

Food availability in the homes of overweight children

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Abstract

Background: The home is a highly influential food environment for young children, dictating what they can and choose to eat. Previous studies exploring the relationship between home food availability (HFA) and diet have only looked at specific foods and have used poor measures of availability that have not been validated. Furthermore, longitudinal relationships between HFA and both diet and weight remain poorly examined.

Objective: To determine if HFA was related to dietary intake and weight over 2 years in overweight children (aged 4-8 years).

Design: This study involved cross-sectional and longitudinal analyses of data that was collected for the Motivational Interviewing in Treatment (MInT) study. Participants were 4-8 year old children (n=206) that had been classified as overweight (BMI $\geq 85^{\text{th}}$ percentile). Demographic information, HFA, dietary intake and anthropometric measurements were gathered at baseline, 12 and 24 months. HFA data was measured with a validated home food inventory redesigned for New Zealand family households. To allow for comparison to the dietary measure four scores were generated from this inventory; obesogenic, fruit and vegetable, non-core foods and sweetened beverage. Dietary intake was measured using the Children's Dietary Questionnaire, completed by parents. From this three scores were generated; fruit and vegetable, non-core foods and sweetened beverage. BMI z-score was determined using CDC cut-offs.

Results: Socio-economic status was the only demographic predictor of household food variety, not maternal education, age of child, size of household, or ethnicity. A greater

presence of obesogenic foods in the home was associated with a higher intake of both non-core foods ($B=0.03$ (0.02, 0.04), $p<0.001$) and sweetened beverages ($B=0.04$ (0.02, 0.05), $p<0.001$) in children. Fruit and vegetable availability was related to higher consumption of fruits and vegetables ($B=0.07$ (0.03, 0.11), $p=0.001$) and to lower consumption of non-core foods ($B=-0.01$ (-0.02, 0.00), $p=0.04$). While HFA remained relatively stable over two years, a change in availability of obesogenic foods in the home was associated with a change in both non-core food ($p=0.025$) and sweetened beverage intakes ($p=0.023$). No relationships were found between change in food availability and change in BMI z-scores.

Conclusion: While food availability in the home does not differ substantially by many demographic factors, nor over time, it is clearly associated with the dietary intake of overweight children. Using the home food inventory could be an effective way to gather information about what foods are available in the homes of overweight children. This information could be used to target specific purchasing behaviours in a bid to create a healthier home food environment that encourages positive dietary changes.

Preface

This thesis uses data from phase 2 of the MInT (Motivational Interviewing and Treatment) study, a two-phase study aimed at screening for and treating overweight in children aged 4-8 years. Phase 2 of the study was a two-year intervention that aimed to reduce excessive weight gain in children that were identified as overweight ($BMI \geq$ CDC 85th percentile) at baseline. Outcome measures were collected at baseline, 12 and 24 months. This thesis focuses on the home food availability data, dietary intake data and anthropometric measurements gathered at these time points.

As part of this thesis the candidate completed the following under supervision from Dr Jill Haszard and Paula Skidmore:

- Reviewed the current literature on home food availability in children and identified gaps
- Reviewed all documentation associated with the MInT Study
- Administered and scored the Home Food Inventory (HFI) to a convenience sample of peers
- Generated research questions
- Completed all statistical analyses presented in this thesis using Stata 14.0, with guidance from biostatistician Dr Jill Haszard
- Presented and interpreted results
- Considered and discussed results, generating conclusions

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List of abbreviations

ANOVA	Analysis of Variance
BMI	Body Mass Index
BPC	Best Practice Care
CDC	Centers for Disease Control and Prevention
CDQ	Children's Dietary Questionnaire
F&V	Fruit and vegetables
FFQ	Food Frequency Questionnaire
HFA	Home Food Availability
HFI	Home Food Inventory
MI	Motivational Interviewing
MInT	Motivational Interviewing and Treatment
NZDep	New Zealand Deprivation Index
SD	Standard Deviation
SES	Socio-economic status

1 Introduction

The 2012/13 New Zealand Health Survey revealed that 1 in 5 children were overweight (22%) and a further 1 in 9 children were obese (11%) (1). These are alarming statistics given that there are a number of both medical and non-medical consequences of child overweight and obesity, which not only affect children in the short-term but also in the long-term as they become adults (2-5).

Childhood obesity has been consistently associated with orthopaedic conditions and major cardiovascular risk factors including high blood pressure and dyslipidemia in childhood (4). Excessive weight places children at an increased risk of suffering diabetes, ischaemic heart disease and stroke in adulthood as well as premature mortality (3). Obesity while young is not only associated with overt health problems but it can also be detrimental to the life experience of the individual. Obese children are more likely to suffer conditions affecting their wellbeing including, low self-esteem, bullying, abnormal sleeping patterns and psychological concerns regarding their physical appearance (2, 4, 5). Additionally, longitudinal associations have been found between obesity in childhood and educational attainment (6, 7) potentially going on to affect unemployment and social exclusion later in life (8).

Given these concerns, addressing the issue of childhood overweight and obesity is a priority. Certain aspects of the wider environment have been identified as becoming increasingly obesogenic leading to excessive energy intakes and sedentary lifestyles among children (9, 10). While settings such as the school and community have been widely explored, the home food environment has been less well investigated, despite it being tipped as an influential setting for children (11).

The 2014 food price index review revealed New Zealanders only spend 23% of their food expenditure outside the home (12), indicating that the vast majority of food is purchased for the home. This suggests that the home food environment may be an important environment to target for the prevention and treatment of childhood overweight and obesity. Additionally, the 2002 National Children's Nutrition Survey found that at least 84% of New Zealand children brought most of the food they consumed at school from home (13). Notably, the survey also found that younger children (5-10 years) were more likely to bring most of their food from home than older children (13). Therefore, this primary school age group of children are likely to be an important group to focus on as they are becoming more independent and have more freedom around food, yet they are still reliant on their parents/caregivers to supply and purchase food for the home. Furthermore, these children will be laying down eating habits that may continue into adulthood (14). Parents are the gatekeepers of the home food supply - targeting their purchasing behaviours could be a simple way to modify the food available to children in the home. This in turn may have a positive impact on what they consume, and therefore their health. While the current literature suggests a relationship between home food availability (HFA) and dietary intake exists, the evidence is not strong. Many studies have used weak measures of HFA (such as subjective questions and tools that have not been validated) (15-25) or have only looked at specific foods such as fruits and vegetables (18, 21-23, 26, 27). Very few studies have investigated whether this relationship between HFA and diet extends to weight change, especially in children (15, 17, 28, 29). Furthermore, most studies have used cross-sectional designs and the longitudinal relationships between HFA and both diet and weight in children remain poorly examined (16-24, 26-35). Lastly, the majority of research has been carried out overseas, predominantly in the US. The aim of the current study is to explore the relationship between home food availability and

dietary intake in children aged 4-8 years over a two-year period, and determine whether this relationship extends to weight change.

2 Literature Review

2.1 Introduction

Given the implications of childhood overweight and obesity, it is important to understand the dynamics that lead to this, in an attempt to expose possible interventions for prevention and treatment. Although childhood obesity is a multifaceted issue, it is likely that the home food environment is highly influential for young children's food intake given this is the place where they get the majority of their food (12, 13). The availability of foods in the home is likely to dictate what children can and choose to eat, therefore parents/caregivers may be in an important position to moderate intake through what they purchase for the home. The following literature review will evaluate the current evidence for measurement of food availability in the home and its relationship with dietary intake and weight in children. The aims of this review are as follows:

- 1) To describe the methods that are commonly used to measure food availability in the home (Section 2.3)
- 2) To explain the Home Food Inventory (36) (Section 2.3.1)
- 3) To review the current literature that has looked at the relationship between home food availability and dietary intake (Section 2.4)
- 4) To review the current literature that has explored the relationship between dietary intake and weight (Section 2.5)
- 5) To identify gaps and disparities in the current literature to draw conclusions about what needs to be achieved in future research (Section 2.6)

2.2 Literature Search Strategy

Studies for this literature review were found during the period of September to October 2014, then reviewed in August 2015 using a search of Medline (1996 to present) via OVID, and PubMed using the following key words in different combinations; home food availability, household food availability, home food supply, inventory, home environment, child/children, overweight, obesity, intake, weight. Additional literature was gathered from the reference lists of published articles. As this study uses a sample of children aged 4-8 years, this review is mainly based on studies in children, however some that include adolescents are mentioned where there is a lack of research among younger children. A table outlining brief study details of the main references used in sections 2.4 and 2.5 can be found in Appendix A.

2.3 Measuring food availability in the home

Availability refers to whether a certain food or foods of interest are present in an environment - in regard to the home environment for example, the presence of carrots in the refrigerator (18). A number of methods have been developed to measure availability of food in the home, with the two main approaches being; documenting foods coming into the home using grocery receipts, and home food inventories, which require study participants or researchers to complete a checklist or questionnaire of foods that are currently available in the home. Many variations of a home inventory have been developed and used in the literature, however many of these are neither validated nor comprehensive (36). For example, a number of studies to date have used very subjective measures, with participants commonly asked the question, “How often are the following foods available in you home?” (16, 17, 19, 20, 23, 25, 32), with a 3- to 5-point Likert response scale with options ranging from “never” to “always”. Such measures are open to perception bias and therefore measurement error. Other studies have used the yes/no questions,

“Have the following foods been available in your home in the past week?” or “Do you always have the following foods available at home?” (15, 18, 21, 22, 24). These measures also rely on participant’s memory and generate an unclear picture of the real home food environment. Very few ask if certain foods are present or absent from the home at the particular time of questioning (27, 33, 34). In a recent review looking at home availability of vegetables and vegetable consumption in children and adolescents, all of the fifteen studies used subjective measures of HFA, with no home inventories or other direct measures of available foods being used (37). This results in perceived measures of HFA rather than actual measures. Cullen et al. (18) and Robinson-O’Brien et al. (38) found that when children and their parents were given the same HFA questionnaire to complete, their responses were significantly different, as they perceived what was available differently. The use of variable, subjective measures makes it difficult to draw accurate conclusions and make appropriate comparisons between studies.

Furthermore, a large proportion of the literature on HFA has focused on certain types of food, with a large amount of emphasis being placed on fruit and vegetables (19, 21, 23, 27, 32, 37, 39-46). Of the 20 studies examined for home food availability in a comprehensive review by McClain and colleagues (47), 13 of these only looked at fruit and vegetables, while only three explored the availability of less healthy options. Additionally, often very few fruit and vegetable items are used to determine availability, with some questionnaires simply asking “How often are fruits and vegetables available in your home?” (16, 17, 19, 34). This simple measure may not give an accurate picture of fruit and vegetable availability in the home. These questions give no way of quantifying the variety of fruit and/or vegetables that may be present in the home and little variation can be detected in participant responses. In the review mentioned previously conducted by Cook and colleagues (37) nine out of the fifteen studies examined were classified as having low comprehensiveness due to limited numbers of items being used to determine

vegetable availability (two or less) . This indicates that further research with more comprehensive measures of availability of foods in the home is warranted.

In recent years, more studies capturing the availability of a combination of both healthy (core) and less healthy (non-core) options have been conducted (15-17, 24, 25, 33, 34, 48, 49). This being said, a number of these have only included a limited number of less healthy items or have used unspecific categories such as “sweets,” “sweet snacks” or “savory snacks” (24, 25, 34). In order to get an accurate picture of home food availability a comprehensive selection of less healthy items must be included in home inventories, as it is these foods that commonly lead to excessive energy intake and weight gain (50).

Lastly, much of the literature investigating availability of food in the home is cross-sectional, meaning food availability is only measured at one point in time. In order to see if changes in home food availability are related to changes in dietary intake and/or weight over time, longitudinal research is required. This allows causal relationships to be investigated.

Due to the various measurement limitations of the current literature discussed above, further research into the possible contribution of home food availability to childhood obesity should make use of comprehensive, objective measures of home availability, such as a validated home food inventory (37).

2.3.1 A validated home food inventory

Currently, no gold standard exists for measuring availability of food in the home, however Fulkerson and colleagues (36) have confirmed that a comprehensive, validated home food inventory is an effective method to use. Some trials have used in-home inventories, which

involve researchers identifying food items that are present in the home (41, 51, 52). However, this method is resource-intensive, time consuming and potentially intrusive, therefore having the participants complete an assessment in a checklist format may be a more practical option (53). Fulkerson and colleagues (36) validated a new home food inventory (HFI) that is simple for participants to complete in their own homes. It is a relatively objective measure that includes a comprehensive range of both healthy and less healthy foods that are known to be associated with child overweight and obesity. This HFI demonstrated substantial criterion and construct validity. To determine criterion validity, checklists completed by participants were compared to those completed by researchers (the gold standard). Agreement between their reports of foods present in the home was substantial when a comprehensive checklist was used, confirming that this is a fairly objective measure of home food availability and could be an effective method for gathering data from participants (36). Construct validation was undertaken in a sample of 342 families to determine if HFI results were correlated to diet history questionnaire results.

It must be kept in mind that this inventory measures what foods are present in the home but not the quantity of these. This means that two households with similar amounts of foods could “score” very differently if one had a wider variety of foods. Results might also vary depending on when household grocery shopping is done, so this should be controlled for. Furthermore, this inventory is based on foods that were identified as major contributors to overall energy intake of adults in the US. Therefore, it would need to be adapted for use in other populations. Despite these few limitations, this home inventory provides an objective and comprehensive measure of home food availability that is suitable for use in families with young children.

2.4 Relationship between home food availability and dietary intake

Many studies have identified positive relationships between home food availability and dietary intake in children, however, the majority of these have been cross-sectional, and as mentioned previously, have used poor measures of home food availability. To date, few longitudinal studies have been conducted, with the majority being undertaken in adolescents and young adults (23, 25, 39, 43, 44). One of these studies did however begin with children at age 10 and followed them into adolescence (25). Due to the lack of longitudinal data in younger children, causal relationships between home food availability and dietary intake cannot be determined. Longitudinal research focusing on younger children may be particularly important given that they develop food preferences and eating habits at an early age, which may be maintained into early adulthood (14).

2.4.1 Fruit and Vegetables

A number of cross-sectional studies carried out overseas have found a significant positive association between availability of fruit and vegetables (some including 100% fruit juice) in the home and intake of these among children (16, 18, 19, 21, 22, 26, 27, 35, 54). Availability of less healthy foods in the home has also been shown to relate to intake of fruit and vegetables in children, with Vereecken and colleagues (25) finding a negative relationship between availability of less healthy foods (sugared soft drinks, sweets and crisps) and fruit and vegetable intake. This is similar to findings by Couch and colleagues (17) where availability of high-calorie, nutrient-poor foods was inversely associated with fruit and vegetable intake.

Furthermore, preferences have been shown to be a predictor of consumption, with higher availability of fruit and vegetables being significantly related to a greater intake of these in children with high fruit and vegetable preferences (18, 30). Moreover, for those with low fruit

and vegetable preferences both availability and accessibility were significant predictors for intake (18). This suggests that children with low fruit and vegetable preferences not only need them available in the home, but also accessible, in order for them to consume them.

2.4.2 Obesogenic Foods and Sweetened Beverages

More recently, studies have started to look at the availability of less healthful foods that are known to contribute to overweight and obesity, rather than just focusing on fruit and vegetables. The majority of studies looking at the relationship between availability of less healthy foods and/or beverages and intakes of these in children have found positive associations (16, 17, 20, 25, 31, 33, 34). However, as mentioned previously, foods were often lumped into broad, unspecific categories such as “sweets,” “sweet snacks” or “savory snacks” (16, 25, 34). This may lead to participant misinterpretation when completing questionnaires or availability checklists, as there is not a clear definition of what foods fall under these categories. For example, one parent may classify a muesli bar as a sweet snack while another parent may not. Again, these broad categories mean that little variation can be detected in participant responses. A large cross-sectional study (n=8,058) looking at availability of sugar-sweetened beverages at school and in the home found students who usually had soft drinks available in the home were almost five times as likely to be high consumers compared to those with low availability (20). This is consistent with findings from Grimm et al. (31) and Couch et al. (17) who identified positive associations between availability of sweetened beverages and intake of these. With substantially higher consumption of non-core foods and drinks linked to availability, this in turn could be related to various health outcomes such as weight gain in children and adolescents. Therefore, it is important to explore similar relationships with a broad range of non-core foods that contribute to excessive energy intake (50).

