Parental feeding practices in New Zealand

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Abstract

Background

Although various parental feeding practices have been associated with dietary intake and body weight in children, many studies are limited by sample size or lack of diversity, perhaps explaining conflicting results. Related areas of interest with limited exploration to date include how parental feeding practices relate to i) problem food behaviours in children and ii) food availability in the home.

Objective

The aim of this thesis was to examine the relationships between parental feeding practices, diet, weight, home food availability, and problem food behaviours in a large, diverse sample of New Zealand children aged 4-8 years.

Methods

1093 children were recruited from general practice and secondary care clinics for a weight screening initiative (The MInT Study). Children and their parents attended a comprehensive health check including measurement of child body mass index (BMI) and completion of a questionnaire detailing measures of child dietary intake, parental attitudes of their child's weight and diet, parental feeding practices, parental discipline practices, demographics, problem food behaviours and home food availability.

A factor analysis of the Comprehensive Feeding Practices Questionnaire determined the feeding practices represented by the data. Examination of these factors in relation to demographic variables (ethnicity, socio-economic status, sex, maternal education and weight status) was undertaken using ANOVA.

Correlations and regression analyses established associations between parental feeding practices and children's dietary intake, the disciplining practices of parents, maternal BMI, problem food behaviours and home food availability using either the full sample or a subsample (overweight children only). This included exploration of some

interactions. Bootstrap analysis was used to determine a linear regression model for BMI z-score.

Results

The reassessment of the factor structure of the Comprehensive Feeding Practices Questionnaire determined that the original twelve factors did not reduce the data appropriately and that a five-factor structure was more suitable for this population. These five feeding practices were: *healthy eating guidance*, *monitoring*, *parent pressure*, *restriction* and *child control*.

These feeding practices varied with demographics, for example parents used more *restriction* and less *pressure* with girls and with overweight children. Furthermore, *healthy eating guidance* and *monitoring* were associated with less dysfunctional parenting practices, more fruits and vegetables, and less sweet drinks. By contrast, *child control* exhibited inverse associations with these factors. Bootstrap analysis indicated that *restriction* ($B=0.37$, $p<0.01$), *parent pressure* ($B=-0.19$, $p<0.01$) and *healthy eating guidance* ($B=-0.13$, $p=0.01$), along with maternal BMI ($B=0.03$, $p<0.01$), some ethnicities and low maternal education all contributed to a linear regression model that explained 18% of the variation in BMI z-score.

Some feeding practices were related to problem food behaviours and parents used different feeding practices with fussy children (more *parent pressure* and *child control* and less *monitoring*).

A comprehensive, relatively objective measure of home food availability showed that availability was associated with dietary intake, but not strongly associated with parental feeding practices. Furthermore, home food availability generally did not moderate the associations between feeding practices and dietary intake, suggesting that these two concepts are independently related to diet.

Conclusion

This thesis gives important new information about how parental feeding practices relate to the dietary intake, weight status and problem food behaviours of children, which can be used in the development of recommendations to parents.

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Table of Contents

List of Tables

List of Figures

List of abbreviations

ANOVA	Analysis of Variance
BMI	Body Mass Index
CEBI	Children's Eating Behaviour Inventory
CFI	Comparative Fit Index
CFQ	Child Feeding Questionnaire
CFPQ	Comprehensive Feeding Practices Questionnaire
CFSQ	Caregiver's Feeding Style Questionnaire
CDQ	Children's Dietary Questionnaire
HFI	Home Food Inventory
MInT	Motivational Interviewing and Treatment – a child weight screening and family-based treatment initiative in New Zealand
NZDep	New Zealand Deprivation Index
PFSQ	Parental Feeding Style Questionnaire
RMSEA	Root Mean Square Error of Approximation
SD	Standard Deviation
SE	Standard Error
SES	Socio-economic status
TLI	Tucker-Lewis Index

Glossary of feeding practices

Restriction	Limiting or regulating the food consumed by the child
Pressure to eat	Urging the child to eat more, for example saying "Just two more bites"
Monitoring	Keeping track of unhealthy foods (sweets, snack food, high-fat food and/or sugary drinks) that the child consumes
Food as a reward	Giving or withholding treat food in response to good or bad behaviour from the child
Healthy eating guidance	Modelling healthy eating, teaching about nutrition and encouraging balance and variety in the diet of the child
Parent pressure	A combination of *pressure to eat* and *food as a reward*
Child control	Allowing the child more freedom over, and control of, their own feeding
Emotion regulation	Feeding a child in response to their emotions, such as fussiness or boredom
Modelling	Demonstrating healthy eating in front of the child
Teaching about nutrition	Talking to the child about why food is good or bad for them
Encourage balance and variety	Encouraging the child to eat a balanced diet with a wide variety of foods
Involvement	Involving the child in the planning, preparation and purchasing of food
Restriction for weight control	Limiting food that the child eats in an attempt to control their weight
Restriction for health	Limiting certain foods that the child eats to ensure a healthier diet
Environment	Making mostly healthy foods available in the home

1. Preface

Parents have an important role to play in the successful prevention and treatment of overweight in childhood. With the current environment described as obesogenic, parents can be the gatekeepers to food and activity for their children and can provide them with tools to negotiate a path to a healthy life. Parents may undertake a myriad of practices when feeding their children. For example, they may be especially controlling or permissive, coercive strategies may be used and they may or may not teach their children about good nutrition. All of these factors have the potential to affect not only a child's dietary intake but also their attitude to food.

This thesis will explore how parents feed their children – how these feeding practices might be measured, and whether they are related to children's actual dietary intake, weight, problem food behaviours and the availability of different foods within the home. To do so, data from the larger MInT (Motivational Interviewing and Treatment) Study has been used. A brief explanation of this study and the candidate's role follows to give context to the sample population and to clarify contribution to the study design and data collection.

The MInT study (1) was a two-phase study to screen for and treat overweight in children:

Phase 1: Children were screened for overweight and parents of overweight children were randomised to receive feedback on their child's weight status using either *motivational interviewing* (MI) or a *usual care* (UC) model. Phase 1 aimed to determine if using motivational interviewing would increase parental acceptance of weight information (by various indices including participation in the subsequent intervention study) and enhance parental motivation to change healthy behaviours in their children.

Phase 2: An intervention that aimed to reduce excessive weight gain over a two-year period in the overweight children from Phase 1 that had agreed to participate further.

Participating families were randomised to either *Tailored Package* or *Usual Care* conditions. *Tailored Package* involved a single multi-disciplinary session for each family with a clinical psychologist, a dietitian, an exercise specialist and a family mentor to identify areas for change, strengths and barriers within the family and to set a plan of action. The mentor then undertook regular contact with the parent(s) to support and assist the family over the two years to make positive changes to their lifestyle. *Usual care* offered a single session with a healthy lifestyle advisor that gave the parent(s) generic information and resources on diet, activity and parenting. No further support was offered in *Usual Care* except for a brief review at the six-month measure.

As this PhD was initially designed to evaluate the main two-year outcomes for the intervention (Phase 2), the candidate played a major role as a mentor in the *Tailored Package* condition. However, delays to recruitment and initial starting of the project required a change of direction in the thesis after the first year, to analysis of the baseline data. At this time, it was decided that the candidate would continue her role as mentor given the relationship she had established with participating families. Thus the candidate undertook a considerable amount of training and work (described below) not clearly apparent in the subsequent chapters. In particular, significant contribution was made in all areas of the wider study, including:

- Input into study design, in particular for Phase 2
- Validation of a portion size measure using data from another study
- Development of some of the measures to ensure appropriateness for use in a New Zealand population, such as the Children's Dietary Questionnaire (CDQ)
- Re-development of the Home Food Inventory to make it appropriate for a New Zealand population, with further research to develop a scoring guide that was in line with the original scoring guide and also one that could be directly compared to the dietary measure (the CDQ)
- All of the Home Food Inventory scoring and data input
- Development of several protocols
- Involvement in training of staff via protocols
- Extensive research, development and production of many resources for *Tailored Package* regarding targets for behaviour change

Along with staff members of the MInT team, the candidate also:

- Was extensively trained in motivational interviewing, clinical skills, anthropometrics and children's behaviour management, with ongoing supervision
- Undertook anthropometric measures on children and adults
- Administered questionnaires to participants. In particular the candidate was the sole administrator of the Phase 2 baseline measures for the *Tailored Package* participants
- Scored questionnaires and generated reports, which were then presented to parents
- Provided weight feedback to parents using motivational interviewing as part of Phase 1
- Mentored families as part of Phase 2, involving facilitation of expert contribution and regular meetings and phone-calls with parents

In preparation for this thesis the candidate:

- Undertook some of the data-cleaning
- Researched and decided on the statistical methods used to analyse the data
- Undertook all statistical analyses that utilised Stata 12.0 (Statacorp, Texas). The exception was the confirmatory factor analyses that were undertaken using MPlus 5.21 (Muthen & Muthen, Los Angeles), however the candidate prescribed and interpreted these analyses
- Sought guidance and advice from the MInT biostatistician when needed

This thesis uses data from the baseline appointments from both Phase 1 (n=1093 children of all sizes) and Phase 2 (n=203 overweight children only).

The literature review describes the currently available evidence for parental feeding practices – how they are measured and the relationships with diet, weight and problem food behaviours of children. Comments are made about the apparent discrepancy between current evidence and the recommendations given for feeding practices by expert committees. The challenges of feeding children are considered and also how the home food environment might have an impact on children's diets and the feeding practices of parents.

Details of the measures that were used for these analyses are covered in the Methods chapter along with a description of the samples.

Chapters 4 and 5 use the Phase 1 sample (n=1093). Chapter 4 describes factor analyses undertaken on a comprehensive measure of parental feeding practices to ensure that the factors are appropriate for subsequent analysis in this dataset. This results in the production of five subscales: *healthy eating guidance*, *monitoring*, *parent pressure*, *restriction* and *child control*. These practices are then used in Chapter 5 to determine associations with dietary intake, parental discipline practices, child weight and demographic factors.

Chapters 6 and 7 use the Phase 2 sample of overweight children (n=203). Problem food behaviours and associations with parental feeding practices are explored in Chapter 6. Of note are the differences between fussy children and non-fussy children, which indicates that perhaps more structure is needed in the feeding environments of fussy children. Chapter 7 investigates home food availability and its relationship with dietary intake and feeding practices. As a comprehensive and relatively objective measure of home food availability was used, the clear links between availability and children's dietary intake provide important results.

Using cross-sectional data, this thesis examines links between parental feeding practices and the diet, weight, behaviour and food environment of children. With large, diverse samples, these analyses provide an important contribution to the body of evidence for parental feeding practices, suggesting direction for future research and with implications for recommendations.

