary iron; as must its absorption inhibitors, such as phytate, and polyphenols from tea and coffee (Hurrell & Egli, 2010; Reddy et al., 2000). The Web–MBIAT (Web–Meal-Based Intake Assessment Tool) program is a dietary assessment tool designed to overcome this limitation. It is a hybrid between an FFQ and a diet history¹, and it asks respondents to describe their food intake by meal, rather than by day (Heath et al., 2005; Heath et al., 2000). Moreover, it operates with a food list that allows respondents to list ingredients for a recipe or mixed dish, so foods eaten can be captured more accurately (Heath et al., 2005). In addition to this, the Web–MBIAT is web-based for easy access and interviewer-administered. Therefore it can be administered with a wider range of populations, including those with limited literacy and numeracy skills (Heath et al., 2005).

However, the Web–MBIAT is a novel approach and accurate estimation of nutrient intake depends on minimizing errors originating from the tool itself, and from the interviewer (Gibson, 2005). This is the premise of the current study. The most recent version of the MBIAT was published in 2005 and validated with men in the United Kingdom (Heath et al., 2005). An earlier version was validated with New Zealand premenopausal adult women (i.e., the target population), however, this was in the late 1990s (Heath et al., 2000). Since then, ANS and food composition data have been updated, so it is important to use these new data to create a contemporary iron food list that is more relevant to the target population. Also, assessing the program’s usability with interviewers will potentially identify issues that may cause interviewer error.

¹ For simplicity, for the remainder of this thesis, the Web–MBIAT will be referred to as an FFQ, although it also has similarities to a diet history.
2 Literature review

2.1 Literature review methods

Figure 1 describes the search strategy used to find articles relevant to the three main topics of this literature review: food frequency questionnaires (FFQs), iron bioavailability, and pretesting methods. Multiple electronic databases were searched: Ovid MEDLINE(R) (1946 to 2012 September 10), Food Science and Technology Abstracts (1969 to 2012 September Week 1) and Web of Science (1900-2012). The University of Otago library catalogue was also used to identify relevant books. Finally, articles suggested by the candidate’s supervisor were reviewed, and reference lists of relevant articles were used to search for more publications.

It was difficult to develop inclusion and exclusion criteria for the literature search because the subjects of interest differed greatly (i.e., iron bioavailability versus pretesting methods). Initially, however, articles identified as potentially relevant were dismissed if their titles or abstracts showed: they were not relevant, they were published earlier than 1999 (unless they were a landmark paper or cited by more recent articles (e.g., a 1985 paper by Willet et al.)), they provided little detail, or if they were about a study population that differed greatly from New Zealand (e.g., Western China).
<table>
<thead>
<tr>
<th>Food frequency questionnaires</th>
<th>Iron bioavailability</th>
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<td>11. (1) AND (6)</td>
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</table>

1. All searches were limited to ‘English Language’, ‘Full Text’ and ‘Humans’

**Figure 1** Search strategy of keywords and Medical Subject Heading (MeSH) terms used to find articles and reviews relevant to food frequency questionnaires, iron bioavailability and pretesting methods
2.2 Food frequency questionnaire as a method of dietary assessment

Food frequency questionnaires are a useful tool for assessing usual dietary intake in groups and populations, and are widely used in research. They are low cost, easy to administer and have low respondent burden (Gibson, 2005). However, they are not without their limitations, including their reliance on respondent memory for foods and quantities consumed in the past (Cade et al., 2002). Currently, there are many methods used to design and develop FFQs which accounts for the wide variety that exist to date (Molag et al., 2007). In light of this variation, several review articles have provided a users’ guide to developing FFQs and have made comparisons between design and development methods based on the purpose and setting of a study (Cade et al., 2002; Cade et al., 2004; McNutt et al., 2008).

2.2.1 Components of a food frequency questionnaire

The first component to consider is the food items of interest, which will largely depend on the purpose of the FFQ. Studies can choose to investigate the total diet, certain food groups or single nutrients (such as iron or calcium) in their target population. This will strongly influence the type and number of food items in the list (McNutt et al., 2008). Naturally, questionnaires assessing the total diet are likely to include more foods than those assessing single food groups or nutrients. However, when the bioavailability of a nutrient is dependent on the presence of certain food groups or nutrients (e.g., iron absorption is influenced by vitamin C, as discussed in section 2.3.2) then additional food items are required (Beck et al., 2012; Cade et al., 2002).
Portion-size is another important component to consider when designing or using FFQs. Originally, FFQs were designed to collect qualitative information; however, with the inclusion of portion-size, quantitative data can also be gathered to assess energy and nutrient intakes (Gibson, 2005). The use of questions on portion-size determines FFQ type; ‘non-quantitative’ or ‘quantitative’ refers to the omission or inclusion of portion-size questions, respectively. A ‘semi-quantitative’ FFQ refers to the use of standard portion-sizes that are specified with each food item, rather than the use of separate questions as with quantitative FFQs (McNutt et al., 2008). For the former, an example would be full fat cow’s milk specified as 1 cup in the food line. The respondent would then indicate the frequency of consuming 1 cup of milk (i.e., the portion-size directs the response). This means that a respondent who does not consume the exact portion specified may have difficulty defining their intake, thus increasing respondent burden. This difficulty highlights that the inclusion of portion-size estimates or questions does not guarantee more valid results (Molag et al., 2007).

The evidence regarding the usefulness of portion-size data is conflicting. One review suggests detailed portion-size data may not provide an accurate estimate of an individual’s intake largely because many foods (such as meat, fruit and vegetables) are consumed in mixed dishes and are therefore harder for individuals to quantify (Molag et al., 2007). In contrast, another review found higher correlation coefficients between the FFQ and reference method when individuals were able to self-report portion-sizes (as opposed to using semi-quantitative or non-quantitative FFQs) (Cade et al., 2004). One way to improve the estimation of portion-size (of whole meals rather than single ingredients in a meal) may
be to administer a quantitative FFQ with visual aids such as photographs of graduated portion-sizes, and measuring cups and spoons (Gibson, 2005; McNutt et al., 2008).

The time frame under investigation can influence the results (Cade et al., 2002). Longer time frames have been associated with larger errors because of problems with respondent memory (Gibson, 2005). Indeed, higher correlations between the FFQ and reference method were found when the time frame was limited to a few months, suggesting caution is needed when retrospective intakes over the past year are assessed (Cade et al., 2004).

It is also important to consider the range of frequency categories asked (e.g., per day/week/month/year). One review suggests 1 to 12 divisions of time should be used in assessing frequency. (Cade et al., 2002). This is in line with another FFQ review which found that the average number of frequency categories was 9 divisions of time (e.g., never or less than 1/month, 1-3/month, 1/week, 2-4/week, 5-6/week, 1/day, 2-3/day, 4-5/day, 6+/day) (Cade et al., 2004). Although most foods will be consumed on a daily or weekly basis, there is a need to include food items that are consumed rarely but may contribute significantly to intake of specific nutrients (e.g., liver if dietary iron is of interest) (Cade et al., 2002). Lastly, another important consideration is the seasonality of foods, especially certain fruits and vegetables such as berry or stone fruits (Horwath, 1993). Frequency categories, such as those listed above, may not accurately reflect the consumption of these seasonal foods. Therefore inclusion of a separate section assessing seasonal foods may be appropriate if characterization of these is important (Cade et al., 2002).
2.2.2 Development of the food list

A food list captures specific foods that are considered high in a nutrient of interest (Molag et al., 2010). There are a number of ways to develop a food list and the method chosen depends largely on the type of data researchers aim to gather. Of specific interest is whether the researchers want to assess absolute intakes of a population, or to rank individuals (Cade et al., 2002; Molag et al., 2010). The first method uses data from representative studies or national surveys to identify commonly eaten foods and portion sizes consumed by the target population. The second method utilizes food composition databases, particularly when single nutrients are the focus of an FFQ (Molag et al., 2010). Often, both methods are used in combination to create a more accurate and effective FFQ (Beck et al., 2012). Of course, problems can arise with mixed dishes that have several ingredients and come in many varieties, such as pizza (McNutt et al., 2008). In the latter case, researchers may have to assume a general recipe or list of ingredients to include in the food list, but this is a limitation that will certainly affect results. Other considerations must also be made independent of which foods to include. The order of food items listed in an FFQ and the food groups they are gathered in can have a cognitive effect on the respondent’s response (Cade et al., 2002). One review suggests that food groups of particular interest (such as red meat for haem iron content) should be placed near the beginning of an FFQ, but not at the start as respondents are likely to make mistakes on the initial questions and to tire later in the questionnaire (Cade et al., 2002).

It is important to explore the development of food composition databases as they vary greatly in quality (Gibson, 2005). Gibson (2005) outlines several methods for developing food composition databases including direct chemical analysis and using data from other sources
The former is often preferred, despite its expense, because food composition data from other sources may not be representative of the target population’s food consumption. For example, cultural differences in food intake and geographic differences in soil nutrient content will influence the accuracy and suitability of the food list, and therefore the FFQ (Gibson, 2005). In fact, the latter also holds true for direct chemical analysis as differences in soil nutrients may also be found within close proximity, therefore scientists must take several food samples across a region to determine an average nutrient content (Gibson, 2005). Systematic errors can arise in sampling and chemical analyses, and random error if methods are imprecise or different methods are used for a nutrient (Gibson, 2005). Therefore, the consistent use of a precise and accurate method is essential to standardize results (Gibson, 2005). Additionally, nutrient content values reflect the amount found in a food rather than that absorbed by the body; a limitation that has serious implications for the dietary assessment of nutrients such as iron (Gibson, 2005).

It should be noted that both food composition databases and food lists of FFQs should be updated regularly to account for new or reformulated foods and products, as these may contribute a significant proportion of a target population’s food or nutrient intake (Gibson, 2005; Molag et al., 2010). Lastly, with any method chosen, it is imperative to pilot or pretest the FFQ — and therefore the food list — on a sample of the target population to assess its ability to collect the desired information (McNutt et al., 2008) (this will be discussed further in section 2.4).
2.2.3 Iron food frequency questionnaire

To date, only a small number of FFQs have focused specifically on dietary iron (Beck et al., 2012; Heath et al., 2005; Heath et al., 2000; Matthys et al., 2004; Williams & Innis, 2005), with the remainder assessing the total diet (Palmer & Morgan, 2012). Of the iron FFQs that were found (Table 2.1), notably from validation studies, comparisons of the results are difficult to make because the study populations differ greatly (i.e., infants (Williams & Innis, 2005) versus premenopausal women (Beck et al., 2012; Heath et al., 2000; Matthys et al., 2004) or middle-aged men (Heath et al., 2005)). Moreover, studies differed in what they were assessing, with one study investigating iron-related dietary patterns (Beck et al., 2012), and the remainder investigating individual food components or nutrients. Therefore comparisons of FFQ design and development will only be made with similar iron FFQs (Table 2.2) (Heath et al., 2005; Heath et al., 2000; Matthys et al., 2004). Indeed the latter two published iron FFQs were variations of the first; which is described as a cross between an FFQ and diet history (Matthys et al., 2004).

The adjusted correlation coefficients (Table 2.1) show that the MBIAT (Meal-Based Intake Assessment Tool) (Heath et al., 2005) performed better in estimating iron (0.76), vitamin C (0.63) and phytate (0.78) intake than the IIAT (Iron Intake Assessment Tool) (Matthys et al., 2004) and New Zealand counterpart (Heath et al., 2000). However, it performed the worst with estimating calcium intake (0.32). Although, it should be mentioned that the reference method used may have affected the correlations — particularly with the IIAT — which used an estimated diet record rather than a weighed diet record. This is an important distinction because the latter (used by the MBIAT and New Zealand version) is considered the gold
<table>
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<td>Caucasian and Chinese infants (8-26 mo)</td>
<td>148</td>
<td>n/a</td>
<td>3-day food record</td>
<td>Iron 0.77</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calcium 0.75</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vitamin C 0.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dietary fibre 0.66</td>
</tr>
<tr>
<td>Beck et al., 2012</td>
<td>New Zealand women (18-44y)</td>
<td>115</td>
<td>n/a</td>
<td>4-day weighed diet record</td>
<td>Dietary Patterns:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>“healthy” 0.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>“sandwich and drinks” 0.62</td>
</tr>
</tbody>
</table>
standard tool for dietary assessment (Cade et al., 2002). Therefore, the true correlations for the IIAT, particularly for estimating calcium intake, could be lower.

Another distinct difference is the method of administration. The MBIAT was interviewer-administered and participants therefore had lower-respondent burden, especially when estimating portion-size. Participants also had three-dimensional food models to assist with this (Heath et al., 2005). In comparison, the IIAT and New Zealand version were self-administered and took participants 60 minutes and 45-90 minutes, respectively, to complete (Heath et al., 2000; Matthys et al., 2004). Although there is little information to determine whether this is an appropriate time to complete an FFQ, it should be noted that unlike the New Zealand version, the IIAT did not use three-dimensional food models to assist participants (Matthys et al., 2004). Rather, they were given an explanation of how to estimate portion-size in an audiovisual introduction prior to completing the FFQ (Matthys et al., 2004). This may have increased the burden on participants and, in turn, affected the correlations reported by the authors.

Finally, all three FFQs used population-specific data and contemporary food composition databases to compile their food lists; the longest (630 items) used by the MBIAT (Table 2.2). However, they differed in the food components they assessed, with the IIAT notably excluding phytate as a food component of interest. This is a limitation because phytate is a known inhibitor of non-haem iron absorption (Gibson, 2005; Hurrell & Egli, 2010) and may significantly affect the estimated iron intake of the population. Another aspect not assessed by all three iron FFQs is supplement use in their target populations. This is an important
<table>
<thead>
<tr>
<th>FFQ characteristics</th>
<th>(Heath et al., 2000)</th>
<th>(Matthys et al., 2004)</th>
<th>(Heath et al., 2005)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study population</strong></td>
<td>New Zealand women (19-31y)</td>
<td>Belgian women (18-39y)</td>
<td>United Kingdom men (40+y)</td>
</tr>
<tr>
<td><strong>Method of administration</strong></td>
<td>Self-administered</td>
<td>Self-administered</td>
<td>Interviewer-administered</td>
</tr>
<tr>
<td><strong>Food components investigated</strong></td>
<td>Total iron</td>
<td>Iron</td>
<td>Total iron</td>
</tr>
<tr>
<td></td>
<td>Haem Iron</td>
<td>Calcium</td>
<td>Haem iron</td>
</tr>
<tr>
<td></td>
<td>Non-haem iron</td>
<td>Vitamin C</td>
<td>Non-haem iron</td>
</tr>
<tr>
<td></td>
<td>Meat iron</td>
<td></td>
<td>Meat iron</td>
</tr>
<tr>
<td></td>
<td>Vitamin C</td>
<td></td>
<td>Total zinc</td>
</tr>
<tr>
<td></td>
<td>Phytate</td>
<td></td>
<td>Phytate</td>
</tr>
<tr>
<td></td>
<td>Calcium</td>
<td></td>
<td>Vitamin C</td>
</tr>
<tr>
<td></td>
<td>Grams of meat/fish/poultry</td>
<td></td>
<td>Calcium</td>
</tr>
<tr>
<td></td>
<td>Tea and coffee</td>
<td></td>
<td>Grams of meat/fish/poultry</td>
</tr>
<tr>
<td></td>
<td>Black tea equivalents</td>
<td></td>
<td>Black tea equivalents</td>
</tr>
<tr>
<td><strong>Food list</strong></td>
<td>Length (n=) 206</td>
<td>209</td>
<td>630</td>
</tr>
<tr>
<td></td>
<td>Number of food groups (n=)</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Checklist length (n=)</td>
<td>80</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>Supplements included?</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Assistance estimating portion-size:</strong></td>
<td>Three-dimensional food models</td>
<td>Instructions given in audiovisual introduction</td>
<td>Three-dimensional food models</td>
</tr>
</tbody>
</table>
omitio made by the authors as supplement use can greatly affect the nutrient intake of a population (Lynch, 2011).

2.3 Food components of relevance to iron nutrition

2.3.1 Total, haem and non-haem iron

Like many micronutrients, intake of dietary iron does not equate to the amount absorbed by the body. For iron, this is in part because the different forms found in food: haem and non-haem iron, are not fully absorbed (Gibson, 2005). Table 2.3 lists the total iron content of selected foods. While the predominant form of dietary iron is non-haem, which is found in plant-based foods such as cereals, legumes and vegetables as well as meat, haem iron is only found in animal foods such as red meat, poultry and fish (Cade et al., 2005). Several original studies have made the assumption that 40% of total iron in animal meat is haem iron, with the remainder being non-haem (Gibson, 2005; Monsen et al., 1978). However, this assumption is a limitation as other studies have proven that different cuts of meat, even from the same animal, have varying levels of haem iron (Valenzuela et al., 2009).

It is well established that haem iron is more bioavailable than non-haem iron. Some studies have assumed 25% of haem iron in the diet is absorbed while other studies have quoted an estimated range of 15-35% (Gibson, 2005; Hurrell & Egli, 2010). In contrast, non-haem iron is believed to be far less well absorbed (approximately 1-15% (Hunt, 2003)), as it is subject to influences from other food components that either enhance or inhibit its absorption (Gibson, 2005).
Table 2.3 Iron content of selected foods (New Zealand Institute for Crop & Food Research, 2010)

<table>
<thead>
<tr>
<th>Food groups</th>
<th>Foods</th>
<th>Iron content (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breads and cereals</td>
<td>sanitarium weet-bix</td>
<td>8.4</td>
</tr>
<tr>
<td></td>
<td>wholegrain bread</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>white bread</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>spaghetti, boiled</td>
<td>0.25</td>
</tr>
<tr>
<td>Fruit</td>
<td>dried apricots</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>apple</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>banana</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>orange</td>
<td>0.13</td>
</tr>
<tr>
<td>Vegetables</td>
<td>spinach, boiled</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>peas, boiled</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>potato, boiled</td>
<td>0.33</td>
</tr>
<tr>
<td>Meat and poultry</td>
<td>lamb liver, fried</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>beef, cooked</td>
<td>3.67</td>
</tr>
<tr>
<td></td>
<td>chicken, cooked</td>
<td>1.02</td>
</tr>
<tr>
<td>Seafood</td>
<td>mussels, steamed</td>
<td>10.93</td>
</tr>
<tr>
<td></td>
<td>oysters, canned</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>sardines, canned</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>tuna, canned</td>
<td>1.54</td>
</tr>
<tr>
<td>Legumes</td>
<td>split lentils, boiled</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>red kidney beans, boiled</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>chickpeas, boiled</td>
<td>1.8</td>
</tr>
<tr>
<td>Eggs and dairy</td>
<td>egg, fried</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>butter</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>milk</td>
<td>0</td>
</tr>
<tr>
<td>Nuts and seeds</td>
<td>pumpkin seeds, roasted</td>
<td>14.9</td>
</tr>
<tr>
<td></td>
<td>sesame seeds, roasted</td>
<td>7.78</td>
</tr>
<tr>
<td></td>
<td>almonds, raw</td>
<td>4.2</td>
</tr>
<tr>
<td>Fats and oils</td>
<td>olive oil</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>margarine (mono and polyunsaturated)</td>
<td>0.05</td>
</tr>
</tbody>
</table>
2.3.2 Enhancers of non-haem iron absorption

The ability of ascorbic acid (vitamin C) to enhance non-haem iron absorption has been thoroughly researched with convincing evidence of a dose-dependent relationship in single-meal studies (Hurrell & Egli, 2010). This type of study is when a single meal rather than a whole diet (meals over several days) is labeled with iron radioisotopes and analyzed for iron bioavailability (Reddy et al., 2000). Ascorbic acid’s method of action is to reduce non-haem iron to the absorbed form (i.e. ferric to ferrous iron) for the body to utilize (Hallberg & Hulthén, 2000). Moreover, it has been found that ascorbic acid can override the negative effects of other known inhibitors such as polyphenols and phytate; a finding that reinforces the importance of including ascorbic acid sources in the diet (Hurrell & Egli, 2010). This is particularly true for vegetarian or vegan diets that do not have exposure to other enhancers of non-haem iron such as animal tissue from meat, fish or poultry (Hurrell & Egli, 2010).