While these findings indicate that there is a clear relationship between availability of both healthy (fruit and vegetables) and less healthy foods in the home and dietary intake in children, the majority of these studies have been cross-sectional meaning the direction of the associations explained above are unclear. It is not known whether children eat more of the foods that are available in the home because they are there, or they eat them because the parents have stocked the home with foods that they prefer. Therefore, longitudinal analyses are needed to determine the stability of home food availability over time and how this relates to dietary intake over time. Furthermore, many of these studies have used poor measures of HFA. A limited number of foods have been used, with a large focus being placed on fruit and vegetables. Comprehensive measures of both dietary intake and home food availability are needed for a better understanding of the relationship between them.

2.5 Relationship between home food availability and weight

While it is important to know how home food availability and dietary intake relate to each other, it is also of interest to determine the possible links with health outcomes, such as child overweight and obesity. Very few studies have looked at the direct relationship between home food availability and weight in children (15, 17, 28, 29). Interestingly, these studies all found no relationship between availability of certain healthy and less healthy foods in the home and body mass index (BMI). Firstly, Gable and Lutz (29) found no difference in food availability in households of obese children versus non-obese children. They investigated a range of foods including fruit and vegetables, breads, meat, dairy, snacks and sweets. Couch et al. (17) found no significant association between availability of low-calorie/nutrient-dense foods or high-calorie/nutrient-poor foods in the home and child BMI. Similarly, a study looking at home

availability of fruit and vegetables also found no significant association with BMI in slightly older children (30). These studies indicate that home food availability and weight of children are not related, despite the clear and consistent link between home food availability and dietary intake discussed in the previous section. Again, these studies were limited by the poor measures of home food availability, which may have influenced results. Only one of these studies (15) used a home food inventory, however participants were asked to report whether items were available in the past week. This relies on participant's memory. The remaining studies all used subjective questions to determine availability (17, 28, 29), with Downs and colleagues (28) having children complete the availability questionnaire. It is known that children and parents perceive home food availability differently (18, 38). Furthermore, these studies have all examined cross-sectional relationships, with the exception of Arcan and colleagues (15) who also carried out prospective analyses. Obesity is a result of prolonged poor lifestyle habits; these studies only consider a snapshot of the situation at one point in time. Longitudinal analysis of home food availability over time could reveal itself as a potential obesity treatment target.

An important factor to note is that all of the studies mentioned have been carried out overseas, predominantly in the United States. Therefore, the results are not necessarily generalisable to the New Zealand population given the difference in demographic characteristics and other environmental factors among these groups. To our knowledge, the only research exploring HFA in New Zealand has been conducted by Utter and colleagues (55), who looked at the relationship between HFA and frequency of family meals among adolescents, and Wilson and colleagues (56), who examined the relationship between HFA and socio-economic status among adults. This further emphasizes the need for the exploration of the relationship between HFA and dietary intake and weight in New Zealand children.

2.6 Conclusion

Due to the alarming rates of child overweight and obesity in New Zealand, possible interventions to target the prevention or treatment of this issue are needed. Given the current evidence, there is a relationship between HFA and dietary intake and yet a flow-on effect to child weight seems not to exist. However, HFA has been poorly measured in a large amount of the literature, with a limited range of foods being investigated, especially less healthy foods. Furthermore, there is very little longitudinal data available making it difficult to determine the causal pathways of availability to health outcomes such as child overweight and obesity. While a large amount of studies have also focused on older children and adolescents, HFA may be especially important for primary school children as they are starting to become more independent around food, but still completely reliant on their parents to purchase food for consumption in the home. They are also at a stage where they are developing preferences and eating habits that may be maintained into adolescence and adulthood. Therefore, further research using comprehensive, validated measures of home food availability in younger children is needed. Furthermore, this research needs to be longitudinal in order to investigate the stability of home food availability over time and how this relates to dietary intake and weight over time. This is important in order to determine whether targeting home food availability could be a viable intervention option to target child overweight and obesity in New Zealand.

3 Objective statement

Previous research has shown a relationship between home food availability and dietary intake in children. However, a large proportion of this research has used non-comprehensive, subjective measures of HFA. Additionally, the majority of this research has been cross-sectional. The relationship between HFA and weight also remains poorly explored, especially among younger children. Therefore, research investigating the longitudinal relationships between HFA and both dietary intake and weight in children is warranted. The primary aim of this study is to explore the relationship between HFA and dietary intake and weight in children over a two-year period.

- Objective 1: To describe the home food availability of overweight children in the MInT study
- Objective 2: To examine the associations between home food availability and demographic variables such as ethnicity and socio-economic status
- Objective 3: To determine if there are cross-sectional relationships between home food availability and dietary intake and/or weight in overweight children
- Objective 4: To determine if home food availability changes over a 2-year period and whether this is related to a change in dietary intake and/or weight in overweight children

4 Participants and Methods

4.1 Study design

The Motivational Interviewing and Treatment (MInT) Study was a two-phase study exploring the screening and treatment of overweight children in Dunedin (57). Measures obtained at baseline of Phase 1 of the study and at 12 months and 24 months of Phase 2 will be used in this thesis.

Phase 1 of the MInT study involved weight-screening children aged 4-8 years, followed by informing parents of their child's weight status using either motivational interviewing (MI) or best practice care (BPC). The primary objective of this phase was to determine which of these two methods allowed for better acceptance of screening results and increased participant's willingness to participate in a two-year intervention, if their child had been identified as overweight.

Phase 2 of the MInT study was a two-year intervention programme aimed at improving weight status among overweight children. The main objective of this was to assess whether a family-based individualized intervention delivered by a MInT mentor with support from a multi-disciplinary team (Tailored Package condition) could improve weight in overweight children compared with usual care. Parents randomized into the Tailored Package condition attended a session with an "expert team" consisting of a MInT mentor (similar to a practice nurse), dietitian, physical activity advisor and a clinical psychologist who helped to recognize current challenges for each family and develop appropriate goals suited to them. The MInT mentor continued to provide support to the family over the two-year intervention period (initially fortnightly, decreasing down to once every 3 months, with approximately 18 visits in total). Those who received Usual Care met once with an advisor who offered general advice regarding healthy

eating, activity, and parenting. This group did not receive further support throughout the two-year period aside from a brief check-in at the measurement appointments at 6, 12 and 24 months. (They attended a second appointment at 6 months where their progress was reviewed, and they were given the opportunity to raise any queries. These were answered but no new information or resources were offered, these sessions lasted 15 to 30 minutes). The main findings of phase 1 and phase 2 have been published elsewhere (57-60).

Ethical approval for the MInT study was obtained from the Lower South Regional Ethics Committee (LRS/09/09/039) and informed consent was obtained from parents at their first appointment.

4.2 Recruitment

Phase 1 of the MInT study involved recruitment of children aged 4-8 years enrolled at most Dunedin general practices and secondary care clinics, representing a cross-section of the Dunedin population. An opt-out system was approved and used for recruitment to enhance enrolment numbers into the study. Parents were sent an invitation for their child to participate in a general health check appointment where they would be informed about the results of this check via one of two methods (motivational interviewing (MI) or best practice care approach (BPC)). The invitation also explained that if eligible they would have the opportunity to participate in the second phase of the study, this being a two-year intervention programme targeting healthy lifestyles for families with young children (see Appendix B for the information brochure and Appendix C for the invitation letter sent to parents).

If parents did not want to participate or did not want any further contact they could call an opt-out phone number provided in the invitation letter. If this was not done after two weeks parents were contacted by phone and given the option to decline participation. Children were excluded from the study if they had any of the following; cystic fibrosis, severe childhood arthritis, severe asthma, inflammatory bowel disease, congenital or chromosomal abnormality, severe developmental delay, if they were on any medication that influenced body composition, or if they were not planning to remain in Dunedin for the following two years.

Those that agreed to take part and met the inclusion criteria were randomized to feedback condition (MI or BPC) and booked into a baseline appointment. Following the initial health check, all parents received feedback and a report card containing the results of their child's screening test. Children that were identified as normal weight ($BMI < 85^{\text{th}}$ percentile) had no further involvement in the study. Parents of children who were classified as overweight ($BMI \geq \text{CDC } 85^{\text{th}}$ percentile) (61) then attended a follow up appointment two weeks later where their response to feedback was assessed and were invited to participate in phase 2 of the study (two-year intervention).

A minimum of 100 children needed to be recruited into in each arm of the phase 2 intervention to detect clinically meaningful differences between the groups in many of the outcomes of interest for the wider MInT study (BMI z-score, physical activity and quality of life). This allowed for an expected 30% dropout rate over the two years and was calculated for 80% power and 5% significance (57).

4.3 Phase 1 measures

4.3.1 Anthropometric measures

Measurements taken at the health check appointment included children's weight, height, waist circumference, body composition and blood pressure. Trained measurers carried out these measurements.

Children's height was measured to the nearest 0.1 cm using a portable Leicester Height Measure (Invita Plastics Ltd, Leicester). Weight was measured to the nearest 0.1 kg using electronic scales (Tanita BC-418), with the child wearing light clothing and no footwear. Measurements were taken twice and averaged. If the two height measures differed by 0.7cm or if the two weight measures differed by more than 0.5kg, a third measure was taken. The two closest measures were used to calculate the mean. Body Mass Index (BMI) was then calculated using these measurements ($\text{BMI} = \text{weight (kg)} \div \text{height (m}^2\text{)}$). The BMI percentile for each child was then determined according to CDC reference norms and categorised into normal weight ($\text{BMI} < 85^{\text{th}}$), overweight ($85^{\text{th}} \leq \text{BMI} < 95^{\text{th}}$) and obese ($\text{BMI} \geq 95^{\text{th}}$) (61). BMI z-scores (standardized measures) were calculated using the CDC growth charts (61). Waist circumference, body composition and blood pressure measures were also taken but are not used in this thesis.

4.3.2 Health check questionnaire

Parents completed an online questionnaire, which assessed motivation for healthy lifestyles, fruit, vegetable and sweetened beverage intake, physical activity and inactivity, parenting style, parental feeding practices and demographics. Measures relevant to this thesis will be covered in more depth in the following paragraphs.

4.3.3 Demographics

Information on child ethnicity and maternal education was gathered using questions from the New Zealand 2006 census (<http://www.stats.govt.nz/Census/about-2006-census/2006-census-questionnaires.aspx>). As participants could have specified that their child belonged to more than one ethnic group, ethnicity was categorized using prioritized ethnicity.

4.3.4 Socio-economic status

Socio-economic status was measured using the New Zealand deprivation index 2006 (NZDep). Indicators such as income, housing, home ownership, employment and qualifications are used from the 2006 census data to create deprivation scores for different areas around New Zealand. A NZDep score of 1 represents low deprivation and a score of 10 represents high deprivation (62). SES was categorized into three groups; high SES (NZDep 1-3), medium SES (NZDep 4-7) and low SES (NZDep 8-10).

4.4 Phase 2 measures

Those who agreed to enter phase two of the study completed additional questionnaires to gather information on their child's dietary intake, home food availability, weight-related behaviours, general behavior, sleep, family functioning, sedentary time and quality of life. Physical activity was also measured over 7 days using an Actigraph accelerometer. Measures relevant to this thesis will be discussed in more depth in the following paragraphs.

4.4.1 Home food availability

Food availability in the home was assessed using a modified version of the Home Food Inventory (HFI) developed by Fulkerson et al (36). As this was originally developed for use in the United States it needed to be adapted to include a wide range of both healthy and less healthful foods

commonly present in New Zealand households. Modifications to the HFI were made by a PhD student in the Department of Human Nutrition, University of Otago (63) with assistance from two New Zealand dietitians. Comparisons between the original and modified versions of the HFI can be found in Appendix E. To facilitate completion of the checklist, the order and categories of foods were altered, such as grouping dried foods together. This was also done to avoid any obvious ‘good food’ versus ‘bad food’ category perception. The variety within food groups was also reduced in order to keep the checklist to a reasonable length. For example, oils were grouped into one item and defined as: Oil (such as olive, canola, vegetable). Parents completed the inventory at home, ticking foods on the checklist if they were currently present in the house or garden. Participants were asked to complete the inventory the day after the main food shop to help account for any variation in time since the last grocery shop. To assess the overall obesogenic household food availability, a summative score was created. All foods that were considered ‘obesogenic’ according to Fulkerson’s criteria (those high in fat and/or sugar) were added to calculate an obesogenic score. In order to represent nutritional recommendations aimed New Zealand children (64) the obesogenic scoring of the HFI was slightly altered from that of the original. Foods that did not feature in the original HFI were classed as obesogenic if they were considered a non-core food in the Children’s Dietary Questionnaire (CDQ) (65) or listed as an occasional food in the Food and Beverage Classification System (64). Scores for non-core foods, fruit and vegetable, fat from dairy and sweetened beverage were also calculated by adding up all foods belonging to these categories, based on the guidelines for the CDQ, the New Zealand food and beverage classification system for years 1-13 (64) and advice from two NZ dietitians. This was done for comparability to the CDQ which was the dietary measure used in the MInT study. The adapted HFI underwent testing by members of the MInT research team (n=10), four of which had children. The candidate also undertook further testing in a convenience sample of

acquaintances (n=8) to gain an experience of completing, administering and scoring the questionnaire. A full copy of the HFI can be found in Appendix D.

4.4.2 Dietary intake

The Children's Dietary Questionnaire (65) was used to assess dietary intake in Phase 2 of the study. This is a 28-item semi-quantitative food frequency questionnaire, which aims to assess the patterns of food intake in children. This tool was designed to be suitable for use in a research setting, particularly for assessing the relationship between dietary patterns and weight status in children. It is straightforward for participants to complete, with a low respondent burden, and is simple for researchers to summate. It includes questions about children's intake over the past 24 hours and the previous week, allowing the calculation of four food group scores including; fruit and vegetable, fat from dairy, sweetened beverage and non-core food. Foods high in fat and/or sugar are considered non-core foods. The CDQ underwent thorough validation testing (test-retest reliability, internal consistency, relative validity and ability to detect change) in five separate samples (65). All subscales showed test-retest reliability and ability to detect change in the expected direction after an intervention aimed at enhancing eating patterns. The fruit and vegetable and non-core foods subscales showed good internal consistency, however the sweetened beverage and fat from dairy subscales did not perform as well. However, this is likely due to the small number of scale items (2 for sweetened beverage and 3 for fat from dairy), in which case lower alpha values for internal consistency may be acceptable (65). The fruit and vegetable and non-core foods subscales showed acceptable relative validity at the group level, however the other two subscales did not. Despite the sweetened beverage and the fat from dairy scores not performing as consistently, overall Magarey and colleagues (65) concluded that the CDQ displayed acceptable reliability and relative validity for assessing group level dietary patterns. It was decided to include the sweetened beverage score as clear associations have been

found between intake of sweetened drinks and weight gain in childhood (66). On the other hand, the fat from dairy score was not included; given that dairy is a recommended food for children (67).

To achieve scores that reflected food group intake in the preceding 24 hours, questions that measured intake in the past week were divided by seven before adding. The fruit and vegetable score was calculated by adding together: items that measured fruit and vegetable variety per day, the number of different fruit and vegetables eaten the day before, the number of occasions that either fruit and/or vegetables were eaten the day before and finally the number of days that either fruit and/or vegetables were consumed in the last week divided by seven. The recommended score calculated (based on Australian dietary guidelines) for this subscale is ≥ 14 . The non-core foods score was calculated by adding the frequency of foods defined as ‘non-core’ (those high in energy/sugar/fat/salt that are recommended to ‘eat sometimes or in small amounts’) consumed in the previous week, divided by seven. The recommended score determined for this sub-scale is ≤ 2 . The sweetened beverages score was calculated by adding items measuring the frequency of fruit juice/fruit drink on the preceding day and the frequency of soft drink/cordial (non-diet types) in the previous week, divided by seven. The recommended score determined for this sub-scale is ≤ 1 . While the CDQ was designed and tested in an Australian population, this population is likely to be very similar to New Zealand. Small adaptations were made to the questionnaire to make it more appropriate for use in New Zealand. For example, equivalent New Zealand specific brands and foods were used as examples in place of Australian ones that appeared in the original. A full copy of the Children’s Dietary Questionnaire can be found in Appendix F.

4.5 Statistical methods

Statistical analysis was completed using Stata 14. Analysis of variance (ANOVA) was used to compare HFA scores by demographic characteristics. Means and standard deviations were calculated and F-tests were used to detect significance between characteristics. If differences were indicated ($p < 0.05$), further pairwise comparisons were made with a Bonferroni adjustment for multiple comparisons.