2. Literature Review

2.1 Introduction

Childhood obesity is a major world-wide health issue (2) with nearly 30% of New Zealand children being overweight or obese (3). Children that are overweight have higher health risks in the future and may currently be experiencing detrimental effects from their weight, in particular psychosocial complications and reduced quality of life as a consequence (4-8). For the treatment and prevention of childhood overweight, expert committees have recommended that children consume greater than five servings of fruits and vegetables a day, reduce consumption of sweet drinks, eat breakfast daily, limit portion sizes and have regular family meals (9, 10). However, many New Zealand children do not achieve these targets (11). As parents are the main source of a child's food experiences, the food that is provided to the child and how it is provided is mostly within the control of parents and consistent evidence has suggested that the inclusion of parents in interventions is important to achieve short- and long-term success (9, 12-17). It may be that parental feeding practices have an important role to play in supporting improvements in nutritional outcomes for children. Yet, what is still not fully understood is how the different feeding practices that parents use might influence the diets, and perhaps the weights, of children (18, 19). A better understanding of the ways that feeding practices relate to diet and weight is needed before appropriate recommendations can be provided to parents around *how* to feed their children to result in healthier outcomes.

The following literature review will evaluate the available research on the child feeding practices of parents. The aims of this review are as follows:
(1) To describe the more commonly used measures of feeding practices and identify any potential problems with these measures (Section 2.2.1).
(2) To describe the Comprehensive Feeding Practices Questionnaire (20) and how it builds on previous measures, and identify any potential problems with this measure (Section 2.2.2).

(3) To describe and critically analyse the literature that has examined the relationships between feeding practices and the diets and weight of children and demographic factors (Section 2.3).
(4) To review the literature that has explored relationships between feeding practices and problem food behaviours in children, such as fussy eating and emotional eating (Section 2.4).
(5) To review studies of parents that have assessed the barriers, challenges and successes in providing their child with a healthy diet, with a focus on feeding practices (Section 2.5).
(6) To review some of the evidence-based recommendations that are available for parental feeding practices, in particular in relation to the prevention and treatment of overweight, and to comment on how well these fit with the literature.
(7) To evaluate the literature that has assessed if home food availability is related to children's diets or parental feeding practices (Section 2.7).
(8) To describe the Home Food Inventory (21) and the pros and cons of this measure (Section 2.7.3).
(9) To conclude by identifying gaps in the research (Section 2.8).

2.1.1 Search methods

This literature search was undertaken using Web of Science and Google Scholar mostly between May 2012 and August 2012. The following search terms were initially used to locate relevant articles: "child feeding", "parent feeding practices" and "home food environment". These searches produced records that contained all of the words entered, not limited to the exact phrase. Relevant references cited within these articles, that were not already sourced, were then located. Specific areas of interest were searched further, using terms such as "food reward", "child food restriction", "secret eating child" and "child control food". As this study uses a sample of children aged 4-8 years, the numerous studies in infants were not reviewed. Samples focusing solely on adolescents were generally excluded, unless considered particularly relevant due to a lack of research in a younger age group. A table of the main references that were used for Section 2.3, accompanied by brief study details and results, can be found in Appendix A.

2.2 Measuring parental feeding practices

Before research can be undertaken to investigate parental feeding practices, an appropriate tool must be developed to measure them. There have been many questionnaires designed to measure various child feeding practices - some have been used more extensively than others, some measure only a few practices of interest and some propose to be more comprehensive. What follows is a brief review of the more frequently used questionnaires and the practices that they measure.

2.2.1 Questionnaires that measure feeding practices

The first questionnaire that assessed child feeding behaviours was the Children's Eating Behaviour Inventory (CEBI) (22), published in 1991, which generated an eating problem score. The CEBI proposed to assess eating and mealtime problems in children from a wide range of ages and also those with various medical and/or developmental disorders. Additionally, this questionnaire considered how child, parent and family factors might contribute to these problems. While not designed as a direct measure of feeding practices in itself, many of the questions from the CEBI formed the basis of future questionnaires.

The Child Feeding Questionnaire (CFQ) by Birch *et al* (23) appears to be the most commonly used measure of feeding practices. Based on an interview structure by Costanzo and Woody (24, 25), the CFQ comprises seven subscales from 27 items: *perceived responsibility*, *perceived parent weight*, *perceived child weight*, *concern about child weight*, *restriction* (6 items), *pressure to eat* (2 items) and *monitoring* (3 items). The final three subscales refer to the actual feeding practices used. *Restriction* involves statements such as "I have to be sure my child does not eat too many sweets/high-fat foods/favourite foods" and "If I did not guide or regulate my child's eating, he/she would eat too many junk foods" with a 5-point Likert response scale (disagree, slightly disagree, neutral, slightly agree, agree). *Pressure to eat* consisted of statements about the parent trying to get the child to eat more, for example "If my child

says “I’m not hungry”, I try to get him/her to eat anyway.” *Monitoring* ascertains how much the parent keeps track of the sweets/savoury snack food/high-fat foods that their child eats with a response scale of never, rarely, sometimes, mostly and always.

All three feeding practices measured by the CFQ are thought to encompass a more general *parental control* construct (26). While this questionnaire has been widely utilised as a tool to assess the feeding practices of parents (27-33), it is limited in its scope. It captures some potentially important aspects of parental control attitudes but these scales do not represent all of the control that a parent may exert over the feeding environment, such as determining what, where and when the child may eat. Furthermore, the Child Feeding Questionnaire does not ask about how much control the child has over their eating, nor does it assess any positive, encouraging practices that parents might use to influence their child’s eating. Using only the CFQ may result in an incomplete picture of the feeding strategies that parents use and may have influenced recommendations with bias on these three factors, as will be explored in the following chapters.

While the initial validation of the CFQ, conducted with a range of ages, showed good model fit (23), this was achieved partly with homogenous and/or inadequately sized samples. Furthermore, subsequent factor analyses were undertaken in samples of other ethnic groups (African-American and/or Hispanic) that indicated poor fit or that modifications to the factors were needed (34, 35). Although these latter studies were in mostly preschool-aged children, these results indicate that the CFQ as it stands might not reduce data to appropriate scales for use in all populations.

The Caregiver’s Feeding Styles Questionnaire (CFSQ) determines a parent’s underlying feeding style by relating it to a general parenting style model (36, 37). It has two scales derived from nineteen items: *demandingness* (12 items) and *responsiveness* (7 items). *Demandingness* measures how much a parent urges their child to eat and whether they threaten, struggle with or coerce them to eat. *Responsiveness* measures how much a parent talks with the child about eating and how much effort they go to make eating an enjoyable experience for the child. These scales are sometimes categorised as *parent-centred* and *child-centred* (38). These two measures are then used to categorise respondents into a feeding style: *authoritarian*

(high demandingness, low responsiveness), *authoritative* (high demandingness, high responsiveness), *indulgent* (low demandingness, high responsiveness) and *uninvolved* (low on both). This questionnaire further extends the measures of feeding practices from the more controlling practices of the Child Feeding Questionnaire to include more positive, child-centred feeding practices. However, while it might assess the feeding environment more adequately than the Child Feeding Questionnaire, the ability to determine exactly which feeding practices and strategies would be more beneficial than others would be difficult in its current form. This is because it focuses on the underlying feeding *style*, which represents different mixes of feeding practices, making it difficult to single out which practice is actually having an effect.

Similar to the CFSQ is the Parental Feeding Style Questionnaire (PFSQ) consisting of 27 items measuring four scales: *emotional feeding* (giving food to calm emotions), *instrumental feeding* (rewarding with food), *prompting and encouragement to eat* (pressure to eat and/or praising); and *control over eating* (parent decides what child eats) (39). Capturing a broad range of practices in a concise questionnaire and published a year after the CFQ, there seem to be advantages to using the PFSQ over the CFQ, which had limitations. However, many researchers continued to choose the CFQ for their studies - this may have been due to the notable results with the CFQ that were published around the same time as the release of the questionnaire (to be covered in Section 2.3). Also, the combination of the two concepts in the *prompting and encouragement to eat* subscale seems a weak point with the PFSQ, as it is potentially mixing a positive practice (praising) and a negative practice (pressuring) into one scale. The use of this scale could then result in misleading conclusions.

There have been other questionnaires proposed to measure different feeding practices in very young children, including the Preschooler Feeding Questionnaire (40). This questionnaire exhibited low consistency scores in the subscales and doubt has been cast on the correct interpretation of the questions by participants (41). Furthermore, it was not designed for children older than preschool age.

More studies into childhood obesity and food intake have resulted in additional feeding practices being investigated, including *permissiveness*, *material reward*, *verbal praise*, *catering on demand*, *child's control*, *parental control*, and *modelling* (30, 32, 42-44).

With so many different measures of feeding practices, it becomes difficult for researchers to know which questionnaire will effectively measure the constructs of interest and importance. Given the limitations and variety of the available questionnaires, Musher-Eizenman & Holub attempted to widen the scope of parental feeding practices with the introduction of the Comprehensive Feeding Practices Questionnaire (20).

2.2.2 The Comprehensive Feeding Practices Questionnaire

The Comprehensive Feeding Practices Questionnaire (CFPQ) was developed to assess feeding practices specifically (20). Based on previous questionnaires and with further questions developed to capture practices deemed important and previously missing, the CFPQ consists of 49 items measuring twelve factors. These factors (defined in the Glossary, page xvi) are as follows:

- *Monitoring* (4 items)
- *Emotion regulation* (3 items)
- *Food as a reward* (3 items)
- *Child control* (5 items)
- *Modelling* (4 items)
- *Restriction for weight control* (8 items)
- *Restriction for health* (4 items)
- *Teaching about nutrition* (3 items)
- *Encourage balance and variety* (4 items)
- *Pressure* (4 items)
- *Environment* (4 items)
- *Involvement* (3 items)

This questionnaire is comprehensive and teases out individual parental behaviours thought to influence a child's diet and/or health. Of note is the measure of restriction that has been broadened and split into two concepts – *restriction for weight control*, asking if parents agreed with statements such as "I restrict the food my child eats that might make him/her fat" and "If my child eats more than usual at one meal, I try to restrict his/her eating at the next meal", and *restriction for health*, using statements

such as “I have to be sure my child does not eat too many sweets” and “If I did not guide or regulate my child’s eating, he/she would eat too many junk foods”. *Restriction for health* captures the *restriction* subscale measured in the Child Feeding Questionnaire while *restriction for weight control* describes a new concept that was based on adult measures of restraint for weight control.

A strength of the CFPQ is the inclusion of numerous feeding practices thought to positively affect diet and health namely, *modelling*, *teaching about nutrition*, *encourage balance and variety*, *environment* and *involvement*. However, the strong, positive correlations found between these factors in the validation study suggest that these concepts are interlinked (20). Indeed it would be logical to assume that a parent that teaches their child about good nutrition also encourages dietary balance and variety, models good eating habits and tries to provide a healthy environment. The distinction between these subscales seems marginal and might undermine the strength of any associations found with these scales. Furthermore, the CFPQ was validated in relatively small, homogenous samples (269 mothers, 248 fathers and 152 mothers, mostly Caucasian and of good education). The first two samples were used to assess a nine-factor structure and the last sample (n=152) provided the data for the final confirmatory analysis on the twelve-factor structure. For factor analyses it is advisable to have at least 5-10 participants per question (45) and this criteria was not met for the analysis on the final questionnaire. This suggests that the factors may not be robust enough for use in other samples.