Indeed, animal tissue has been found to enhance non-haem iron absorption more than ascorbic acid in a complex-meal study by Reddy et al (2000). This type of study is when meals containing multiple enhancers and inhibitors of iron absorption are labeled with radioisotopes for iron bioavailability analysis (Reddy et al., 2000). However the authors have suggested this finding could be due to test meals containing large amounts of animal tissue which may have masked the full influence of ascorbic acid (Reddy et al., 2000). This highlights the importance of complex-meal studies when investigating non-haem iron absorption, as single-food studies do not consider possible interactions with other enhancers or inhibitors in the diet (Gibson, 2005; Reddy et al., 2000).
It is not clear what the properties of animal tissue are that make it such an important enhancer of non-haem iron absorption. As Hurrell and Egli (2010) suggest, the majority of evidence indicates that the muscle protein fraction of animal tissue could be at play, while other evidence suggests the answer may lie specifically with cysteine-containing peptides. Despite this uncertainty, it is clear that animal sources such as egg albumin do not exhibit the same enhancing effects as animal tissue; with the latter shown to enhance non-haem iron absorption 2-3 times, and the former showing no effect (Björn-Rasmussen & Hallberg, 1979).

Finally, other food components have been observed to enhance non-haem iron absorption including alcohol, vitamin A and β-carotene; however more research is needed to support or contradict the few studies that exist to date (García-Casal et al., 1998; Hallberg & Hulthén, 2000).

### 2.3.3 Inhibitors of non-haem iron absorption

Phytate or phytic acid (myo-inositol hexakisphosphate (IP6)) is found in plant-based foods such as unrefined legumes and grains. It is a well-known inhibitor of non-haem iron absorption (Gibson, 2005), and operates by binding minerals (such as iron) to form complexes that cannot be absorbed by the body (Bohn et al., 2008). Table 2.4 lists the phytate content of selected foods. Phytate is difficult to analyze because it can be hydrolyzed — by acids, bases or enzymes — to lower inositol phosphates (e.g., tri-, tetra-, and pentaphosphates (IP3, IP4, and IP5, respectively) (Sandberg et al., 1999)); and these can have similar chemical (Harland et al., 2004), but not necessarily physiological (Bohn et al., 2008), properties. There are different methods to determine the phytate content of foods, however, earlier methods (e.g., anion-exchange analytical method) are less specific and...
<table>
<thead>
<tr>
<th>Food groups</th>
<th>Foods</th>
<th>Phytate content (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breads and cereals</td>
<td>bread, American rye</td>
<td>942</td>
</tr>
<tr>
<td></td>
<td>bread, whole wheat</td>
<td>390</td>
</tr>
<tr>
<td></td>
<td>oatmeal or rolled oats, cooked</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>wheat cereal, Raisin Bran (Kellogg’s)</td>
<td>695</td>
</tr>
<tr>
<td>Fruit and vegetables</td>
<td>apple, not pared</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>carrot, raw</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>potato, boiled in skin, pared</td>
<td>80</td>
</tr>
<tr>
<td>Legumes</td>
<td>chickpeas, dry, boiled, drained</td>
<td>207</td>
</tr>
<tr>
<td></td>
<td>kidney beans, canned, drained (Super Giant)</td>
<td>289</td>
</tr>
<tr>
<td></td>
<td>navy beans, boiled, drained</td>
<td>345</td>
</tr>
<tr>
<td>Nuts and seeds</td>
<td>almonds</td>
<td>970-2111</td>
</tr>
<tr>
<td></td>
<td>brazil nuts</td>
<td>1320-1799</td>
</tr>
<tr>
<td></td>
<td>peanuts, roasted</td>
<td>680-2008</td>
</tr>
<tr>
<td></td>
<td>walnuts</td>
<td>580-1977</td>
</tr>
<tr>
<td>Snacks</td>
<td>potato chips</td>
<td>147</td>
</tr>
<tr>
<td></td>
<td>popcorn, plain (Orville Redenbacher’s)</td>
<td>39</td>
</tr>
</tbody>
</table>

1. Some food groups such as meat, poultry and seafood have been omitted as these do not contain any phytate (Oberleas & Harland, 1981)  
2. (Oberleas & Harland, 1981)  
3. (Harland et al., 2004)  
4. (Amirabdollahian & Ash, 2010)
accurate than the more recent high performance liquid chromatography method (Harland et al., 2004).

Many single-meal studies have found that even small amounts of phytate can inhibit non-haem iron absorption (Hurrell & Egli, 2010; Hurrell et al., 1992). However, as discussed previously, single-meal studies have a limited ability to account for the influences of other inhibitors or enhancers in whole diets (Gibson, 2005). In their algorithm, Reddy et al. (2000), propose that in a mixed meal containing both phytate and ascorbic acid, the ascorbic acid can reduce the inhibitory effect of phytate on non-haem iron absorption. Moreover, they proposed that the greater the amount of phytate present in a meal, the greater the ability of ascorbic acid to act as an enhancer (Hallberg & Hulthén, 2000). Additionally, phytate loses some capacity for inhibition when processed (i.e., when foods are milled, heated, soaked and fermented) or subjected to degradation by phytase, indicating that it is a less potent inhibitor than once thought (Hurrell & Egli, 2010).

It should also be noted that, independent of other non-haem iron influencers, phytate’s degree of inhibition may not be dependent on the total amount contained in a meal. Indeed, Hallberg and Hulthén (2000) suggest that the number of phosphate groups attached to inositol, and not the moles of phytate, determines its inhibitory effect (Hallberg & Hulthén, 2000). This is supported by another study which investigated the effects of less-phosphorylated inositol phosphates on iron absorption in humans: IP3, IP4, and IP5 (Sandberg et al., 1999). Results of the study showed that pure fractions of IP5 had significantly less inhibition of iron absorption than IP6. Moreover, pure fractions of IP4 and IP3 showed no significant inhibition whatsoever (Sandberg et al., 1999). The authors do
suggest however, that in mixes of different inositol phosphates, IP3 and IP4 can interact with higher-phosphorylated inositol phosphates to increase mineral-binding capacity, and therefore inhibition of non-haem iron absorption (Sandberg et al., 1999).

Another well-known inhibitor of non-haem iron absorption is a group of compounds called polyphenols which are commonly found in plant-based foods and beverages such as legumes, cereals, tea and coffee (Hallberg & Hulthén, 2000; Hurrell et al., 1992). A cup of tea (~200ml) has been found to reduce non-haem iron absorption by about 70-80% when consumed with or shortly after a meal. The variation in this observed inhibitory effect may be caused by differences in brands of tea as well as steeping times, and is presumably a function of the varying amount of phenols present (Hallberg & Hulthén, 2000).

However, in a study by Reddy et al (2000), mixed-meal tests revealed polyphenols had no significant effect on non-haem iron absorption, suggesting that in the presence of other enhancers or inhibitors, polyphenols are far less potent than on their own (Reddy et al., 2000). However, Reddy et al (2000) acknowledge the limitation that several methods exist for assaying polyphenols (as they have many forms), and so inconsistencies between study assay methods make it difficult to compare results meaningfully (Reddy et al., 2000).

Another suggested inhibitor is calcium, but with far less convincing evidence. Despite observations that calcium doses between 75 and 300mg inhibited non-haem and haem iron absorption, mixed-meal studies have found no such effect, particularly in the presence of enhancers such as ascorbic acid (Hallberg et al., 1991; Hallberg & Hulthén, 2000; Reddy et al., 2000). More recently, animal proteins (i.e., milk and egg proteins) and soy have also been
suggested to inhibit non-haem iron absorption, however more research is needed to explore this (Hallberg & Hulthén, 2000; Hurrell & Egli, 2010).

2.4 Methods used for pretesting questionnaires

Pretesting is an essential step in the development of questionnaires. Pretesting should be undertaken in a sub-sample of the population group for whom the questionnaire has been developed, to ensure that appropriate improvements are made (Cade et al., 2002). For FFQs, these improvements can include clarification of food names and portion-sizes, and ensuring instructions are clear for respondents to understand (Cade et al., 2002).

In the past, validation studies have not reported their methods used for pretesting FFQs, and this has been highlighted as an area for improvement for future publications (Dennis et al., 2003; Subar et al., 1995). However, several studies have explored pretesting methods for survey questionnaires which may be applicable to FFQs. One such study lists three approaches used extensively for pretesting in qualitative research: cognitive interviewing, focus groups and consensus panels (Oremus et al., 2005). In cognitive interviewing (which involves a one-on-one interview), the concurrent method has the participant verbalize their thought process as they respond to a question. The retrospective method is undertaken after the survey is concluded and uses a series of probes (Oremus et al., 2005). While the cognitive interviewing approach can obtain useful information on questionnaire wording, format and understanding, it is however expensive and time-consuming to administer, and participants can limit how much they want to share (Oremus et al., 2005).
The final two approaches use participant groups to gather qualitative information and may provide more insight than one-on-one methods such as cognitive interviewing. Focus groups rely on interaction and dialogue between participants through the use of open-ended questions, whereas consensus panels are more structured and formal to limit group interaction. This is an important distinction between the two approaches because focus group discussions often digress greatly from the desired topic. (Oremus et al., 2005).

In recent decades, the introduction of computers has seen a change in how questionnaires are administered; and computer-assisted interviews have become increasingly common. These new modes of administration require adaptation of traditional pretesting methods, and must consider questionnaire format and design as well as software technicalities as areas for improvement (Presser et al., 2004). These areas should be explored from the perspective of the interviewer as well as the respondent. This is because computer-assisted interviews often include an interviewer who asks questions and completes the questionnaire as the respondent responds. This unique interaction between the respondent, interviewer and computer program is complex in nature and may be a source of many issues and biases, and must therefore be explored (Presser et al., 2004).
3 Objective statement

There is often a great cost in time and money involved in assessing dietary intakes, especially in a large sample size of a given population. Economic, efficient, and low burden methods of dietary assessment, such as food frequency questionnaires (FFQs), are often appropriate in these settings. However, the majority of current FFQs assess nutrient intakes by overall daily intake, rather than by meals. This means that nutrient intake will not necessarily reflect bioavailability, particularly for nutrients that are affected by other food components (e.g., non-haem iron absorption is influenced by vitamin C and phytate). This is a significant implication as nutrient bioavailability is often more important than total nutrient intake at the physiological level. This thesis will assess the usability of the Web–Meal-Based Intake Assessment Tool (Web–MBIAT) which estimates intake of dietary iron and key absorption modifiers by meal.

The aims of this project are (a) to generate a food list to measure dietary intake of iron and its main enhancers and inhibitors and (b) to pretest the Web–MBIAT to assess its usability from the perspective of the interviewer.

Objectives:

1) To generate a food list suitable for premenopausal adult New Zealand women (aged 19-50y) that will assess their dietary intake of iron and absorption modifiers (i.e., vitamin C; meat, fish, poultry; phytate; and polyphenols from tea and coffee).
2) To pretest the Web–MBIAT program with a sample of interviewers (n=10) from the Department of Human Nutrition, University of Otago, with the intent to explore its usability from the perspective of interviewers for the purpose of identifying issues and suggestions for improvement.
4 Participants and methods

4.1 Overview

Two iron food lists were developed — a main and a short food list — to be used in the Web–MBIAT (Web–Meal-Based Intake Assessment Tool) program. Both food lists were subject to inclusion and exclusion criteria. There was no hierarchy for these, and all were applied to each food item. This was so that if one criterion was changed, a food item could still be included or excluded on account of meeting other criteria for inclusion or exclusion. Once developed, the food lists were incorporated into the Web–MBIAT program. The program and a user’s manual were then pretested with interviewers to assess their usability.

4.2 Web–MBIAT program

The Web–MBIAT program is a nutrition assessment tool that is a hybrid between a food frequency questionnaire (FFQ) and a diet history. The program asks respondents to describe their usual intake in an average week in the past month using a main food list. A short food list is used at the end to prompt respondents of items they may have forgotten that can contribute an appreciable amount to a food component of interest. Information on meal type, amount and frequency is gathered, and is analysed for nutrient content immediately after completing the FFQ. The current version is web-based and interviewer-administered, and has been adapted from two pre-existing validated versions; the first validated with New Zealand premenopausal adult women (aged 19-31y) (Heath et al., 2000); the second validated with men in the United Kingdom (aged 40+y) (Heath et al., 2005). As the Web–MBIAT is a novel approach to dietary assessment and may be unfamiliar, Figure 2
<table>
<thead>
<tr>
<th>Key term</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meal occasion</td>
<td>The ‘time’ a meal is eaten</td>
<td>Breakfast, morning snack, lunch meal, afternoon snack, evening meal, evening snack</td>
</tr>
<tr>
<td>Overall meal frequency</td>
<td>How often a meal occasion is eaten in an average week, in the past month</td>
<td>If breakfast is eaten every day of the week, it would have a meal frequency of ‘7’ (Figure 3a)</td>
</tr>
<tr>
<td>Meal instance</td>
<td>What is eaten for a meal occasion</td>
<td>A respondent may eat weet-bix and milk for breakfast during the week (one meal instance), and eggs for breakfast in the weekend (another meal instance). Therefore the respondent is having 2 meal instances for breakfast in an average week (Figure 3b)</td>
</tr>
</tbody>
</table>

Figure 2 Web–MBIAT key terms (Heath et al., 2005)
explains key terms used in the program and Figure 3 displays screen shots depicting key terms.

4.3 Development and analysis of main food list

To compile foods that are high in the nutrients of interest, the candidate developed a food list using two sources: FOODfiles nutrition composition data for the iron and vitamin C content of foods (New Zealand Institute for Crop & Food Research, 2010); and the New Zealand Adult Nutrition Survey (ANS) 2008/09 data for food groups that had an appreciable contribution to the target population’s iron and vitamin C intake (University of Otago & Ministry of Health, 2011a). The phytate content of foods was gathered using literature, and this is further described in section 4.3.1.3. Data for grams of meat, fish and poultry (MFP) in foods from FOODfiles were obtained from a previous Masters of Dietetics project (Barris, 2013). The food list was reviewed by the candidate’s supervisor — for its content and justification for inclusion or exclusion of food items — several times during the development process.

4.3.1 Inclusion criteria

4.3.1.1 Iron

Food items chosen either contained at least 2mg iron/100g or were generic food items that contributed at least 4% of total iron intake for New Zealand females aged 19-50y (Table 4.1). The percent contribution of at least 4% was set because a natural break in the data was observed at that point (University of Otago & Ministry of Health, 2011a). The cut-off of 2mg iron/100g was set to include foods that are considered to be high in iron (i.e., red meat, chicken, fish, beans and lentils (Ministry of Health, 2003)).
1. This is the first window/question asked in the FFQ. Note ‘Breakfast’ has a meal frequency of ‘7’ for this respondent, as explained in Figure 2.

2. This is the second window in the FFQ. Note there are two meal instances for breakfast for this respondent; one for the week day, another for the weekend as explained in Figure 2.

Figure 3 Screen shots depicting Web–MBIAT key terms
4.3.1.2 Vitamin C

All food items chosen either contained at least (i) 7mg vitamin C/100g or (ii) 10mg vitamin C/100g for non-alcoholic drinks, or were generic food items that contributed at least 10% to dietary vitamin C for New Zealand females aged 19-50y (Table 4.2). The cut-off of 7mg vitamin C/100g was used to allow the inclusion of commonly eaten fruits and vegetables that are likely to contribute an appreciable amount to vitamin C intake in the target population (e.g., apples, which are consumed more per capita in New Zealand than other countries (Coriolis Research Limited., 2006)). The cut-off of 10mg vitamin C/100g for non-alcoholic beverages was used to allow the inclusion of some fruit juices that the candidate considered common in New Zealand (e.g., ‘Fresh-up’ juice, which is a New Zealand brand (Frucor Beverages Limited, 2013)). The percent contribution of at least 10% was set because a natural break in the data was observed at that point (University of Otago & Ministry of Health, 2011a).

4.3.1.3 Phytate

The current FOODfiles does not have phytate values for foods; therefore a search of the literature was used to obtain these. As a guide, 50mg of phytate per 100g of food was used as a cut-off where phytate values were provided. This was based on a study which showed that phytate inhibition of zinc absorption was dose-dependent – similar to inhibition of non-haem iron absorption – and was significant when a food contained 50mg or more per 100g (Fredlund et al., 2006).

Generally, foods high in phytate include wheat-containing foods (e.g., wheat bran and wheat germ), nuts (e.g., peanuts and almonds) and legumes (e.g., chickpeas and beans), therefore
Table 4.1 Food groups that contribute at least 4% to total dietary iron in New Zealand women aged 19-50y (percent(95% CI)) (University of Otago & Ministry of Health, 2011)

<table>
<thead>
<tr>
<th>Food groups</th>
<th>Females 19-30y</th>
<th>Females 31-50y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread</td>
<td>9.2(7.6-10.7)</td>
<td>11.2(10.0-12.5)</td>
</tr>
<tr>
<td>Grains and pasta</td>
<td>8.6(6.5-10.8)</td>
<td>6.6(5.3-7.8)</td>
</tr>
<tr>
<td>Breakfast cereals</td>
<td>7.9(5.8-10.0)</td>
<td>9.7(8.1-11.3)</td>
</tr>
<tr>
<td>Vegetables</td>
<td>7.6(5.8-9.5)</td>
<td>8.6(7.3-9.9)</td>
</tr>
<tr>
<td>Potatoes, kumara and taro</td>
<td>7.2(5.8-8.6)</td>
<td>5.7(4.8-6.6)</td>
</tr>
<tr>
<td>Non-alcoholic beverages</td>
<td>6.3(5.0-7.6)</td>
<td>6.4(5.3-7.5)</td>
</tr>
<tr>
<td>Bread-based dishes</td>
<td>5.8(4.1-7.5)</td>
<td>4.5(3.3-5.6)</td>
</tr>
<tr>
<td>Poultry</td>
<td>4.9(3.7-6.0)</td>
<td>4.0(3.2-4.8)</td>
</tr>
<tr>
<td>Beef and veal</td>
<td>4.1(2.4-5.8)</td>
<td>7.0(5.6-8.4)</td>
</tr>
<tr>
<td>Fruit</td>
<td>4.1(3.3-4.9)</td>
<td>5.1(4.3-5.8)</td>
</tr>
</tbody>
</table>
these were included in the final food list for phytate (Amirabdollahian & Ash, 2010; Oberleas & Harland, 1981). Where possible, generic foods were included to limit the length of the food list (e.g., ‘bread, multigrain’ was included to account for all brands of multigrain bread, e.g., Burgen or Tiptop). Animal sources such as meat contain no phytate (Oberleas & Harland, 1981), therefore these were not considered to be phytate sources in the final food list.