A bar graph was created using Microsoft Excel to demonstrate the relationship between HFA and household size. As some households had more than one child participating in the study, duplicates were excluded. Mean HFA scores (and standard deviations) at baseline, 12 and 24 months were calculated, followed by conducting a paired t-test to investigate change in these over time. Again, siblings were excluded in this analysis. To assess the cross-sectional relationships of HFA scores with dietary scores and weight, mixed effects regression analyses using data from all three time-points were undertaken adjusted for age, sex, ethnicity, socioeconomic status, maternal education and intervention condition. Repeated measures were accounted for by including participant ID as a random effect nested within family group (as there were some siblings). Regression coefficients (B), confidence intervals and p-values were calculated. When examining the relationship between change in HFA scores over 2 years and change in BMI or dietary intake, HFI scores at 2 years were the outcome variables in a linear regression, with change in the dietary score or BMI z-score as the predictor variable, adjusted for baseline HFA score and other demographic covariates listed previously. Residuals for all regressions were assessed for homogeneity of variance and normality.

5 Results

5.1 Participants

The flow of participants through Phase 1 and into Phase 2 of the MInT study is illustrated in Figure 1 (page 24). Of the 203 participants who attended the baseline appointment for Phase 2, 200 returned a completed home food inventory (HFI) at baseline. Of these participants, 97 were allocated to the Usual Care intervention condition and 103 were allocated to the Tailored Package. The drop out rate was low, with 181 children (89% of 203) remaining at 24 months. Of the 181 participants that attended appointments at 12 and 24 months, 168 returned completed HFI's.

Table 1 (page 25) displays the demographic characteristics of participants entering Phase 2 of the study. The average age of the children at baseline was 6.4 years (SD=1.4) with 45% (n=90) being male. The majority of participants identified as New Zealand European, making up 71% of the sample, followed by Maori (18.5%). The average BMI z-score of children (from US reference data (61)) was 1.6 (SD=0.46) with scores ranging from 1.0-3.6. Sixty-one percent of participants were classed as overweight (BMI between the 85th and 95th percentiles) with the remainder being classed as obese (BMI $\geq$ 95th percentile). Over half of the mothers (66%) were overweight with an average BMI of 29.2kg/m² (SD=6.1). The Phase 2 sample included children from 10 different general practices, 2 paediatric outpatient clinics and the remainder (n=13) were extras who were either siblings of those participating in the study or people who heard about the study and asked to be involved.

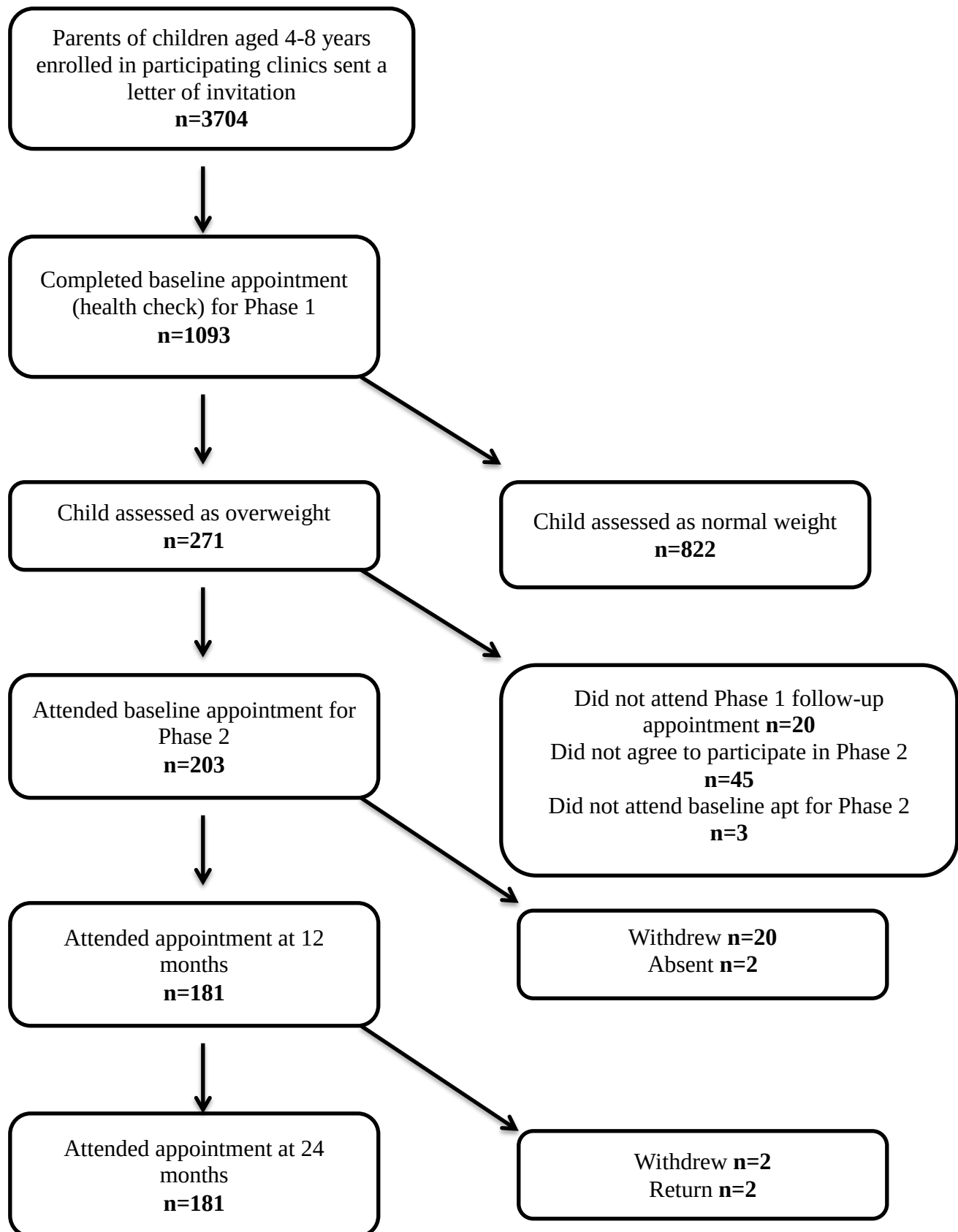


Figure 1: Flow of participants through study

Table 1: Demographic characteristics of participants at baseline

	Phase 2	
	n=200	
	n	%
Ethnicity (n=200)		
New Zealand European	142	71.0
Maori	37	18.5
Pacific Island	11	5.5
Asian	6	3.0
Other	4	2.0
Socio-economic status (n=194)		
Low	49	25.3
Medium	70	36.1
High	75	38.7
Maternal Education (n=197)		
Some secondary	60	30.5
Completed secondary	14	7.1
Tertiary qualification ¹	37	18.8
University Degree	74	37.6
Other	12	6.1
Child weight status (n=200)		
Overweight ²	121	60.5
Obese ³	79	39.5

¹Not university degree²85th percentile ≤ BMI <95th percentile³ BMI ≥95th percentile

5.2 Home food availability and demographic characteristics

The relationship between home food availability (HFA) at baseline and demographic characteristics was explored to determine if availability of food in the home was impacted by certain characteristics. Overall, the average variety of obesogenic foods in the home at baseline was 20 with a range of 3 to 34, the average variety of fruit and vegetables in the home was 30 with a range of 11 to 61, the average variety of non-core foods score was 14 with scores ranging from 3 to 36 and finally, the average sweetened beverage score was 1.5 with scores ranging from 0 to 5. The results displayed in Table 2 (page 28) reveal that those of high socioeconomic status (low deprivation) had significantly more obesogenic foods ($p=0.016$) and fruits and vegetables ($p=0.002$) in the home than those of lower socioeconomic status (high deprivation). On average high-SES households had four more varieties of obesogenic foods in the home and six more varieties of fruit and vegetables in the home than low-SES households. No further significant differences were found.

At baseline there were significant positive correlations between availability of fruit and vegetables and availability of sweetened drinks ($r=0.2$), non-core foods ($r=0.4$) and obesogenic foods ($r=0.4$) (all $p<0.001$). Positive correlations were also seen between availability of sweetened drinks and availability of non-core foods ($r=0.5$) and obesogenic foods ($r=0.6$) (both $p<0.001$). These positive correlations indicate that if there is more variety of one food group in the house then there will be more of the others, or vice versa, suggesting that some households have more food in general than other households. Figure 2 (page 27) illustrates that HFA scores did not differ according to household size. The average number of people in a household was 4 people with a range of 2 to 8 people. Siblings from the same household were excluded in this analysis leaving a total of 181 participants.

The results displayed in Table 3 (page 30) reveal no significant differences between HFA scores and age at any of the three time points (baseline, 12 months, 24 months). By looking down each age column in Table 3 the very small changes in scores over time for each age group are illustrated and this is explored further in the following section (Section 5.3).

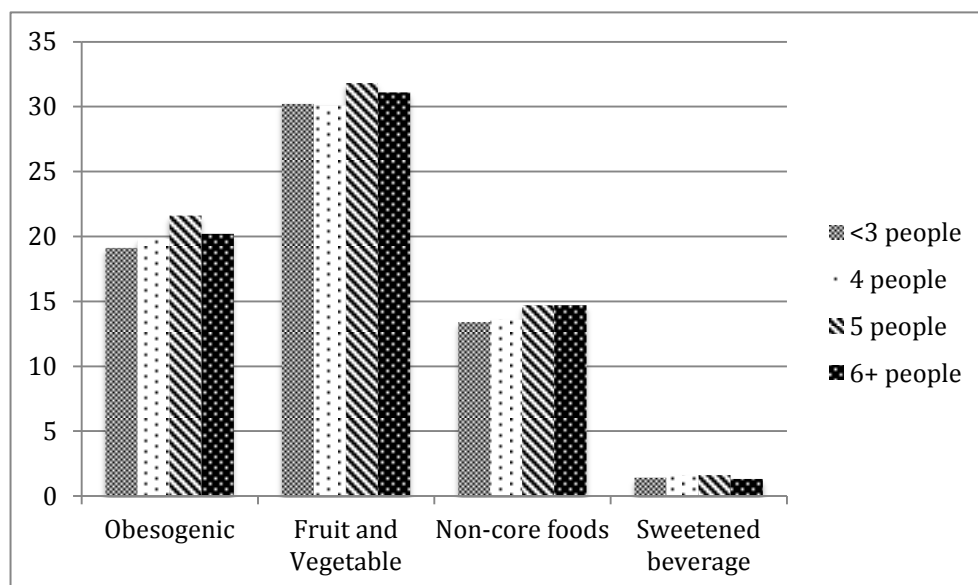


Figure 2: Home food availability scores household size

Table 2: Home food availability scores by demographic characteristics at baseline¹

	Home food availability scores			
	Obesogenic	Fruit and vegetable	Non-core foods	Sweetened beverage
Overall (n=200)	19.8 (7.3)	30.3 (9.3)	13.8 (6.1)	1.5 (1.2)
Ethnicity				
New Zealand European (n=142)	20.1 (7.3)	30.5 (8.5)	14.0 (6.2)	1.6 (1.1)
Maori (n=37)	19.6 (7.9)	31.5 (11.9)	13.6 (6.0)	1.4 (1.3)
Pacific Island (n=11)	17.8 (4.7)	26.0 (6.7)	12.6 (3.6)	1.18 (0.98)
Other ² (n=10)	18.6 (8.2)	26.6 (10.4)	11.5 (7.0)	1.2 (1.3)
	p=0.736	p=0.203	p=0.538	p=0.544
Socio-economic status				
Low (n=49)	17.7 (7.6)	27.0 (10.5)	12.6 (6.3)	1.3 (0.9)
Medium (n=70)	19.4 (7.6)	30.0 (8.7)	13.5 (6.0)	1.5 (1.4)
High (n=75)	21.5 (7.6)³	32.7 (8.4)⁴	14.8 (6.1)	1.6 (1.1)
	p=0.018	p=0.003	p=0.140	p=0.286
Maternal Education				
Some secondary (n=60)	21.1 (8.5)	30.4 (9.9)	14.6 (6.8)	1.8 (1.2)
Completed secondary (n=14)	20.5 (6.5)	28.1 (7.3)	15.6 (5.8)	1.5 (0.9)
Tertiary qualification ⁵ (n=37)	18.8 (8.1)	30.3 (8.7)	13.3 (5.9)	1.2 (1.2)

University degree (n=74)	19.8 (6.4)	31.7 (9.0)	13.2 (5.3)	1.4 (1.1)
Other (n=12)	16.1 (4.7)	24.2 (9.3)	13.0 (8.0)	0.9 (0.90)
	p=0.226	p=0.091	p=0.515	p=0.073
Weight status				
Overweight ⁶ (n=121)	19.5 (7.5)	30.9 (9.5)	13.4 (5.9)	1.5 (1.2)
Obese ⁷ (n=79)	20.3 (7.1)	29.3 (9.0)	14.3 (6.3)	1.4 (1.1)
<i>p-value</i>	p=0.447	p=0.249	p=0.280	p=0.369

¹Mean (SD)

²Includes Asian (n=6), Melaa (n=1) and other (n=3)

³Significantly different from low SES (p=0.016)

⁴Significantly different from low SES (p=0.002)

⁵Not university degree

⁶85th percentile $\leq$ BMI < 95th percentile

⁷BMI" $\geq$ 95th percentile

Table 3: Home food availability score by age¹

	Age at baseline (years)					<i>p-value</i>
	4 (n=45)	5 (n=38)	6 (n=41)	7 (n=45)	8 (n=30)	
Home food availability scores						
Obesogenic score						
Baseline	20.6 (7.6)	18.0 (7.7)	20.3 (7.9)	19.3 (6.5)	20.5 (7.0)	0.481
12 months	20.2 (7.9)	17.9 (8.7)	17.7 (6.9)	18.3 (7.8)	20.3 (5.6)	0.478
24 months	20.1 (7.6)	17.7 (7.5)	17.9 (6.7)	18.2 (7.9)	19.3 (5.8)	0.597
Fruit and vegetable						
Baseline	29.7 (7.8)	32.5 (11.2)	28.6 (8.4)	30.8 (9.3)	29.7 (10.0)	0.432
12 months	29.7 (9.3)	30.1 (10.7)	28.8 (9.5)	30.7 (9.7)	31.8 (8.8)	0.829
24 months	30.2 (9.1)	31.2 (9.3)	28.5 (8.3)	31.4 (9.5)	28.0 (10.0)	0.477
Non-core foods						
Baseline	14.7 (6.1)	12.4 (5.9)	13.7 (6.4)	13.3 (6.0)	14.7 (5.9)	0.416
12 months	14.3 (6.2)	13.2 (7.8)	12.1 (5.4)	12.7 (6.2)	14.5 (4.7)	0.471
24 months	14.2 (5.7)	12.1 (5.4)	12.5 (5.0)	11.9 (5.3)	13.5 (4.4)	0.319

Sweetened beverage

Baseline	1.7 (1.2)	1.3 (1.2)	1.6 (1.3)	1.5 (1.0)	1.3 (1.1)	0.501
12 months	1.5 (1.2)	1.3 (1.3)	1.3 (1.0)	1.5 (1.8)	1.2 (0.9)	0.865
24 months	1.4 (1.2)	1.2 (1.0)	1.1 (1.1)	1.4 (1.2)	1.1 (0.9)	0.731

¹Mean (SD)

5.3 Change in home food availability over two years

The results displayed in Table 4 (page 33) show that obesogenic, non-core food and sweetened beverage home food availability scores all decreased from baseline to 12 months and then again from 12 months to 24 months, however a significant decrease was only detected in the obesogenic score in the first 12 months ($p=0.006$). When an interaction term with intervention condition was added to the model, this indicated that change in obesogenic food score was moderated by the intervention condition that the household was participating in (intervention condition*time: $p=0.011$). Families in the tailored package intervention condition had a significantly decreased obesogenic score after 12 months (change = -1.4, $p<0.001$), while families in the usual care condition had no significant change to the number of obesogenic foods in the home after 12 months ($p=0.470$). Over the two-year period some households did have considerable changes in their availability scores, with 11 households decreasing their obesogenic score by more than 10 foods and 10 households increasing their fruit and vegetable score by more than 10 foods.

5.4 Cross-sectional associations between home food availability and diet and weight

Table 5 (page 35) looks at the cross-sectional relationships between HFA and diet at baseline, 12 months and 24 months. This revealed that those with more variety of obesogenic or non-core foods in the home were more likely to have a higher intake of non-core foods ($p<0.001$) and sweetened beverages ($p<0.001$). Furthermore, greater variety of fruit and vegetables in the home was significantly associated with a lower intake of non-core foods ($p=0.040$) and a higher intake of fruit and vegetables ($p=0.001$).