The CFPQ shows promise as a comprehensive measure of feeding practices that could be used to provide evidence for future recommendations on child feeding. However, for researchers to have confidence in the factors proposed, further validation and confirmatory analyses need to be undertaken.

2.3 Parental feeding practices

There have been numerous studies that have explored the feeding practices of parents and the potential relationships with child outcomes. Results to date demonstrate consistency for some practices but inconsistency for others. For many practices, the

evidence remains inconclusive. A summary table of the literature used in the following sections is available in the Appendices (Appendix A).

2.3.1 Restriction

Restriction, as measured by the Child Feeding Questionnaire (CFQ), is how much a parent limits and regulates the child's access to less healthy foods.

Perhaps the most prominent findings on *restriction* arise from multiple publications from a single, longitudinal study undertaken in one relatively homogenous sample (n=197) of 5-year-old Caucasian American girls (27, 46-49). In this study, parents completed the CFQ and the girls were exposed to laboratory tests to assess short-term energy regulation and eating in the absence of hunger. Short-term energy regulation was determined by giving the girls a low energy drink at the first visit, followed by a self-selected lunch. At the second visit the drink was of high energy and it was then noted how much the girls altered their lunch intake to account for the increased energy pre-load. To measure eating in the absence of hunger, the girls were assessed for hunger after the self-selected lunch to ensure that they weren't hungry. Afterwards they were allowed free access to a range of palatable foods while in a room by themselves. The amount of food consumed was recorded. Three 24-hour diet-recalls and anthropometric measures were also undertaken in this sample and these measures were repeated both 2 and 4 years later.

From this study it was shown cross-sectionally that maternal *restriction*, as assessed by the CFQ, was related to high fat intake at age 7 and a compromised ability to control short-term energy intake at age 5 (47, 48). Longitudinal results in this same sample also showed that maternal *restriction*, measured at age 5, was positively associated with eating in the absence of hunger at age 7 and that this relationship was strengthened in overweight girls by 9 years of age (27, 46). With the support of these longitudinal results, the theory that *restriction* predicts eating in the absence of hunger gained ground. Indeed, recommendations against restrictive feeding practices, based in part on this data, began to appear for both the prevention and treatment of overweight (9).

There are, however, factors that are often overlooked when considering this study. The most notable was the very specific sample of Caucasian girls, which was chosen because of their higher risk for eating disorders. The authors very clearly stated that the results of the study were not applicable to the general public. Other studies have shown no association between *restriction* and eating in the absence of hunger in both boys and girls, although these samples were small (n=53 & n=52) (50, 51). Also, in all of these studies, disinhibited eating was measured in a setting that is unlikely to reflect the child's usual environment – rather, a situation with no parental monitoring, a variety of palatable snack food to choose from and instructions that specifically allowed the child to eat. While it has generally been assumed that maternal *restriction* influences food behaviours, it is just as conceivable that a child that is more responsive to food and eats more in unrestricted environments might be subject to more restrictive practices from parents. Indeed, *restriction* was related to *lower* 24-hour energy intakes at 5 years of age in this sample (48), which might be a better indicator of its association with overall diet, although at 7 years of age *restriction* was assessed to be marginally higher in the girls that consumed more dietary fat (>30% energy from fat) (47).

While the results of this study (27, 46-49) should be interpreted with caution, further evidence has linked parental *restriction* with higher child weight (52-57) and intake of unhealthy foods (53, 58, 59). However, most of these studies were cross-sectional and in small sample sizes (n≤120). Furthermore, Webber *et al* (55), with a sample size of 213, went on to show that *concern about overweight* mediated the relationship between *restriction* and child weight. This indicates that the real relationship is most probably between parental *restriction* and *concern* about their child's weight, rather than a direct link with weight. This is supported by other studies that have shown links between *restriction* and *concern for overweight* (23, 27). Therefore these results suggest that it is likely to be the weight that influences the use of restrictive feeding practices, rather than the other way around. Moreover, the fact that there were longitudinal associations between *restriction* and eating in the absence of hunger do not necessarily indicate a causal pathway. Alternatively it may suggest that this measure of maternal *restriction* is a strong predictor of those children that are more likely to overeat when in an obesogenic environment later in life, and potentially those over-eating tendencies were becoming apparent at 5 years of age.

Indeed, more recent research is indicating that there may be *benefits* to restrictive feeding practices. A longitudinal study by Campbell *et al* (28) has shown positive long-term effects of *restriction* on child weight. This study demonstrated that maternal *restriction* when children were 5-6 years old was significantly associated with reduced BMI z-scores 3 years later, even after adjustment for baseline BMI z-score, baseline maternal BMI, maternal education and sex (28). However, this was not the case for 10-12 year old children, perhaps illustrating the reduced impact of parental feeding practices in older children. Hennessy *et al* (60) demonstrated that *restriction* within an *involved* feeding style was also associated with lower BMI z-scores. Meanwhile, Powers *et al* (33) showed that a positive association between *restriction* and child weight only held for obese mothers and otherwise the association was negative. Interestingly, parental obesity demonstrated the opposite moderating effect in a study by Sud *et al* (57), where the positive relationship between *restriction* and child BMI was held only in those with non-obese parents. Furthermore, restrictive feeding practices were associated with *lower* consumption of energy-dense food and drinks in this experimental study (57). *Restriction* was also associated with less snacking and more breakfast and fruit consumption in a very large sample (n=943), which concluded that restrictive feeding practices were related to other leptogenic lifestyle factors (56).

Longitudinal results are few and mixed, showing positive (61), negative (28) and no (29) association between *restriction* and increased body weight. However the study by Faith *et al* (61), which showed *restriction* predicted higher BMI z-scores, was undertaken in a very small sample (n=57), unlike Campbell *et al* (28) who illustrated that *restriction* predicted lower BMI z-score over three years in a more substantial sample (n=204).

Contrasting results are apparent, however it seems the stronger the sample size, the more likely that the links with *restriction* are with improved health outcomes. Furthermore, it makes sense that parental *restriction* could be higher in parents who are concerned that their child is carrying excess weight and whose children are more responsive to food. This does not necessarily indicate a causal effect from *restriction*, especially considering recent longitudinal evidence linking it to reduced BMI z-scores (28). To conclusively determine whether *restriction* should or shouldn't be recommended, and in what circumstances, more research in large samples is required.

2.3.2 Pressure to eat

Pressure to eat assesses how much a parent places importance on their child eating enough and may encourage them to eat more. Unlike *restriction*, the large amount of evidence available for *pressure to eat* is generally in agreement.

Parents used less *pressure to eat* with overweight children (27, 62, 63) and *pressure* was consistently associated with lower child BMI (30, 31, 33, 52, 60, 61, 64, 65). *Pressure to eat* has also been associated with an increased intake of unhealthy food (47, 62, 66-68), a decreased intake of healthy food (49, 67, 68) and a higher energy intake (66). Adding further weight to this evidence, an experimental study of 27 children showed that pressuring them to eat resulted in negative reactions to a healthy food, and children that weren't pressured ate more of that food at a subsequent eating session (65). Although one cross-sectional study has shown that *pressure* was associated with *healthier* food habits (42), their measure of parental *pressure* was broadened to include how much the parent pushes the child to try new foods and eat vegetables.

Pressure to eat was more commonly used by parents of lean children and children with a less healthy diet. Based on an assumption that lean children might be more likely to have healthier diets than overweight children, these two relationships seem to be opposing each other. These contrasting results could be an artefact of inaccurate or selective dietary measures. Alternatively they could suggest that parents are compensating for either perceived low weight of the child and/or inadequate diet with increased *pressure to eat*. This might be particularly true for children that are picky eaters and refuse healthier foods – resulting in a less healthy diet and more *pressure to eat*. Relationships with picky eating should be explored and the long-term effect of *pressure to eat* on diet and weight evaluated.

Longitudinal research in a very small sample has shown that *pressure to eat* was related to lower BMI z-scores over time in children at high risk for obesity (n=24, based on maternal pre-pregnancy BMI) (61). While in a larger sample (n=121) no association with weight change over time was observed (29). Results indicating an effect on

weight are far from conclusive and are only seen in small samples. Effects of *pressure to eat* on diet are also uncertain. Furthermore, cross-sectional results may be highlighting how a parent alters their practices in response to their child's weight, behaviour or diet. While, the long-term effects of *pressure to eat* on diet and weight are yet to be determined, the limited experimental results suggest detrimental effects of pressure on the consumption of healthy food.

2.3.3 Monitoring

Monitoring refers to how much a parent keeps track of the unhealthy food that their child eats and is often assessed using the Child Feeding Questionnaire (23). As such, it has been included in many studies, but produced few significant outcomes with respect to diet and weight (27, 31, 47, 54, 55, 59, 60, 62-64, 66). While the majority of associations with *monitoring* have been found to be null, three studies have shown otherwise (52, 61, 69). *Monitoring* was associated with healthier eating in a large Mexican sample (69). It has also been shown to be more prevalent in parents of children with excess weight (52) and was associated with lower BMI z-scores over time in children with low risk for obesity (61).

2.3.4 Food as a reward

This practice looks at whether parents offer or withhold treat food in response to good or bad behaviour. Not widely studied, it has been associated with an increased intake of unhealthy food (30, 42) and a decrease in healthy food (62). It was also negatively associated with weight of children (30, 57), indicating that parents were less likely to use *food as a reward* with heavier children. Offering *food as a reward* has been shown to increase preference for the reward food in an experimental setting (70).

2.3.5 Child control

Encouraging and allowing the child to self-regulate their own food intake is recommended for the prevention and treatment of overweight (9, 10). However, as the

ability to self-regulate is thought to decrease with age and increased weight (71-73), good evidence must support this advice so as not to result in inappropriate eating or over-consumption. The practice of *child control*, which enables self-regulation, can be viewed in two ways but is often presented as the antithesis of the parental controlling practices such as *restriction*, *pressure* and *monitoring*.

One way that *child control* can be assessed is asking how much the child is allowed to regulate their own food intake at meals when a variety of foods, preferably healthy options, are presented - the child is free to consume what and how much they like, with no interference from parents. This type of practice is captured by Kroller *et al*'s questionnaire and has been associated in cross-sectional analyses with an increased intake of healthy food and decreased BMI (30, 62). This version of *child control* is thought to illustrate the flipside to the negative associations of *pressure* and *restriction* with healthy eating patterns, that is, allowing the child more control over their food intake may result in healthier outcomes. However, an inverse relationship between these feeding practices of *parental control* and *child control* is yet to be shown.

Clear benefits of allowing more *child control* over food intake have not yet been shown, particularly in overweight children. While mostly small laboratory studies have demonstrated that very young children regulate their food intake requirements appropriately, older children (> 3 years old) tend to eat more when served larger portions and do not regulate intake as well, especially if at higher risk of obesity (71, 72, 74-77). Allowing children to self-serve their own food has shown both positive (76) and negative (78) effects on food intake. It is interesting to speculate whether the capacity to self-regulate energy intake observed in infants (79) is compromised in older and specifically overweight children, who may require more guidance and control from the parent, such as serving smaller portion sizes.