4.3.1.4 Meat, fish and poultry
Meat, fish and poultry were considered to be 100% meat. This meant that it was not necessary to differentiate between different cuts of meat, so generic composite cuts were used. Data for MFP content in foods from FOODfiles were gathered by Ashleigh Barris, a former University of Otago Masters of Dietetics student (Barris, 2013), and permission to use the data was given for the current study. For mixed dishes, 30g of MFP in a mixed dish was used as a cut-off. This was based on a study which proposed that a low availability meal for non-haem iron absorption contained less than 30g of MFP (Monsen et al., 1978).

4.3.1.5 Tea and coffee
Food items were also included to account for inhibition of non-haem iron absorption by polyphenols found in tea and coffee (Hallberg & Hulthén, 2000; Hurrell et al., 1992).
Table 4.2 Food groups that contribute at least 10% to dietary vitamin C in New Zealand women aged 19-50y (percent(95% CI)) (University of Otago & Ministry of Health, 2011)

<table>
<thead>
<tr>
<th>Food groups</th>
<th>Females 19-30y (percent(95% CI))</th>
<th>Females 31-50y (percent(95% CI))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>24.3(19.8-28.9)</td>
<td>29.5(26.3-32.6)</td>
</tr>
<tr>
<td>Fruit</td>
<td>20.5(16.6-24.4)</td>
<td>24.7(21.7-27.8)</td>
</tr>
<tr>
<td>Non-alcoholic beverages</td>
<td>20.5(15.7-25.2)</td>
<td>13.7(10.9-16.6)</td>
</tr>
<tr>
<td>Potatoes, kumara and taro</td>
<td>13.6(10.2-17.0)</td>
<td>11.9(10.0-13.9)</td>
</tr>
</tbody>
</table>
4.3.2 Exclusion criteria

4.3.2.1 Similar food item already in food list
A food item was excluded if a similar item had already been included in the food list (e.g., ‘Biscuit, chocolate base, ‘Digestive/Wheat’ was excluded because ‘Biscuit, plain, ‘Digestive’ had already been included). This was so to limit the length of the food list.

4.3.2.2 Non-generic and not commonly eaten
Generic and unbranded foods were used where possible. Non-generic foods that had a generic food available were excluded (e.g., cox orange and red delicious apples were excluded because the generic ‘apple, assorted variety’ was in the food list).

Foods, such as ethnic foods (e.g., Māori bread or Tongan soup), that were unlikely to be consumed frequently by the target population were also excluded.

The candidate compiled a list of food substitutions to be used by the interviewer during pretesting if any of these excluded foods were consumed. This list was incorporated into the user’s manual which can be found in Appendix A.

4.3.2.3 In a form not normally consumed
Food items were excluded if they were in a form not normally consumed such as raw, uncooked, dry or powdered food items (e.g., raw beef or flour).
4.3.2.4 Portion-size extremely small

Some foods, such as herbs and spices, were unlikely to contribute an appreciable amount to the intake of a food component of interest because their portion-size is extremely small.

4.3.2.5 Mixed dishes

Few mixed dishes were included in the food list as the Web–MBIAT allows for these to be entered manually as a new recipe. This is particularly important for recipes that have several variations that could alter the respondent’s apparent iron intake (e.g., lasagne, which can be made with legumes (for vegetarian lasagne) or with minced meat). However, recipes and mixed dishes from fast food outlets (e.g., McDonald’s burgers or Indian butter chicken) were included if they were likely to be consumed by the target population, or were considered difficult to enter manually as a new recipe (e.g., falafel).

4.3.3 Analysis

The ‘sum’ formula in Microsoft Excel 2007 (Microsoft, 2007) was used to describe the main food list. Totals of food items that were included or excluded were calculated. Totals were also calculated for food items grouped by justification for inclusion (e.g., above a cut-off etc.), reason for exclusion (e.g., below a cut-off etc.), or by food groups (e.g., ‘vegetables’).

4.4 Development of short food list

A short food list was developed to prompt the respondent for forgotten foods that may contribute significantly to their iron, vitamin C or phytate intake. A copy of the short food list can be found in Appendix B. As with the main food list, cut-off values were used as a guide.
to determine which foods to include (see below). However, not all foods above the cut-offs were included. Foods that were not in final edible form (e.g., wholemeal flour), were deemed highly uncommon (e.g., fresh guava), or were consumed in extremely small portions (e.g., chilli) were not included. The short food list was reviewed once by the candidate’s supervisor— for its content and justification for inclusion or exclusion of food items — during the development process.

For iron, the cut-off was set at 8mg /100g. This was derived from the recommendation by the U.S. Office of Dietary Supplements that a food providing 20% or more of the daily value (or recommended dietary intake (RDI)) is considered high in that nutrient (Office of Dietary Supplements). However, applying this to the Australian and New Zealand RDI for iron for females aged 19-54y (i.e., 16mg/day), set the cut-off at 3.2mg iron/100g (Ministry of Health, 2003). This was considered too low as a large number of food items would be included in the short list. Therefore, foods were included in the short food list if they provided at least 50% of the RDI, which is 8mg iron/100g.

For vitamin C, the cut-off was set at 80mg/100g so that a small number of foods extremely high in vitamin C would be identified (n=4). It is important to note that an attempt was made to use the same approach as for iron. However, issues arose with the New Zealand RDI for vitamin C for adult females (30mg/day). This is a low cut-off set as a minimum to prevent scurvy (Ministry of Health, 2003). Using this cut-off, would mean a large proportion of food items would be included in the short list. Therefore, this approach was discarded. Instead the cut-off was set at 80mg/100g vitamin C because a natural break in the data was observed at this point.
Finally, for phytate, the cut-off was set at 750mg/100g based on a study that considered a high phytate food contained at least this amount (Amirabdollahian & Ash, 2010).

4.5 User’s manual
A user’s manual was developed by the candidate in conjunction with another Master of Dietetics student to assist interviewers when using the Web–MBIAT. The user’s manual was not reviewed by others before being pretested with interviewers but was thoroughly checked by both candidates; however a thorough attempt was made to provide clear and concise instructions for all steps in the FFQ process. A copy of the user’s manual can be found in Appendix C.

4.6 Pretesting the Web–MBIAT program
4.6.1 Participants
Participants were recruited from the Department of Human Nutrition, University of Otago, and were invited to participate by email. A copy of the recruitment email can be found in Appendix D. This was the source for participants because the Web–MBIAT program is designed to be used by Nutritionists and Dietitians. To be eligible, participants had to be staff (considered to be dietitians or nutritionists), or graduate students in the Department. Participants were excluded if they did not consent to audio recording of the interview. Category B ethics for this study was granted by the Head of Department of Human Nutrition at the University of Otago, Dunedin, New Zealand; and written consent was collected from all participants before taking part. A copy of the information sheet and consent form can be
found in Appendix E, and a copy of the recruitment protocol can be found in Appendix F. For the remainder of this thesis, participants will be referred to as ‘interviewers’.

4.6.2 Data collection

Pretesting occurred in April 2013 at the Department of Human Nutrition, University of Otago, Dunedin, New Zealand, where interviewers were invited to attend an approximately 1.5 hour audio recorded session. A copy of the pretesting interview protocol can be found in Appendix G. Interviewers were first asked to complete a brief questionnaire (Appendix H) about their age, sex, if English was an additional language, previous experience with FFQs, and perceived confidence with using computer programs (on a scale of 1-10). Interviewers were then given the user’s manual to familiarise themselves with the Web–MBIAT program before conducting the FFQ with the respondent; and queries were answered. Each interviewer conducted the FFQ with the same respondent (i.e., the candidate) who used a standardized diet; and this was timed to measure the length of time taken to use the Web–MBIAT program. A copy of the standardized diet can be found in Appendix I.

Finally, interviewers were asked questions to direct their feedback on the usability of the Web–MBIAT program and user’s manual. A copy of the interview questions can be found in Appendix J. The interview questions were designed to cover key areas for investigation which were identified in the literature (Fleming, 2009; Presser et al., 2004). These areas included the Web–MBIAT interface, understanding of instructions and questions, and logic of navigation. Additionally, questions also included feedback on the main food list, and the user’s manual. After completing the sessions, each interviewer was given a $20 reimbursement.
4.6.3 Analysis

The average time taken to conduct the FFQ was calculated. Additionally, the time taken for each interviewer to conduct the FFQ was compared to their corresponding experience with FFQs and level of confidence with using computer programs. This was used to identify whether an interviewer had difficulty conducting the FFQ (i.e., if they fell below the mean) due to issues with the Web–MBIAT program or to their lack of confidence or experience.

Feedback from interviewers was used to determine issues identified and suggestions for improvement; and to generate a count for each of the issues and suggestions for dietitians/nutritionists, for graduate students, and for all interviewers (Rabiee, 2004). Qualitative data were gathered by transcribing audio-taped sessions of interviewers’ feedback until saturation of points was reached. After this, issues and suggestions were tallied, and quotes were transcribed that illuminated them (Rabiee, 2004). Predetermined categories were identified to sort the data. These categories were the Web–MBIAT ‘interface,’ ‘instructions and questions’, ‘logic and navigation’, ‘food list’ and user’s manual (Presser et al., 2004). Attention was given to issues raised by at least two interviewers; and the remainder were considered to reflect personal preference. Attention was given to all suggestions, because different suggestions could address a single issue.
5 Results

5.1 Food list

5.1.1 Main food list

The main food list for iron contained 420 items (Appendix K), which is approximately 16% of the total number of foods in FOODfiles (i.e., 2710 foods) (Table 5.1). When combined with a food list designed for zinc and its absorption modifiers, developed by another Master of Dietetics candidate, the combined main food list used in the Web–MBIAT contained 664 items.

There were three reasons for food items to be included in the main food list for iron (Table 5.1). The main reason for inclusion was meeting the cut-offs for iron; vitamin C; meat, fish and poultry (MFP); or phytate (407(96.9%)). A similar number of items were included for each of the four cut-offs, ranging from approximately 32-40% of the total number of foods included.

Many of the items that met a food component cut-off also met one or more of the Adult Nutrition Survey (ANS) 2008/09 criteria for inclusion: being part of a food group that contributed to the iron (≥4%) or vitamin C (≥10%) intake of New Zealand females aged 19-50y (University of Otago & Ministry of Health, 2011a). An additional 9 items (2.1%) that met the ANS criteria but did not meet any food component cut-off were also included. The least common reason for inclusion was a food item being tea or coffee (4(1.0%)).
Table 5.1 Number of foods included in the main food list and justification

<table>
<thead>
<tr>
<th>Foods above at least one cut-off:</th>
<th>Included (%) of foods in FOODfiles</th>
<th>Included (%) of total number of foods included</th>
<th>Included (%) of category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron (≥2mg/100g)</td>
<td>152(37.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin C (≥7mg/100g; (≥10mg/100g in non-alcoholic beverages))</td>
<td>156(38.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat, Fish, Poultry (≥30g/100g)</td>
<td>129(31.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phytate (≥50mg/100g)¹</td>
<td>163(40.0)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Foods below all four cut-offs but meeting the ANS criteria: 9(2.1)

Iron 9(100.0)

Vitamin C 9(100.0)

Tea or coffee 4(1.0)

Total number of foods 420(15.5)

1. Foods could fulfil criteria for more than one food component, so percentages do not add up to 100%
2. Many of these foods also met one or more of the Adult Nutrition Survey (ANS) 2008/09 criteria for inclusion (i.e., were from a food group that provided at least 4% of iron or at least 10% of vitamin C in the diets of adult New Zealand women (aged 19-50y) in the ANS 2008/09 (University of Otago & Ministry of Health, 2011)
3. Cut-off was applied where values were given in the literature. However, foods were also included that contained cereals, grains, legumes, nuts or seeds, as these were food groups likely to contain appreciable amounts of phytate (Amirabdollahian & Ash, 2010; McKenzie-Parnell & Guthrie, 1986; Oberleas & Harland, 1981)
Conversely, there were 6 reasons for food items to be excluded from the main food list for iron: similar item already in the food list; not commonly consumed by the target population; branded or non-generic food item; in a form not normally consumed; extremely small portion-size; or non-standard or uncommon recipe or mixed dish.

Overall, 2290 or approximately 85% of foods from FOODfiles were excluded (Table 5.2). Apart from being below the food component cut-offs, the main reason for exclusion of a food was that it was similar to a food item already listed in FOODfiles. A total of 1069 items (approximately 47% of exclusions) were excluded for this reason. The least common reason for exclusion was that a food item had an extremely small portion-size, with only 102 items (approximately 5% of exclusions) excluded for this reason. A third of foods (32.8%) had multiple reasons for exclusion.

Of the 21 food groups found in FOODfiles, only 4 did not appear in the main iron food list because they did not contain, or had only trace amounts, of the food components of interest (Table 5.3). These were ‘alcoholic beverages’, ‘dairy’, ‘fats and oils’, and ‘soups’. The greatest proportion of items included from a food group was 53.8% for ‘nuts and seeds’.

### 5.1.2 Short food list

The final number included in the short food list for iron was 24 items. When combined with the short food list for zinc created by another Masters of Dietetics candidate, the combined short food list used in the Web–MBIAT contained 47 items. For the iron short food list, the greatest number of items were included for meeting the phytate cut-off; a total of 11 foods. Nine items met the cut-off for iron, and 4 items meet the cut-off for vitamin C.
<table>
<thead>
<tr>
<th>Similar food item already in food list</th>
<th>Excluded (84.5)</th>
<th>Excluded (% of foods in FOODfiles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not commonly consumed by the target population</td>
<td>584(25.5)</td>
<td></td>
</tr>
<tr>
<td>Branded or other non-generic foods</td>
<td>632(27.6)</td>
<td></td>
</tr>
<tr>
<td>In a form not normally consumed</td>
<td>540(23.6)</td>
<td></td>
</tr>
<tr>
<td>Portion-size extremely small</td>
<td>102(4.5)</td>
<td></td>
</tr>
<tr>
<td>Non-standard or uncommon recipe or mixed dish</td>
<td>164(7.2)</td>
<td></td>
</tr>
</tbody>
</table>

**Total number of foods**

| 2290(84.5) |  |

---

1. Many foods met multiple criteria, so percentages do not add up to 100%
2. ‘Non-generic’ includes branded food items that had a generic substitute (e.g., generic wholegrain bread used rather than Burgen bread)
3. Foods excluded due to form include raw, uncooked, dry and powdered food items (e.g., flour, raw beef)
4. Foods excluded due to being consumed in extremely small portions (e.g., herbs and spices)
5. Non-standard or uncommon recipes and mixed dishes include those that are not typical in the target population diet (e.g., Tongan soup), or that have several variations (e.g., lasagne)
5.2 Interviewers

Ten interviewers were recruited for pretesting: 3 people who had been employed as dietitians or nutritionists (i.e., ‘dietitians/nutritionists’), and 7 graduate students from the Department of Human Nutrition, University of Otago (Table 5.4). All interviewers were female with a mean age of 25 years; however graduate students were younger with ages ranging between 22 and 28 years. Four interviewers had English as an additional language. Dietitians/nutritionists had the most experience with food frequency questionnaires (FFQs), having administered a mean of 4.0 different FFQs, and having completed 5.0 themselves. Conversely, graduate students had the least experience — particularly with administering FFQs — having administered a mean of 0.7 FFQs and completed 2.9 themselves. All interviewers ranked their confidence with using computer programs high, with a mean rating of 8.6, and a range of 8 to 10.

The average time taken for interviewers to complete the FFQ was approximately 38 minutes (Table 5.5). The dietitians/nutritionists took the least time, with a mean of 34 minutes (range 33 to 35 minutes). Graduate students took longer, with a mean of approximately 39 minutes (range of 30 to 59 minutes). All interviewers increased their speed towards the end of the questionnaire as they became more familiar with the program. Also, most interviewers felt that they could complete the questionnaire faster with more training and practice. Interviewer 3 said:

“Even though it probably took me this time, about an hour, I would say that if I had to do it a second time, I could probably cut that speed by half. Because I know what I’m doing, I’m not fiddling around.”
<table>
<thead>
<tr>
<th>Food groups</th>
<th>Included (% of food group total)</th>
<th>Excluded (% of food group total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakery products</td>
<td>29(14.6)</td>
<td>170(85.4)</td>
</tr>
<tr>
<td>Beverages, alcoholic</td>
<td>0(0)</td>
<td>33(100)</td>
</tr>
<tr>
<td>Beverages, non-alcoholic</td>
<td>14(9.3)</td>
<td>136(90.7)</td>
</tr>
<tr>
<td>Breakfast cereals</td>
<td>12(21.4)</td>
<td>44(78.6)</td>
</tr>
<tr>
<td>Cereals and pseudo-cereals</td>
<td>27(20.9)</td>
<td>102(79.1)</td>
</tr>
<tr>
<td>Dairy</td>
<td>0(0)</td>
<td>156(100)</td>
</tr>
<tr>
<td>Eggs</td>
<td>1(6.7)</td>
<td>14(93.3)</td>
</tr>
<tr>
<td>Fast foods</td>
<td>61(30.8)</td>
<td>137(69.2)</td>
</tr>
<tr>
<td>Fats and oils</td>
<td>0(0)</td>
<td>50(100)</td>
</tr>
<tr>
<td>Finfish</td>
<td>22(14.4)</td>
<td>131(85.6)</td>
</tr>
<tr>
<td>Fruit</td>
<td>61(26.9)</td>
<td>166(73.1)</td>
</tr>
<tr>
<td>Meat</td>
<td>34(8.8)</td>
<td>353(91.2)</td>
</tr>
<tr>
<td>Meat products</td>
<td>14(17.7)</td>
<td>65(82.3)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>1(1.5)</td>
<td>66(98.5)</td>
</tr>
<tr>
<td>Nuts and seeds</td>
<td>28(53.8)</td>
<td>24(46.2)</td>
</tr>
<tr>
<td>Recipes</td>
<td>8(4.3)</td>
<td>180(95.7)</td>
</tr>
<tr>
<td>Sauces and condiments</td>
<td>4(6.0)</td>
<td>63(94.0)</td>
</tr>
<tr>
<td>Shellfish</td>
<td>13(40.6)</td>
<td>19(59.4)</td>
</tr>
<tr>
<td>Snack foods</td>
<td>17(27.4)</td>
<td>45(72.6)</td>
</tr>
<tr>
<td>Soups</td>
<td>0(0)</td>
<td>59(100)</td>
</tr>
<tr>
<td>Sugar, confectionary and spreads</td>
<td>10(13.7)</td>
<td>63(86.3)</td>
</tr>
<tr>
<td>Vegetables</td>
<td>64(23.0)</td>
<td>214(77.0)</td>
</tr>
</tbody>
</table>

1. Food groups according to FOODfiles manual (Sivakumaran & Huffman, 2011)
Additionally, the majority of interviewers considered that the Web–MBIAT was a faster method than other examples of dietary assessment, and it gathered more information with less respondent burden.