Table 4: Home food availability scores at three time points¹

	Time points				
	Baseline (n=181)	12 months (n=153)	24 months (n=151)	Change 1 st 12 months	Change 2 nd 12 months
Home food availability scores					
Obesogenic	20.1 (7.2)	18.9 (7.6)	18.7 (7.1)	-1.3 (6.0)*	-0.2 (4.8)
Fruit and vegetable	30.6 (9.4)	29.6 (9.5)	29.9 (9.2)	-0.8 (7.6)	0.5 (7.3)
Non-core foods	13.9 (6.0)	13.3 (6.3)	12.8 (5.1)	-0.6 (4.8)	-0.7 (5.6)
Sweetened beverage	1.5 (1.2)	1.4 (1.3)	1.3 (1.1)	-0.1 (1.2)	-0.1 (1.3)

¹Mean (SD)

*p=0.005

Finally, greater sweetened beverage availability was associated with greater non-core food (p=0.001) and sweetened beverage intake (p<0.001).

Table 6 (page 36) shows that there was no relationship between BMI z-score and home food availability, even after adjustment for age, gender, ethnicity, socioeconomic status, maternal education and intervention condition.

Table 5: Cross sectional associations between HFA and diet at three time points¹

	Dietary scores					
	Non-core	<i>p-value</i>	Fruit and Vegetables	<i>p-value</i>	Sweetened beverages	<i>p-value</i>
Home food availability scores						
Obesogenic	0.03 (0.02, 0.04)	p<0.001	-0.05 (-0.10, 0.03)	p=0.064	0.04 (0.02, 0.05)	p<0.001
Fruit and Vegetables	-0.01 (-0.02, 0.00)	p=0.040	0.07 (0.03, 0.11)	p=0.001	0.00 (-0.02, 0.01)	p=0.397
Non-core foods	0.03 (0.02, 0.05)	p<0.001	-0.03 (-0.09, 0.03)	p=0.317	0.04 (0.03, 0.06)	p<0.001
Sweetened beverages	0.12 (0.05, 0.19)	p=0.001	-0.25 (-0.54, 0.04)	p=0.098	0.19 (0.12, 0.27)	p<0.001

¹Coefficient (95% confidence interval)

Table 6: Cross-sectional association between HFA and BMI z-score¹

	BMI z-score	p-value	BMI z-score	p-value
	<i>unadjusted</i>		<i>adjusted²</i>	
Home food availability score				
Obesogenic	0.001 (-0.004, 0.006)	0.766	0.001 (-0.005, 0.006)	0.816
Fruit and Vegetable	-0.001 (-0.005, 0.002)	0.451	-0.001 (-0.005, 0.003)	0.724
Non-core foods	-0.001 (-0.006, 0.005)	0.830	-0.001 (-0.007, 0.005)	0.737
Sweetened beverage	0.009 (-0.016, 0.035)	0.477	0.004 (-0.023, 0.031)	0.789

¹Coefficient (95% confidence interval)²Adjusted for age, sex, ethnicity, socioeconomic status, maternal education, family id and intervention condition

5.5 Longitudinal relationships between home food availability and diet and weight

Given HFA was measured at 3 time points it was then evident to look at the longitudinal relationships between change in HFA and change in both diet (CDQ scores) and weight (BMI z-scores) over the two-year period. The results of these analyses, displayed in Table 7 (page 38), demonstrate a significant relationship between increased obesogenic HFA with increased non-core food ($p=0.025$) and sweetened beverage intake ($p=0.023$) over the two years. After adjusting for age, gender, ethnicity, socioeconomic status, maternal education and intervention condition these results were strengthened, therefore only the adjusted models are presented. No relationships were found between change in HFA scores and change in BMI z-scores.

Table 7: Change in HFA with change in diet (dietary scores) and weight (BMI z-score) over 2 years ¹

Change in home food availability scores								
	Obesogenic	p-value	Fruit and Vegetable	p-value	Non-core foods	p-value	Sweetened beverage	p-value
Dietary scores change								
Fruit and Vegetable	-0.05 (-0.155, 0.037)	0.229	0.00 (-0.070, 0.075)	0.938	-0.07 (-0.185, 0.039)	0.198	-0.241 (-0.760, 0.278)	0.360
Non-core foods	0.03 (0.004, 0.052)	0.025	0.00 (-0.023, 0.013)	0.590	0.02 (-0.006, 0.052)	0.115	0.00 (-0.128, 0.131)	0.981
Sweetened beverage	0.03 (0.004, 0.050)	0.023	0.00 (-0.013, 0.021)	0.642	0.014 (-0.014, 0.043)	0.318	0.04 (-0.078, 0.167)	0.467
BMI z-score change	0.00 (-0.011, 0.006)	0.576	0.00 (-0.006, 0.008)	0.759	0.00 (-0.016, 0.004)	0.256	0.02 (-0.029, 0.064)	0.464

¹Effect size (95% confidence interval)

Adjusted for age, gender, socioeconomic status, ethnicity, maternal education and intervention condition

6 Discussion

6.1 Summary of main findings

This thesis describes the home food environment of overweight children in Dunedin and demonstrates that there is a clear relationship between home food availability and dietary intake in these children. A unique aspect of the current research was the exploration of the longitudinal relationships between HFA and both dietary intake and weight, which has been poorly investigated previously, especially among this age group. Overall, there was very little change in availability over the two-year period, however a decrease in availability of obesogenic foods in the home was related to a decrease in both non-core food intake and sweetened beverage intake. Despite these links, no relationships were found between HFA score change and BMI z-score change, quite possibly due to; HFA scores remaining relatively stable over the two-years, the HFI measuring variety of foods not quantity, and of course the multifaceted nature of overweight and obesity.

6.2 Home food availability and demographic characteristics

The average numbers of each of the food categories available in the home at baseline were as follows: 20 obesogenic, 30 fruit and vegetables, 14 non-core foods and 1.5 sweetened beverages. Interestingly, HFA scores did not differ by ethnicity, maternal education, age or number of people in the household. This suggests that using HFA as a tool for assessing availability in households of varying demographic characteristics could be suitable. Notably, the HFI could be used effectively among varying household sizes due to the consistent results seen between HFA and number of people in the household. The only difference observed was among socio-economic status, with those of high socio-economic status having significantly more of both obesogenic foods and fruit and vegetables than those of low socioeconomic

status. While it may be expected that those of higher SES may have more variety of fruit and vegetables in the home, which is also consistent with research carried out both in New Zealand (56) and overseas (22, 68), it was interesting to find that they also had higher obesogenic scores. This is inconsistent with research carried out in New Zealand, with Utter and colleagues (55) finding that secondary school students living in more deprived areas were more likely to have less healthy items such as chocolates and soft drinks available in the home. The reasoning behind this is that foods high in added fats and/or sugars are often considered an affordable way to provide calories, as they are a cheap option for consumers. However, given our results show increased availability of both fruit and vegetables and obesogenic foods, this suggests that those of high SES have more food in the home altogether at one point in time. This is supported by the positive correlations found between the HFA scores. On average, those of high SES had 4 more obesogenic food types in the home and 6 more varieties of fruit and vegetables than those of low SES. This could be due to the fact that those of lower SES simply don't have the money to buy a wide variety of foods each week, or that they buy smaller amounts of food more frequently. Another explanation could be that those of low SES eat out more, for example takeaways, so these foods are not present in the home. Given the HFI used in the current study was a comprehensive, accurate and relatively objective measure of HFA these results are reliably robust.

6.3 Home food availability and dietary intake

Similar to previous findings, cross-sectional associations were observed between HFA and dietary intake. Greater availability of obesogenic foods in the home was associated with higher intakes of both non-core foods and sweetened beverages. This is consistent with research carried out overseas among children of similar age (16, 17, 29, 31, 33-35). These studies all found that greater availability of food and/or drinks high in sugar and/or fat was related to higher intake of these foods.

Similar results were seen when looking at fruit and vegetables, with greater availability of these being associated with higher intake. This is consistent with findings in children of similar age (16, 18, 19, 21, 22, 26, 27, 35). Interestingly, higher availability of fruit and vegetables was also associated with lower intake of non-core foods. This suggests that intake of non-core foods may be replaced by intake of fruit and vegetables when the availability of fruit and vegetables is higher. Very little research has looked at the impact of fruit and vegetable availability on intake of less healthful foods, however availability of unhealthy foods has been negatively associated with fruit and vegetable intake (17, 25, 44, 69). This same effect was not seen in the present study. While greater availability of obesogenic foods, non-core foods and sweetened beverages did all relate to lower fruit and vegetable intakes in our study, none of these were significant.

These results suggest that foods that are available in the home have a large impact on what children eat. Limiting availability of obesogenic foods, non-core foods and sweetened beverages in the home could be an effective way of decreasing intake of these. Moreover, increasing variety of fruit and vegetables may not only help to increase intake of these but also decrease intake of less desirable non-core foods.

While HFA remained relatively stable over the two-year period, a change in availability of obesogenic foods in the home was associated with a change in both non-core food intake ($p=0.025$) and sweetened beverage intake ($p=0.023$). For example, for every 5 fewer obesogenic foods in the house after two years, there was a 0.2 decrease in non-core food intake score and a 0.2 decrease in sweetened beverage score. This suggests that changing availability of obesogenic foods in the home is also associated with changing intake of non-core foods (foods high in fat and/or sugar) and sweetened beverages. The majority of research looking at the longitudinal relationship between HFA and dietary intake to date has been

among adolescents. Vereekan and colleagues (25) followed children (beginning at 10 years old) for four years. Comparable to our findings, they found that availability of unhealthy foods (soft drinks, sweets, biscuits and crisps) was positively associated with intake of these but also negatively associated with intake of fruit and vegetables. Interesting findings from Busick and colleagues (42) have shown that increased exposure to foods, such as fruit and vegetables increases pre-schoolers' willingness to try these foods. Food habits laid down at a young age can be carried through to adulthood (14). Our results suggest that targeting parents' purchasing behaviors could be an effective way of managing intake of foods among overweight children to help to create a better home food environment at this important stage in their lives.

6.4 Home food availability and weight

While the relationship between home food availability and food intake is important, whether this translated into weight outcomes is also of high interest. Firstly, no cross-sectional relationship was observed between HFA and weight status. This is consistent with the literature for children of similar age (17, 28, 29). Interestingly, when looking at the longitudinal relationships between HFA and BMI z-scores, still no relationship was found, even after adjustment for age, gender, ethnicity, socioeconomic status, maternal education and intervention condition. Furthermore, the effect sizes and confidence intervals were very small indicating that a clinically relevant relationship between home food availability and BMI z-score is highly unlikely. This could be due to the marked stability in HFA over two years, with very few changing their food environment substantially. Also, while we used a comprehensive home food inventory to measure HFA, we did not measure the quantities of different foods in the home, instead capturing a measure of variety. This could have had an impact as those with similar amounts of food in the home could have scored very differently if one had a wider variety of foods. Quantity of foods in the home may have more to do with

weight change rather than variety. However, recent research by Vadiveloo and Parekh (70) suggests that food variety may be an important factor to improve weight outcomes. They state that for this effect to be as beneficial as possible, there must be a combination of both increased variety of more healthful foods and a decrease in variety of less healthful foods. While we showed links between change in HFA and change in diet, this did not extend to change in weight, perhaps due to the multifactorial nature of weight change.

6.5 Strengths and limitations of this research

This research used a large sample size and with repeated time-points the power to detect associations was strengthened, with the use of mixed-models. The sample also had diverse demographic characteristics making the results applicable to a wider NZ population. This study had a high retention rate with 80% of the participants who entered Phase 2 of the study remaining at the end of year two. A comprehensive measure of home food availability was used (36) - the Home Food Inventory is a validated tool, which was modified especially for use in New Zealand - it is a vast improvement on the tools used in much of the HFA literature to date, providing a more accurate, objective measure of food in the home. At baseline 200 (out of 203) completed HFI's were returned and at both 12 months and 24 months 168 completed HFI's were returned (out of 181). This low number of missing questionnaires demonstrates that the HFI is an acceptable and accurate form of measurement for parents of overweight children.

An important strength of the current study was the longitudinal design. This was beneficial due to the lack of longitudinal research previously done in this area, allowing causal relationships to be investigated and an examination of HFA stability over time.

One potential limitation of this study is that the HFI only measures the different types of foods in the home, not the quantity of these; therefore it is more a measure of variety. Two

households with similar amounts of foods could score very differently if one has a wider variety of foods. Only conducting one HFI at each time point also has limitations. It does not address intra-household variation of food supply, which may be influenced by: when groceries are bought; income cycles; demands of work outside the home; family events such as celebrations; and seasonality (71, 72). An attempt was made to control for when groceries were bought by asking participants to complete the HFI the day after the main food shop. Participants were also asked to indicate if there were any special reasons why the week they filled this out may differ from normal (for example, child's birthday party). The CDQ, while reliable and validated, doesn't provide an easily interpreted measure of how much the child is consuming, where a diet record would have provided a more accurate measure, the respondent burden is substantially higher. Finally, it must be kept in mind that this study was carried out in a sample of overweight children; therefore relationships found are not generalisable to the general population.

6.6 Conclusion

In conclusion, this study highlights that there is a clear relationship between food availability in the homes of overweight children and dietary intake. Not only were cross-sectional relationships found between food availability and dietary intake, but a decrease in availability of obesogenic foods over the two-year period was associated with a decrease in non-core food intake and sweetened beverage intake. This indicates that HFA could be an appropriate target for dietary change. Focusing on parents purchasing behaviors could be an effective way to alter what is available in the home and therefore improve children's diets. In particular, decreasing foods high in sugar and/or fat that are known to contribute to weight gain. It was interesting to find that despite these associations between HFA and diet, no relationships were found between availability and weight, neither cross-sectional nor longitudinal. However, this could have been due to the overall small changes in food availability scores over the two-year

period. Lastly, it is well known that overweight and obesity is a complex issue. Our results show that there is certainly a relationship between availability of food in the home and intake, therefore the home food environment may be manipulated to improve children's diets, however, this may need to be coupled with other lifestyle changes to see improvements in weight.

7 Application to Dietetic Practice

Given parents and caregivers are the gatekeepers to the home; their decisions are key determinants of children's eating habits. Using the HFI as a tool in practice may be a beneficial way to gauge what types of foods are available in the homes of overweight children, as it has proven to be an acceptable and objective measure in these families. This information could be used to target specific purchasing behaviours in a bid to create a healthier home food environment. Concentrating on purchasing behaviours could potentially be less stigmatizing than focusing solely on dietary intake and weight for a child that is overweight. For those homes with more obesogenic foods available, encouraging a decrease in variety of these foods could be a beneficial way to decrease intakes of non-core foods and sweetened beverages. These foods are known to contribute to weight gain and therefore reducing them in the home will help to improve overall diet quality. For those homes with less fruit and vegetables available, encouraging parents/caregivers to purchase more of these foods could be an effective way to increase children's intake of these. Along with this, parents and caregivers from lower SES households may need information on affordable fruit and vegetable options, for example shopping in season and choosing canned or frozen varieties. Additionally, looking beyond the summary scores would be a relatively easy way to see what actual foods are available in the home. Given the known issues with diet reporting (under-reporting or changing eating on recording days), this HFI may provide opportunities for discussions around specific foods (for example; "tell me about the muesli bars in your home...") and working to find appropriate alternatives that may not have been picked up with a diet record. Supporting families to make these improvements and sustain them will help to improve diet quality and hopefully, over time, improve weight outcomes.