This leads to the alternative view of *child control*, that is how much the child controls their food provision – whether they are allowed to help themselves to snacks and other food in the house and whether it is the child that determines, in part, what food is provided for them. This is more like the *child control* subscale from the CFPQ and is captured by the constructs of *catering on demand* and *permissiveness* in Vereecken *et al'*s studies, which were both associated with less healthy dietary intakes (67, 80).

Furthermore, a measure of *child's food choice* in a large, diverse sample was related to higher BMI (81). These results suggest that an environment where the child is allowed to eat more freely what and when they like might result in less healthy outcomes.

The first interpretation of *child control* is based on the absence of *restriction* and *pressure* at mealtimes and corresponds to a situation where the capacity to self-regulate appetite can thrive. However, clear benefits to weight or diet have not yet been shown. The second interpretation of *child control* captures a situation where the child controls much of their food provision throughout the day – a practice that encompasses a wider variety of feeding situations, with potential for high impact. Both interpretations have contrasting associations in the few studies to date. Further research is needed into both these constructs to direct recommendations appropriately with a clear distinction between the two.

2.3.6 Parent control

This construct measures how much the parent controls the child's eating and might be considered the opposite to *child control*. It is not a commonly used measure, consisting of questions involving *restriction* and *pressure to eat* (82). Similar to these practices, *parent control* has been related to less healthy eating habits, such as reduced fruit and vegetable consumption (69, 82). However, it has also been shown to be associated with less overweight in girls in a large, diverse sample (83).

A different *parental control* measure was used by Powers *et al* (33), which asked how much the parent decided what, where, how and when the child ate, encompassing a much broader notion of feeding control. This study showed that *parent control* was associated with higher child BMI z-scores only when the mother was obese (33). Further to this, Rhee *et al* (84) measured controlling feeding practices with one question, "Do you let your child eat what he/she feels like eating?" A four-point response scale ranged from *definitely no* to *definitely yes*. This measure of *parent control* used in a large longitudinal study and was associated with decreased BMI z-scores in boys. Interestingly, an increase in BMI z-score in girls between the ages of 4 and 7 years was associated with an increase in controlling feeding practices between

the ages of 7 and 9 years, indicating that *parental control* increased as a response to weight gain (84).

Results are mixed but it is likely that *parent control* changes as a response to weight gain and may have long-term benefits to boys' weight.

2.3.7 Other feeding practices

Other feeding practices have also been studied, but to a much lesser degree. The following are a selection of practices that have been found to have significant relationships with dietary factors.

Emotion regulation looks at whether parents use food to regulate their child's emotions, such as boredom, fussiness or upset. This practice has been associated with children eating more sweet snack food in the absence of hunger (85). *Modelling* measures how much parents demonstrate healthy eating to their children. *Modelling* has been associated with an increased intake of healthy food (30, 49, 66) and a decrease in unhealthy food (30). *Verbal praise* and *encouragement* for eating fruits and vegetables has been associated with a higher consumption of fruits and vegetables and lower consumption of soft drinks (42). Similarly, *reinforcement* for eating healthy food was positively related to better dietary intake (69). *Limit setting* was negatively related to unhealthy eating in boys in a large sample (69).

Covert control feeding practices are those that the parent does without the child noticing, like avoiding eating out at particular places or only buying certain foods. Such practices have been associated with lower unhealthy snack intake, less neophobia (refusal of new foods) and higher fruit and vegetable intake (32, 68). *Overt control* feeding practices are those that the child is aware of, like structuring eating and encouragement or pressuring the child to eat more. This has been positively related to fruit and vegetable intake at meals and to healthy snack intake, but also to BMI (32, 68). This again illustrates a confounding situation where a feeding practice is associated with both healthier diets but higher BMI (as also seen with *pressure to eat* – although with inverse associations to *overt control*). It may be that *overt control* is

related to healthier food intake and it may also be that parents concerned for the weight of their child increase their *overt control*.

It appears from this review that the Child Feeding Questionnaire inadequately captures all of the feeding practices that are likely to be influential and yet it has been widely utilised. In particular, more evidence is needed to determine the effects of *child control* and *parent control* using consistent measures. *Restriction* has had varied results and yet there have been recommendations to avoid restrictive feeding practices – more longitudinal results are required. Clearly there are links between feeding practices and the diet and weight of children, but these need to be elucidated with more research.

2.3.8 Influences on feeding practices

Parents might adapt their feeding practices depending on the weight status of their child or their concern for their child's weight, however demographic differences in feeding practices are also evident.

It has been shown that mothers use more *pressure to eat* and *monitoring* with boys (29, 54) and more *praise* with girls (29, 86), indicating that parents may feed boys and girls differently. Previous research has also suggested that the associations between feeding practices and diet and weight might differ between the sexes (53, 59, 69, 83). This underlines the fact that any results from research undertaken in a sample consisting of only one sex do not necessarily apply to children of the other sex until proven so.

Maternal factors also influence the use of feeding practices. Higher maternal education has been linked with more *monitoring* (62), less permissive feeding practices and more *verbal praise* (42). More *restriction* was reported from overweight mothers and fathers (52), while higher levels of *restriction* and *parent control* were associated with excess weight in children only if their mother was obese in one study (33), and only if their parents were non-obese in another (57). Obese mothers have also been shown to use less *control* with their child's eating and also use food more for *emotion regulation* and as a *reward* (39). These contrasting results for maternal control may occur due to differing populations or the measures used. Alternatively, they might be attributable to

two implications of maternal obesity – a higher obesity risk for the child and/or increased likelihood that the home environment is obesogenic (48). An obese mother might be concerned for the higher obesity risk and alter feeding practices, for example more *restriction*, or an obese mother might be part of the obesogenic environment, exhibiting little control over food and offering it as a reward.

Ethnicity has also been shown to influence feeding practices (29, 31, 33, 52, 54, 83). In the US, African-American mothers have reported more *restriction*, *pressure to eat* and *monitoring* than Caucasian mothers (29, 54), while Caucasian British parents used more *monitoring* and less *pressure to eat* than other ethnicities (31). The contrasting results for different ethnic groups illustrate how there may be population-specific differences in the use of feeding practices. There may also be differences in the reporting of feeding practices, demonstrated by the lack of model-fit of the Child Feeding Questionnaire in a sample of differing ethnicity compared with the original analysis (23, 35). This emphasises the importance of ensuring that the measure to be used is appropriate for the population of interest.

Households of higher socio-economic status (SES) used more *reasoning*, *praise* and *food rewards* during mealtimes (86) and restricted unhealthy foods more than lower-SES households (87). These variations might be due to differences in food security, education and/or responses to the questionnaires. It is not known if families from disparate levels of deprivation respond similarly to questions on parental feeding practices.

It is evident that demographic factors have links with feeding practices. Because of this, the tools used to measure these practices must be suitable for the population in which they are being used, demographic factors must be adjusted for and care must be taken when applying the results to other groups.

2.4 Parental feeding practices and problem food behaviours in children

Problem food behaviours in children include such actions as refusing foods, neophobia, throwing tantrums or arguing about food, hiding or stealing food, and comfort eating (88). Furthermore, behaviours that indicate early dieting or those that might be precursors to binge eating are of concern in children and any relationships with parental feeding practices need to be determined.

2.4.1 Picky eating/food fussiness

Picky eating and food fussiness have been shown to positively associate with parental *restriction*, *pressure* and *rewarding* (89-92). However, some results suggest no relationship (91, 93) and one study linked food fussiness to *permissive parenting* (94). Additionally, *monitoring* and *encouraging balance and variety* were both related to lower levels of food fussiness in a sample of 3-6 year old children (92).

Longitudinally, *pressure to eat* at age 7 was associated with picky eating at age 9 in girls, suggesting a predictive effect (95). Neophobia was related to less *covert control* of eating and was also related to more *parental control* (*restriction* and *pressure*), indicating that these feeding practices might sometimes be employed by parents in response to challenging eating behaviours (68, 82).

2.4.2 Emotional eating, external eating, eating in the absence of hunger and secretive eating/food hiding

Eating in the absence of hunger, emotional eating (eating in response to heightened emotions), external eating (wanting to eat when around food or seeing/smelling food), and secretive eating may all correlate with binge eating in children and adolescents (96). However, it is unclear if these are related to parental feeding practices.

As already reviewed, a longitudinal study showed a relationship between restrictive feeding practices at age 5 and eating in the absence of hunger at age 7 and 9 in girls (27, 46). Another study of 3-8 year old children showed a positive relationship between *restriction* and emotional overeating (94). However, different research has also shown no association between emotional overeating and *restriction* or *pressure to eat* (90). These studies were undertaken with the parents completing the measure of feeding practices – results differ markedly to those where it was the child's perception of feeding practices that was measured.

The Kid's Child Feeding Questionnaire (97) parallels the parent version and has shown that *pressure to eat*, from the child's perspective, was positively associated with both emotional eating and external eating in a study of 5 year old Caucasian girls (97). Interestingly, the same relationship existed in another study but only held true for boys and not girls (98). This could be accounted for by the differences in study population, with the latter study being conducted in a larger sample of Dutch children aged 7-12 years. None of these associations existed when the parent-reported feeding practices were used. When perceived by the child, *restriction* was related to lower levels of external eating and emotional eating, but no relationship existed when data on parents' perceptions were used (97, 98). The inverse relationship here between child-perceived *restriction* and both external eating and emotional eating was found to be stronger in younger children (7-9 years) than older (10-12 years) (98).

It appears that child-perceived *restriction* is related to less food behaviour problems and parent-perceived *restriction* is related to more. Carper *et al* (97) showed that there was a weak association between child and parent reported levels of *pressure to eat* but no association for *restriction*. The contrasting results from these questionnaires might indicate that different concepts were being captured as the parents and children might have interpreted the questions differently, or it could be that other factors have impacted on their responses, such as social desirability (an attempt to give answers for the approval of others).

In a study of adolescents, *restriction* was associated with more food hiding and a positive association observed between *monitoring* and food hiding became non-

significant when adjusted for demographics (99). These results have not been replicated in younger children.

2.4.3 Restrained eating and unhealthy weight control behaviours

Parental *restriction*, as perceived by the child, was associated with higher levels of restrained eating in a study of 7-12 year old children, and this was moderated by child weight where the association was stronger for overweight children (98). However, in another study no relationship was shown between *restriction* and restrained eating in girls, although daughters' perception of *maternal pressure to lose weight* was linked to more restrained eating (100). In adolescents, parental *restriction* has been positively associated with unhealthy weight control behaviours (99). Meanwhile, *pressure to eat* from the child's perspective, was positively associated with restrained eating in girls, which seems logical given that parents would more likely urge a child to eat if they were purposely not eating (97).