5.3 Pretesting

5.3.1 Positive feedback

All interviewers had positive comments when asked about what they liked or found easy to do using the Web–MBIAT program. The most common features liked were: the icons and their logic (i.e., a plus sign was to add an item, a minus sign was to subtract an item) (Appendix C, page 43); the three options to enter measurements of food (i.e., amount in grams, measure descriptions (e.g., cups and slices), and volume) (Appendix C, page 11); and the favourites/history list (Appendix C, pages 19-22). There were mixed reactions to the food list, particularly its length and exclusion of major food groups (e.g., ‘fats and oils’), but overall interviewers acknowledged that it was adequate for the purpose of measuring iron and zinc intake. Interviewers also had positive feedback about the user’s manual. The feature most commonly liked were the screen shots to explain instructions and the icon key (Appendix C, page 43).

5.3.2 Issues identified

Despite the positive feedback, all interviewers identified issues with the program and user’s manual (Table 5.5). For all interviewers, the program category with the highest issue count was ‘logic and navigation’ (total of 21 counts). The program category with the second
Table 5.4 Interviewers’ characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Dietitians/Nutritionists (n=3)</th>
<th>Graduate students (n=7)</th>
<th>All (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean(range))</td>
<td>27.7(26-31)</td>
<td>24.0(22-28)</td>
<td>25.1(22-31)</td>
</tr>
<tr>
<td>Sex (total):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Male</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>English as additional language (total)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Previous use of FFQs:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of different FFQs administered, (mean(range))</td>
<td>4.0(0-10)</td>
<td>0.7(0-3)</td>
<td>1.7(0-10)</td>
</tr>
<tr>
<td>Number of different FFQs completed, (mean(range))</td>
<td>5.0(2-10)</td>
<td>2.9(0-8)</td>
<td>3.5(0-10)</td>
</tr>
<tr>
<td>Perceived confidence with using computer programs (scale 1-10)(^1), (mean(range))</td>
<td>9.0(8-10)</td>
<td>8.4(8-10)</td>
<td>8.6(8-10)</td>
</tr>
</tbody>
</table>

1. Confidence scale - 1 is the lowest, 10 is the highest
highest issue count was ‘instructions and questions’ (total of 5 counts), and the program category with the lowest issue count was the ‘food list’ (total of 3 counts).

5.3.2.1 Issues with ‘logic and navigation’ and ‘instructions and questions’

The most common issues (Table 5.5) regarding ‘logic and navigation’ in the Web–MBIAT program were: case-sensitive or correct spelling needed when searching food items (total of 10 counts); interviewers could not correct errors easily (total of 4 counts); and forgetting overall meal frequencies when describing meal instances (Figures 2 and 3) (total of 3 counts).

In terms of the overall ‘logic and navigation’ of the program, several interviewers expressed a feeling of being lost during the initial stages of the FFQ. Interviewer 8 said:

“I was very lost at the start because there were no instructions for the interviewer. So I didn’t know what to expect”.

Also, some interviewers initially thought the Web–MBIAT was a traditional FFQ. However, upon using the program; a few described it as a diet recall. Interviewer 1 said:

“This program is very different from my expectation, because...I thought we were going to do a food frequency questionnaire, but apparently this is more of a dietary recall tool.”

This was also expressed by another interviewer. She said:

“In the ANS they used a 24hr recall, and I think this is similar because they used a step-by-step web-based questionnaire.”
Table 5.5 Time taken to complete FFQ and issues identified (median)

<table>
<thead>
<tr>
<th>Category</th>
<th>Dietitians/Nutritionists (n=3)</th>
<th>Graduate Students (n=7)</th>
<th>All (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time taken (minutes) to FFQ (mean(range))</td>
<td>34.0(33-35)</td>
<td>39.3(30-59)</td>
<td>38.1(30-59)</td>
</tr>
<tr>
<td><strong>Issues identified with Web–MBIAT</strong> (count(median for the group))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘Interface ’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Boring colour/no pictures</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>– Icons blurry/too small</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>‘Instructions and questions’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– ‘Overall meal frequency’ confusing</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>– Too many prompts to save</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>‘Logic and navigation’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Case-sensitive/correct spelling</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>– Could not correct errors easily/no ‘undo’ button</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>– Forgot ‘overall meal frequency’ when describing ‘meal instances’</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>– Have to click ‘+’ to add each food item</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>– Took time to find the best matching food item</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>‘Food list’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Some food items did not make sense e.g., ‘lean and fat’</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>– No Supplements</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Issues identified with user’s manual</strong> (count(median for the group))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– No colour</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>– No overview/introduction to Web–MBIAT</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>– Too long/wordy</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
All interviewers identified searching food items in the search field was an issue. The most common reason for this was the case-sensitive search using ‘Starts with’ or ‘contains’ in the scroll down menu. This is where interviewers had to start a search term with an uppercase letter for the former, and a lowercase letter for the latter (Appendix, page 8). Interviewer 4 said:

“...the capital and the small letters. Yeah it’s really confusing sometimes, especially when you can’t find food items. For someone who doesn’t actually know the Web–MBIAT, it could be really hard for them.”

Another issue identified with searching food items was the need to have correct spelling in order to find foods. Interviewer 1 said:

“...because you are not using the correct term, I am not able to identify the food items. That means a longer time required for the interview.”

Another example of this issue was with interviewer 6 (from overseas), who could not find ‘yoghurt’ in the database because she entered ‘yogurt’ into the search field.

The inability to easily correct an error or go back to another window was another common issue identified with the ‘logic and navigation’ of the program (total of 4 counts). Interviewer 3 said:

“...if I accidently clicked on something I can’t just push a button. Because usually with programs these days you can just click on a reverse button to undo what you just did. And that would make it quite easy especially if you’re going to have to do a questionnaire on many, many people.”
Another issue identified (total of 3 counts) was difficulty remembering the overall meal frequency of a meal occasion when describing a meal instance. This typically happened towards the end of the questionnaire. Interviewer 2 said:

“...breakfast was all right, but when you got to lunch and dinner, you had to remember what they had said the first time”.

Three interviewers also had trouble understanding the ‘overall meal frequency’ window (Figure 3a), both in the context of ‘logic and navigation’ and ‘instruction and questions’.

Interviewer 8 said:

“I just got a little confused about how it asks you at the start, how many times they have the meal....but I didn’t really understand that it was just to get a base of how many days a week you have breakfast, rather than how many days of the week you have THAT breakfast. “

Finally, for ‘instructions and questions’, only 2 interviewers (one from each group) found issue with the prompts to save; namely that they were too frequent.

5.3.2.2 Issues with the ‘food list’

Only graduate students identified issues with the food list (Table 5.5), and these were: some food items did not make sense (2 counts) and supplements were not included (1 count). For the latter, interviewer 3 explained why this was an issue. She said:

“I didn’t see anything about supplements...because supplements can really affect your iron and zinc intake, so maybe that can be something to include”.

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5.3.2.3 Issues with the user’s manual

Interviewers identified 11 issues with the manual (Table 5.5). Overall, the most common issue identified was the lack of colour (total of 5 counts), as the manual was printed in black and white. Another major issue was the lack of context given for the Web–MBIAT (total of 4 counts), with several interviewers (2 dietitians/nutritionists and 2 graduate students) confused about its background and purpose. Finally, two interviewers found issue with the length (a total of 48 pages). Interviewer 1 said:

“It just puts me off. I wasn’t very interested in reading it because it’s just too wordy.”

5.3.3 Suggestions for improvement

All interviewers offered suggestions to improve the Web–MBIAT program and user’s manual (Table 5.6). Regarding the program, the suggestions were most commonly to do with ‘logic and navigation’, ‘interface’, and the ‘food list’, each with a total of 5 counts. Conversely, the program’s ‘interface’ had the least suggestions (2 counts). These were provided only by dietitians/nutritionists.

5.3.3.1 Suggestions to improve ‘logic and navigation’ and ‘instructions and questions’

The most common suggestion (Table 5.6) regarding ‘logic and navigation’ of the Web–MBIAT program was: removal of case-sensitive searching or having suggestions for correct spelling when searching food items (2 counts from graduate students), and adding a meal item without clicking the ‘+’ icon (2 counts from dietitians/nutritionists) (Appendix C, page 7). In terms of the former, one interviewer felt that removing the case-sensitive feature would be adequate particularly the ‘Starts with’ option. She said:
<table>
<thead>
<tr>
<th>Category</th>
<th>Dietitians/Nutritionists (n=3)</th>
<th>Graduate Students (n=7)</th>
<th>All (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Web–MBIAT (count(median for the group)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘Interface’</td>
<td>2(1)</td>
<td>0(0)</td>
<td>2(1)</td>
</tr>
<tr>
<td>– More colour, include pictures</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>– Bigger icons on the screen</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>‘Instructions and questions’</td>
<td>4(1)</td>
<td>1(0)</td>
<td>5(2)</td>
</tr>
<tr>
<td>– More prompts for questioning respondents</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>– Have a virtual step-by-step guide</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>– Prompt at the end of describing a meal has overall meal frequency entered at the beginning instead of ‘0’</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>‘Logic and navigation’</td>
<td>2(0)</td>
<td>3(1)</td>
<td>5(1)</td>
</tr>
<tr>
<td>– Suggested spelling when searching food items</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>– Take out case-sensitive search</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>– Adding meal item without clicking ‘+’</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>– Have ‘overall meal frequency’ window asked per meal occasion rather than all at once</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>‘Food list’</td>
<td>0(0)</td>
<td>5(2)</td>
<td>5(2)</td>
</tr>
<tr>
<td>– Prompt to let interviewer know that food group is not included</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>– Include more food items</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>– Prompt about what cooking methods are equivalent e.g., cooking methods of baking, roasting, frying are considered the same</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
“I think you can use the ‘contains’ search instead of using the ‘Starting with’ search, and that would be more useful.”

Another interviewer felt that having suggested spelling or a ‘did you mean...?’ feature might overcome the issue of incorrect spelling (e.g., ‘yoghurt’ versus ‘yogurt’) or foods that have different names (e.g., ‘multigrain’ and ‘wholegrain’ bread).

Another suggestion (1 count) to improve both ‘logic and navigation’ and ‘instructions and questions’ was to help interviewers remember the overall meal frequency of meal occasions gathered from the first question (Figure 3a). The interviewer suggested having meal instances asked per meal occasion rather than all at once (e.g., the interviewer would ask how many times the respondent ate breakfast in a week, and would then describe each meal instance for breakfast before moving on to the next meal occasion – morning snack etc.). Interviewer 2 said:

“...maybe if you ask just before you did each meal, that would be good...like ‘how many times would you have breakfast?’, and then go into ‘how many times would you have THIS meal for breakfast?’”.

Alternatively to this regarding ‘instructions and questions’, two interviewers suggested the prompt asking ‘how often during an average week do you have this meal?’ which appears after describing a meal instance (Appendix C, page 13) should state the overall meal frequency for that meal occasion instead of ‘0’. That way, interviewers will know whether to ask the respondent if they have another meal instance for that meal occasion, especially if the respondent replies with a different number.
### Table 5.6 Continued

<table>
<thead>
<tr>
<th>Category</th>
<th>Dietitians/Nutritionists (n=3)</th>
<th>Graduate Students (n=7)</th>
<th>All (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>User’s manual (count(median for the group))</td>
<td>8(2)</td>
<td>11(2)</td>
<td>19(4)</td>
</tr>
<tr>
<td>- Print in colour</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>- Include full food list</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>- Include overview/introduction of the Web–MBIAT program</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>- Place icon key and food substitutions list in the</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>beginning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Have two manuals: one for conducting the FFQ, and another</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>for additional features e.g., entering client details</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Another suggestion made regarding ‘instructions and questions’ was having more prompts to question respondents (2 counts from dietitians/nutritionists). Interviewer 5 said:

“You need to ask the proper questions, you need to prompt properly. It would be helpful to have a standard question ...to ask the subject and to decrease bias”.

This was reinforced by another interviewer who said:

“It would be helpful to have a general statement that the interviewer would read out to the interviewee... so that both will know what to expect.”

Lastly for ‘instructions and questions’, one interviewer felt a virtual tutorial would be helpful to guide interviewers through the FFQ, especially when first learning how to use the program. Interviewer 4 said:

“...if it had like a tutorial it would be great, like a step-by-step pop-up window for them to know what to do next just for the first time. And then you have an option to click that you don’t need the tutorial anymore.”

5.3.3.2 Suggestions for the ‘food list’

Only graduate students provided suggestions for the food list (5 counts), particularly to include prompts for interviewers when choosing food items (Table 5.6). The two suggestions (2 counts for each) were prompts to notify interviewers of excluded food groups, and cooking methods considered to be the same, as they described a meal instance.

Although not identified as an issue, one interviewer felt the food list should include more foods. However, a few interviewers liked the limited food list because it was easier to choose food items. Interviewer 4 said:
“...you don’t need to think about what option to take, especially if there’s more than one option. It’s a big struggle otherwise”.

Another interviewer said:

“I think the food list is quite adequate because, you will find a food that is pretty similar to the food that the participant said”.

5.3.3.3 Suggestions for the user’s manual

The user’s manual had 19 suggestions in total. The two most common suggestions were to have the manual printed in colour (total of 5 counts); and to include the full food list in alphabetical order for interviewers to refer to if they have difficulty searching for a food item (total of 5 counts). The second most common suggestion (total of 4 counts) was to provide an introduction or background paragraph about the purpose of the Web–MBIAT, for both the interviewer and the respondent. This would also explain why some food groups were missing from the food list and why cooking methods were not important (i.e., because only a few food components were of interest). Interviewer 4 said:

“...at the beginning, it would be good to have a little note saying this web-based questionnaire is actually aimed to identify or investigate the iron and zinc intake, and not for multi-nutrient intake.”

Even though it was not identified as an issue, another common suggestion (3 counts) made only by graduate students, was to have the icon key and list of substitutions (Appendix C, pages 43-48) at the front of the manual so that interviewers were more familiar with them before administering the FFQ. Finally, to address the length of the user’s manual, two
interviewers (one from each group) suggested having two manuals instead; a manual on how to conduct the FFQ, and another for extra features of the program.

5.4 Proposed modifications to the Web–MBIAT and user’s manual

Following pretesting and gathering interviewers’ feedback, the candidate has proposed several modifications be made to improve the Web–MBIAT program and user’s manual. These are listed in Figure 4.
<table>
<thead>
<tr>
<th>Web–MBIAT</th>
<th>User’s manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove case-sensitive searching, or if not feasible,</td>
<td>Print the manual in colour to increase visual appeal</td>
</tr>
<tr>
<td>Include tips on how to search food items effectively with correct spelling</td>
<td>Include an introduction to the Web–MBIAT program, briefly explaining what it is (i.e., hybrid between FFQ and diet history) and its purpose</td>
</tr>
<tr>
<td>(e.g., ‘yoghurt’ versus ‘yogurt’) or variations of one food item (e.g., ‘whole-grain’ bread is also known as ‘multi-grain’ bread)</td>
<td>Place food substitutions and icon key at the beginning of the manual so interviewers can utilize them as they are learning how to administer an FFQ</td>
</tr>
<tr>
<td>Add more prompts for questioning respondents to guide interviewers through the FFQ. This is most important for transitioning between the ‘overall meal frequency’ (<a href="#">Figure 3a</a>) and the ‘meal instances’ windows (<a href="#">Figure 3b</a>), which interviewers expressed they had most difficulty with</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 4** Proposed modifications to Web–MBIAT program and user’s manual
6 Discussion and conclusion

A main and a short list of foods containing iron and its absorption modifiers were developed that had 420 items and 24 items, respectively. Although interviewers in the pretesting phase of the project were positive about the Web—MBIAT, the pretesting revealed several issues that need to be addressed. With respect to the main combined food list, although it was longer than previous MBIAT versions, a few interviewers felt uncomfortable because it did not include a comprehensive list of foods. In addition, one interviewer felt that the exclusion of supplements was an issue. With respect to the Web—MBIAT program, interviewers had an issue with ‘logic and navigation’, for instance problems with the search function and lack of prompts to guide interviewers when questioning respondents. The candidate therefore proposes a number of modifications; including a Web—MBIAT introduction in the user’s manual, assessing supplement use, removing case-sensitive searching of food items, and having more prompts to guide the interviewer.

6.1 Food lists

With 664 items, the main combined food list is extensive compared to traditional paper-based food frequency questionnaires (FFQs) (Cade et al., 2002). This is also true of the main iron food list, which contained 420 items. This is despite entire food groups not being included (i.e., ‘alcoholic beverages’, ‘dairy’, ‘fats and oils’, and ‘soups’). Interestingly, this is also considerably longer than several FFQs assessing iron intake. Indeed, in a review of New Zealand and Australian iron FFQs, the food list length ranged from 74 to over 300 items (Palmer & Morgan, 2012). However, direct comparisons cannot be made because the Web—MBIAT does not specifically investigate the frequency of consumption for each food
item. Rather, it assesses intake by meals — similar to a diet history (Gibson, 2005) — and this is the defining characteristic of the Web–MBIAT program. Comparisons can be made however, with earlier validated versions of the Web–MBIAT program (Heath et al., 2005; Heath et al., 2000; Matthys et al., 2004). Comparing the correlation coefficients for iron against reference methods, the United Kingdom version performed better (0.76) (Heath et al., 2005) than its New Zealand (0.52) (Heath et al., 2000) and Belgian (0.45) (Matthys et al., 2004) counterparts. Although the former was interviewer-administered and the latter two were self-administered, authors of the United Kingdom study discounted this as a reason for their version’s better performance (Heath et al., 2005). Instead, they suggested it was likely due to the extensive food list used (630 items), compared to its earlier versions: 206 items (New Zealand) (Heath et al., 2000) and 209 items (Belgian) (Matthys et al., 2004).

Even with a longer food list (664 items) than the United Kingdom version (630 items), several interviewers were initially uncomfortable using it because whole food groups and many cooking methods were not included. An explanation for this reaction may be that some interviewers approached the Web–MBIAT as a diet recall program — similar to that used in the Adult Nutrition Survey (ANS) 2008/09, which used a comprehensive food list (University of Otago & Ministry of Health, 2011b). A similar problem with prior expectations was highlighted by interviewer 1 who had expected to be asked to pretest a traditional paper-based FFQ and was unfamiliar with the Web–MBIAT’s novel meal- rather than food-based approach. In an effort to help interviewers work with the main food list, interviewers were given a list of food substitutions which could assist them with selecting food items. However many did not use it, perhaps because it was at the back of the user’s manual. Interestingly, the most experienced interviewer, who had administered over 100 diet recalls using
FOODfiles, actually liked the shortened length of the main food list because she could quickly find foods to enter. This suggests that with further practice, interviewers would become familiar with the food list and feel more confident administering the FFQ. Additionally, the suggestion to include an introduction in the user’s manual describing the purpose of the Web–MBIAT (i.e., to assess intake of iron and zinc, and their absorption modifiers, rather than assess the whole diet) may also help interviewers build confidence using the program.