8 References

1. Ministry of Health. New Zealand Health Survey: Annual update of key findings 2012/13. Wellington, New Zealand: Ministry of Health 2013.
2. Maggio AB, Martin XE, Saunders Gasser C, Gal-Duding C, Beghetti M, Farpour-Lambert NJ, et al. Medical and non-medical complications among children and adolescents with excessive body weight. *BMC pediatrics*. 2014 Sep 14;14(1):232. PubMed PMID: 25220473. Eng.
3. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. *Int J Obes*. 2011 07//print;35(7):891-8.
4. Reilly JJ, Methven E, McDowell ZC, Hacking B, Alexander D, Stewart L, et al. Health consequences of obesity. *Archives of Disease in Childhood*. 2003 September 1, 2003;88(9):748-52.
5. Tsiros MD, Olds T, Buckley JD, Grimshaw P, Brennan L, Walkley J, et al. Health-related quality of life in obese children and adolescents. *Int J Obes*. 2009 03/03/online;33(4):387-400.
6. Booth JN, Tomporowski PD, Boyle JME, Ness AR, Joinson C, Leary SD, et al. Obesity impairs academic attainment in adolescence: findings from ALSPAC, a UK cohort. *Int J Obes*. 2014 10//print;38(10):1335-42.
7. Smith E, Hay P, Campbell L, Trollor JN. A review of the association between obesity and cognitive function across the lifespan: implications for novel approaches to prevention and treatment. *Obesity Reviews*. 2011;12(9):740-55.
8. Kieselbach T. Long-Term Unemployment Among Young People: The Risk of Social Exclusion. *Am J Community Psychol*. 2003 2003/09/01;32(1-2):69-76. English.
9. Lobstein T, Baur L, Uauy R. Obesity in children and young people: a crisis in public health. *Obesity Reviews*. 2004;5:4-85.
10. Swinburn B, Egger G, Raza F. Dissecting Obesogenic Environments: The Development and Application of a Framework for Identifying and Prioritizing Environmental Interventions for Obesity. *Preventive Medicine*. 1999 12//;29(6):563-70.
11. Miller DP. Associations between the home and school environments and child body mass index. *Social Science & Medicine*. 2011 3//;72(5):677-84.
12. Statistics New Zealand. Food price index review: 2014. Wellington, New Zealand: 2014. Report No.
13. Ministry of Health. NZ Food NZ Children: Key results of the 2002 National Children's Nutrition Survey. Wellington, New Zealand: Ministry of Health, 2003.
14. Nicklaus S, Boggio V, Chabanet C, Issanchou S. A prospective study of food preferences in childhood. *Food Quality and Preference*. 2004 10//;15(7-8):805-18.
15. Arcan C, Hannan PJ, Fulkerson JA, Himes JH, Rock BH, Smyth M, et al. Associations of home food availability, dietary intake, screen time and physical activity with BMI in young American-Indian children. *Public Health Nutr*. 2013 Jan;16(1):146-55. PubMed PMID: 22376987. Epub 2012/03/02. eng.
16. Campbell KJ, Abbott G, Spence AC, Crawford DA, McNaughton SA, Ball K. Home food availability mediates associations between mothers' nutrition knowledge and child diet. *Appetite*. 2013 12/1//;71(0):1-6.
17. Couch SC, Glanz K, Zhou C, Sallis JF, Saelens BE. Home Food Environment in Relation to Children's Diet Quality and Weight Status. *Journal of the Academy of Nutrition and Dietetics*. 2014.
18. Cullen KW, Baranowski T, Owens E, Marsh T, Rittenberry L, de Moor C. Availability, Accessibility, and Preferences for Fruit, 100% Fruit Juice, and Vegetables Influence

- Children's Dietary Behavior. *Health Education & Behavior*. 2003 October 1, 2003;30(5):615-26.
19. Ding D, Sallis JF, Norman GJ, Saelens BE, Harris SK, Kerr J, et al. Community food environment, home food environment, and fruit and vegetable intake of children and adolescents. *J Nutr Educ Behav*. 2012 Nov-Dec;44(6):634-8. PubMed PMID: 21531177. Epub 2011/05/03. eng.
 20. Hebden L, Hector D, Hardy LL, King L. A fizzy environment: Availability and consumption of sugar-sweetened beverages among school students. *Preventive Medicine*. 2013;56(6):416-8.
 21. Kouli E, Jago R. Associations between self-reported fruit and vegetable consumption and home availability of fruit and vegetables among Greek primary-school children. *Public Health Nutrition*. 2008;11(11):1142-8.
 22. Kratt P, Reynolds K, Shewchuk R. The role of availability as a moderator of family fruit and vegetable consumption. *Health education & behavior : the official publication of the Society for Public Health Education*. 2000 Aug;27(4):471-82. PubMed PMID: 10929754. Epub 2000/08/10. eng.
 23. Larson N, Laska MN, Story M, Neumark-Sztainer D. Predictors of Fruit and Vegetable Intake in Young Adulthood. *Journal of the Academy of Nutrition and Dietetics*. 2012;112(8):1216-22.
 24. Lipsky LM, Nansel TR, Haynie DL, Mehta SN, Laffel LMB. Associations of food preferences and household food availability with dietary intake and quality in youth with type 1 diabetes. *Appetite*. 2012 10//;59(2):218-23.
 25. Vereecken C, Haerens L, De Bourdeaudhuij I, Maes L. The relationship between children's home food environment and dietary patterns in childhood and adolescence. *Public Health Nutr*. 2010 Oct;13(10A):1729-35. PubMed PMID: 20883573. Epub 2010/10/05. eng.
 26. Reynolds KD, Hinton AW, Shewchuk RM, Hickey CA. Social Cognitive Model of Fruit and Vegetable Consumption in Elementary School Children. *Journal of Nutrition Education*. 1999 1//;31(1):23-30.
 27. Wyse R, Campbell E, Nathan N, Wolfenden L. Associations between characteristics of the home food environment and fruit and vegetable intake in preschool children: A cross-sectional study. *BMC Public Health*. 2011;11.
 28. Downs SM, Arnold A, Marshall D, McCargar LJ, Raine KD, Willows ND. Associations among the food environment, diet quality and weight status in Cree children in Québec. *Public Health Nutrition*. 2009;12(09):1504-11.
 29. Gable S, Lutz S. Household, Parent, and Child Contributions to Childhood Obesity. *Family Relations*. 2000;49(3):293-300.
 30. Gallaway MS, Jago R, Baranowski T, Baranowski JC, Diamond PM. Psychosocial and demographic predictors of fruit, juice and vegetable consumption among 11-14-year-old Boy Scouts. *Public Health Nutr*. 2007 Dec;10(12):1508-14. PubMed PMID: 17686203. Epub 2007/08/10. eng.
 31. Grimm GC, Harnack L, Story M. Factors associated with soft drink consumption in school-aged children. *Journal of the American Dietetic Association*. 2004 8//;104(8):1244-9.
 32. Hanson NI, Neumark-Sztainer D, Eisenberg ME, Story M, Wall M. Associations between parental report of the home food environment and adolescent intakes of fruits, vegetables and dairy foods. *Public Health Nutr*. 2005 Feb;8(1):77-85. PubMed PMID: 15705248. Epub 2005/02/12. eng.
 33. Johnson L, van Jaarsveld CH, Wardle J. Individual and family environment correlates differ for consumption of core and non-core foods in children. *The British journal of nutrition*. 2011 Mar;105(6):950-9. PubMed PMID: 21110911. Epub 2010/11/30. eng.

34. McGowan L, Croker H, Wardle J, Cooke LJ. Environmental and individual determinants of core and non-core food and drink intake in preschool-aged children in the United Kingdom. *Eur J Clin Nutr.* 2012 03//print;66(3):322-8.
35. Spurrier N, Magarey A, Golley R, Curnow F, Sawyer M. Relationships between the home environment and physical activity and dietary patterns of preschool children: a cross-sectional study. *Int J Behav Nutr Phys Act.* 2008 2008/05/30;5(1):1-12. English.
36. Fulkerson J, Nelson M, Lytle L, Moe S, Heitzler C, Pasch K. The validation of a home food inventory. *Int J Behav Nutr Phys Act.* 2008 2008/11/04;5(1):1-10. English.
37. Cook LT, O'Reilly GA, DeRosa CJ, Rohrbach LA, Spruijt-Metz D. Association between home availability and vegetable consumption in youth: a review. *Public Health Nutrition.* 2014.
38. Robinson-O'Brien R, Neumark-Sztainer D, Hannan PJ, Burgess-Champoux T, Haines J. Fruits and Vegetables at Home: Child and Parent Perceptions. *Journal of Nutrition Education and Behavior.* 2009 9//;41(5):360-4.
39. Arcan C, Neumark-Sztainer D, Hannan P, van den Berg P, Story M, Larson N. Parental eating behaviours, home food environment and adolescent intakes of fruits, vegetables and dairy foods: longitudinal findings from Project EAT. *Public Health Nutrition.* 2007;10(11):1257-65.
40. Befort C, Kaur H, Nollen N, Sullivan DK, Nazir N, Choi WS, et al. Fruit, Vegetable, and Fat Intake among Non-Hispanic Black and Non-Hispanic White Adolescents: Associations with Home Availability and Food Consumption Settings. *Journal of the American Dietetic Association.* 2006 3//;106(3):367-73.
41. Bryant M, Stevens J, Wang L, Tabak R, Borja J, Bentley ME. Relationship between Home Fruit and Vegetable Availability and Infant and Maternal Dietary Intake in African-American Families: Evidence from the Exhaustive Home Food Inventory. *Journal of the American Dietetic Association.* 2011 10//;111(10):1491-7.
42. Busick DB, Brooks J, Pernecky S, Dawson R, Petzoldt J. Parent food purchases as a measure of exposure and preschool-aged children's willingness to identify and taste fruit and vegetables. *Appetite.* 2008 11//;51(3):468-73.
43. Larson NI, Neumark-Sztainer DR, Harnack LJ, Wall MM, Story MT, Eisenberg ME. Fruit and Vegetable Intake Correlates During the Transition to Young Adulthood. *American Journal of Preventive Medicine.* 2008 7//;35(1):33-7.e3.
44. Pearson N, Ball K, Crawford D. Predictors of changes in adolescents' consumption of fruits, vegetables and energy-dense snacks. *British Journal of Nutrition.* 2011;105(05):795-803.
45. Pearson N, Biddle SJ, Gorely T. Family correlates of fruit and vegetable consumption in children and adolescents: a systematic review. *Public Health Nutr.* 2009 Feb;12(2):267-83. PubMed PMID: 18559129. Epub 2008/06/19. eng.
46. Rasmussen M, Krølner R, Klepp K-I, Lytle L, Brug J, Bere E, et al. Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: quantitative studies. *Int J Behav Nutr Phys Act.* 2006 2006/08/11;3(1):1-19. English.
47. McClain AD, Chappuis C, Nguyen-Rodriguez ST, Yaroch AL, Spruijt-Metz D. Psychosocial correlates of eating behavior in children and adolescents: a review. *Int J Behav Nutr Phys Act.* 2009;6:54. PubMed PMID: 19674467. Pubmed Central PMCID: PMC3224918. Epub 2009/08/14. eng.
48. Krukowski RA, Harvey-Berino J, West DS. Differences in home food availability of high- and low-fat foods after a behavioral weight control program are regional not racial. *Int J Behav Nutr Phys Act.* 2010;7:69. PubMed PMID: 20868503. Pubmed Central PMCID: PMC2954950. Epub 2010/09/28. eng.

49. Raynor HA, Polley BA, Wing RR, Jeffery RW. Is Dietary Fat Intake Related to Liking or Household Availability of High- and Low-Fat Foods? *Obesity Research*. 2004;12(5):816-23.
50. Ambrosini GL. Childhood dietary patterns and later obesity: a review of the evidence. *Proceedings of the Nutrition Society*. 2014;73(01):137-46.
51. Hearn MD, Baranowski T, Baranowski J, Doyle C, Smith M, Lin LS, et al. Environmental Influences on Dietary Behavior among Children: Availability and Accessibility of Fruits and Vegetables Enable Consumption. *Journal of Health Education*. 1998 1998/02/01;29(1):26-32.
52. Rosno EA, Steele RG, Johnston CA, Aylward BS. Parental Locus of Control: Associations to Adherence and Outcomes in the Treatment of Pediatric Overweight. *Children's Health Care*. 2008 2008/05/09;37(2):126-44.
53. Pinard CA, Yaroch AL, Hart MH, Serrano EL, McFerren MM, Estabrooks PA. Measures of the home environment related to childhood obesity: a systematic review. *Public Health Nutrition*. 2012;15(01):97-109.
54. van Ansem WJ, Schrijvers CT, Rodenburg G, van de Mheen D. Is there an association between the home food environment, the local food shopping environment and children's fruit and vegetable intake? Results from the Dutch INPACT study. *Public Health Nutrition*. 2013;16(07):1206-14.
55. Utter J, Denny S, Crengle S, Ameratunga S, Clark T, Maddison R, et al. Socio-economic differences in eating-related attitudes, behaviours and environments of adolescents. *Public Health Nutrition*. 2011 Apr 2011;14(4):629-34. PubMed PMID: 858361065; 20576201. English.
56. Wilson R, Gearry RB, Grant E, Pearson J, Skidmore PM. Home food availability is associated with multiple socio-economic indicators in 50 year olds from Canterbury, New Zealand. *Asia Pacific journal of clinical nutrition*. 2014 2014;23(4):714-22. PubMed PMID: 1639486379; 25516330. English.
57. Taylor R, Brown D, Dawson A, Haszard J, Cox A, Rose E, et al. Motivational interviewing for screening and feedback and encouraging lifestyle changes to reduce relative weight in 4-8 year old children: design of the MInT study. *BMC Public Health*. 2010 2010/05/24;10(1):1-11. English.
58. Dawson AM, Brown DA, Cox A, Williams SM, Treacy L, Haszard J, et al. Using motivational interviewing for weight feedback to parents of young children. *Journal of Paediatrics and Child Health*. 2014;50(6):461-70.
59. Taylor RW, Cox A, Knight L, Brown DA, Meredith-Jones K, Haszard JJ, et al. A Tailored Family-Based Obesity Intervention: A Randomized Trial. *Pediatrics*. 2015 August 1, 2015;136(2):281-9.
60. Taylor RW, Williams SM, Dawson AM, Taylor BJ, Meredith-Jones K, Brown D. What Factors Influence Uptake into Family-Based Obesity Treatment after Weight Screening? *The Journal of Pediatrics*. 2013 12//;163(6):1657-62.e1.
61. Kuczmarski R OC, Guo S, Grummer-Strawn L, Flegal K, Mei Z, et al. CDC growth charts for the United States: methods and development . *Data from the National Health Survey*. 2000:1-190.
62. White P. Gunston J SC, Atkinson J, Crampton P Atlas of Socioeconomic deprivation In New Zealand NZDep2006. Wellington, New Zealand: Ministry of Health; 2008.
63. Haszard J. Parental feeding practices in New Zealand. Dunedin: University of Otago; 2013.
64. Ministry of Health. Food and beverage classification system for years 1-13. Wellington, New Zealand: Learning Media Limited; 2007.
65. Magarey A, Golley R, Spurrier N, Goodwin E, Ong F. Reliability and validity of the Children's Dietary Questionnaire; A new tool to measure children's dietary patterns. *International Journal of Pediatric Obesity*. 2009;4(4):257-65.

66. Malik VS, Pan A, Willett WC, Hu FB. Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. *The American Journal of Clinical Nutrition*. 2013 October 1, 2013;98(4):1084-102.
67. Ministry of Health. Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2-18 years): A background paper. Wellington, New Zealand: Ministry of Health 2012.
68. Kendall A, Olson CM, Frongillo Jr EA. Relationship of Hunger and Food Insecurity to Food Availability and Consumption. *Journal of the American Dietetic Association*. 1996 10//;96(10):1019-24.
69. Campbell KJ, Crawford DA, Salmon J, Carver A, Garnett SP, Baur LA. Associations Between the Home Food Environment and Obesity-promoting Eating Behaviors in Adolescence. *Obesity*. 2007;15(3):719-30.
70. Vadiveloo MK, Parekh N. Dietary Variety: An Overlooked Strategy for Obesity and Chronic Disease Control. *American Journal of Preventive Medicine*.
71. Sisk C, Sharkey J, McIntosh W, Anding J. Using multiple household food inventories to measure food availability in the home over 30 days: a pilot study. *Nutr J*. 2010 2010/04/15;9(1):1-12. English.
72. Sharkey JR, Dean WR, St John JA, Huber JC, Jr. Using direct observations on multiple occasions to measure household food availability among low-income Mexicano residents in Texas colonias. *BMC Public Health*. 2010;10:445. PubMed PMID: 20670423. Pubmed Central PMCID: PMC2921392. Epub 2010/07/31. eng.