Evidence-based recommendations for parental feeding practices need to have been shown to result in better outcomes for children but also that they are safe, in that they are not related to the precursors of eating disorders. So far the few studies that have evaluated the relationships between feeding practices and problem food behaviours in children have shown mixed results, with many using the child's perception of feeding practices. As there is no clear consensus and with some factors indicating potential associations with problem behaviours – particularly restrained eating and unhealthy weight control behaviours in adolescents – further investigation is certainly warranted.

2.5 Challenges of feeding children

While much quantitative research has been undertaken on the child feeding practices of parents, qualitative research has also been used to gather information on how parents feed their children. This research has tended to indicate what parents find difficult when providing food to their child and what strategies they attribute to a child's healthy

diet. The following studies suggest the types of practices and outcomes that require investigation.

A healthy diet, without overeating, is needed for the optimum growth and development of children and is a cornerstone for the prevention and treatment of obesity (9). However, parents report challenges in providing their child with a healthy diet, most commonly children's preferences for less healthy foods and distaste for healthy foods (101-105). Picky eating is particularly stressful for parents and can result in family conflict at mealtimes (101, 106, 107). It is interesting to note that more meal-time challenges and less positive meal-time interactions were observed in families with obese children compared with non-obese children (108).

According to some parents, resistance from the child was the major barrier to improving their diet (104, 105). On the other hand, focus groups with teachers showed that they tended to blame parents for the poor eating habits of children, citing low levels of monitoring and modelling, and much too permissive parenting (104). Health professionals counselling parents of overweight preschoolers also felt that mothers didn't set suitable limits on their child's eating, and used food inappropriately to control behaviour and show love and affection (109). This was further supported by a qualitative study of mothers with children that had healthy diets, which suggested that parental control was the most important factor in determining what children ate, over and above child preferences, along with teaching and encouragement of healthy eating (110). Moreover, after interviews with parents of overweight children, Curtis *et al* (111) proposed that an increase in children's control of their own eating and the fact that parents felt they had limited influence, might have a role in the development of overweight. Indeed, some parents have indicated that they let their child choose what foods to eat for meals and snacks in an effort to reduce conflict (101, 107).

New Zealand parents have said that they have a very important role in ensuring their child eats healthily, but only 60% (of a sample of over 1000) said that they found this easy (102). Parents have expressed a desire to learn more about how to overcome these challenges and how best to achieve a healthy diet for their children (102, 103, 106). They were frustrated that health professionals might tell them *what* their child should

be eating but gave no guidance on *how* to achieve that, in particular around picky eating (112).

From these mostly qualitative studies, parental control of children's feeding appears to be an important factor in ensuring a healthy diet. Quantitative studies into the broad concepts of child and parent control (not limited to *restriction* and *pressure*) are lacking. This should be a direction for future research. Interestingly, recommendations to avoid restrictive feeding practices and encourage autonomy of eating (as will be explained more thoroughly in the next section) seem in contrast to what the experiences of parents and health professionals suggest. This may be due to inadequate measures and numbers of studies to address these control themes. Overall, many parents struggle with child feeding and want to know *how* to overcome difficulties, in particular with child resistance and pickiness, therefore these should have a place when investigating feeding practices and in the resulting recommendations.

2.6 Recommendations for child feeding

Recommendations for how parents should feed their children to ensure a healthy diet and weight have been published by expert committees for the prevention and treatment of overweight, along with recommendations on diet, physical activity, sedentary activities and sleep. However, as the evidence base is largely inconclusive it could be argued that this has resulted in some potentially inappropriate guidelines.

One US expert committee put together by the American Medical Association, the Health Resources and Service Administration, and the CDC (Centers for Disease Control and Prevention) was made up of appointed scientists, three writing groups, and representatives from 15 disciplines. Tasked with updating the 1998 recommendations on childhood obesity, they advised that for the prevention and treatment of overweight, health professionals should be *"discouraging a restrictive parenting style (restrictive parenting involves heavy monitoring and controlling of a child's behavior) regarding child eating"* and parents should *"avoid overly restrictive feeding behaviors"* (9). This

advice was strongest for children under 12 years of age. However, since this paper was published (in 2007) more research on restriction has indicated potential benefits, particularly for children at higher risk of obesity (28, 33, 56, 57, 60). While it is not always clear what research was used as the foundation for these recommendations, it is likely that longitudinal research in 5-year old Caucasian girls (27, 46-49), (which was stated to be not generalisable to other populations) and research in infants (79) was used. Furthermore, real detriment from restrictive feeding practices has yet to be seen using appropriate dietary and weight measures. As the recommendations were targeted at reducing obesity in childhood and adolescence, there must be good evidence that *removing* parental restriction of high-fat foods does not have an unintended effect. Mothers of highly food-responsive, obese children may indeed balk at the idea of allowing their child to eat any amount freely, with little monitoring or limitation. Indeed, these recommendations conflict with what qualitative research says is needed for the healthy diets of children – more parental control and limit setting. Based on the current evidence, the advice to avoid restrictive feeding practices appears premature.

Both this expert committee and the American Academy of Pediatrics advised that parents should be *"encouraging children's autonomy in self-regulation of food intake and setting appropriate limits on choices"* (10) and that they should *"allow the child to self-regulate his or her meals"* (9). Health professionals are told in a review article on the determinants of healthy eating in children that *"it is important to let parents know that children who are self-regulated in diet may better handle the current food-surplus environment"* (113). The evidence for these recommendations may well have come from research in infants and although it appears that infants self-regulate energy intake well, there are concerns that this ability is overcome earlier in life than previously thought (79). There is also a huge difference between a normal-weight infant regulating their milk intake, and an older child who is already overweight. Allowing a child to self-regulate their food intake has not yet been shown to be an effective strategy in primary school-aged overweight children. Furthermore, these two guidelines (to avoid restriction and allow self-regulation) have the potential to be misinterpreted to mean that an increase in freedom around food consumption should be allowed, which could have undesirable results. Given these cautions, the research to date is not strong enough to uphold these recommendations.

While the advice to avoid restrictive feeding practices and allow self-regulation does not seem well supported by evidence, the recommendation for parental modelling of healthy food choices is endorsed by research (30, 49, 66) and is unlikely to result in adverse effects. Hence, its inclusion in guidelines seems appropriate (10).

Overall these feeding recommendations were given with the aim of improving the diet and, in particular, the weight of children. However, parents have stated that they need guidance on *how* to overcome behaviour problems related to food (Section 2.5) and these are not addressed by the recommendations. In their review article, Scaglioni *et al* stated *"unfortunately, few parents receive any guidance in how to promote food acceptance"* (113). This, along with the studies presented in Section 2.5, illustrate a need for clear, practical recommendations for parents and it is preferable that there is evidence to prove the intended effect of those recommendations.

The New Zealand food and nutrition guidelines for healthy children and young people (aged 2-18 years) (114) offer comprehensive recommendations on how to feed children, ranging from how many meals and snacks are appropriate, how to react to fussy behaviour and the distinct roles of the children and parents when it comes to food (see Appendix G for full list of recommendations). These include "Make mealtimes fun", "Have meals together", "Encourage children to try new foods", "Encourage family members to stop eating when they feel full", "Don't encourage continuous eating" and "Don't use rewards or force or push a child to eat". While these guidelines are much more useful to parents and seem mostly logical, they are generally not evidence-based. However, until further evidence is provided, it seems sensible to make available these practical recommendations.

Guidance on parental feeding is wanted by parents and needed for potential improvement of child health. Recommendations should be backed by evidence and therefore more high quality research must be undertaken so that consensus can be reached.

2.7 Home food availability

Overall, New Zealanders spend only 21% of their food expenditure outside the home (115), meaning that the vast majority of food eaten is from the home environment. Furthermore, it was shown from the 2002 New Zealand Children's Nutrition Survey (11) that at least 84% of children brought most of their food for school from home. While considerable attention has been drawn to the negative influences of fast-food stores, advertising and food purchasing sites in and around schools (7), the place where children (and adults) get the majority of their food is from home. Therefore more research should focus on this environment.

Parents most likely have control over what food is bought and grown and stored in the household. How this might affect the diets of children and the feeding practices of parents is reviewed in the subsequent chapters.

2.7.1 Dietary associations with home food availability

The food that is available in the home is likely to affect what food is acceptable to and eaten by children. However, while the evidence to support this is consistent, it is not strong. A recent comprehensive review investigated the correlates of dietary intake in children and adolescents including home food availability (116). While all seventeen studies that were examined for home food availability showed positive associations with various dietary intake measures, ten of the studies looked only at fruit and vegetable consumption (some including fruit juice consumption) (117-126) with very few capturing some measure of less healthy food availability (127-129). Furthermore, many of the studies were undertaken predominantly in adolescents (119, 120, 125-128, 130, 131).

The tools used to measure home food availability are varied and in some instances very crude (121, 123, 125, 126, 130, 132) such as "How often are fruits and vegetables available in your home?" These types of measures are not highly differential, where a distinction between those with high and low availability is not clear. Subjective measures such as this may also be affected by perception bias, where the child and the

parent perceive the availability of food differently (133-135). Other comprehensive reviews have also recognised home food availability as an important factor in the dietary intake of children (136-140) but identified a lack of good objective measures that also included unhealthy food as a weakness in the currently available literature.

2.7.2 Parental feeding practices and home food availability

Parental feeding practices might also be influenced by home food availability. While many studies that have included a measure of food availability have also investigated a few parental feeding practices, including parental *modelling* (117, 120, 121, 123-125, 128, 131), parental *support*, and *encouragement for healthy eating* (120, 121, 123, 126, 130, 131, 141), very few have looked at the associations between these factors (120, 123). Fruit and vegetable availability was shown to positively correlate with parental *modelling*, *encouragement* and *support* (120, 123). Young *et al* (120) further investigated this by showing that availability moderated the effects of *modelling* and *support* on the consumption of fruits and vegetables. Results indicated that it was only when fruit and vegetable availability was high that parental *modelling* was positively associated with consumption and only when availability was low that parental *support* was positively associated with consumption (120). It is currently unknown if other parental feeding practices, such as *restriction*, *pressure*, *monitoring* and *child control*, are influenced by the home food environment or vice versa. Provision of the food in the home would be considered within the control of the parent and could be encompassed in a measure of parental control. Indeed it has been considered a covert feeding practice of control (32).

2.7.3 The Home Food Inventory

An inventory or checklist of foods in the home presents a comprehensive and potentially objective measure of home food availability. While many inventories or checklists have been created, they are often developed to measure specific food groups for particular reasons (142). However, Fulkerson *et al* developed and validated a Home Food Inventory (HFI) to assess the availability of a comprehensive range of foods in the home, including fruits and vegetables and less healthy foods (21). The HFI

exhibited both criterion and construct validity, which indicated that this measure was objective and supported the proposed theory that the foods available correlated with the foods eaten. Additionally, this construct validation was undertaken in a large sample (n=342) of families.