One interviewer noticed the Web–MBIAT program did not ask about supplement use and suggested this should be assessed to improve the program’s accuracy in measuring iron intake. While only one interviewer expressed this as an issue, there are very good reasons for including supplements in dietary assessment. Indeed, Palmer and Morgan (2012) state that not assessing supplement use was a limitation of the iron FFQs they reviewed. Moreover, in a study by Willett et al (1988), validation correlations improved when supplements were taken into account for the majority of micronutrients, including iron. The candidate considers that iron supplements such as ferrous fumarate and ferrous sulphate (PHARMAC), as well as over-the-counter multivitamins, should be added to the current iron food list because supplements can contribute greatly to an individual’s iron intake. This is likely the case for the target population (i.e., New Zealand premenopausal adult women) who are known to have a greater risk of iron deficiency than other populations (e.g., men and postmenopausal women), and are therefore more likely to be taking supplements.

Indeed, a study investigating the effect of blood loss and diet on the aetiology of mild iron deficiency in New Zealand women found that approximately 24% of women were taking supplements in the year before the study (Heath et al., 2001). More importantly, the authors
reported that among those taking iron supplements, the median intake of supplemental iron was 8.6mg iron/day. This is approximately the New Zealand and Australian estimated average requirement for iron (8mg/day) (Commonwealth Department of Health and Aging et al., 2006). This is an appreciable amount that would be overlooked with the current iron food list, unless questions about supplement use were asked in a separate questionnaire.

6.2 Web–MBIAT program

In pretesting, the main issue identified was with the program’s ‘logic and navigation’; mainly, the case-sensitive searching and lack of prompts to use when interviewing the respondent. With respect to the former, the majority of interviewers felt searching food items was time-consuming, perhaps because it required the correct spelling and use of upper or lower case letters. Interestingly, the average time taken to administer the FFQ was approximately 38 minutes, which is faster than earlier MBIAT versions (Heath et al., 2000; Matthys et al., 2004). However, it is difficult to compare this meaningfully with earlier MBIAT studies and other literature because their method of administration differed (e.g., self-administered (Heath et al., 2000; Matthys et al., 2004) versus interviewer-administered; computerised versus paper-based (Cade et al., 2002)), which will ultimately influence the length of time needed to complete the questionnaire. Moreover, the interviewer-administered MBIAT version (Heath et al., 2005) did not investigate the time taken. However, all interviewers in the current study felt they could complete the FFQ faster with more practice. They also agreed that their time taken was appropriate compared to other dietary assessment tools (e.g., 24 hour diet recall or weighed diet record). This was because the Web–MBIAT gathered detailed information about recipes and meals — in some ways similar to a diet
recall — but was a measure of ‘usual’ intake, with less respondent burden than a weighed diet record (Gibson, 2005).

Some interviewers felt lost during the initial stages of using the Web–MBIAT, particularly when asking the respondent about overall meal frequency and meal instances. Several suggestions were made to improve this, including more prompts for questioning the respondent, or having a virtual guide to assist interviewers. In fact, one interviewer highlighted this was an issue because it exposed the Web–MBIAT to more biases, such as social desirability bias. There may be truth to this statement given the Web–MBIAT is a novel method of dietary assessment, adopting characteristics of both an FFQ and diet history. Indeed, with respect to the latter, Jain (1989) acknowledges the importance of asking standardized questions to minimize bias, particularly when obtaining portion-sizes. Perhaps having a standardized approach to using the Web–MBIAT would not only reduce bias but also give interviewers more structure and direction navigating through the FFQ, particularly when transitioning between the ‘overall meal frequency’ and ‘meal instances’ windows.

6.3 Study strengths and limitations

A key strength of this study was the use of ANS 2008/09 data (University of Otago & Ministry of Health, 2011a) to identify food groups that contributed to iron and vitamin C intake in the target population. This is an approach for developing a food list that is strongly supported by the literature (Cade et al., 2002; Gibson, 2005). This approach could, however, not be used with phytate, as no current data exist on the phytate intake of ANS 2008/09 participants.
Another key strength is the way interviewer feedback was elicited after pretesting.

Retrospective cognitive interviewing and semi-structured interviewing were used, both of which provide more detailed information than methods such as survey questionnaires (Presser et al., 2004; Woods, 2011). Although the former relies on memory, so is considered to be less reliable than other forms of cognitive interviewing (Oremus et al., 2005), interviewers were asked for their feedback immediately after pretesting, so were unlikely to have forgotten their experience. The main advantage of semi-structured interviewing was the ability to add questions to explore responses further (Woods, 2011), particularly with the dietitians and nutritionists, who were more experienced and provided more feedback.

A key limitation of this study was not having complete data on the phytate content of foods as FOODfiles is yet to include this information. To overcome this, the candidate considered using fibre content as a proxy for phytate; based on a study which reported that intake of fibre and phytate both increased when following guidelines for dietary fibre (Prynne et al., 2010). However, this approach was rejected because evidence suggests that inhibition of non-haem iron absorption by cereal-based foods is due to phytate, and not fibre (Brune et al., 1992). As a result, the candidate had difficulty deciding which foods to include in the food lists for phytate. The literature provided some values for the phytate content of foods; however, several papers were old (Oberleas & Harland, 1981) or reported phytate content in American or branded items that are not in New Zealand (Harland et al., 2004). Moreover, some papers (Amirabdollahian & Ash, 2010; Oberleas & Harland, 1981) did not use high performance liquid chromatography to determine the phytate content of foods, which provides more specific and accurate results than earlier methods (Harland et al., 2004).
Another limitation was that interviewers were pretested on their first encounter with the Web–MBIAT program, which therefore did not reflect their long-term ability to use it. A more robust approach would have given interviewers the opportunity to use the program beforehand. Moreover, using a standardized diet did not necessarily simulate reality because the respondent was familiar with the diet, and so did not have to rely on memory to recall information. True respondents would have difficulty recalling what and how much they ate.

6.4 Recommendations for future research

Looking forward, the next stage should be to modify the program and user’s manual as suggested in this thesis. The program must then be validated against weighed diet records (Cade et al., 2002) to assess its performance before being used to determine intake of iron and its absorption modifiers in New Zealand premenopausal adult women.

6.5 Conclusion

A main (420 items) and short (24 items) food list have been developed to assess iron intake and its absorption modifiers in premenopausal adult New Zealand women. Pretesting the Web–MBIAT program (including the food lists) and the user’s manual with interviewers revealed some issues with the program’s ‘logic and navigation’; although overall interviewers were positive about the program. Modifications proposed by the candidate include: having a Web—MBIAT introduction in the user’s manual, including supplements, removing case-sensitive searching of food items, and having more prompts to question respondents. The next step is to modify and validate the Web–MBIAT (against weighed diet records), with premenopausal adult New Zealand women to determine how well it estimates intake of iron and its absorption modifiers.
7 Application of research to dietetic practice

Food frequency questionnaires (FFQs) are not typically used in dietetic practice. This is because they are designed to estimate nutrient intakes on a population level, and not when results are required for an individual, such as in a one-on-one consultation between a dietitian and client (Gibson, 2005).

However, dietitians working in research — particularly in nutrition epidemiology (Gibson, 2005) — or public health, do use FFQs (New Zealand Dietitians Board, 2010; Penumetcha et al., 2012). They are tools which are commonly used to explain why populations are at risk of, or have nutrient deficiencies. This is especially important for iron which is the most common nutrient disorder in the world (World Health Organization, 2013), and as we know from New Zealand population data, iron status is a greater issue in pre-menopausal women than in post-menopausal women (University of Otago & Ministry of Health, 2011a).

This research has shown that pretesting is an important component in the development of any dietary assessment tool, particularly when the method is a novel approach like the Web–MBIAT program. The implication of this in dietetic practice is considerable because it reinforces the importance of pretesting any new tool with the intended population (to gather feedback and make subsequent changes) to ensure the tool is understandable, useable, and effective in its purpose.

The Web–MBIAT program — once modified and validated — will help researchers define the dietary patterns and iron intake of premenopausal adult women. Results may determine a
need for refining or developing public health policy, dietary guidelines or resources (such as pamphlets), regarding iron intake in this population. These findings can then be used as a part of the evidence base informing the dietetic consultations with premenopausal adult women clients.
References


Palmer MA, & Morgan CL. (2012). How well are we validating food frequency questionnaires that measure dietary iron intakes of Australian and New Zealand adults? Nutrition & Dietetics, 69, 159-166.


frequency questionnaires: a qualitative approach using cognitive interviewing.

Journal of the American Dietetic Association, 95, 781-788.


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## Bakery products

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<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread crumbs, white, dried</td>
<td>Bread, white, sliced, prepacked</td>
</tr>
<tr>
<td>Chapati</td>
<td>Bread, Ciabatta</td>
</tr>
<tr>
<td>Chinese bread, steamed</td>
<td>Bread, Ciabatta</td>
</tr>
<tr>
<td>Cream crackers</td>
<td>Cracker, assorted flavours</td>
</tr>
<tr>
<td>Cruskits</td>
<td>Rice cracker, plain, composite</td>
</tr>
<tr>
<td>Currant bun</td>
<td>Bun, iced</td>
</tr>
<tr>
<td>Fruit biscuit, flat</td>
<td>Biscuit, malt</td>
</tr>
<tr>
<td>Fruit cake</td>
<td>Cake, chocolate, standard</td>
</tr>
<tr>
<td>Garlic bread</td>
<td>Bread, white, sliced, prepacked</td>
</tr>
<tr>
<td>Hundreds &amp; Thousands iced biscuit</td>
<td>Biscuit, ‘Gingernut’</td>
</tr>
<tr>
<td>Italian style bread</td>
<td>Bread, Ciabatta</td>
</tr>
<tr>
<td>Madeira cake</td>
<td>Doughnut, ring</td>
</tr>
<tr>
<td>Maori bread, white, fried</td>
<td>Bread, white, sliced, prepacked</td>
</tr>
<tr>
<td>Oaty fruit biscuit, low fat</td>
<td>Biscuit, fruit, ‘Digestive’</td>
</tr>
<tr>
<td>Panini</td>
<td>Bread, white, sliced, prepacked</td>
</tr>
<tr>
<td>Shrewsbury biscuit</td>
<td>Biscuit, ‘Gingernut’</td>
</tr>
<tr>
<td>Soy and Linseed bread</td>
<td>Bread, wheatmeal, sliced, prepacked</td>
</tr>
<tr>
<td>Sponge cake, jam filled</td>
<td>Cake, chocolate, standard</td>
</tr>
<tr>
<td>Toasted bread</td>
<td>Untoasted version of corresponding bread</td>
</tr>
<tr>
<td>Turkish bread</td>
<td>Bread, Ciabatta</td>
</tr>
<tr>
<td>Water crackers</td>
<td>Cracker, assorted flavours</td>
</tr>
</tbody>
</table>

## Beverages, non-alcoholic

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powdered drink flavours e.g., Raro (excludes low energy varieties)</td>
<td>Drink flavour, navel orange, diluted</td>
</tr>
<tr>
<td>Cranberry Juice</td>
<td>Juice, tomato, McCoy</td>
</tr>
<tr>
<td>Grapefruit juice, sweetened</td>
<td>Juice, tomato, McCoy</td>
</tr>
<tr>
<td>Pineapple, grapefruit, grape or blackcurrant juice</td>
<td>Juice, orange, unsweetened</td>
</tr>
<tr>
<td>Instant coffee (powder) or decaffeinated</td>
<td>Coffee, brewed</td>
</tr>
<tr>
<td>Coffee, espresso</td>
<td>Coffee, brewed</td>
</tr>
</tbody>
</table>

Note: Smoothie – If the smoothie is fortified use ‘Smoothie, berry fruit, fortified’ but if it is not fortified enter the smoothie as a new recipe
### Breakfast cereals

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Bran Wheat Flakes, Kellogg’s</td>
<td>Bran cereal</td>
</tr>
<tr>
<td>Frosties, Kellogg’s</td>
<td>Froot Loops, Kellogg’s</td>
</tr>
<tr>
<td>Fruitful Breakfast, Hubbards</td>
<td>Light &amp; Tasty, Sanitarium</td>
</tr>
<tr>
<td>Porridge made with milk</td>
<td>Porridge, prepared with water and add in milk separately</td>
</tr>
<tr>
<td>Weet-Bix Oat Bran, Sanitarium</td>
<td>Wheat, puffed, Sanitarium</td>
</tr>
<tr>
<td>Weeties, Sanitarium</td>
<td>Wheat, puffed, Sanitarium</td>
</tr>
</tbody>
</table>

Note: Use ‘Light & Tasty’, Sanitarium for all flavours of Light & Tasty

### Cereals and pseudo-cereals

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frozen spaghetti meal</td>
<td>Lasagne, beef, frozen meal</td>
</tr>
<tr>
<td>Vegetable flavoured pasta, boiled</td>
<td>Pasta, plain, boiled</td>
</tr>
<tr>
<td>Jasmine rice</td>
<td>Rice, white, polished, boiled</td>
</tr>
<tr>
<td>Macaroni or spaghetti, boiled</td>
<td>Pasta, plain, boiled</td>
</tr>
</tbody>
</table>

### Dairy

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colby Cheese</td>
<td>Cheese, cheddar, tasty</td>
</tr>
<tr>
<td>Condensed milk, sweetened, whole</td>
<td>Milk, evaporated, whole</td>
</tr>
<tr>
<td>Goat milk</td>
<td>Milk, trim, 0.5% fat, composite</td>
</tr>
<tr>
<td>Gouda cheese</td>
<td>Cheese, Edam</td>
</tr>
<tr>
<td>Greek style yoghurt</td>
<td>Yoghurt, Yoplait ‘Lite’ asst frt, low f, swt</td>
</tr>
<tr>
<td>Gruyere cheese</td>
<td>Cheese, Egmont</td>
</tr>
<tr>
<td>Lite milk (1.5% fat), Trim milk (0.5%), Ultra trim milk (0.3% fat), High calcium milk (0.1% fat)</td>
<td>Milk, whole, 3.3% fat, composite</td>
</tr>
<tr>
<td>Mild cheddar cheese</td>
<td>Cheese, cheddar, tasty</td>
</tr>
<tr>
<td>Mozzarella cheese</td>
<td>Cheese, processed</td>
</tr>
<tr>
<td>Parmesan cheese</td>
<td>Cheese, swiss</td>
</tr>
<tr>
<td>Quark</td>
<td>Cheese, ricotta</td>
</tr>
<tr>
<td>silicone cheese</td>
<td>Cheese, blue vein</td>
</tr>
<tr>
<td>UHT milk</td>
<td>Milk, whole, 3.3% fat, composite</td>
</tr>
</tbody>
</table>

### Eggs

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poached eggs</td>
<td>Egg, chicken, boiled</td>
</tr>
</tbody>
</table>
## Fast foods

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curried prawns and rice</td>
<td>Green curry, chicken</td>
</tr>
<tr>
<td>McDonalds hamburger</td>
<td>Burger, hamburger</td>
</tr>
<tr>
<td>Steak pie</td>
<td>Pie, mince, individual size, spmkt, rte</td>
</tr>
<tr>
<td>KFC coleslaw</td>
<td>Coleslaw</td>
</tr>
<tr>
<td>McDonalds fried egg</td>
<td>Egg, fried in vegetable oil</td>
</tr>
</tbody>
</table>

## Finfish

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cod, smoked, poached</td>
<td>Hoki, smoked, flesh, poached</td>
</tr>
<tr>
<td>Eel, flesh, stewed</td>
<td>Hoki, smoked, flesh, poached</td>
</tr>
<tr>
<td>Monkfish</td>
<td>Tuna, skipjack, flesh, raw</td>
</tr>
<tr>
<td>Salmon, Atlantic, fillet, raw</td>
<td>Hoki, smoked, flesh, poached</td>
</tr>
<tr>
<td>Sole</td>
<td>Trevally, flesh, baked</td>
</tr>
</tbody>
</table>

Notes:
- Assume all varieties of canned tuna are Tuna, canned in brine, drained
- Assume all cooking methods are the same e.g., grilled, baked, steamed or fried
- If the desired variety of fish cannot be found or the participant does not know what kind of fish was consumed use Mackerel, fried

## Fruit

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currants, dried</td>
<td>Sultanas</td>
</tr>
<tr>
<td>Figs, dried</td>
<td>Sultanas</td>
</tr>
</tbody>
</table>

## Meat

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goose</td>
<td>Turkey, comp cuts, l, f&amp;s, rstd, w/oven bag</td>
</tr>
</tbody>
</table>

Note: All cuts of meat (beef, lamb and turkey) are grouped into composite cuts excluding chicken breast, venison and mutton

## Meat products

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frankfurters</td>
<td>Sausage, preckd, dry fried, asst meats&amp;flvr</td>
</tr>
<tr>
<td>Frozen roast meals</td>
<td>Beef Roast, frzn meal, w/roast potato veg, rte or enter food components in individually</td>
</tr>
<tr>
<td>Ham and pork, canned</td>
<td>Pork, ham</td>
</tr>
</tbody>
</table>
### Recipes

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Custard egg pudding</td>
<td>Pudding, sponge, fruit, steamed</td>
</tr>
<tr>
<td>Flan, cheese and egg</td>
<td>Quiche, Lorraine</td>
</tr>
<tr>
<td>Hummus, homemade</td>
<td>Hummus, original, 6.5% fat, commercial</td>
</tr>
</tbody>
</table>

Note: Kebab, lamb, yoghurt marinade is not an ingredient but a lamb kebab which has yoghurt marinade

### Sauces and condiments

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coleslaw dressing</td>
<td>Dressing, ‘Potato salad’, Eta</td>
</tr>
<tr>
<td>Feta and Spinach dip</td>
<td>Sour cream dip</td>
</tr>
</tbody>
</table>

### Snack foods

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato straws</td>
<td>Potato crisps, plain</td>
</tr>
<tr>
<td>Sweet potato chips</td>
<td>Potato crisps, plain</td>
</tr>
</tbody>
</table>

### Soups

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish chowder</td>
<td>Soup, chicken, condensed, canned</td>
</tr>
</tbody>
</table>

### Sugar, confectionery and sweet spreads

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mars bar</td>
<td>Chocolate, Cadbury, ‘Moro’, bar</td>
</tr>
</tbody>
</table>

### Vegetables

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fennel</td>
<td>Puwha, sow thistle, leaves &amp; upper stem, boil</td>
</tr>
<tr>
<td>Parsnip and carrot, mashed</td>
<td>Carrot, flesh, boiled, drained</td>
</tr>
<tr>
<td>Swede</td>
<td>Turnip, flesh, boiled, drained</td>
</tr>
</tbody>
</table>
Appendix B: Short iron food list
- **Iron (≥8mg/100g)**
  - Mussels
  - Oysters
  - Sardines
  - Liver
  - Kidney
  - Pate
  - Pumpkin seeds
  - Sesame seeds
  - Pine nuts

- **Vitamin C (≥80mg/100g)**
  - Capsicum
  - Parsley (not as a garnish)
  - Black currants
  - Kiwifruit

- **Phytate (≥750mg/100g)**
  - Wheat germ
  - Wheat bran
  - Bran cereals (e.g. Sultana Bran, All Bran)
  - Wholegrain bread
  - Peanuts (and peanut butter)
  - Almonds
  - Cashews
  - Walnuts
  - Brazil nuts
  - Sunflower seeds
  - Sesame seeds
Appendix C: Web–MBIAT user’s manual

(Some formatting changed for binding)
Web–MBIAT
Manual
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Getting Started

Logging into Web-MBIAT

1. Go to the website http://binky.otago.ac.nz/dietary/opening.das

2. Login using the username and password provided

3. Click

4. Click on ‘Web-MBIAT Pilot studies’ under ‘Projects’ on the menu on the left hand side.

4. Click
Setting up

Before beginning or continuing a diet record, you need to first set up the food list used.