9 Appendices

Appendix A: Literature review table

Appendix B: MInT study information brochure

Appendix C: Invitation letter to parents

Appendix D: Home Food Inventory

Appendix E: Comparisons between original and modified versions of the HFI

Appendix F: Children's Dietary Questionnaire

Appendix A: Literature review table

Reference	Aim	Participants	Study Design	Relevant outcome measures	Relevant Results
CROSS-SECTIONAL STUDIES					
Koui E & Jago R (2008). <i>Associations between self-reported fruit and vegetable consumption and home availability of fruit and vegetables among Greek primary-school children.</i> (21)	To look at the relationship between home availability of fruit and vegetables and self-reported fruit and vegetable consumption	-n=167 -10-11years old -Greek	Cross-sectional	-F&V consumption measured via FFQ (16 fruit and 16 vegetable items and two fruit juices) -Home availability of F&V was measured via a questionnaire completed by students. Questionnaire asked whether F&V on the given list were available in their home during the past week (Yes or No)	-Fruit availability was significantly associated with fruit intake ($r=0.707$, $P<0.001$) and vegetable intake ($r=0.459$, $P<0.001$). -Vegetable availability was significantly correlated with fruit intake ($r=0.472$, $P<0.001$) and vegetable consumption ($r=0.510$, $P<0.001$).
Wyse R, Campbell E, Nathan N, Wolfenden L (2011). <i>Associations between characteristics of the home food environment and fruit and vegetable intake in preschool children.</i> (27)	To identify characteristics of the home food environment that are associated with increased intakes of fruits and vegetables	-n=396 parents -3-5 years old -Australia	Cross-sectional	-Parents completed the fruit and vegetable subscale of the Children's Dietary Questionnaire (CDQ). This required them to report the variety and frequency of fruit and vegetables consumed by their child over the past 24 hours and past 7 days. -To measure availability of fruit and vegetables in the home parents were read a list of 19 commonly consumed fruits and 24 commonly consumed vegetables from the CDQ. They were asked to identify those that were present in their home at the time.	-Higher fruit and vegetable consumption in children was significantly associated with having a wider variety of fruits and vegetables in the home ($p=0.006$).

Cullen KW, Baranowski T, Owens E, Marsh T, Rittenberry L, de Moor C (2003). <i>Availability, Accessibility, and Preferences for Fruit, 100% Fruit Juice, and Vegetables (FJV) Influence Children's Dietary Behavior.</i> (18)	1.To look at the relationship between child and parent reported FJV availability and accessibility to child reported FJV consumption	-n=225 children -n=88 participating parents -9-12 years old -Texas (Mix of African-American, Euro-American, Mexican-American)	Cross-sectional	-Dietary intake measured via 7-day diet record completed by children. -Availability of fruit, vegetables and 100% fruit juice was assessed via questionnaire. This included 3 fruit juices, 13 fruits and 18 vegetables. Children were asked whether these were present in the home in the past week; response Yes/No. This was completed by children at school and by parents during telephone interviews.	-Fruit and vegetable intake were significantly positively correlated with child-reported availability of F&V ($p<0.05$) but not parent-reported availability. -Availability and accessibility of F&V were both significantly related to intake for children with low FJV preferences. Only availability was significantly related to intake in children with high FJV preferences.
Kratt P, Reynolds K, Shewchuk R (2000). <i>The role of availability as a moderator of family fruit and vegetable consumption.</i> (22)	To investigate F&V availability as a moderator of family fruit and vegetable consumption	-n=1,196 child-parent pairs -9-10 years old -American	Cross-sectional	-Children's dietary intake measured via 24hr recall-students completed a face-to-face interview on 5 days of the week and by telephone on 2 days of the week. -Fruit and vegetable availability measured via questionnaire complete by parents. Questions asked about the presence of F&V items in the home during the week prior: 11 vegetables, 11 fruit. 4 questions addressed the location and preparation and fruit and vegetables in the home (eg. F&V on the counter, in the fridge, cut up?).	-Homes with high availability of fruit and vegetables had significantly higher intakes of fruit and vegetables compared to those with low availability ($p=0.02$). Those with medium availability of fruit and vegetables in the home had significantly higher intakes of them compared to those with low availability ($p=0.01$).
Reynolds KD, Hinton AW, Shewchuk RM, Hickey CA (1997). <i>Social Cognitive Model of Fruit and Vegetable Consumption in Elementary School Children.</i> (26)	To create a model based on social cognitive theory and nutrition literature to explain F&V intake in children.	-n=414 -9 years old -86% European American 14% African American	Cross-sectional	-Dietary intake –a single 24 hour diet recall collected for each student, completed by students -F&V availability-questionnaire assessed the presence of 11 fruit and 11 vegetables in the home, as well as nine other forms of F&V (eg. 100% pure juice). A sum score was created. (The data were randomly divided into two samples (split 1 and split 2), to allow for the development of the model in split 1 and confirmation in split 2).	-Availability of F&V had a direct influence on F&V consumption in two of the subsamples (split 1 –path coefficient=0.08, t-value=2.06, $p<0.05$), (girls – path coefficient=0.09, t-value=2.60, p -value<0.05). -Availability had a direct influence on motivation but not consumption in the other two subsamples (split 2 and males).

Ding D, Sallis JF, Norman GJ, Saelens BE, Harris SK, Kerr J, et al (2012). <i>Community food environment, home food environment, and fruit and vegetable intake of children and adolescents.</i> (19)	To evaluate the association between home food environment and fruit and vegetable intake	-n=171 adolescent parent pairs (aged 12-18years) and -n=116 parents of children (aged 5-11years) -American	Cross-sectional	-F&V intake measured via 2 questions (number of servings of fruit and vegetables the adolescent or child ate in a typical day) in questionnaire complete by either parent or adolescent. -HFA was measured via questionnaire (16 food items categorized into more healthful and less healthful) 5-point response ranging from never to always.	-Availability of fruit and vegetables in the home was positively associated with fruit and vegetable intake in both adolescents and children. Availability of more-healthful food in the home was positively associated with fruit and vegetable intake in adolescents but not children. Availability of less-healthful food in the home was positively associated with fruit and vegetable intake in adolescents but not children.
Johnson L, van Jaarsveld CH, Wardle J (2011). <i>Individual and family environment correlates differ for consumption of core and non-core foods in children.</i> (33)	To examine the relationship between the home environment and the intake of core and non-core foods.	-n=342 - twins aged 11 years and their parents -British	Cross-sectional	-Dietary intake assessed via validated FFQ (including 45 foods-27 “core foods” and 18 “non-core foods”) completed by mothers. -HFA was measured using a questionnaire (reported whether a list of 118 foods were currently present or absent from the home) -All food classified as “core” or “non-core” based on Australian Dietary guidelines. Core foods included those in the five core food groups- breads and cereals, fruit, vegetables, dairy products, meat and fish.	-A higher availability of non-core foods (biscuits, cakes etc.) was associated with a higher intake of these foods. -Availability of core foods was not associated with intake of core foods.
Campbell KJ, Abbott G, Spence AC, Crawford DA, McNaughton SA, Ball K (2013). <i>Home food availability mediates associations between mothers’ nutrition knowledge and child diet.</i> (16)	To look at the association between HFA and mothers’ nutrition knowledge and child food intake	-n=536 (children and mothers) -5-12 years old -Australian (living in socioeconomically disadvantaged neighborhoods)	Cross-sectional	-Child’s dietary intake measured using a FFQ completed by mothers (reported usual frequency of consumption in 1 month of fruit, vegetables, potato crisps or salty snack foods, chocolate or confectionary, cakes/doughnuts/sweet biscuits, soft drink and fruit juice). -HFA measured via questionnaire completed by mothers (reported whether the foods listed above were available in the home never, sometimes, usually or always).	-Home availability of fruit, vegetables, potato crisps or salty snack foods, chocolate or confectionary, cakes/doughnuts/sweet biscuits, soft drink and fruit juice were each significantly associated with the child’s intake of the corresponding food or drink (all $p<0.0005$).

Hanson NI, Neumark-Sztainer D, Eisenberg ME, Story M, Wall M (2005). <i>Associations between parental report of the home food environment and adolescent intakes of fruits, vegetables and dairy foods.</i> (32)	To explore the relationship between HFA, parent dietary intake and adolescent intake of fruit, vegetables and dairy foods.	-n=902 adolescents & their parent/guardian -American (Sub set of participants from project EAT)	Cross-sectional	-Availability of fruit, vegetables, soft drink and dairy -Intake of above -Dietary intake measured via FFQ (149 items) completed by students -HFA measured via parent interview over the phone. This assessed availability of fruit, vegetables, soft drink and dairy. Question asked: How often are these foods available in your home? 4 point scale from always to never	-Availability of F&V was positively associated with intakes of these in girls (t-trend = 2.70, $p<0.01$) but not in boys. In girls soft drink availability was inversely associated with dairy intake (t-trend = 2.08, $p=0.04$)
McGowan L, Croker H, Wardle J, Cooke LJ (2012). <i>Environmental and individual determinants of core and non-core food and drink intake in preschool-aged children in the United Kingdom.</i> (34)	-To explore the environmental and individual predictors of children's intake of 'core' (fruits and vegetables) and 'non-core' (snacks and sweetened beverages) foods	-n=434 -2-5 years old -British Participants from the Poppets Study (parent-report community survey)	-Cross-sectional	-Core food intake (F&V) was assessed via a survey asking: 'How many servings of fruit (vegetables) does your child typically eat, including those eaten at meals and a snacks?'. Seven point response scale (from 'less than once per week' to 'three or more per day') -Non-core food intake was assessed by asking: 'How often does your child have the following as a snack or drink between meals: sweets, sweet snacks, savory snacks, sweetened carbonated drinks and other sweetened drinks?' Seven point response scale (from 'never/rarely' to 'three or more times per day'). -Availability of each of the foods previously mentioned was assessed by asking the question 'Are any of the following foods and drinks in your house right now'. Response categories for each were yes/no/don't know.	-Greater availability of non-core foods in the home predicted the intake of non-core snacks ($B=0.10$; $P=0.022$) but not non-core drinks ($B=0.15$, $p=0.084$). -Home availability of F&V did not predict fruit ($B=0.42$, $p=0.131$) or vegetable intake ($B=0.21$, $p=0.074$).
Lipsky LM, Nansel TR, Haynie DL, Mehta SN, Laffel LMB (2012). <i>Associations of food preferences and household food availability with dietary intake and quality in youth with Type I</i>	To explore the relationships between food preferences and availability with dietary intake in youth with type 1 diabetes	-n=252 -8-18 years old -American -All type 1 diabetics	Cross-sectional	-Dietary intake assessed using 3 day diet record (completed by participants and parents). -HFA was assessed via a survey completed by parents. Parents reported household availability (yes/no) of each food item over the past 7 days. Fruit (18 items), vegetables (26 items), wholegrains (8 items), refined grains (4 items), fats/sweets (5 items)	-A positive association was observed between availability of fruit and intake of fruit and whole grains ($B=0.21$, $SE=0.07$, $p<0.01$) and availability of whole grains and intake of whole grains ($B=0.20$, $SE=0.06$, $p<0.001$). -No significant association was found between availability of

diabetes. (24)					vegetables, refined grains and fats/sweets and intake of these foods.
Downs SM, Arnold A, Marshall D, McCargar LJ, Raine KD, Willows ND (2009). <i>Associations among the food environment, diet quality and weight status in Cree children in Québec.</i> (28)	To investigate the association among children;s diet quality, weight status and food environment.	-Quebec, Canada -aged 9-12 years -n=201 -29.9% were overweight -34.3% were obese	Cross-sectional	-Dietary intake was measured using a 24 hour dietary recall (done 3 times with each child on non-consecutive days) -HFA of F&V, potato chips, milk, soda pop and real fruit juice was assessed using a questionnaire from the project EAT survey. Children were asked questions by an interviewer. They were asked to respond whether items were never, sometimes, usually or always available. -Height and weight were measured and used to calculate BMI. Children were then categorized as normal weight, overweight or obese using International Obesity Taskforce age- and gender-specific cut-offs.	Children who often had soda, real fruit juice and milk in the home had significantly higher intakes of each of these compared (p=0.049, p=0.024, p=0.024) to children who seldom had these in the home. No relationship was found between home food availability and weight status.
Spurrier N, Magarey A, Golley R, Curnow F, Sawyer M. <i>Relationships between the home environment and physical activity and dietary patterns of preschool children.</i> (35)	To explore the relationships between home environment characteristics and children's dietary patterns and physical activity	-n-280 -4-5 years old -Australian	Cross-sectional	-Dietary intake was measured using the Children's Dietary Questionnaire (CDQ). 24 item questionnaire completed by parents. Includes Likert scale questions to assess dietary patterns. From this four food group scores are calculated (F&V, fat from dairy products, sweetened beverages and non-core foods). -HFA measured by direct observation by interviewers. They looked at quantity of F&V, high fat/sugar non-core snack foods, fat content of dairy products and sweetened drinks present in the home. -Amounts were recorded on 4-point Likert scales based on amounts of food groups required by an average size family in a week (Australian Guide to Healthy Eating).	The availability of the following food groups were associated with intake of these foods (F&V, p<0.001; fat in dairy, p=0.001; sweetened beverages, p=0.004- <0.001; non-core foods, p=0.01- <0.001).

Gallaway MS, Jago R, Baranowski T, Baranowski JC, Diamond PM (2007). <i>Psychosocial and demographic predictors of fruit, juice and vegetable consumption among 11-14-year-old Boy Scouts.</i> (30)	To assess which psychosocial and demographic characteristics impact fruit, juice and vegetable (FJV) consumption in boys. To look at the relationship between availability of these and weight.	-Texas, USA -Boys ages 11-14 years -n=473	Cross-sectional	-FJV intake was assessed using a validated FFQ completed by a parent of guardian. -Home availability of FJV was assessed using a validated 48-item questionnaire completed by a parent or guardian -Height and weight measured. BMI and BMI percentile were calculated using CDC growth charts.	-No significant association was found between BMI and home food availability -Home availability was a significant predictor of FJ and V consumption (both $p<0.001$).
Couch SC, Glanz K, Zhou C, Sallis JF, Saelens BE (2014). <i>Home Food Environment in Relation to Children's Diet Quality and Weight Status.</i> (17)	To look at the relationship among the home food environment, child/parent characteristics, diet quality and weight status	-n=699 child-parent pairs -6-11 years old -Non-hispanic white children	Cross-sectional	-Dietary intake measured via 24hour recall on 3 occasions (child reported with parental assistance) -HFA measured via survey completed by parents (reported how often 12 food items were available on likert scale-never, rarely, sometimes, often, always) -Availability of 8 high-calorie, nutrient-poor items (chocolate candy, other candy, cakes/brownies/muffins/cookies, regular chips/crackers, sweetened breakfast cereals, juices, regular sodas, sports drinks) -Availability of four low-calorie, nutrient-dense items (raw fruit, raw vegetables, unsweetened cereals, baked chips/low-fat crackers/pretzels. -Height and weight we measured and used to calculate BMI, BMI z-scores, BMI percentiles and weight status using CDC growth chats	-Availability of unhealthy foods was positively associated with intake of high calorie beverages and inversely associated with fruit and vegetable intake and DASH (dietary approaches to stop hypertension) score in children. -Availability of healthy foods was positively associated with DASH score and with sweet and savoury snacking (unexpectedly) in children. -No association was found between HFA and BMI or child overweight
Gable S, Lutz S (2000). <i>Household, Parent, and Child Contributions to Childhood Obesity.</i> (29)	-To explore the relationships between demographic characteristics and home environment	-n=65 parent-child pairs -6-10 years old -American (majority Caucasian)	Cross-sectional	-Dietary intake was measured using a 31-item FFQ completed by parents. Foods were categorized into breads and starches, F&V, sweet drinks and candy, meat and mixed dishes and dairy products.	-Greater availability of sweets in the home was associated with higher intake of fats ($r=0.33$; $p<0.01$), sugars ($r=0.25$; $p<0.05$) and junk foods ($r=0.03$; $p<0.05$). Availability of chips and salty snacks was also

	characteristics. -To compare obese and non-obese children by demographics, food availability, parenting beliefs and attitudes, child food intake and activities.			-HFA was measured via a survey completed by parents. This measured availability of F&V, bread, cereals, rice, pasta, meats, dairy products, salty snacks; and frozen desserts and snacks using a 5-point Likert scale ranging from hardly ever to always. -Height and weight were measured then BMI calculated to distinguish obese from non-obese children.	positively associated with junk food intake ($r=0.03$; $p<0.05$). -There was no significant difference in HFA between the households of obese and non-obese children.
Hebden L, Hector D, Hardy LL, King L. <i>A fizzy environment: Availability and consumption of sugar-sweetened beverages among school students.</i> (20)	To explore associations between sugar-sweetened beverage (SSB) availability at school and in the home, and intake of these	-n=8058 -4-16 years old -Australian (Participants of the New South Wales Schools Physical Activity and Nutrition Survey)	Cross-sectional	-Parents of children aged 4-8 completed a questionnaire on behalf of their child. Students aged 9-16 completed the same questionnaire at school. -SSB intake was assessed using the question 'Please indicate how many cups of the following drinks you (your child) usually consume(s)...soft drink, cordials or sports drink, such as lemonade or Gatorade.' Five response categories ranging from ≤ 1 cup/week to ≥ 2 cups/day. -Availability of soft drinks at home was assessed with the question 'How often do you have soft drinks available in your home?' (only assessed among students aged 6-19). Responses: 'usually', 'sometimes' or 'never/rarely.'	Students aged 9 to 16 who usually had soft drinks available at home were almost five times as likely to be high consumers (≥ 5 cups per week). (AOR 4.63; 95%CI 3.48, 6.17)
Grimm GC, Harnack L, Story M (2004). <i>Factors associated with soft drink consumption in school-aged children.</i> (31)	To identify factors that are related to soft drink consumption in school-aged children	-n=560 -8-13 years old -American	Cross-sectional	-Dietary intake of soft drinks was measured via a mail survey completed by children. They were asked how often they drank soft drinks. 5 response options ranging from "everyday" to "less than once a week or never." -Availability of soft drinks was also measured via this survey however exact questions were not specified.	Availability of soft drinks in the home was significantly associated with soft drink consumption. OR=2.82 CI=1.51, 5.29 (odds of consuming soft drinks five or more times per week)