While the HFI has the potential to more accurately measure home food availability in families compared to brief questionnaires, the respondent burden is slightly higher because of the checklist to complete. Furthermore, there is the possibility of increased loss of data because the HFI is completed in the home and there may be variation in results depending on whether the household had recently been grocery shopping. The HFI also does not measure quantity of each food identified to be in the home, so two households with similar results could actually have quite contrasting amounts of food. Essentially it captures a measure of the variety of different foods in the home. As the HFI was developed in the US and therefore consists of food commonly purchased and consumed there, modification would be required before using it in other populations. However, because of the comprehensive and objective nature of the HFI and the validation in families, it presents a tool that could more accurately and thoroughly investigate the relationships between home food availability, parental feeding practices and the dietary intake of children.

The provision of food to the home is one way that parents can control what their child consumes, as the child is often limited to what is in the home environment. It could therefore play a central role to the feeding practices used and the food consumed by the child. The evidence for the influence of home food availability on dietary intake of children thus far is consistent but weak, based the measures used. Furthermore, relationships between home food availability and parental feeding practices have not been fully explored.

2.8 Conclusion

There are many tools used to measure feeding practices for research purposes. The most commonly used is the Child Feeding Questionnaire which only measures three practices, namely *restriction*, *pressure to eat* and *monitoring*. However, the Comprehensive Feeding Practices Questionnaire combines this with the majority of other measures into one questionnaire and resulted in twelve subscales. While validated, this questionnaire does require further analysis and validation to improve confidence in the scales presented.

To date, there is some consensus on the relationships between certain feeding practices and the diet and weight of children. In general, less healthy eating behaviours were consistently associated with *pressure to eat*, *food as a reward*, *emotion regulation* and *child control (permissive)*, whereas healthier dietary intake was linked to *modelling, verbal praise, encouragement, reinforcement* and *limit setting*. Higher weight status was related to more *monitoring, restriction, food as a reward* and *child's food choice*, with *pressure to eat* consistently associated with lower BMI. However, the most studied feeding practice (*restriction*) has had conflicting results and *monitoring*, another highly studied practice, has mostly shown no relationships. This review illustrated that there may be many feeding practices with potentially important links, but there were very few studies that went beyond examining only *restriction, pressure to eat* and *monitoring.* Furthermore, studies using larger sample sizes are needed to reduce the possibility of spurious results and to potentially elucidate those relationships that have so far lacked consensus. Cross-sectional research should also be wary of postulating causal pathways, as it is likely that parents report using some feeding practices in response to their child's weight and bidirectional relationships may be present with diet also.

As many feeding practices have shown to be influenced by demographic factors, such as SES, maternal BMI and ethnicity, these factors must be assessed and their effect on feeding practices examined and controlled for when researching this topic. Furthermore, the tool used to measure feeding practices should be fit for the study

population and any resulting recommendations should take into consideration the groups to which they are most likely to apply.

There have been a handful of studies that have shown that problem food behaviours of children were related to parental feeding practices, however many of these used the child's perception of the feeding practice, resulting in a loss of consistency and comparability with other research and complicating the wider understanding of the feeding practice. As problem food behaviours were cited as a major barrier to parents in providing their child a healthy diet, more research is needed to better understand how feeding practices might be related to these behaviours, and ultimately to be able to offer advice to parents on how to overcome these barriers.

Presently, recommendations have discouraged restrictive practices and encouraged self-regulation of food intake by the child, particularly at mealtimes. However, parental control of children's eating was widely regarded to be an important factor in providing them a healthy diet. These contradict each other, indicating that more good evidence is needed to create appropriate recommendations. This is particularly important as many parents expressed that it was difficult to feed their child a healthy diet and they wanted clear guidelines on how to achieve a healthy outcome for their child.

Further to this, the home food environment might have an important role to play in how effective feeding practices are at improving the diets of children, however investigation of this has, to date, been meagre.

More investigation of parental feeding practices, with large samples and comprehensive measures, is required to achieve a greater understanding of which practices are beneficial or detrimental to child health outcomes. This is important so as to inform those developing feeding recommendations for parents, which are urgently required.

2.9 Objectives of this thesis

1. Can the original twelve-factor structure of the Comprehensive Feeding Practices Questionnaire be applied to a large, diverse sample of New Zealand children? If not, how many factors demonstrate better fit in this sample?

As the Comprehensive Feeding Practices Questionnaire was factor analysed in relatively small, homogenous samples, a confirmatory factor analysis will be undertaken using a large, diverse sample to determine if the previously defined twelve factors are appropriate in this dataset. If the existing factors do not prove to be a good fit, an exploratory factor analysis will subsequently be undertaken.

2. Which feeding practices are associated with demographics, dietary intake, discipline practices of parents and weight status in New Zealand children?

More research in large, diverse samples is required to elucidate the relationships between feeding practices and demographics, dietary intake, and weight of children. Such analyses will be undertaken in this large sample using the feeding practices identified by the Comprehensive Feeding Practices Questionnaire in Objective 1. Furthermore, investigation into associations with parental discipline practices will also be undertaken to explore how these different parenting practices might be related.

3. Are demographics, feeding practices, dietary intake and discipline practices associated with BMI z-scores?

Parental feeding practices have been associated with body weight in children, but the practices examined were typically different for each study. Furthermore, samples were often small and homogenous. Using this large sample, associations of parental feeding practices, dietary intake, demographics and discipline practices with child BMI z-scores will be examined.

4. Which feeding practices are associated with problem food behaviours in a sample of overweight children?

Parents describe their children's problem food behaviours as a barrier to providing a healthy diet. Limited research has shown that some behaviours have been associated with feeding practices. Using a sample of 4-8 year old overweight children, associations between feeding practices and problem food behaviours will be determined.

5. Do parents feed fussy overweight children differently to non-fussy overweight children?

As parents have cited picky eating and resistance as barriers to a healthy diet, differences in the feeding practices of parents with fussy and non-fussy (as identified by parents) overweight children will be investigated.

6. Is home food availability associated with dietary intake in overweight children aged 4-8 years?

Measures of home food availability are often limited and potentially subjective. By using a comprehensive and relatively objective measure, links between home food availability and dietary intake of overweight children will be determined.

7. Do home food availability and parental feeding practices interact to affect the dietary intake of overweight children?

Whether the feeding practices of parents have different relationships with dietary intake depending on the home food environment is not yet known. An exploratory analysis of the interactions between the two and their effect on dietary intake will be undertaken.

8. What potential theories or recommendations (if any) for future examination are indicated by the results of the analyses undertaken for this thesis?

As current recommendations around parental feeding practices are not well supported by research, any advances from this thesis will be proposed.

3. Methods and sample description

3.1 The MInT Study

The MInT (Motivational Interviewing and Treatment) Study was a two-phase study investigating the screening and treatment of overweight in young children (1). This thesis used data from the baseline measures of both Phase 1 and Phase 2 of the MInT Study.

Phase 1 was a weight-screening initiative of children aged 4-8 years. The primary aim of Phase 1 was to investigate whether providing parents with feedback about their child's overweight status using motivational interviewing would improve acceptance of the information and therefore result in greater uptake into a two-year intervention, compared to a best practice approach of providing feedback. The results of this randomised controlled trial are not covered in this thesis.

Phase 2 was a two-year intervention trialling a family-based, parent-led treatment approach to childhood overweight. The primary objective was to determine if the *Tailored Package* condition resulted in less weight gain in children over two years compared with *Usual Care*. *Tailored Package* consisted of a one-off group session for each family with a dietitian, an exercise specialist, a psychologist and a mentor where a treatment plan was devised for that family. The mentor then provided regular and ongoing support for the next two years, with limited guidance from the consultants. *Usual care* consisted of one appointment at which generic healthy lifestyle advice was given, with a review at 6 months. The results of this randomised controlled trial are not covered in this thesis.

The MInT Study was given ethics approval by Lower South Regional Ethics Committee (LRS/09/09/039) and parents gave informed consent at their first appointment.

This thesis uses data obtained from baseline measures from both phases to examine various aspects of parental feeding practices in a New Zealand sample of children with a focus on overweight children.

The methods used to collect the data that was utilised for this thesis are presented here. Information on specific statistical methods used for particular analyses are described in each relevant chapter (Chapters 4-7).

3.2 Recruitment

The first phase of the MInT Study involved recruitment of children aged 4-8 years from primary and secondary medical clinics across Dunedin, New Zealand. This study received ethical approval to use an *opt-out* system of recruitment, rather than recruiting via advertisement or similar methods. All parents with children of eligible age (4-8 years inclusive) that were enrolled at these clinics were sent a letter of invitation to attend a health check appointment at which they would receive information about their child's growth (Phase 1). The invitation went on to outline that families may then be eligible to participate in a two-year programme aimed at improving healthy lifestyles of families with young children (Phase 2).

The invitation contained an opt-out phone number that parents could call if they did not want to participate and did not want further contact. If no opt-out had been actioned after two weeks parents were contacted by phone at which point they could decline to participate. Five separate attempts to make contact, at different times of the day, were undertaken before potential participants were classed as 'non-contactable'. Children were excluded if they had severe disabilities, were on medication that might affect body composition or were not expecting to be living in Dunedin for the next two years. Eligible siblings of participants were also recruited, along with any eligible families that contacted the study of their own accord. Figure 1 (page 52) illustrates the flow of recruitment through to Phase 2.

Once recruited, participants attended a health check appointment, where children were assessed for overweight (BMI ≥ 85th percentile (143)). If the child was not overweight, parents were given individualised information on their child's growth and a resource package of information on healthy lifestyles. Families of these normal weight children had no further participation in the study. Parents of overweight children received individualised information on their child's growth delivered using motivational interviewing or a best practice care approach. A follow-up appointment two weeks later determined parental and child responses to feedback, but will not be covered in this thesis. At the follow-up appointment, parents were invited to participate in Phase 2 – the two-year intervention.

The sample size for Phase 1 was determined by the sample required for the two-year intervention (Phase 2). One hundred children in each intervention group were required in order to detect a 0.2 unit difference in BMI z-scores (at the 5% significance level, powered at 90%) at two years. This also allowed sufficient numbers for investigating various secondary variables of interest (1). Therefore, recruitment for Phase 1 would conclude once 200 participants had agreed to enter Phase 2.

3.3 Phase 1 measures

Phase 1 measures were collected at the health check appointment – anthropometric measurements were taken and a questionnaire completed by the parent/guardian.

3.3.1 Anthropometric measures

Participating children's height, weight, waist circumference, body composition by bio-impedance, and blood pressure were measured by trained measurers.

Children's height was obtained using a portable Leicester Height Measure (Invicta Plastics Ltd, Leicester) to the nearest 0.1cm. Weight was measured with digital scales (Tanita BC-418) to the nearest 0.1kg with the child in light clothing and no footwear. Measures were taken twice and averaged. A third measure was taken if the two height

measures differed by more than 0.7cm or if the two weight measures differed by more than 0.1kg; the two closest measures were used to calculate the mean.

Body Mass Index (BMI) was calculated (BMI = weight (kg) ÷ (height (m))^2) and z-scores derived from US reference data (143). Following this, child weight status was categorised using BMI percentiles into normal weight (BMI < 85th), overweight (85th ≤ BMI < 95th) and obese (BMI ≥ 95th). Results for waist circumference, body composition and blood pressure are not included in this thesis. Maternal BMI was calculated from measurements taken in clinic when mothers gave consent, with the remainder from self-reported data.