1. In the left panel under ‘Set up’, click ‘General details’.

2. Under ‘Type’, select ‘MBIAT’ from the scroll down menu.

3. Under ‘Food list used’ select ‘MBIAT Food list – Sub-set of P&FR foodFiles 2010’ from the scroll down menu.
4. Once completed, click ‘Save’. You will be taken back to the project menu.

5. Click ‘Preferences’ under ‘Set up’ in the left panel.

6. For ‘Time/occasion format’, select ‘MBIAT (defaults)’ from the scroll down menu.

7. Once completed, click ‘Save’ and you will be taken back to the project menu.

**Add a new participant**

1. Click on ‘Records’ under ‘Diets’ in the menu.
This will bring you to ‘Your Diet Records’ page below which will have a record of all the participant diets which you have already entered (it is blank as none have been entered).

2. Click on ‘New’ under ‘Interviews’ in the menu.

The window below will appear, make the necessary changes then click ‘Start’.

3. Leave the automatically generated record ID or type into the box the ID record desired

4. Put 1 in this box

5. Enter the date the questionnaire is being completed

6. Click
Conducting an FFQ

After clicking start (see the last step in ‘Add a new participant’) the ‘Meals’ window will appear:

1. Fill in the boxes as appropriate

2. Click Continue Close
Entering a simple meal

The ‘Meal instances’ window will appear with all the eating occasions previously identified.

1. To add a new meal (i.e., breakfast) click the breakfast completed box (which has the ✗ in it).

2. Click the describe meal button, ➔, on the bottom toolbar.

A closer look:

Several icons, each with a function, are at the bottom of the window.

- **Reload data** displays the meal instances from the last save
- **Save** any changes which have been made to the meal
- **Meal counts** allows the meal counts to be edited
- **Describe meal** this will take you to the edit meal page
- **Delete a meal**
- **Exit** the ‘Meal instances’ page taking you back to ‘Your Diet Record’ page
3. To add a new food item click the add item button, +.
4. Type the name of the food item into the box which pops up.

A closer look:

- **Reload data** displays the food diary from the last save.
- **Delete** food items from the food diary.
- **Paste item** pastes a replica of the copied item at the bottom of the food list.
- **Save** any changes which have been made to the food diary.
- **Add item** allows new food items to be added to the food diary.
- **Copy row** allows food items to be copied.
- **Exit** the ‘Edit meal’ page, taking you back to the ‘Meal instances’ page.
- **New recipe** add a new recipe to the food list when the desired/similar food item cannot be found.
- **View nutrients** allows you to look at the nutritional content of a selected food item.
- **Filter** the food list items to refine searches.
- **View recipe** allows you to look at the ingredients and the quantity used in recipes.
5. Click the ‘Food list item’ box next to the food item (in red) which was just entered, doing this will cause the Web-MBIAT to search the food list for the food item which was entered.

6. If the desired food item does not appear in the list of food items a custom search can be conducted by typing in the search box. Searches can also be refined using the drop down menus on either side of the search box. Note: the search box is case sensitive.
7. When you have found the food item desired double click on it. It will then appear in the ‘Food list item’ box and the food item which you entered will turn black.

8. If you would like more information about any of the food items you can obtain a nutritional analysis by clicking on the food item then pressing on view nutrients, . A nutrient list for the selected food item will pop up under the ‘Favourites/History’ window.
9. You can also get more information about the recipes by clicking on the food item then pressing the view recipes button. This will bring up a pop up window under the ‘Favourites/History’ window with the ingredients and the amounts used in the recipe selected.
10. To enter in the amount of the food item which was eaten, click on the ‘Amount’ box next to the food item.

After clicking the ‘Amount’ box another box will pop up which offers a variety of different ways to describe the amount of the food item consumed.

11. Enter in the amount consumed using the most appropriate unit of measurement. Select only one method for recording the amount as the Web-MBIAT uses a hierarchy if more than one method is recorded i.e. A value in the ‘Measure descriptions’ ‘How many’ column takes priority over a value in the ‘Volume information’ ‘How many’, which takes priority over a value in the ‘Amount’ column.
12. Now would be a good time to save the data which you have entered by clicking . Remember to save regularly. A little green triangle is present in the amount column of all unsaved data.

13. Repeat steps 3-12 until everything consumed at the specified meal occasion has been entered. Remember to save regularly.
14. When all the data for a meal occasion has been entered click the exit button, 

15. The following box will pop up, if the record is completed click OK otherwise click cancel and enter in any missing data.

16. Another box will pop up, enter value as appropriate
One meal occasion has now been completed.

17. A descriptor can be typed into the descriptor column to describe the meal occasion i.e. weekday breakfast

18. Click then type a descriptor if desired
Entering a new recipe

You may need to enter a new recipe when you cannot find a particular recipe in the food list, or it may be more accurate to create your own.

1. Click  to enter name of food item e.g., sandwich.
2. Then click on next to the food item, to create a new recipe.

3. A new window will appear to enter ingredients. Note: the recipe name is at the top of the window to help you stay on track.

Enter ingredients by clicking on .
4. You will be prompted to enter ingredients one after the other.

For a sandwich, you may enter ‘bread’, ‘cheese’, ‘lettuce’ and ‘chicken’ for example. In each ingredient, you can search the food list and enter the amount, just as you did with the steps in entering a new diet record (see page 6, 7 and 9).

Once you have completed the recipe, click 📜 to save, and ✋ to exit back to the ‘Meal definition’ window.
5. Enter the amount of the recipe (as a percentage) that has been eaten.

Once you have completed entering the amount, click to save.

If there is another new recipe to enter for this meal, repeat the steps outlined in this section.
If there are other food items to enter, repeat the steps outlined in entering a new diet record.
Click \(\times\) to exit back to the ‘Meal instances’ window.

Note:

1. You cannot use \(\text{nutrient view}\) to view nutrients of a new recipe.

2. Do not click \(\text{create recipe}\) at the bottom of the food list. This will aim to create a new recipe for the food list, and not for defining your meal.

**Editing food items**

Entered food items can be edited very simply by clicking the box which you wish to edit in the edit meal window. For example if you wish to change the amount which has been entered click the amount box which is to be edited and the pop up will appear. The same can be done for the Item. To change the food list item click the food item you wish to change and double click on the food item you wish to replace it with.

**Favourites**

When entering food items into a meal occasion there is a panel on the side which is titled ‘Favourites/History’. Food items can be added to the favourites list to make entering commonly consumed food items quick and simple.

1. Once a food item has been entered into a meal occasion (see steps 3-8 of entering a simple meal) double click the food item. This will cause the food item to appear in the favourites list

2. Save the favourites list by clicking the save button, \(\text{save}\).
1. Double click

Food item has appeared here

2. Click
3. In order to use items in the favourites list add a new item as normal (step 3-5 of entering a simple meal) then double click the desired item from the favourites list.

4. Food items can also be deleted from the favourites list by clicking on the item (in the favourites list) and clicking delete.
History

When entering food items into a new meal occasion you are able to get a list of the food items and amounts which have already been entered for this participant. The history can be used to enter food items which have already been entered (in other meal occasions) in the same quantity in this new meal occasion.

1. Add a new food item as normal (step 3 and 4 of entering a simple meal).

2. Click history on the ‘Favourites/History’ panel. This will change the favourites list to a record of the previously entered food items for this participant.
3. Click the ‘Food list item’ box and instead of selecting a food item from the food list select the desired item from the history list.

The food item will then appear in the food diary in the quantity previously consumed. This is very useful if a participant consumes an item often e.g., coffee.

4. The history list can easily be converted back to the favourites list by clicking favourites on the ‘Favourites/History’ panel
Copying and pasting food items

Food items can also be copy and pasted, producing a replica of the item chosen. This is particularly useful if a food item is consumed more than once in a particular meal occasion.

1. Click on the food item that is to be copied.

2. Press copy row,

3. Click paste, , and the food item will appear at the bottom of the food list. Using the paste button will paste the last item copied to the food diary therefore an item can be copied just once but pasted multiple times (creating multiple copies of the item).
Add a new meal occasion

1. A new meal occasion can be added by clicking the add button, +, on the ‘Meal instances’ page. This will bring up an empty row beneath the current meal list.

2. Click the empty ‘Meal’ column and a box will pop up

3. Choose the desired meal occasion from the drop down meal
**Edit meal counts**

1. Click the meal count button, ![image](image.png), in the ‘Meal instances’ window.

2. This will take you back to the meals window where changes can be made as desired.
Edit meal occasion

1. On the ‘Meal instances’ page click the completed box next to the meal which you wish to edit.

2. Click the describe meal button, ➔.

This will take you back to the ‘Meal definition’ window where you can make the necessary changes.
Continuing a diet record

1. After logging in, on the left panel under ‘Projects’, click on ‘Web-MBIAT Pilot Studies’.

2. Then click on ‘Records’ under ‘Diets’ in the left panel.
3. To continue a diet record, click on the diet ID to select, and then click ‘continue diet record’ at the bottom of the window. Note: from the left panel, you can also view all diet records from other interviewers, or begin a new one.

At any time during continuing a diet record, you can change any information that has been entered previously. This may be saved automatically or you will be prompted to save your progress.

A closer look:

- **3a. Click**
- **3b. Click**

**Filter** to sort through diet records
**Arrows to move back and forth between pages of diet records**
**Add a new diet record**
**Continue diet record**
**Exit to exit window**

**Save** to save any changes made to diet record identification (e.g., ID, day #, diet date etc)
**Import diet records** from other sources (e.g., Diet Cruncher)
**Delete a diet record**
**Nutrient analysis of a single or multiple diet records**

**Help button**
The forgotten food list

1. Once you have completed describing all meals, click ‘Continue’.

2. A new window will appear with a list of forgotten foods that the respondent may have forgotten to mention during the FFQ. These foods contain high amounts of the nutrients and food components being assessed (i.e., iron, zinc, and their associated absorption modifiers).

Scroll through the list with the respondent. If they have forgotten a food, click ‘Edit meals’ and you will be taken back to the ‘Meal instances’ window (seen in step 1) to make changes. If the respondent has not forgotten a food item, click ‘Continue’.
3. Before moving on to nutrient analysis, you will be prompted to confirm number of meals per week. Make the necessary changes if needed, and once completes, click ‘Analysis’ for nutrient analysis of the FFQ (see Nutrient Analysis section).

Note: clicking ‘Close’ will take you back to the ‘Your Diet Record’ window.

**Nutrient Analysis**

You can analyse the nutrient content of a single or multiple diet records.

1. Click on ‘Records’ under ‘Diets’ in the left panel.
2. To analyse a single diet record (in either ‘View all’ or ‘View yours’), click on the ID of the desired diet record. This will now appear in the text field next to ‘Analyse all interviews for’. Note: for the Web-MBIAT, ‘all interviews’ will be only one diet record per client.

3. Click 📢 at the top of the window to analyse the diet.

Note: here you also have the option to print diet records. Simply click 🖨️ at the top of the window to print.
4. A new screen will appear with average values of nutrient content for your selected diet record: per meal occasion and per day (with both adjusted and unadjusted values).

Here, you can also chose to export data under each nutrient analysis by clicking . This will prompt you to save the file to an Excel spreadsheet for example.

Once you have completed nutrient analysis, click ‘Close’ or on any to exit back to the diet record window, as seen in step 2.
5. To analyse all diet records, click (Nutrient analysis ALL) at the bottom of the window.

You will be prompted to confirm the analysis of all data selected. Click OK.

6. A new screen will appear with average values of nutrient content for each diet record: per meal occasion and per day (with both adjusted and unadjusted values).

To export data or exit nutrient analysis window, follow instructions in step 4.
Additional features

Printing a diet record

1. To print, select the diet record ID. This will now appear in the text field next to ‘Analyse all interviews for’. Then click to print.

2. A new window will appear with the selected diet record in print format. To print, simply click on the print icon. Note: you can also choose to download the file.

3. Once completed, click on to close the report.
View personnel/edit your details

To view personnel:

1. In the left panel, click on ‘View’ under ‘Personnel’.

2. Here you can choose to add, delete, edit or import users for current staff by clicking on the corresponding icon (see icons list on page 41).

3. Click on ‘Save’ if changes have been made.

Note: You can also view ‘Available staff’ within the same window.
To view or edit your details:

1. In the left panel, click on ‘View’ under ‘My details’. Here you can edit your details (e.g., name or email address).

2. Once completed, click ‘Save’ and you will be taken back to the project menu. Note: clicking ‘Cancel’ will take you to the main menu.
Client data

The Web-MBIAT allows you to view and edit client details, as well as booking appointments in the calendar.

To view/edit client details:

1. On the left panel, click ‘Details’ under ‘Client data’. A list of all Web-MBIAT clients will appear.

2. To view/edit details for a specific client, click on the desired ID and then click at the bottom of the window.

A closer look:

Several icons, each with a function, are at the bottom of the screen when you view diet records.
3. A new window will appear with titled ‘Patient details’. Once completed, click either ‘Save’ or ‘Close’ and you will be taken back to the ‘Client details’ window.

To make an appointment

1. Click on the desired client ID and then click .

1a. Click

1b. Click
2. A new window will appear titled ‘Appointments’ showing a calendar with the current date highlighted. Note: you can view the calendar in a month, week or day format.

3. Click on the desired date and time e.g. Wed 10/4, 9am.

4. You will be prompted to enter your client’s name. Click ‘OK’.
5. Once entered, your client’s name will appear in the date and time field selected. To view or edit appointment details, click on the appointment on the calendar.

6. A pop-up window will appear outlining appointment details. Here you can make changes or delete the appointment altogether.

Note: You can also access the calendar from the left panel. To do this, click ‘Calendar’ under ‘Client data.’
To change calendar options

1. In the left panel, click ‘Calendar options’ under ‘Client data’. A new window will appear. Here you can change formatting options for the calendar (e.g., slot duration and start time etc).

2. Once changes have been made, click ‘Save’ and you will be taken back to the project menu.

2. Click to save changes
Potential problems

- What is the Unknown report for?

- When a project is analysed an ‘Unknowns’ report may display on the screen. This report includes all the participants and foods and nutrients for which there is missing information. All Unknowns need to be investigated then corrected or accepted as true unknown values.

  Examples include:
  - Data not entered correctly, i.e., missing amounts, foods not selected, recipes with missing amounts or foods not entered.
  - Foods not in food groups.
  - Missing density values so volumes of foods will not calculate to gram amounts.
  - Missing nutrient/food component values.

- Internet connection- the Web-MBIAT is best used with a broadband connection, as a fast connection speed is needed to move between steps efficiently. Using dial-up may slow down the completion of the questionnaire.

- Type of web browser –Kai-Culator (which hosts Web-MBIAT) has been developed for use with major browsers and requires Javascript and Cookies to be enabled.
  - If you have problems with Internet Explorer try adding "binky.otago.ac.nz" to the Trusted Sites zone. This is found under Tools | Internet options | Security tab.
  - Alternatively, you can use Mozilla Firefox
  - If you continue to have problems, please contact Charlie Blakely at charlie.blakey@otago.ac.nz
# Food list notes and substitutions

## Bakery products

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread crumbs, white, dried</td>
<td>Bread, white, sliced, prepacked</td>
</tr>
<tr>
<td>Chapati</td>
<td>Bread, Ciabatta</td>
</tr>
<tr>
<td>Chinese bread, steamed</td>
<td>Bread, Ciabatta</td>
</tr>
<tr>
<td>Cream crackers</td>
<td>Cracker, assorted flavours</td>
</tr>
<tr>
<td>Cruskits</td>
<td>Rice cracker, plain, composite</td>
</tr>
<tr>
<td>Currant bun</td>
<td>Bun, iced</td>
</tr>
<tr>
<td>Fruit biscuit, flat</td>
<td>Biscuit, malt</td>
</tr>
<tr>
<td>Fruit cake</td>
<td>Cake, chocolate, standard</td>
</tr>
<tr>
<td>Garlic bread</td>
<td>Bread, white, sliced, prepacked</td>
</tr>
<tr>
<td>Hundreds &amp; Thousands iced biscuit</td>
<td>Biscuit, ‘Gingernut’</td>
</tr>
<tr>
<td>Italian style bread</td>
<td>Bread, Ciabatta</td>
</tr>
<tr>
<td>Madeira cake</td>
<td>Doughnut, ring</td>
</tr>
<tr>
<td>Maori bread, white, fried</td>
<td>Bread, white, sliced, prepacked</td>
</tr>
<tr>
<td>Oaty fruit biscuit, low fat</td>
<td>Biscuit, fruit, ‘Digestive’</td>
</tr>
<tr>
<td>Panini</td>
<td>Bread, white, sliced, prepacked</td>
</tr>
<tr>
<td>Shrewsbury biscuit</td>
<td>Biscuit, ‘Gingernut’</td>
</tr>
<tr>
<td>Soy and Linseed bread</td>
<td>Bread, wheatmeal, sliced, prepacked</td>
</tr>
<tr>
<td>Sponge cake, jam filled</td>
<td>Cake, chocolate, standard</td>
</tr>
<tr>
<td>Toasted bread</td>
<td>Untoasted version of corresponding bread</td>
</tr>
<tr>
<td>Turkish bread</td>
<td>Bread, Ciabatta</td>
</tr>
<tr>
<td>Water crackers</td>
<td>Cracker, assorted flavours</td>
</tr>
</tbody>
</table>

## Beverages, non-alcoholic

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powdered drink flavours e.g., Raro (excludes low energy varieties)</td>
<td>Drink flavour, navel orange, diluted</td>
</tr>
<tr>
<td>Cranberry Juice</td>
<td>Juice, tomato, McCoy</td>
</tr>
<tr>
<td>Grapefruit juice, sweetened</td>
<td>Juice, tomato, McCoy</td>
</tr>
<tr>
<td>Pineapple, grapefruit, grape or blackcurrant juice</td>
<td>Juice, orange, unsweetened</td>
</tr>
<tr>
<td>Instant coffee (powder) or decaffeinated</td>
<td>Coffee, brewed</td>
</tr>
<tr>
<td>Coffee, espresso</td>
<td>Coffee, brewed</td>
</tr>
</tbody>
</table>