LONGITUDINAL STUDIES					
Larson N, Laska MN, Story M, Neumark-Sztainer D (2012). <i>Predictors of Fruit and Vegetable Intake in Young Adulthood</i> . (23)	To identify factors influencing fruit and vegetable intake in young adulthood	-n= 1,130 -15 years old at baseline -American -Participants of Project EAT I, II and III (Eating and Activity in Teens and Young Adults)	-Longitudinal -Follow-up at 5 years and 10 years	-Dietary intake measured via FFQ at 3 time points over 10 years (intake of F&V) -HFA measured via survey (how often are fruit, vegetables and unhealthy foods available-four responses ranging from never to always)	-Higher availability of F&V and lower availability of unhealthy foods in adolescence and emerging adulthood were predictive of fruit and vegetable intake 5 and 10 years later
Vereecken C, Haerens L, De Bourdeaudhuij I, Maes L (2010). <i>The relationship between children's home food environment and dietary patterns in childhood and adolescence</i> . (25)	To identify aspects of the home food environment (parent's intake, availability and food related parenting practices) that are associated with dietary patterns during childhood and in adolescence	-n=609 (parent-child pairs) -10 years old at baseline -Flemish Participants of Eating and Activity study	-Longitudinal -Follow-up at 4 years	-Dietary intake measured via FFQ completed by children/adolescents. They were asked how many times a week they usually consume fruit, vegetables, sugared soft drinks, sweets and crisps. Seven response categories ranging from never to every day more than once. -Availability of fruit, soft drinks, biscuits, sweets and crisps was measured on a 3-point response scale ('always/mostly' available, 'sometimes' and 'never') completed by parents	-Higher availability of unhealthy food at baseline was significantly associated with a lower intake of fruit and vegetables at both baseline and follow up. -A lower unhealthy availability score (i.e. lower availability of unhealthy foods) at baseline was associated with a higher fruit and vegetable score (i.e. higher intake of fruit and vegetables) in children at both baseline and follow-up
Arcan C, Hannan PJ, Fulkerson JA, Himes JH, Rock BH, Smyth M, et al (2013). <i>Associations of home food availability, dietary intake, screen time and physical activity with BMI in young American-Indian children</i> . (15)	To look at the association between home environmental factors and BMI in young American-Indian children	-n=424 -4-8 years old -American-Indian children	-Cross-sectional and prospective -Follow-up at 15 months	-Dietary intake measured via FFQ (consumption over past month) -HFA measured via survey completed by parents (reported whether 47 food items were available in the past week, including: fruit, vegetables, beverages, salty snacks, sweet snacks and meats and other high fat foods) -Anthropometry-weight and height measured, BMI calculated, weight status determined using CDC growth charts.	-There was no significant difference in HFA among BMI categories, except for whole milk being more available in the homes of overweight children.

Arcan C, Neumark-Sztainer D, Hannan P, van den Berg P, Story M, Larson N (2007). <i>Parental eating behaviours, home food environment and adolescent intakes of fruits, vegetables and dairy foods: longitudinal findings from Project EAT. (39)</i>	-To assess the longitudinal relationship between HFA of fruit, vegetables and dairy foods and intake of these among adolescents and their parents.	-n=509 adolescent-parent pairs -Mean age at baseline: 12.6 years -American -Participants from Project EAT (Eating Among Teens)	-Longitudinal -Follow up at 5 years	-Adolescent's intake of fruit, vegetables and dairy products were measured using the semi-quantitative YAQ (youth adult questionnaire). This included 11 fruit and juice items, 16 vegetables and 4 dairy items. Likert scales were used to assess mean daily servings over the past year. This was completed by adolescents. -HFA of F&V was assessed via questionnaire completed by parents. They were asked: "How often are fruits and vegetables available in your home?" Answers were given on a 4-point Likert scale ranging from always to never.	-There was no significant association between HFA of F&V at baseline and intake of these at follow-up among adolescents
Pearson N, Ball K, Crawford D (2011). <i>Predictors of changes in adolescents' consumption of fruits, vegetables and energy-dense snacks. (44)</i>	To assess the associations between environmental factors and changes in adolescents eating behaviors over 2 years.	-n=1850 -12-15 years old at baseline -Australian	-Longitudinal -Follow-up at 2 years	-Dietary intake measured via FFQ. This measured intake of 37 food items during the previous month, with seven response categories ranging from "never" to "several times a day". This study only used data from a subset of 6 food items from the FFQ, which were categorized into 3 food groups: fruit, vegetables and energy-dense snacks. -HFA was measured via a questionnaire completed by adolescents. This asked how frequently the following were available in the home: fruit, vegetables, cakes or sweet biscuits, potato crisps or salty snacks, chocolate or lollies. Answers ranged from never to always on a 4-point Likert scale.	-Availability of energy-dense foods was negatively associated with changes in fruit consumption and positively with changes in energy-dense snack intake. Availability of fruit and vegetables was positively associated with change in vegetable intake.

Appendix B: MInT Study information brochure

What's in it for me to take part?

There are lots of benefits to being in MInT:

- » you will get to see health professionals for free to talk about your whānau's health
- » your whole family's health may benefit
- » you'll be part of an important study that could help all NZ whānau/families
- » it won't cost you anything
- » the kids will find it fun

What use will be made of the information collected?

Only the researchers will have access to the information. All data and questionnaires will be kept confidential. Group results of the project may be published, but not in a way that could identify any individual child or family.

Can we change our minds and withdraw from the study?

Deciding whether to take part in the study is entirely your choice. You can withdraw from the project at any time and do not have to give any reason for doing so. Withdrawing from the project will not affect your healthcare or that of your child in any way.

What if I have any questions?

If you require an interpreter, one can be provided. You are welcome to have a friend, family member or whānau support you. If you have any queries or concerns about your rights as a participant in this study you may wish to contact a Health and Disability Services Consumer Advocate:

Telephone (03) 479 0265 or
Freephone 0800 37 77 66 or
Freefax 0800 2787 7678 or
Email advocacy@hdc.org.nz

If you have any specific Māori issues or concerns please contact Linda Grennell at 0800 377 766.

If you have any questions about our project, either now or in the future, please contact us on the phone, mobile or fax numbers, or email address below.

MInT Study
c/- Department of Human Nutrition
P O Box 56, Dunedin, New Zealand
Telephone (03) 479 5953
Mobile 021 187 5589
Fax (03) 470 3598
Email: mint@otago.ac.nz

This study has ethical approval from the Lower South Regional Ethics Committee.

Do you have a child aged 4–8 years?



Then take part in our study aimed at improving health in young children and their whānau/families (MInT)

Why?

What children eat, how active they are, how they behave and family relationships are all important for children's growth.

We want to see if giving whānau/families extra support around healthy eating, having fun being active, effective parenting, and enjoying time together as a family can improve their health and well-being. We want to identify the best way to talk to whānau/families about these sensitive issues, so they feel ready to make positive changes that help them and their children grow up healthy and strong.

What will be involved?

Part One

If you and your whānau/family decide to take part, we would like you and your child to come to the doctor's rooms for a health check. Your child's growth and blood pressure will be measured and you will be asked to complete some questions about your whānau/family. Some of you will be asked to visit the hospital on a separate day to measure your child's body composition using a DXA scan. This is a bit like an x-ray (except DXA only uses a very small amount of radiation—about the same as you would get on a short plane flight) and is fun for the kids.

You will be allocated by chance to one of two different ways of getting the results of the health check. If you agree, we would like to tape the meeting where we discuss the results so we can review how we gave the information to you. While this is happening, your child(ren) can have fun trying the new active sports games on Nintendo Wii. A time will be made for one of the researchers to meet with you to get feedback about how useful this information was to you. If you are eligible, you can then choose to take part in the next stage of the study.

Part Two

If you participate in the second phase of the study, you will be assigned to one of two groups:

(1) Usual care or (2) Tailored package. Neither you, nor the researchers can choose which group you go into. Therefore you have to be willing to participate in either of the groups.



Usual care:

If you are in this group, you will have one session with our healthy lifestyle advisor and then we will ask you to visit the research clinic once a year for a brief interview and to measure the growth and activity of your child.



Tailored package:

If you are in this group, you will meet with a support mentor and healthy lifestyle consultants to create a plan that encourages your whānau/family to eat healthily, have fun being active, address any behaviour issues and achieve positive changes in family relationships, depending on the areas you have identified as being important for your whānau/family.

Your support mentor will be available on a regular basis (initially fortnightly decreasing down to once every 3 months, 18 visits in total) to assist you to follow your plan and make any changes you think would be helpful.

All participants of Part Two

We would like to ask you about what your child eats, what food is available to them, their mood, their behaviour, and how your whānau/family functions.

We would also like to measure your child's physical activity using a small device which is about the size of a watch but is worn on an elastic belt around the waist. We would like to repeat these measurements and the questionnaires two more times (1 and 2 years later).

Appointments will generally be held at the university or the hospital but we could visit you in your home if you would prefer. We will pay all your travel costs.

What are the risks to participants?

We do not see that there will be any risks involved with being in the project. Although we need to measure weight in children, the focus of the programme is not on weight, but rather on health and fun for all the whānau/family. In the unlikely event of a physical injury as a result of taking part in the study you will be covered by the accident compensation legislation with its limitations.

Appendix C: Invitation letter to parents

[date]

[address]

[address]

[address]

[address]

Dear *Parent(s) name*

As a society we want children to grow and thrive, and develop into healthy adults. However, we are still discovering how children develop, and this is why we are writing to you. We would like to invite your whanau/family to participate in an exciting project called MInT. We hope this study will find out how children in Otago are growing, how best to talk to families about their children's growth, and how to support positive changes that will assist children. We hope you will agree to take part in this important study, because the results will help us improve children's health and benefit all New Zealanders.

What does taking part mean for you and your family?

If you agree to take part in this study, your child will have a basic health check and we'll tell you about the results. You may think this is strange as you may have already had a health check with your GP or the hospital, but we think that this check will give you more information than a usual visit. We would also like you to tell us how useful the information we give you is, and whether we could improve it. We hope you will then take part in the next stage of the study if you are eligible. The next stage will involve being in one of two groups, where you will receive support to help you and your whanau/family have fun being active, eat well, and enjoy time together as a family. Being in MInT is free and we'll also pay your travel costs to attend appointments or we can come and see you in your home if you would prefer.

Please find enclosed an information brochure that describes the study in more detail. MInT received ethical approval to send you this letter of invitation through contact details provided by the Broadway Medical Centre. You can contact us if you do **not** want to take part, using one of the options at the bottom of this letter (fax, email, landline (answer-phone only), or mobile). Please tell us your name and that of your child and we will not contact you again. If we do not hear from you, one of the researchers will contact you in about a week to see if you would like to take part. If you would like to speak to someone in person about the project before that, please use the contacts below and ask for Nicky (Project Co-ordinator) or Rachael (Team Leader).

Thank you for thinking about the MInT study and how this might help both your whanau/family and our health system find out the best way of helping families become and stay happy and healthy.

Yours faithfully,

Dr Rachael Taylor
Team Leader

Appendix D: The home food inventory



mint

Home Food Inventory

Participant ID:

Please complete this **the day after the main food shop** has taken place.

Look in areas in your home where your household stores food, including the fridge, freezer, pantries, cupboards and other storage areas. Tick each food if it is present anywhere in your home (open or unopened) **regardless of how much there is**. If you have food growing (such as fruits and/or vegetables) include those that are ready to eat now.

Please make sure that you complete this while looking in your cupboards and fridge and not by memory. Look for all foods that might fit into the description given and if you are unsure which category a food belongs in (for example certain breakfast cereals), just write the name and brand next to the table.

Thank you.

How many people living in your household this week?

Adults and teenagers:

Children:

Infants (less than a year of age):

On what day did you do your MAIN SHOP this week?

On what day did you fill in this questionnaire?

Are there any special reasons why this week may differ from 'normal' in terms of household food (for example, child's birthday party)?

DAIRY AND DAIRY-TYPE FOODS AND DRINKS

	Full fat milk (such as blue-top milk, include long-life milk)
	Reduced fat milk (such as light-blue-top, green-top or yellow-top, slim, trim, include long-life milk)
	Flavoured milk (such as chocolate, strawberry)
	Soy or rice milk
	Cream
	Sweetened condensed milk
	Full fat evaporated milk
	Reduced fat evaporated milk (light)
	Reduced cream
	Regular coconut cream or milk
	Reduced fat coconut cream or milk (lite)
	Butter (including half butter/half margarine blends)
	Margarine or table spread (including 'Logicol')
	Full-fat yoghurt (such as Greek yoghurt, Puhoi Valley)
	Reduced fat yoghurt (most other yoghurts – Fresh n Fruity, Meadow Fresh, all children's yoghurts)
	Dairy food (such as 'Calci Yum')
	Custard or ready-to-eat mousse
	Regular cheese (block or grated) (such as Colby, Tasty, Parmesan)
	Lower fat cheese (such as Edam, Light, Mozzarella)
	Low fat cheese (such as cottage cheese, light cottage cheese, ricotta, quark, reduced fat cheeses)
	Snack size cheese (such as processed slices, triangles, sticks)
	Other cheese (such as soft cheeses: camembert, brie, fruit cheese, feta)
	Regular cream cheese (such as 'Philadelphia')
	Reduced fat cream cheese (such as 'Philadelphia spreadable')
	Regular sour cream
	Reduced fat sour cream (lite)
	Ice-cream in a tub
	Sugar-free ice-cream (such as 'Zilch')
	Single serve ice-creams (such as 'Magnums', 'Trumpets', 'Jelly-Tips')
	Milk-based frozen ice-blocks (such as 'Moosies', 'Moo', 'Paddle Pop')
	Sorbet/gelato/frozen yoghurt
	Cheesecake
	Cream puffs/éclairs

DRIED FOODS

	Pasta (white or brown)
	Instant noodles with flavour sachet (such as 'Fantastic', 'Indo mie', 'Maggi')
	Plain noodles (such as egg noodles, vermicelli, udon)
	Rice (any kind)
	Couscous, bulghar wheat or quinoa
	Dried pasta dishes (such as 'Easy Mac', 'Continental Pasta and Sauce')
	Dried rice dishes (such as rice risotto)
	Dried mashed potato
	Soup packets (such as 'Cup-a-soup', 'Kings soup mix')

CANNED FOODS (other than fruit and vegetables)

	Desserts (creamed rice)
	Dinners (Stews, 'Big Eats', macaroni cheese)
	Fish (and other seafood) (such as tuna, sardines)
	Chicken
	Meat (such as chicken, corned beef)
	Soup (such as condensed soups or ready-to-eat)
	Spaghetti in tomato sauce (such as 'Watties Spaghetti')

OTHER MEAL INGREDIENTS

	Mayonnaise, ranch dressing or other creamy salad dressings
	Reduced fat or lite salad dressings
	Oil (such as olive, canola, vegetable)
	Lard or other cooking fat
	Tomato sauce or other sauces (such as soy, Worcester, fish, sweet chilli etc)
	Pasta sauces (tomato based)
	Other pasta sauces/simmer sauces/meal bases (such as cheesy pasta, curries, sweet and sour)

VEGETABLES – tick all that apply

Fresh	Canned/ Jars	Frozen	Dried	
				Mixed vegetables (all kinds)
				Asparagus
				Baked beans
				Beans (such as green beans, broad beans, string beans)
				Beetroot
				Broccoli /Broccoflower
				Brussel Sprouts
				Cabbage
				Capsicum (red, green, yellow, orange peppers)
				Carrots
				Cauliflower
				Celery
				Chickpeas
				Corn
				Courgette/zucchini
				Cucumber
				Eggplant/aubergine
				Kidney beans (including chilli beans)
				Leeks
				Lentils
				Lettuce
				Mushrooms
				Onions/shallots/spring onion
				Other legumes/beans/grains (such as butter beans, barley)
				Parsnip
				Peas
				Potatoes
				Pumpkin or squash
				Radish
				Spinach/silverbeet
				Sprouts (including alfalfa, bean)
				Sweet potato/kumara
				Taro
				Tomatoes
				Yams