Children were then taken to a play-room while the parent completed the questionnaire and received feedback on their child's growth.

3.3.3 Parent questionnaire

Parents completed the questionnaire online at the appointment, although a few elected to complete it on paper. This questionnaire included demographic information and a collection of established questionnaires designed to measure the amount of physical activity, screen time, fruit, vegetable and sweet drink intake, amount of sleep, motivation to change lifestyle factors, perception of and concern for child's weight, the parent/child relationship, parental feeding practices and parental discipline practices. As not all of these are used in this thesis, only the relevant measures will be covered in more detail.

3.3.4 Demographics

Parents completed questions on maternal education and child ethnicity using the New Zealand 2006 census questions (http://www.stats.govt.nz/Census/about-2006-census/2006-census-questionnaires.aspx), shown in Table 1, page 42. Maternal education was subsequently categorised into *some secondary* (if highest level of education was lower than Bursary or Higher School Certificate or NCEA Level 3 –

these are the standard New Zealand high school qualifications gained in year 13 when students are usually 17-18 years of age), *completed secondary*, *tertiary qualification* (not university degree), *university degree,* and *other*.

Ethnicity was categorised using prioritised ethnicity, as participants could have indicated that their child identified with more than one ethnic group. The final categories were *New Zealand European* (if indicated NZ European/pākeha or Other European AND did not identify any of the following ethnicities), *Māori* (if indicated Māori), *Pacific Island* (if indicated any Pacific Island ethnicity AND did not identify as Māori), *Asian* (if indicated any Asian ethnicity AND did not identify as Māori OR Pacific Island) and *Other* (if indicated any other ethnicity AND did not identify as any of the previous ethnicities).

3.3.5 Fruit, vegetable and sweet drink intake

Three questions assessed the child's usual dietary intake. These questions, along with their response scales are presented in Table 1 (page 42).

3.3.6 Perception of and concern for child's weight and importance of a healthy diet

Table 1 (page 42) shows the questions that were asked about parental concern and perception of their child's weight. There is also a statement on how much they valued the importance of a healthy diet for their child and the parent indicated on a scale of 0 – 10 how much they felt the statement applied to them. This question was adapted from Miller and Johnsons' Motivational Screening Measure (144).

3.3.7 Parental discipline practices

To determine if feeding practices were related to other parenting practices, a measure of parental discipline strategies was used. This was measured by the Parenting Scale, which has thirty statements where the respondent marks on a seven-point scale between

Table 1: Questions for Phase 1 assessment at the health check appointment

Maternal education

Mothers – what is **your** highest level of education? *Please tick one circle only*	o Primary school o Some high school o School Certificate or NCEA Level 1 o Sixth Form Certificate or NCEA Level 2 o Bursary or Higher School Certificate or NCEA Level 3 o College of Education Certificate o Polytechnic Diploma o University Degree o Other (please describe)……..

Ethnicity

To which ethnic group(s) does your child belong? *Please tick all the boxes that apply*	o NZ European o Māori o Samoan o Tongan o Cook Island Māori o Niuean o Chinese o Indian o Other (such as Dutch, Japanese, Tokelauan etc). Please state: …….

Dietary intake

How many servings of fruit would your child usually eat each day? (*count 1 serve as the amount that would fit in the palm of their hand*)	o My child doesn't eat fruit o ½ serve o 1 serve o 1 ½ serves o 2 serves o 2 ½ serves o 3 or more serves
How many servings of vegetables would your child usually eat each day? (*count 1 serve as the amount that would fit in the palm of their hand*)	o My child doesn't eat vegetables o ½ serve o 1 serve o 1 ½ serves o 2 serves o 2 ½ serves o 3 or more serves
How many glasses of sweetened drinks would you child usually have each day? (*include fizzy, fruit juice, fruit drinks, cordial and energy drinks*)	o None or less than ½ drink o ½ drink o 1 drink o 2 drinks o 3 drinks o 4 or more drinks

Perception of and concern for overweight

Compared to other children of the same age and sex, how would you rate your child's weight?

- o Underweight
- o A little underweight
- o About right
- o A little overweight
- o Overweight

How concerned are you about your child's weight?

- o Not at all concerned
- o Not concerned
- o A little concerned
- o Quite concerned
- o Very concerned

Importance of a healthy diet

It is important that my child eats a healthy diet

0 1 2 3 4 5 6 7 8 9 10

Definitely not Probably not Maybe Probably Definitely

Examples from the Parenting Scale

When my child misbehaves…

o o o o o o o

I do something right away — I do something about it later

I threaten to do things that…

o o o o o o o

I am sure I can carry out — I know I won't actually do

I am the kind of parent that…

o o o o o o o

Sets limits on what my child is allowed to do — Lets my child do whatever s/he wants

Examples from the Comprehensive Feeding Practices Questionnaire

If my child eats more than usual at one meal, I try to restrict his/her eating at the next meal

- o Disagree
- o Slightly disagree
- o Neutral
- o Slightly agree
- o Agree

If my child eats only a small helping, I try to get him/her to eat more

- o Disagree
- o Slightly disagree
- o Neutral
- o Slightly agree
- o Agree

If this child does not like what is being served, do you make something else?

- o Never
- o Rarely
- o Sometimes
- o Mostly
- o Always

two alternate endings to each statement (145). For examples from this questionnaire, see Table 1.

From these 30 responses, factor scores are determined, which represent the types of discipline strategies used by parents. Many studies have undertaken validation on the parenting scale and have produced two or three subscales: *Laxness*, *over-reactivity* or *verbosity*, with *verbosity* more likely to be excluded (145-148). A factor analysis on the Phase 1 data was undertaken to ascertain the subscales appropriate for this dataset (see Chapter 5 for more detail).

3.3.8 Parental feeding practices

As covered in Section 2.2.2, the Comprehensive Feeding Practices Questionnaire consists of 49 items that include either questions or statements about different feeding practices with a five-point Likert response scale (20). Examples of the items from this questionnaire are shown in Table 1 and the complete questionnaire can be found in Appendix B. The published questionnaire proposes twelve subscales, which were covered in more depth in Section 2.2.2, however analysis for this thesis includes the determination of appropriate subscales for this dataset (see Chapter 4 for more detail).

3.3.9 Socio-economic status

The New Zealand deprivation index 2006 (NZDep) was used as a measure of socio-economic status (SES). The NZDep uses factors from the 2006 census data, such as income, housing, employment, qualifications and home facilities to determine deprivation in areas (neighbourhoods) around New Zealand on a scale of 1 to 10 (149). Home address was used to determine NZDep status and SES was then categorised into tertiles with NZDep 1-3 being low deprivation (*high SES*), NZDep 4-7 was medium deprivation (*medium SES*) and NZDep 8-10 represented high deprivation or *low SES*.

3.4 Phase 2 measures

As outlined in Sections 3.1 and 3.2, the following measures were only obtained in participants with overweight children who agreed to enter Phase 2. These parents were given a Home Food Inventory to complete at home (see Section 3.4.1). Parents subsequently attended a baseline appointment at which they completed a questionnaire including measures of the child's dietary intake, problem weight-related behaviours, general child behaviour, sleep, family functioning, and quality of life. Physical activity, sleep and sedentary time were also measured across one full week using Actigraph accelerometers. Measures relevant to this thesis are explained in more detail, as follows.

3.4.1 Home food availability

The Home Food Inventory (HFI) was developed by Fulkerson *et al* (21) and adapted for New Zealand foods. Further information on the modifications that were made to the original HFI can be found in Appendix F. Parents completed the inventory at home and ticked the checklist if the food was currently present in the house or ready in the garden. To try and account for variation in time since the last grocery shop, all participants were asked to complete the inventory the *day after* the main food shop. An *obesogenic home food availability* score was obtained by summing the number of obesogenic foods in the household, using Fulkerson's criteria (high fat and/or sugar foods – for details see Appendix F). For comparability to the dietary measure (the Children's Dietary Questionnaire - see Section 3.4.2), a *non-core foods* score and a *fruit and vegetable* score were also calculated by summing the foods present in the house that fit these definitions, on the basis of the guidelines for the Children's Dietary Questionnaire (CDQ) (150), the New Zealand food and beverage classification system for primary schools (151), and following advice from two experienced dietitians. Further information on how foods were classified is in Appendix F. While the *obesogenic* and *non-core food availability* categories were very similar, both scales were used in this thesis: the *obesogenic home food availability* score was used in most analyses, as it has been subject to more validation; the *non-core food availability* score

Table 2: Questions for Phase 2 baseline assessment

Examples from the Home Food Inventory

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**.		English muffins (such as fruit, cheese, plain)
		Fruit loaf or bread
		Cakes (such as cakes, muffins)
		Slices (such as caramel slice, lolly cake, brownie etc)
		Scones and pancakes (including pikelets, crumpets, waffles)

Examples from the Children's Dietary Questionnaire

In the past 24 hours, how many times did your child eat vegetables, regardless of the amount? eg salad in sandwich and vegetables in evening meal = twice	o Nil o Once o Twice o 3 times o 4 times o 5 or more times
In the past 24 hours, how many different types of fruit did your child eat (fresh, canned, stewed or dried)?	o None o 1 o 2 o 3 o 4 o 5 or more
In the past 7 days, how often has your child had biscuits, cakes, muffins, doughnuts, slices or fruit pies?	o Nil o Once o Twice o 3 times o 4 times o 5 times o 6 or more times
In the past 7 days, how often has your child had pies, pastry, sausage roll or spring roll?	o Nil o Once o Twice o 3 times o 4 times o 5 times o 6 or more times

Examples from the Lifestyle Behaviour Checklist

To what extent has this behaviour been a problem for you with your child in the last month: Whinges or whines about food?	1 Not at all	2 A little	3	4 Somewhat	5 Much	6 7 Very much
To what extent has this behaviour been a problem for you with your child in the last month: Refuses to eat certain foods (ie fussy eating)?	1 Not at all	2 A little	3	4 Somewhat	5 Much	6 7 Very much
To what extent has this behaviour been a problem for you with your child in the last month: Eats food to comfort themselves when feeling let down or depressed?	1 Not at all	2 A little	3	4 Somewhat	5 Much	6 7 Very much

was used to compare with *non-core food* intake, specifically testing if home availability of these foods was related to dietary intake. Initial testing of the adapted HFI was undertaken within the MInT research team (n=10) of which four had children. A short example of the MInT HFI is shown in Table 2, page 46 and the complete version can be found in Appendix E.