Note: Smoothie – If the smoothie is fortified use ‘Smoothie, berry fruit, fortified’ but if it is not fortified enter the smoothie as a new recipe
# Breakfast cereals

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Bran Wheat Flakes, Kellogg’s</td>
<td>Bran cereal</td>
</tr>
<tr>
<td>Frosties, Kellogg’s</td>
<td>Froot Loops, Kellogg’s</td>
</tr>
<tr>
<td>Fruitful Breakfast, Hubbards</td>
<td>Light &amp; Tasty, Sanitarium</td>
</tr>
<tr>
<td>Porridge made with milk</td>
<td>Porridge, prepared with water and add in milk separately</td>
</tr>
<tr>
<td>Weet-Bix Oat Bran, Sanitarium</td>
<td>Wheat, puffed, Sanitarium</td>
</tr>
<tr>
<td>Weeties, Sanitarium</td>
<td>Wheat, puffed, Sanitarium</td>
</tr>
</tbody>
</table>

Note: Use ‘Light & Tasty’, Sanitarium for all flavours of Light & Tasty

# Cereals and pseudo-cereals

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frozen spaghetti meal</td>
<td>Lasagne, beef, frozen meal</td>
</tr>
<tr>
<td>Vegetable flavoured pasta, boiled</td>
<td>Pasta, plain, boiled</td>
</tr>
<tr>
<td>Jasmine rice</td>
<td>Rice, white, polished, boiled</td>
</tr>
<tr>
<td>Macaroni or spaghetti, boiled</td>
<td>Pasta, plain, boiled</td>
</tr>
</tbody>
</table>

# Dairy

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colby Cheese</td>
<td>Cheese, cheddar, tasty</td>
</tr>
<tr>
<td>Condensed milk, sweetened, whole</td>
<td>Milk, evaporated, whole</td>
</tr>
<tr>
<td>Goat milk</td>
<td>Milk, trim, 0.5% fat, composite</td>
</tr>
<tr>
<td>Gouda cheese</td>
<td>Cheese, Edam</td>
</tr>
<tr>
<td>Greek style yoghurt</td>
<td>Yoghurt, Yoplait ‘Lite’ asst frt, low f, swt</td>
</tr>
<tr>
<td>Gruyere cheese</td>
<td>Cheese, Egmont</td>
</tr>
<tr>
<td>Lite milk (1.5% fat), Trim milk (0.5%), Ultra</td>
<td>Milk, whole, 3.3% fat, composite</td>
</tr>
<tr>
<td>trim milk (0.3% fat), High calcium milk (0.1%</td>
<td></td>
</tr>
<tr>
<td>fat)</td>
<td></td>
</tr>
<tr>
<td>Mild cheddar cheese</td>
<td>Cheese, cheddar, tasty</td>
</tr>
<tr>
<td>Mozzarella cheese</td>
<td>Cheese, processed</td>
</tr>
<tr>
<td>Parmesan cheese</td>
<td>Cheese, swiss</td>
</tr>
<tr>
<td>Quark</td>
<td>Cheese, ricotta</td>
</tr>
<tr>
<td>Silton cheese</td>
<td>Cheese, blue vein</td>
</tr>
<tr>
<td>UHT milk</td>
<td>Milk, whole, 3.3% fat, composite</td>
</tr>
</tbody>
</table>

# Eggs

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poached eggs</td>
<td>Egg, chicken, boiled</td>
</tr>
</tbody>
</table>
### Fast foods

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curried prawns and rice</td>
<td>Green curry, chicken</td>
</tr>
<tr>
<td>McDonalds hamburger</td>
<td>Burger, hamburger</td>
</tr>
<tr>
<td>Steak pie</td>
<td>Pie, mince, individual size, spmkt, rte</td>
</tr>
<tr>
<td>KFC coleslaw</td>
<td>Coleslaw</td>
</tr>
<tr>
<td>McDonalds fried egg</td>
<td>Egg, fried in vegetable oil</td>
</tr>
</tbody>
</table>

### Finfish

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cod, smoked, poached</td>
<td>Hoki, smoked, flesh, poached</td>
</tr>
<tr>
<td>Eel, flesh, stewed</td>
<td>Hoki, smoked, flesh, poached</td>
</tr>
<tr>
<td>Monkfish</td>
<td>Tuna, skipjack, flesh, raw</td>
</tr>
<tr>
<td>Salmon, Atlantic, fillet, raw</td>
<td>Hoki, smoked, flesh, poached</td>
</tr>
<tr>
<td>Sole</td>
<td>Trevally, flesh, baked</td>
</tr>
</tbody>
</table>

Notes:
- Assume all varieties of canned tuna are Tuna, canned in brine, drained
- Assume all cooking methods are the same e.g., grilled, baked, steamed or fried
- If the desired variety of fish cannot be found or the participant does not know what kind of fish was consumed use Mackerel, fried

### Fruit

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currants, dried</td>
<td>Sultanas</td>
</tr>
<tr>
<td>Figs, dried</td>
<td>Sultanas</td>
</tr>
</tbody>
</table>

### Meat

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goose</td>
<td>Turkey, comp cuts, l, f&amp;s, rstd, w/oven bag</td>
</tr>
</tbody>
</table>

Note: All cuts of meat (beef, lamb and turkey) are grouped into composite cuts excluding chicken breast, venison and mutton

### Meat products

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frankfurters</td>
<td>Sausage, preckd, dry fried, asst meats&amp;flvr</td>
</tr>
<tr>
<td>Frozen roast meals</td>
<td>Beef Roast, frzn meal, w/roast potato veg, rte or enter food components in individually</td>
</tr>
<tr>
<td>Ham and pork, canned</td>
<td>Pork, ham</td>
</tr>
</tbody>
</table>
## Recipes

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Custard egg pudding</td>
<td>Pudding, sponge, fruit, steamed</td>
</tr>
<tr>
<td>Flan, cheese and egg</td>
<td>Quiche, Lorraine</td>
</tr>
<tr>
<td>Hummus, homemade</td>
<td>Hummus, original, 6.5% fat, commercial</td>
</tr>
</tbody>
</table>

Note: Kebab, lamb, yoghurt marinade is not an ingredient but a lamb kebab which has yoghurt marinade.

## Sauces and condiments

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coleslaw dressing</td>
<td>Dressing, ‘Potato salad’, Eta</td>
</tr>
<tr>
<td>Feta and Spinach dip</td>
<td>Sour cream dip</td>
</tr>
</tbody>
</table>

## Snack foods

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato straws</td>
<td>Potato crisps, plain</td>
</tr>
<tr>
<td>Sweet potato chips</td>
<td>Potato crisps, plain</td>
</tr>
</tbody>
</table>

## Soups

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish chowder</td>
<td>Soup, chicken, condensed, canned</td>
</tr>
</tbody>
</table>

## Sugar, confectionery and sweet spreads

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mars bar</td>
<td>Chocolate, Cadbury, ‘Moro’, bar</td>
</tr>
</tbody>
</table>

## Vegetables

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Food Item to Select in Web-MBIAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fennel</td>
<td>Puwha, sow thistle, leaves &amp; upper stem, boil</td>
</tr>
<tr>
<td>Parsnip and carrot, mashed</td>
<td>Carrot, flesh, boiled, drained</td>
</tr>
<tr>
<td>Swede</td>
<td>Turnip, flesh, boiled, drained</td>
</tr>
</tbody>
</table>

Note: The food list only includes food items which affect iron and zinc absorption; therefore, there will be food items that will not be found in the Web-MBIAT, these include fats and oils, herbs and spices and alcoholic beverages.
Appendix D: Recruitment email
Dear Staff Member or Graduate Student,

My name is Areege Hussein and I am writing to ask if you would be interested in participating in an important study as part of my Master of Dietetics program. The study is looking at the ease of use of a computerized food frequency questionnaire (FFQ) (designed to estimate iron intakes in women aged 18-50y) from the perspective of an interviewer.

Interviews will be conducted in the weeks beginning 15th and 22nd of April, and it is estimated your participation will take around one and a half hours. This will include teaching you how to use the FFQ, asking you to use it and then asking you to describe your experience and any feedback you may have.

If you choose to participate, you will be given a $20 voucher to recognize the costs involved with participating in this study.

This study has been reviewed and approved by the Department of Human Nutrition, the University of Otago. Further information regarding the study can be found on the information sheet attached.

If you are interested, please send me an email with a date and time you are available. My email address is at the bottom of this message.

Thank you in advance for your time and consideration, it is greatly appreciated.

Sincerely,

Areege Hussein
Masters of Dietetics Candidate
Department of Human Nutrition
University of Otago
husar221@student.otago.ac.nz

Dr Anne-Louise Heath
Senior Lecturer
Department of Human Nutrition
University of Otago
(03) 4798379
anne-louise.heath@otago.ac.nz

If you have any concerns about the ethical conduct of the research you may contact the University of Otago Ethics Committee through the Human Ethics Committee Administrator (ph 03 479-8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Appendix E: Information sheet and consent form
How user-friendly is the Web-MBIAT dietary assessment tool?

INFORMATION SHEET FOR PARTICIPANTS

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the aim of the project?
The “Web-MBIAT” (Web version of the Meal-Based Intake Assessment Tool), is a web-based questionnaire that has been developed to collect information on usual food intake by meal. This is unusual because food questionnaires usually ask people to remember what they eat in general, rather than in different meals. The aim of this project is to ask 10 pre-menopausal women to fill in the questionnaire on line, and 10 to use it as an interviewer, and tell us how well they think it works, and how they think it could be improved. This project is being undertaken as part of the requirements for the Masters of Dietetics course, but will also contribute to improvements in the Web-MBIAT so that it can be used effectively in studies of iron and zinc intake in women in New Zealand, Australia and elsewhere.

What type of participants are being sought?
We are seeking approximately 20 participants (10 of whom will be premenopausal adult women). Participants will be given a $20 voucher to recognize the costs involved with participating in this study.

What will I be asked to do?
Should you agree to take part in this project, you will be asked to attend an audiotaped one-to-one interview which will take approximately 1.5 hours. The interview will collect information on how well the Web-MBIAT questionnaire works for you, and what you think of its design. You will also be invited to discuss possible solutions or improvements to the MBIAT questionnaire.

What data or information will be collected and what use will be made of it?
The interview will gather information on how easy it is to use the Web-MBIAT questionnaire with the general line of questioning focussing on its design and format. Any opinions and possible recommendations you have for improvement will also be covered. Data gathered will be used to improve the usability of the MBIAT questionnaire before it is used for further studies at a later date. We will also ask some standard questions about you (for example, your age category and ethnicity).
so that we can describe the group of people who have been involved. This information will be collected by ID number and will be kept anonymous.

As noted above, the interview will be audiotaped and transcribed. The researchers, their supervisors, research assistants, transcribers and yourself, will have access to this transcript. You will be able to correct or withdraw your script if you choose to do so. Every endeavour will be made to preserve participant anonymity.

All other data collected will be securely stored in such a way that only those mentioned above will be able to gain access to it. At the end of the project any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which they will be destroyed.

This project may involve an open-questioning technique focusing on the topics described above. The precise nature of the questions which will be asked has not been determined in advance, but will depend on the way in which the interview develops.

**Can I change my mind and withdraw from the project?**

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

**What if I have any questions?**

If you have any questions about our project, either now or in the future, please feel free to contact:

Catherine Luey and/or Areege Hussein
Department of Human Nutrition
University Telephone Number […] University Telephone Number […]
lueca621@student.otago.ac.nz husar221@student.otago.ac.nz

and/or Dr Anne-Louise Heath
Department of Human Nutrition
(03) 4798379
anne-louise.heath@otago.ac.nz

This study has been approved by the Department stated above. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479-8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

15 Dec 2012
How user-friendly is the Web-MBIAT dietary assessment tool?

CONSENT FORM FOR PARTICIPANTS

I have read the Information Sheet on this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:
1. My participation in the project is entirely voluntary;
2. I am free to withdraw from the project at any time without any disadvantage;
3. Personal identifying information (audiotapes, transcripts) will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for at least five years;
4. This project may involve an open-questioning technique. The general line of questioning will focus on how easy it is to use the Web-MBIAT questionnaire, and its design and format. Any opinions and possible recommendations I have for improvement will also be covered. The precise nature of the questions which will be asked has not been determined in advance, but will depend on the way in which the interview develops.
5. I am aware that if the line of questioning develops in such a way that I feel hesitant or uncomfortable, I have the right to decline to answer any particular question(s).
6. I will be given a $20 voucher to recognize the costs involved with participating in this study.
7. The results of the project may be published and available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve my anonymity.

I agree to take part in this project.

.................................................. ..................................................
(Signature of participant) (Date)

.................................................................
(Name of participant)  15 Dec 2012
Appendix F: Recruitment protocol
Purpose of Sending email

Objective: To recruit participants who are staff or graduate students at the Department of Human Nutrition, University of Otago, as interviewers for the Web-MBIAT study.

Equipment required

Protocols: P-1: Sending recruitment email and replying back to potential participants

Paperwork: Recruitment email, consent form and information sheet

Department of Human Nutrition, University of Otago, email contact list: List accessed by Madeline Sim (Administrative Secretary) at the Department of Human Nutrition office.

Steps - Before

Ensure you have the recruitment email, consent form and information sheet prepared before approaching Madeline Sim to send email to Department of Human Nutrition staff and graduate students.

Replying to potential participants via email

1) Thank participant for showing interest
2) Describe interview session (what, where, and length)
3) Organize time and place for interview session (for the weeks beginning 15th and 22nd April)
4) Remind participant they can leave the study at any time
5) Give participant contact details to answer any questions they may have

Record the date and time for the interview session in the participant file (word document) and the Web-MBIAT program.

Steps - After

Check the date and time for the interview session is the same in the participant file and the Web-MBIAT program. If not email the participant again to check which time and date are the right ones and make appropriate corrections.
Appendix G: Pretesting interview protocol
Purpose of Interview

Objective: To gather qualitative and quantitative feedback from each interviewer on the usability of the Web–MBIAT program and its user’s manual.

Equipment required

Protocols: P-2: Interview Protocol

Paperwork: participant file, consent form, information sheet, user’s manual, interviewer characteristics questions, feedback questions

Recording: Dictaphone, timer

Web-MBIAT program: Program open at the Department of Human Nutrition, University of Otago

Steps - Before

Ensure you have in front of you the consent form, information sheet, user’s manual, interviewer characteristics questions, and feedback questions. Also have Dictaphone ready to record the session, and the Web–MBIAT program open.

Begin Interview session

1) Introduce self
2) Ask participant to read information sheet and sign consent form
3) Describe what will happen in the session (1. Interviewer characteristics, 2. User’s manual and brief guide to Web–MBIAT program, 3. Conduct FFQ, and 4. Feedback questions)
4) Begin recording
5) Ask interviewer characteristics questions
6) Give user’s manual and answer any questions
7) Conduct FFQ and record time to complete
8) Ask feedback questions
9) Thank them for their time and give $20 reimbursement

- Hello, I am Areege and I will be interviewing you today about your experience with the Web–MBIAT program and its user’s manual.
- Before we begin, please read and sign...(Collect signed consent form and place in participant file).

Information sheet and consent form – handout
Signed consent form - collect
• This session will take...hours. First I will ask you a few general questions about... Then I will give you...to familiarise yourself with the Web–MBIAT program. Please do not hesitate to ask me a question, I am here to help.

<table>
<thead>
<tr>
<th>Dictaphone – recording</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questions</td>
</tr>
<tr>
<td>- Age</td>
</tr>
<tr>
<td>- Sex</td>
</tr>
<tr>
<td>- English as first language</td>
</tr>
<tr>
<td>- Previous FFQ experience</td>
</tr>
<tr>
<td>- Confidence scale for using computer programs</td>
</tr>
</tbody>
</table>

User’s manual – hand out

• Next we will use the Web–MBIAT program to conduct the FFQ. You will be the interviewer and I will be your respondent. As we go, please do not hesitate to ask me any questions. *(Begin timing the FFQ interview and record time on paper once finished).*

<table>
<thead>
<tr>
<th>Web–MBIAT program – open</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timer – begin timing</td>
</tr>
</tbody>
</table>

• Finally, I will ask you questions about...to get your feedback. This will take about...minutes. *(Write down feedback on paper and place in participant file).*

<table>
<thead>
<tr>
<th>Web–MBIAT feedback questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Interface</td>
</tr>
<tr>
<td>- Instructions/questions</td>
</tr>
<tr>
<td>- Logic/navigation</td>
</tr>
<tr>
<td>- Main and short food list</td>
</tr>
<tr>
<td>- User’s manual</td>
</tr>
</tbody>
</table>

• This completes the session. Thank you...for your time. Here is... *(Keep record of who receives reimbursement).*

| Reimbursement ($20 voucher) - handout |

### Steps - After

Give signed consent forms to Anne-Louise Heath. Keep participant file (interviewer characteristics, voice recording, FFQ time and feedback answers) in a secure room.
Appendix H: Interviewer characteristics questions
Web-MBIAT interviewer questionnaire

- Name:

- Age:

- Position at Dept Human Nutrition: Staff/Student (please circle one)
  - If you are a student, please specify study details:

- Is English your first language? Yes/No (please circle one)

- Have you previously worked as a Dietitian or Human Nutritionist? Yes/No (please circle one)
  - If yes, please state how long you worked for:

- In the past, how many types of food frequency questionnaires (FFQs) have you:
  - Administered:
  - Completed:

- On the scale below, please indicate how confident you are with using computer programs (0 – not confident, 10 – very confident).

  0 1 2 3 4 5 6 7 8 9 10

  Not confident  Very confident
Appendix I: Standardised diet used for pretesting
Meal occasions in an average week

- Breakfast: 7 times
- Morning snack: 7 times
- Lunch: 7 times
- Afternoon snack: 3 times
- Dinner: 7 times
- After dinner snack: 0 times

Meal instances

- Breakfast: type 1 (4 times in a week):
  - Coffee (1 C)
  - Porridge (1 C)
  - Yoghurt (1/2 C)
  - Apple (1 medium)

- Breakfast type 2 (3 times in a week):
  - Coffee with milk (1 cup)
  - Eggs (2 large)
  - Wholegrain toast (2 thin slices)
  - Banana (1 medium)

- Morning snack (7 times in a week):
  - Mixed nuts (30g)
  - Raw carrot (1 medium)
  - Herbal tea (1 C)
• Lunch (7 times in a week):
  Sandwich:
    Wholegrain bread (2 thin slices)
    Chicken breast (1/2 C)
    Lettuce (2 leaves)
    Cucumber (4 slices)
    Tomato (2 slices)
    Orange (1 medium)

• Afternoon (3 times):
  Fresh ‘n’ Fruity lite yoghurt (1/2 C)
  Raw carrot (1 medium)

• Dinner type 1 (3 times):
  Beef stir-fry:
    Beef (100g)
    Broccoli and Cauliflower (2 C)
    Oil (1 Tb)
    Soy sauce (1 Tb)
    Chilli sauce (1 Tb)
    Herbal tea (1 C)

• Dinner type 2 (3 times):
  Salmon (1 fillet)
  Spinach fresh (2 cups)
  Pumpkin roasted (1.5 C)
  Peas (1/4 C)
  Herbal tea (1 C)
Appendix J: Pretesting interview questions
Method: Retrospective interviewing

Sample: End-users (interviewers)

Goal: Usability evaluation

General questioning

1) What aspects did you like about using the Web-MBIAT?