FRUIT – tick all that apply

	Dried fruit (such as apricots, raisins, sultanas, apples, mango, dates etc)		
Fresh	Canned/ Jars	Frozen	
			Mixed fruit/fruit salad
			Apples
			Apricots
			Avocado
			Bananas
			Berries (such as raspberries, strawberries, blueberries)
			Cherries
			Feijoa
			Grapes
			Grapefruit, lemons or limes
			Kiwifruit (green and gold)
			Mandarins
			Mango
			Melons (such as watermelon, honeydew, rockmelon)
			Nectarines
			Oranges, tangerines or tangelos
			Passionfruit
			Pawpaw/Papaya
			Pears/Nashi
			Peaches
			Persimmons
			Pineapple
			Plums
			Rhubarb
			Tamarillo

MEAT (these may be in fridge or freezer, include cooked leftovers)

	Shaved or sliced meats (such as ham, chicken, beef, pastrami)
	Salami, pepperoni, luncheon or other sausage-style sandwich meat
	Bacon
	Beef (such as roasts, mince, stewing beef, steaks)
	Pork (such as chops, mince)
	Lamb/mutton (such as roasts, mince, chops, steaks)
	Chicken (such as pieces, whole, mince, smoked)
	Fish (fresh or frozen fillets without crumbs or batter)
	Other seafood, excluding fish (such as shellfish)
	Crumbed, battered or fingers of fish
	Sausages, Sizzlers, hot dogs, saveloys, cheerios, frankfurters etc
	Prepared, packaged specialty meat dishes (such as crumbed schnitzel, stuffed chicken breasts)
	Nuggets or patties of meat (such as chicken nuggets, beef patties)
	Other meat (such as venison, goat)

OTHER CHILLED/FROZEN FOODS

	Eggs
	Tofu
	Soy products (not milk, such as vegetarian sausages)
	Falafel
	Coleslaw
	Potato salad
	Other prepared salads
	Fresh pasta
	Ready made fresh soups and sauces (such as those in pouches or tubs but not cans)
	Oven fries/hash browns/wedges/ready-to-roast veges
	Pizza/pizza-style snacks
	Pies/sausage rolls/savouries
	Asian snacks (such as spring rolls, samosas)
	Frozen/chilled packaged, prepared meals/snacks (such as lasagne, stir-fries, burritos, butter chicken, quiche)
	Ice-blocks
	Sweet pies (such as fruit pies, lemon meringue pie)
	Pastry (such as short, sweet, filo)

BAKERY (include home-made baked goods)

	White bread (include sliced, unsliced, rolls, Rewena, bagels, pita breads, wraps, roti, naan, chapati and tortilla)
	Brown/wholemeal/wholegrain bread (include sliced, unsliced, rolls, bagels pita breads, wraps and tortilla)
	English muffins (such as fruit, cheese, plain)
	Fruit loaf or bread
	Sweet breads (such as iced buns, doughnuts, croissants)
	Cakes (such as cakes, muffins)
	Slices (such as caramel slice, lolly cake, brownie etc)
	Scones and pancakes (including pikelets, crumpets, waffles)
	Chocolate coated biscuits (such as 'Tim Tams', 'Mallowpuffs', 'Toffee Pops')
	Cookies and fancy biscuits (such as chocolate chip, peanut brownies, Anzac biscuits, wafers, crème filled biscuits, home-made)
	Plain biscuits (such as 'Vanilla Wine', 'Superwine', 'Arrowroot', home-made)
	Large sized cookies (such as 'Cookie Time', home-made or large bakery biscuits)
	Garlic bread
	Desserts (such as 'Aunt Betty's', self-saucing puddings, fruit crumble, pavlova , homemade, meringues)

SPREADS

	Honey, jam or marmalade
	Marmite or vegemite
	Hazelnut spread (such as 'Nutella')
	Peanut butter
	Hummus (including flavoured hummus)
	Pesto or dips

SNACKS

	Chocolate bars – any size (such as ‘Moro’, ‘Dairy Milk’, ‘Crunchie’, ‘Fruit and Nut’)
	Chocolate covered or filled candy, fruit or nuts (such as Pineapple Lumps, ‘Jaffas’, ‘M & Ms’, chocolate raisins, chocolate peanuts, chocolate almonds)
	Chocolate chips/buttons or cooking chocolate
	Baked fruit cereal bars (such as ‘Twists’, baked fruit sticks)
	Nuts or seeds or fruit and nut/seed mixes (such as almonds, peanuts and raisins, scroggin)
	Muesli, nut or cereal bars (such as ‘Snacker’, ‘Natural Nut Bar’, ‘Snak logs’, ‘LCMs’, ‘Brunch bar’, homemade)
	Cheese and cracker packets (such as ‘Le Snak’)
	Potato chips (all flavours and sizes)
	Flavoured corn snacks (such as ‘Twisties’, ‘Rashuns’, ‘Burger Rings’, ‘Big Uns’ – any sizes)
	Corn chips, tacos or grain chips (such as nachos, ‘Grain waves’ – any sizes)
	Puffed chips (such as ‘Poppajacks’, vege crisps)
	Whole grain, reduced fat or corn crackers (such as ‘Vitaweat’, ‘Corn thins’, ‘Ryvita’, rice wafers, rice crackers)
	All other crackers (including flavoured such as ‘Shapes’, ‘Snax’, cream crackers)
	Fruity snacks (such as ‘Fruit for Yonks’, ‘Roll-ups’, ‘Fruit strings’, ‘Fruit nuggets’, ‘Marine Mix’)
	Butter or caramel popcorn (including microwave popcorn and pre-popped popcorn)
	‘Lite’, candy or plain popcorn (popped or unpopped)
	Pretzels
	Sweets/lollies (such as ‘Barley Sugars’, ‘Fruit Jubes’, ‘Natural Confectionary’, fudges)
	Jelly/instant pudding/chocolate mousse mixes (including diet/lite)

BREAKFAST FOODS

	Breakfast drinks (such as ‘Up & Go’)
	Traditional breakfast cereals (such as ‘Weetbix’, porridge, cornflakes, rice bubbles, bran-based cereals, muesli, light muesli (such as ‘Light & Tasty’))
	Fancy breakfast cereals (such as ‘Cocopops’, ‘Nutrigrain’, ‘Fruit Loops’, ‘Crispix’, ‘Honey Snaps’, ‘Crunchy Nut Cornflakes’)

BEVERAGES

	Cordial or syrup (including soda stream syrup)
	Diet cordial or syrup (including soda stream diet syrup)
	Juice or fruit drink (such as pure fruit juice, 'Just Juice', 'Golden Circle', 'Twist')
	Powdered drink (such as 'Raro', 'Refresh')
	Diet powdered drinks (such as 'Diet Refresh', 'Thriftee')
	Soft drink (such as 'Coke', 'Fanta', lemonade)
	Diet or zero soft drink
	Sports or energy drinks (such as 'Mizone', 'Powerade', 'V', 'Red Bull', 'Vitamin water')
	Bottled water (including flavoured water)
	Milkshake mixes (such as 'Nesquik', 'Make a Shake')
	'Milo'/hot chocolate/other hot milk drink mixes

Thank you very much for your time ☺

Appendix E: Comparison between original and modified versions of the Home Food Inventory (63)

Original HFI (17 food categories)	Modified HFI (13 food categories)
Cheese (11 items) Milk/Dairy (10 items) Butter, margarine and oils (8 items) Total (29 items)	Dairy and dairy-type foods and drinks (30 items) <i>Not so many cheese varieties included.</i> <i>Includes coconut cream (and lite), soy milks and some frozen desserts.</i> <i>Oils moved to 'meal ingredients.'</i>
Salad dressing (2 items) Condiments (4 items + 'others') Total (6 items)	Other meal ingredients (8 items) <i>Includes salad dressings, oils, cake mixes, sauces and pasta sauce.</i>
Vegetables (20 items)	Vegetables (34 items) <i>Extras: baked beans, brussel sprouts, chickpeas, courgette/zucchini, eggplant/aubergine, kidney beans, lentils, onions, other legumes, parsnip, radish, sprouts, taro, yams.</i>
Fruit (26 items)	Fruit (27 items) <i>Dried fruit now as a separate option.</i>
Deli, Luncheon, sandwich meat and sausage (6 items) Meats and other protein (10 items) Total (15 items)	Meat (14 items) <i>Eggs, tofu and legumes now in other categories.</i>
Frozen desserts (7 items) Microwave or Quick-cook frozen foods (8 items) Total (15 items)	Other chilled/frozen foods (14 items) <i>Includes eggs, tofu, prepared salads, fresh pasta, fish sauces, fresh soups, frozen snacks, iceblocks, and sweet pies.</i>
Bread (12 items)	Bakery (13 items) <i>Includes cakes, scones, biscuits, desserts, slices.</i> <i>Reduced bread options to two.</i>
Prepared desserts (8 items) Chips, crackers and other snack foods (18 items + 'others') Candy (5 items) Total (31 items)	Snacks (17 items) <i>Most of 'prepared desserts' is now in 'bakery'. Did not include any low-fat options for chips (not really an option in NZ).</i>
Dry breakfast cereal (3 items)	Breakfast foods (3 items)
Beverages (9 items)	Beverages (11 items)
	Dried foods (8 items) Canned foods (6 items) Spreads (7 items) <i>These foods were added as they constitute a reasonable proportion of the NZ diet (pasta, rice, noodles, tinned spaghetti, canned meat or fish, marmite, jam etc.)</i>
Total (167 items)	Total (192 items)

Appendix F: The Children's Dietary Questionnaire



Baseline Intervention Questionnaire

Welcome to phase 2 of the MInT study.

This questionnaire has 3 sections and should take about 30 minutes to complete. Please answer every question and remember that there *are no right or wrong answers*.

Please ask the researchers if you have any questions - thank you for your time.

Section 1: Your child's food intake

Questions 1 to 3 ask about the number of servings of foods your child would **normally** eat in their main meal of the day (usually dinner, sometimes the midday meal).

1 portion is the *amount that would fit in the palm of your child's hand.*

Thinking over the past week...

1 In your child's main meal, how much meat, poultry, fish or eggs do they usually eat?

- ☐ None
- ☐ ½ a portion
- ☐ 1 portion
- ☐ 1½ portions
- ☐ 2 portions
- ☐ More than 2 portions

2 In your child's main meal, how much potato, kumara, pasta, rice or bread do they usually eat?

- ☐ None

- ☐ ½ a portion
- ☐ 1 portion
- ☐ 1½ portions
- ☐ 2 portions
- ☐ More than 2 portions

3 In your child's main meal, how much colourful vegetables or salad do they usually eat?

- ☐ None
- ☐ ½ a portion
- ☐ 1 portion
- ☐ 1½ portions
- ☐ 2 portions
- ☐ More than 2 portions

Questions 4 to 35 ask about your child's eating habits. Some refer to the past week and some refer simply to the past 24 hours. Please read each question carefully.

4 How many days over the last week did your child eat breakfast?

- ☐ No days
- ☐ 1 day
- ☐ 2 days
- ☐ 3 days
- ☐ 4 days
- ☐ 5 days
- ☐ 6 days
- ☐ Every day

5 How many days over the last week did the family/household sit down to eat dinner together?

- ☐ No days
- ☐ 1 day
- ☐ 2 days
- ☐ 3 days
- ☐ 4 days
- ☐ 5 days
- ☐ 6 days
- ☐ Every day

6 Do you have any of the following rules when eating dinner?

Television must be turned off ☐ Yes

	☐	No
Telephone is not answered	☐	Yes
	☐	No

7 Please tick whether your child has eaten any of the following fruit (fresh, canned or stewed) over the past 7 days. Tick every circle that applies.

- | | | |
|-----------------------------------|-----------------------------------|-----------------------------------|
| ☐ Fruit salad | ☐ Berries | ☐ Orange |
| ☐ Peach | ☐ Mango | ☐ Dried fruit |
| ☐ Banana | ☐ Watermelon | ☐ Apple |
| ☐ Apricot | ☐ Rockmelon | ☐ Pineapple |
| ☐ Pear/Nashi | ☐ Mandarin | ☐ Pawpaw |
| ☐ Nectarine | ☐ Plum | ☐ Kiwifruit |
| ☐ Grapes | ☐ Other fruit | |

8 Please tick whether your child has eaten any of the following vegetables (cooked, raw or canned) over the past 7 days. Tick every circle that applies.

- | | | |
|---|--|---------------------------------------|
| ☐ Pumpkin/Squash | ☐ Carrot | ☐ Cabbage |
| ☐ Cauliflower | ☐ Broccoli | ☐ Brussel sprouts |
| ☐ Potato (not hot chips)
potato | ☐ Corn | ☐ Kumara/sweet |
| ☐ Peas and beans | ☐ Spinach/Silverbeet | ☐ Lettuce |
| ☐ Tomato | ☐ Cucumber | ☐ Celery |
| ☐ Capsicum | ☐ Mushroom | ☐ Eggplant |
| ☐ Zucchini/Courgette
Parsnip/Taro/Yams | ☐ Squash | ☐ |
| ☐ Mixed frozen vegetables | ☐ Other vegetables | |
| ☐ Legumes (chickpeas, lentils, kidney beans, baked beans) | | |
| ☐ Vegetables in mixed dishes (soups and stews) | | |

Questions 9 to 19 ask about the past 24 hours only. How often has your child had each of the following food/drink items in the past 24 hours?

9 Fruit juice / fruit drink

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 or more times

10 Water

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 or more times

11 Full cream milk including flavoured milk (Blue top milk) as a drink or on cereal

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 or more times

12 Reduced fat milk, including flavoured milk (Light blue, Yellow or Green top milk) as a drink or on cereal

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 or more times

13 Cheese and / or cheese spreads

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times

- ☐ 5 or more times

14 Regular fat yoghurt or custard (includes Greek yoghurt, Puhoi Valley)

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 or more times

15 Reduced yoghurt / low fat custard (most yoghurt deg. Fresh'n'Fruity, MeadowFresh, Calci-Yum etc)

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 or more times

16 Vegetables (raw, cooked or canned). How many times did your child eat vegetables regardless of the amount eg. salad in sandwich and vegetables in evening meal = twice

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 or more times

17 Fruit (fresh, canned, stewed, dried). How many times did your child eat fruit regardless of the amount eg. banana at breakfast, apple for lunch, canned peaches at dinner = 3 times

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 or more times

18 In the last 24 hours, how many different types of vegetables did your child eat (raw, cooked or canned)?

- ☐ None
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 or more

19 In the last 24 hours, how many different types of fruit did your child eat (fresh, canned, stewed or dried)

- ☐ None
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 or more

Questions 20 to 35 asks about the past 7 days. How often has your child had each of the following food/drink items in the past 7 days?

20 Peanut butter or Nutella

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

21 Pre-sugared or “fancy” cereals (eg Coco Pops, Fruit Loops)

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

22 Biscuits, cakes, muffins, doughnuts, slices or fruit pies

- ☐ Nil
- ☐ Once
- ☐ Twice

- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

How often has your child had each of the following food/drink items in the past 7 days?

23 Potato chips/crisps, flavoured corn snacks (eg Twisties) or crackers

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

24 Lollies, muesli or fruit bars

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

25 Chocolate (bar/block/coated biscuits)

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

26 Soft drink, Cordial or Powdered drinks (eg Raro) (not diet varieties)

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

27 Ice-cream or Ice-blocks

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

28 Cheese and/or cheese spreads

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

29 Pie, pastry, sausage roll or spring roll

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

30 Pizza

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

31 Hot chips or French fries

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

32 Hot Dog / Sausages / Processed meats (eg. Sizzlers, luncheon sausage, belgium, salami)

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

33 Takeaway (eg McDonalds, KFC, Fish n Chips/Chicken Shop)

- ☐ Nil
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 or more times

34 How many days in the last week did your child have some vegetables (raw, cooked or canned)?

- ☐ No days
- ☐ 1 day
- ☐ 2 days
- ☐ 3 days
- ☐ 4 days
- ☐ 5 days
- ☐ 6 days
- ☐ Every day

35 How many days in the last week did your child have some fruit (fresh, canned, stewed, or dried, not including fruit juice)?

- ☐ No days
- ☐ 1 day
- ☐ 2 days
- ☐ 3 days
- ☐ 4 days
- ☐ 5 days
- ☐ 6 days
- ☐ Every day