2) What aspects did you not like about using it?

Further probing

3) What did you find easy to use or do?

4) What did you find difficult to use or do?

5) What are your thoughts about the time and effort taken to complete a questionnaire using the Web-MBIAT?

6) What do you think about the layout and design?

7) What do you think about the flow of using the Web-MBIAT?
   a. Were the steps logical?
   b. How would you improve it?

8) What do you think about the food list?

9) What do you think about the instruction manual?
   a. Was it helpful?
   b. How would you improve it?

10) Any further comments or suggestions?
Appendix K: Main iron food list
**Bakery products**

- Bread, white, sliced, prepacked
- Bread, wheatmeal, sliced, prepacked
- Bread, multi-grain, light, sliced, prepacked
- Croissant
- Bread, multi-grain, heavy, prepacked
- Bread, Ciabatta
- Cracker, wholemeal and sesame
- Bread, pumpernickel
- Muffin, blueberry
- Muffin, chocolate
- Muffin, bran
- Bun, iced
- Bun, spiced
- Bread, sunflower & barley, sl, prepacked
- Bread, white, high fibre, sl, ppkd
- Bread, currant, sliced, prepacked
- Bread roll, whml, pre-packaged
- Bread roll, white, pre-packaged
- Doughnut, ring
- Biscuit, plain, 'Digestive'
- Bread, pita, wholemeal, pre-packaged
- Bread, wheat/oat, sliced
- Bread, wheat/rye, sliced & unsliced
- Bagel, plain
- Bread, Pita, White (NZR)

**Beverages, non-alcoholic**

- 'Bournvita', powder
- 'Activate' Probiotic drink, Meadow fresh, Assorted
- 'Milo', powder, fortified09
- Smoothie, berry fruit, fortified
- Juice, orange, unsweetened
- 'Lucozade'
- Tea, Indian, infused
- Cocoa, powder
- Coffee, brewed
- Juice, apple, unsweetened, 'Fresh Up'
- Drink flavour, navel orange, diluted
- Tea, herbal, ready to drink
- Tea, instant, lemon flvr, sweetened, powder
- Chocolate, drinking, powder

**Breakfast cereals**

- Bran cereal
- Weet-Bix Oat Bran, Sanitarium
- Corn flakes, 'Sanitarium'
Ricies, 'Sanitarium'
Wheat bran biscuits
Porridge, prepared with water
`Coco Pops', Kellogg's
Muesli, toasted, sweetened
`Sustain', Kellogg's
`Light & Tasty', Sanitarium
Muesli, natural, Sanitarium
Muesli porridge

Cereals and pseudo-cereals
Spaghetti, in tomato sauce, canned
Tempeh
Rice, Sushi, cooked, part of California roll
Rice, wild, cooked
Noodles, Japanese, udon, boiled
Quinoa, cooked
Crispy noodles
Tofu, regular, steamed, microwaved
Wheat bran
Wheat germ
Pasta, egg, boiled
Pasta, plain, boiled
Pasta, wholemeal, boiled
Spaghetti bolognaise, frozen meal
Macaroni cheese, frozen meal

Couscous, cooked
Oat bran
Rice, white, polished, boiled
Noodles, egg, boiled
Rice, brown, boiled
Yoghurt, soy
Ravioli, fresh, beef and pork, cooked
Tortellini, fresh, spinach, cooked
Noodles, rice, boiled
Bulgur, boiled
Semolina, cooked
Rice cake, original

Eggs
Egg, fried in vegetable oil

Fast foods
Soup, Chicken Sweetcorn, Chinese
Chinese, Sweet & Sour Pork
Stirfry, Black Bean Beef, Chinese
Stirfry, Chicken & Cashew Nuts, Chinese
Noodles, Chinese, Chow Mein, Combination
Fried Rice, Chinese, Combination
Beef salad, Thai
Green curry, Chicken
Pad Thai, W Egg Chicken, Noodles
Butter Chicken
Chicken Masala
Rogan Josh, Lamb
Beef Korma
Beef Madras
Wonton, pork filled, frozen, deep fried, retail
Roll, Deli Choices, McDonald's
Potato and Gravy, KFC
Potato, fries, Independent Shop All (2009)
Burger, 'Quarter Pounder', McDonald's
Chicken, barbecue, front portion, KFC
Pork, with garlic & chilli sauce
Pork, spare ribs, barbecue sauce
Chicken, with garlic & chilli sauce
Spring roll, deep fried
Seafood with vegetables comb., stir fried
Beef, with pineapple & ginger
Beef, with cashews
Squid, with broccoli, stir-fried
Potato, hashbrown, McDonald's
Nugget, chicken, McDonald's
Juice, orange, McDonald's
Potato, wedges, KFC, skin off, spiced
Fish, fillet, crumbed, frozen, fried
Burger, bacon
Fish, battered, deep fried
Fish, cake, deep fried
Burger, cheese
Pizza, supreme, medium, thick, P'Hut
Potato salad, KFC
Burger, hamburger
Fish, fingers, baked
Sweet & sour fish
Crab, in black bean sauce
Chop suey, pork
Chow mein, beef
Chicken & almonds
Chow mein, chicken
Chop suey, chicken
Chicken, lemon
Beef in oyster sauce
Burger, 'Big Mac', McDonald's
Beef satay
Steak in black bean sauce
Pork in plum sauce (NZR)
Pork barbecued (NZR)
Duck and mushrooms, steamed
Sweet & sour duck
Prawns, garlic
Prawns, satay
Sweet & sour prawns
Prawn cutlets (NZR)
## Finfish
- Cod, flesh, steamed
- Trout, Rainbow, flesh, baked
- Kahawai, flesh with bones, canned
- Trevally, flesh, grilled
- Hoki, smoked, flesh, poached
- Kahawai, flesh, grilled
- Salmon, flesh, smoked, export quality
- Eel, smoked
- Pate, fish
- Anchovy, canned in oil, drained
- Sardines in tomato sauce, canned
- Tuna, canned in brine, drained
- Mackerel, canned, drained
- Mackerel, fried
- Salmon, Red, canned
- Sardines, drained solids, canned
- Flounder, flesh, baked
- Hoki, flesh, grilled
- Tarakihi, flesh, grilled
- Gurnard, flesh, grilled
- Orange Roughy, flesh, baked
- Snapper, flesh, baked

## Fruit
- Mangoes, fruit and syrup, canned
- Apple, assorted variety, flesh & skin, fresh
- Pear, assorted variety, flesh & skin, fresh
- Strawberries, fresh, NZ
- Avocado, assorted variety, flesh, fresh
- Grapes, red or green, European type, raw
- Kiwifruit ZESPRI GREEN (Hayward)
- Kiwifruit ZESPRI GOLD ('Hort16A')
- Melon, Cantaloupe, flesh, fresh
- Blackcurrant, frozen, Ben Ard
- Melon, Honeydew, flesh, fresh
- Melon, Rock, comb. cultivars, flesh, fresh
- Orange, juice, freshly extracted
- Orange, flesh, fresh
- Papaya, fruit and juice, canned
- Passion fruit, flesh and seeds, fresh
- Peaches, flesh and skin, fresh
- Peaches, dried
- Pineapple, canned, w/o syrup
- Pineapple, flesh, fresh
- Plum, combined cultivars, fl & s, fresh
- Pomegranate, juice, fresh extract
- Prunes, dried, flesh and skin
- Raspberries, canned, syrup not drained
- Raspberries, fresh
- Raspberries, Marcy, frozen, unsweetened
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhubarb, w/sugar, stewed</td>
<td></td>
</tr>
<tr>
<td>Sultanas</td>
<td></td>
</tr>
<tr>
<td>Tamarillo, Yellow, flesh and seeds, fresh</td>
<td></td>
</tr>
<tr>
<td>Tangerine, flesh, fresh</td>
<td></td>
</tr>
<tr>
<td>Watermelon, flesh, fresh</td>
<td></td>
</tr>
<tr>
<td>Persimmon, flesh, fresh</td>
<td></td>
</tr>
<tr>
<td>Tangelo, flesh, fresh</td>
<td></td>
</tr>
<tr>
<td>Banana, cooking, in unsalted water, boiled</td>
<td></td>
</tr>
<tr>
<td>Pawpaw, Australian, fresh</td>
<td></td>
</tr>
<tr>
<td>Mandarin, fresh</td>
<td></td>
</tr>
<tr>
<td>Pineapple, canned in pineapple juice, drained</td>
<td></td>
</tr>
<tr>
<td>Pears, canned in light syrup</td>
<td></td>
</tr>
<tr>
<td>Apricots, canned in light syrup</td>
<td></td>
</tr>
<tr>
<td>Apricot, flesh &amp; skin, fresh</td>
<td></td>
</tr>
<tr>
<td>Apricots, dried</td>
<td></td>
</tr>
<tr>
<td>Banana, flesh, fresh</td>
<td></td>
</tr>
<tr>
<td>Blackberries, fresh</td>
<td></td>
</tr>
<tr>
<td>Blackberries, fruit &amp; juice, stewed w/sugar</td>
<td></td>
</tr>
<tr>
<td>Blackberries, frozen, unsweetened</td>
<td></td>
</tr>
<tr>
<td>Currants, Black, Magnus, unsweetened, frozen</td>
<td></td>
</tr>
<tr>
<td>Blueberries, Jersey, unsweetened, frozen</td>
<td></td>
</tr>
<tr>
<td>Boysenberry, fresh</td>
<td></td>
</tr>
<tr>
<td>Cherries, flesh &amp; skin, fresh</td>
<td></td>
</tr>
<tr>
<td>Currants, Black, fresh</td>
<td></td>
</tr>
<tr>
<td>Currants, Black, fruit &amp; juice, stewed w/sugar</td>
<td></td>
</tr>
<tr>
<td>Dates, dried, flesh and skin</td>
<td></td>
</tr>
</tbody>
</table>

**Meat**

- Beef, corned beef, canned
- Chicken, flesh, deli-cooked, supermarket
- Venison, leg medallion, cooked, "Silver Fern"
- Venison, diced, cooked, "Silver Fern"
- Chicken, breast, smoked, skin removed before eaten
- Pork, bacon, rashers, lean, grilled
- Pork, ham
- Sheep, heart, roasted
- Lamb, kidney, fried
- Lamb, liver in flour, fried
- Beef, kidney, stewed
- Lamb, sweetbreads, crumbed, fried
- Beef, liver in flour, stewed
- Beef, heart, stewed
- Beef, mince, lean, stewed

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit salad, fresh</td>
<td></td>
</tr>
<tr>
<td>Grapefruit, flesh &amp; syrup, canned</td>
<td></td>
</tr>
<tr>
<td>Guava, fruit and syrup, canned</td>
<td></td>
</tr>
<tr>
<td>Lemon, juice, freshly extracted</td>
<td></td>
</tr>
<tr>
<td>Lychees, fruit &amp; syrup, canned</td>
<td></td>
</tr>
<tr>
<td>Mandarins, fruit &amp; syrup, canned</td>
<td></td>
</tr>
</tbody>
</table>

**Fruit**

- Tamarillo, Yellow, flesh and seeds, fresh
- Tangerine, flesh, fresh
- Watermelon, flesh, fresh
- Persimmon, flesh, fresh
- Tangelo, flesh, fresh
- Banana, cooking, in unsalted water, boiled
- Pawpaw, Australian, fresh
- Mandarin, fresh
- Pineapple, canned in pineapple juice, drained
- Pears, canned in light syrup
- Apricots, canned in light syrup
- Apricot, flesh & skin, fresh
- Apricots, dried
- Banana, flesh, fresh
- Blackberries, fresh
- Blackberries, fruit & juice, stewed w/sugar
- Blackberries, frozen, unsweetened
- Currants, Black, Magnus, unsweetened, frozen
- Blueberries, Jersey, unsweetened, frozen
- Boysenberry, fresh
- Cherries, flesh & skin, fresh
- Currants, Black, fresh
- Currants, Black, fruit & juice, stewed w/sugar
- Dates, dried, flesh and skin
Lamb, comp. cuts, lean, cooked
Sheep, mutton, ribloin, lean, roasted
Chicken, breast, lean & fat, roasted
Chicken, comp cuts, lean & fat, roasted
Turkey, comp cuts, l&f, roasted in oven bag
Pork, skin, cooked
Pork, mince, grilled
Beef patty, frozen, fried
Beef, comp cuts, lean & fat, trimmed, cooked
Lamb, comp. cuts, lean & fat, trimmed, cooked
Mutton, leg, lean, roasted
Mutton, loin chop, lean, grilled
Mutton, forequarter chop, lean, stewed
Chicken, comp cuts, lean, fat & skin, roasted
Chicken, liver cuts, flour, fried
Duck, lean, fat & skin, roasted
Pork, belly rashers, lean & fat, grilled
Pork, kidney, stewed, salt added
Pork, liver in flour, stewed

**Meat products**

Sausage, ham and chicken luncheon
Beef Roast, frzn meal, w/ roast potato veg, rte
Salami, low fat
Paste, meat

Pie, pork, individual size
Pate, chicken liver
Pate, pork liver
Sausage, beef, grilled
Pastrami, beef
Beef, corned, silverside, lean
Nugget, chicken, crumbed, baked
Sausage, preckd, grilled, asst meats & flvr
Sausage, fresh, grilled, asst meats & flvr
Nugget, chicken, battered, baked

**Miscellaneous**

‘Marmite’

**Nuts and seeds**

Almonds, raw
Seeds, flaxseed, USA
Nuts, almonds, dry roasted, without salt added
Peanuts all types, dry-roasted, without salt
Nuts, pistachio, dry roasted, with salt added
Mixed nuts, salted
Peanut butter, smth&crh, salt add, no sugar
Peanuts, raw
Walnuts, raw
Chestnuts, roasted
Pecan nuts, oil roasted, salted
Pine nuts, raw
Pistachio nuts, raw
Pumpkin seeds, roasted, salted
Sesame seeds, roasted
Sunflower seeds, oil roasted, salted
Cashew nuts, roasted, unsalted
Macadamia nuts, unroasted
Hazelnuts, dry roasted, unsalted
Brazil nuts, raw
Cashew nuts, raw
Seeds, sunflower, dry roasted, unsalted
Chestnuts, raw
Hazelnuts, raw
Coconut, flesh, raw
Coconut, desiccated
Nuts, Pecan, dried, raw
Sesame seeds, whole, dried, raw

Recipes
Scone, wholemeal
Sausage roll, short pastry (NZR)
Chutney, tomato
Coleslaw
Falafel, vegetarian, fried
Kebab, lamb, yoghurt marinade

Kebab, vegetable
Pie, meat, one crust

Sauces and condiments
Guacamole
Sauce, mint
Tomato puree
Hummus, original, 6.5% fat, commercial

Shellfish
Shrimp, canned, drained
Oyster, battered, deep fried
Scallops, battered, deep fried
Squid, in flour, fried
Fritters, Paua, deep fried
Cockles, boiled for 5 minutes
Crab meat, canned in brine
Lobster, cooked
Mussel, Green, steamed
Crab meat stick, imitation, surimi
Tuatua fritters
Oyster, Dredge, canned
Oyster, Pacific, flesh, raw

Snack foods
Potato crisps, plain
‘One square meal’, OSM
Vogel’s, Scroggin Clusters, Apricot & Nut Cone, waffle, ice cream
Popcorn, air-popped
Fruit & nut bar
Nut & seed bar, assorted
Muesli bar, chocolate chip
Beef jerky
Popcorn, buttered, salted, commercial
Pretzels
Oriental mix, rice based
Muesli bar
Raisins, yoghurt coated
Rice bar, ‘Rice Bubbles Treats’
Noodles, chickpea, fried (Bombay mix)
Cereal soft bar, wholemeal, frt, asstd flvr

**Sugar, confectionary and spreads**
Candies, Chocolate, dark, 60-69% cacao solids
Cherries, glace
Syrup, Golden
Treacle, Black
Liquorice ‘Allsorts’
Chocolate bar, with peanuts
Chocolate bar, plain
Marmalade, artificially sweetened
Peanuts, coated with milk chocolate
Molasses

**Vegetables**
Beans, Haricot, boiled, drained
Baked beans, canned, in tomato sauce, Watties
Tomatoes, assorted variety, flesh, skin and seeds, raw
Carrot, raw
Lettuce, assorted variety, heart, fresh
Potato, assorted variety, flesh, boiled
Broccoli, boiled
Yams, Pacific, cooked
Sweet potato, flesh, boiled, drained
Radishes, flesh and skin, raw
Spinach, NZ, leaves & upper stem, boil, drnd
Spinach, NZ, leaves & upper stem, raw
Tomatoes, canned, drained
Turnip, flesh, boiled, drained
Beans, Mung, dahl, cooked
Watercress, leaves & upper stem, raw
Asparagus, canned, drained
Beans, Adzuki, cooked
Beans, Black, cooked
Beans, Broad, boiled
Beans, Butter, boiled
Beans, Green, boiled
Beans, Red Kidney, boiled
Pumpkin, flesh, baked
Taro, combined cultivars, corms, cooked
Kumara, flesh & skin, salt added, baked
Vegetables, 3 mixed, frozen, boiled, drained
Vegetables, 4 mixed, frozen, boiled, drained
Silverbeet, boiled for 10 minutes
Cabbage, White, boiled, drained
Asparagus, comb. cultivars, steamed, drained
Brussel Sprouts, inner leaves, boil, drnd
Cabbage, Red, inner leaves, raw
Cabbage, Chinese, cooked
Cabbage, Chinese, raw
Corn, Sweet, baby, canned, drained
Coriander, leaves, fresh
Capsicum, Red, raw
Tomatoes, in tomato juice, canned
Capsicum, Red, boiled
Chives, raw
Tomato paste, salted

Artichoke, boiled w/o salt, water drained
Cabbage, White, inner and outer leaves, raw
Tomatoes, sun-dried
Mushrooms, fried in oil
Potato, frzn fries, straight, canola, bkd
Carrot, flesh, boiled, drained
Cauliflower, boiled, drained
Celery, stem, raw
Corn, Sweet, kernels on cob, boiled, drained
Cucumber, flesh, raw
Greens, Spring, leaves, boiled
Leeks, bulb, boiled, drained
Lentils, split, boiled, drained
Lettuce, outer leaves, raw
Onion, flesh, fried in dripping
Onion, Spring, flesh of bulb, raw
Parsley, leaves, raw
Parsnip, flesh, boiled, drained
Peas, Green, canned, drained
Peas, Green, frozen, boiled
Pepper, Green, boiled, drained
Capsicum, Green, flesh, raw