3.4.2 Dietary intake

Given the known difficulties in obtaining accurate information from time intensive diet records (152, 153), as well as the large respondent burden from multiple other methods, it was decided to assess dietary intake in the Phase 2 sample with the Children's Dietary Questionnaire (CDQ) (150). The CDQ includes questions about the child's intake of foods both over the past 24 hours and the previous week. Answers are combined to give four scores; *fruit and vegetable*, *non-core food*, *sweetened beverage* and *fat from dairy* intake. *Non-core foods* are defined as high fat and/or sugar foods. Examples of some of the questions are presented in Table 2 and the full questionnaire can be found in Appendix C. This questionnaire was designed as an easily administered and easily scored tool to measure the dietary intake of children in a research setting, in particular for research on childhood obesity. Magarey *et al* undertook thorough testing and validation (internal consistency, test-retest reliability, relative validation and ability to detect change) on the CDQ using five different samples (150). The results of this testing indicated that the scores for *fruit and vegetable* and *non-core food* intake performed more reliably than the other two scales (namely *sweetened beverage* and *fat from dairy* intake) and therefore only these two sub-scales are used for the analyses in the following chapters.

The scoring was undertaken as described by Magarey *et al* (150): "Fruit and vegetable score was calculated by summing items measuring fruit variety per day (number of varieties in the last seven days divided by seven), vegetable variety per day (as for fruit), the number of different fruits and vegetables on the previous day, the number of occasions on the previous day that either fruit and/or vegetables were consumed and the number of days in the last week divided by 7 that either fruit and/or vegetables were eaten." The formula for the fruit and vegetable score is: q1/7 + q2/7 + q10 + q11 + q12

+ q13 + q28/7 + q29/7. (Questions are in Appendix C). The score for non-core food was found by adding questions 14-19, 21, 23-27 and then dividing by seven (150).

3.4.3 Problem food behaviours

The Lifestyle Behaviour Checklist (LBC) is a 25-item list of potential problem behaviours in overweight children centred around eating, activity and their weight (88). Questions ask first whether each behaviour is a problem and second, the parent's confidence in dealing with that problem. Only the problem scale was used in the MInT study with seven response options. This thesis used questions 1 -15, which assessed behaviours associated with food such as refusing food, whining, yelling or arguing about food, stealing or hiding food and comfort eating. Questions 16-25 asked about problems with physical activity and social situations and were not relevant for this examination. Examples of the questions are shown in Table 2 and the complete questionnaire is in Appendix D.

3.5 Sample description

3.5.1 Phase 1 sample

Overall 1096 participants (49.7% male) were recruited throughout March 2010 to August 2011 into Phase 1 of the MInT Study and attended a health check appointment. They were between the ages of 4.0 and 9.3 yrs (mean = 6.5 yrs; SD=1.4), of which 1093 were included in the final analyses. Figure 1 shows the numbers that declined to participate, were non-contactable or were excluded.

Table 3, page 50, shows the demographic characteristics of the samples used for Phase 1 and Phase 2 analyses. Compared to national data, the sample of 1093 slightly under-represented the three main non-European ethnic groups in New Zealand (Māori, Pacific and Asian – 15%, 7% and 9% respectively from the 2006 national census -

Table 3: Demographics of Phase 1 (n=1093) and Phase 2 (n=203) participants

	Phase 1 n=1093		Phase 2 n=203	
	n	%	n	%
Ethnicity				
New Zealand European	823	75.3	144	70.9
Māori	151	13.8	38	18.7
Pacific Island	42	3.8	11	5.4
Asian	47	4.3	6	3.0
Other	30	2.7	4	2.0
Socio-economic status				
Low	224	20.5	49	24.9
Medium	412	37.7	72	36.6
High	425	38.9	76	38.6
Maternal education				
Some secondary	293	26.8	60	29.6
Completed secondary	73	6.7	14	6.9
Tertiary qualification[1]	224	20.5	39	19.2
University degree	448	41.0	75	37.0
Other	55	5.0	15	7.4
Child weight status				
Normal weight[2]	822	75.2	-	-
Overweight[3]	166	15.2	121	60.0
Obese[4]	105	9.6	82	40.0

[1]Not university degree
[2]BMI < 85th percentile
[3]85th percentile ≤ BMI < 95th percentile
[4]BMI ≥ 95th percentile

http://www.stats.govt.nz/Census/2006CensusHomePage.aspx). However this was a considerable over-representation for these ethnicities within Dunedin's region of Otago, from where the sample for was drawn (7% Māori, 2% Pacific Island and 4% Asian from the 2006 census - http://www.stats.govt.nz/Census/2006CensusHomePage.aspx).

This sample was generally of higher SES and maternal education than New Zealand as a whole. National census data from 2006 showed the New Zealand population was approximately 30% high SES, 40% medium SES and 30% low SES. The education levels of females aged 20-50 years in the 2006 census indicated that 38% had some secondary education, 19% completed secondary, 10% had a tertiary qualification that wasn't a university degree and 21% had a university degree. Nevertheless the successful recruitment demonstrated a diverse cross-section of the population, as shown in Table 3.

If a participant had a sibling that was also eligible and the parent wished for them to be included in the study as well, they were then enrolled and a health check appointment was made for the sibling(s). Often these appointments were combined so that the family only had to make one visit. In total there were 937 families participating in Phase 1. Of these, 130 families had two children, 11 families had three children and 2 families had four children in the study. Adjustment for these family clusters is made and explained in the subsequent analyses.

3.5.2 Phase 2 sample

The final number of participants recruited into Phase 2 was 203. The flow of participants from invitation through Phase 1 and follow-up to the baseline appointment for Phase 2 is illustrated in Figure 1, page 52. The mean age of Phase 2 participants on the date of their initial health check appointment was 6.4 years (SD = 1.4) from a range of 4.1 – 9.0 years and the average BMI z-score was 1.6 (SD=0.5) from a range of 1.0 – 3.6. There were more girls than boys in this sample (girls: n=112 (55%), boys: n=91 (45%)). Other demographic information for the Phase 2 sample is shown in Table 3.

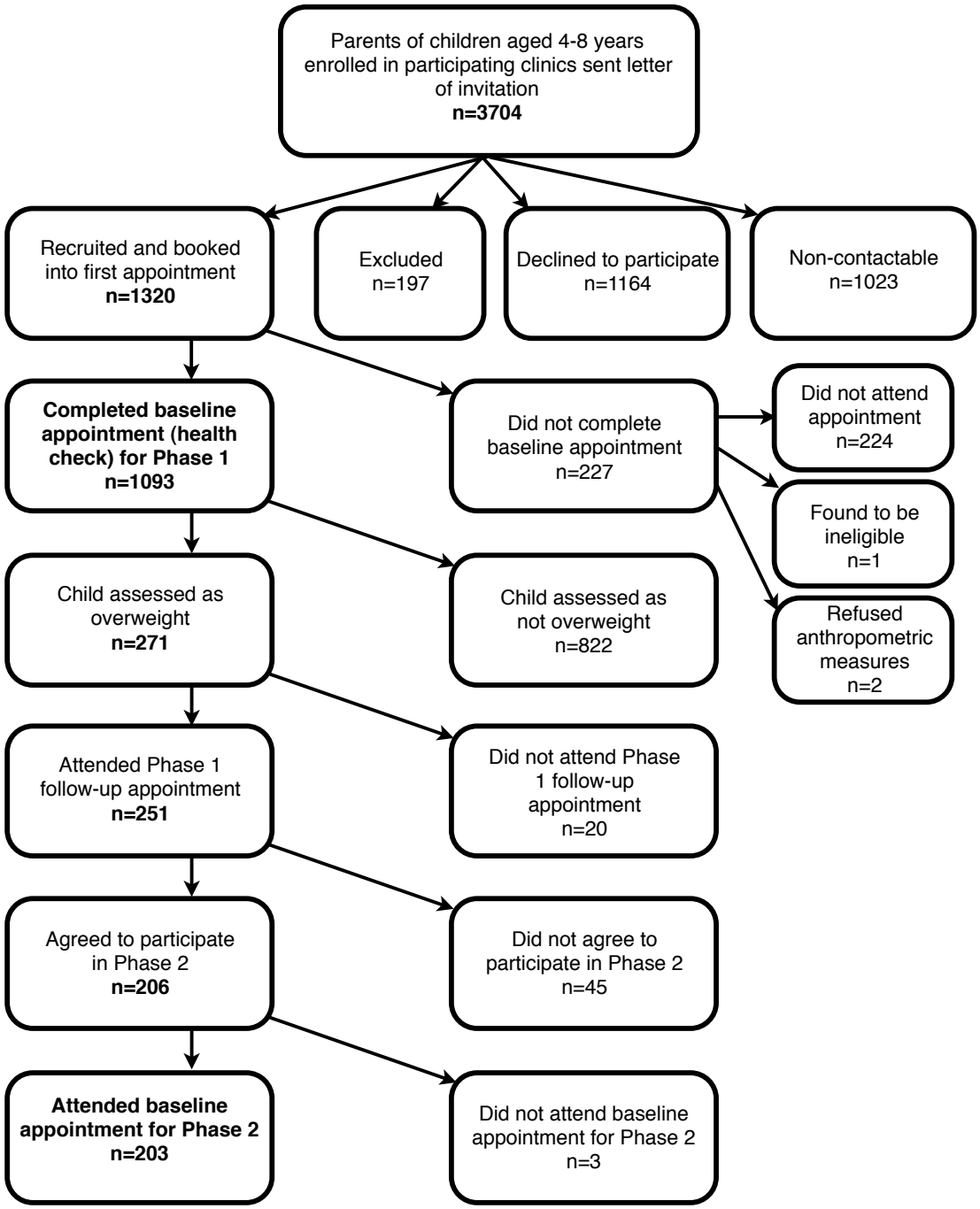

Figure 1: Recruitment process for Phase 1 and Phase 2

4. Factor analysis of the Comprehensive Feeding Practices Questionnaire

4.1 Introduction

A variety of measures have been used to assess a range of different child feeding practices, mostly using questionnaires. Interest arose in the 1980s when Costanzo and Woody found that greater parental restriction of girls' eating was associated with overweight (24, 25). Since 2001, the most widely used instrument to measure feeding practices has been the Child Feeding Questionnaire, which incorporated assessment of parental restriction of a child's diet with monitoring of child food intake and pressure on the child to eat (23). Additional child feeding practices of interest from other researchers include *parental control* (encompassing aspects of *restriction* and *pressure to eat*) (26, 39, 69, 82), *emotion regulation* (when food is used to control the child's moods) (39), *prompting & encouragement* (39, 42, 69), *rewarding* (when food is given or withheld in response to good or bad behaviour) (39, 62), *parental modelling* (62, 66) and how much the child controls his/her own eating (42, 62, 84).

With the introduction of the Comprehensive Feeding Practices Questionnaire (CFPQ) in 2007 (20), the measurement of feeding practices was broadened. This questionnaire was designed to measure twelve different feeding practices that parents were thought to employ, thereby creating a tool that incorporated and expanded the current measures, allowing for a better description of child feeding practices (20). The CFPQ included the three factors from the CFQ (although it purposely distinguished between *restriction for health* and *restriction for weight control*) with additional factors that assessed a variety of other practices, including how much the child controls his/her own eating, the extent to which a parent uses food to regulate their child's emotions or behaviour and how much the parent models, teaches and encourages healthy eating (20). The twelve factors were developed from existing feeding measures and from surveys with parents, resulting in a 49-item questionnaire. In the initial paper published, a confirmatory factor analysis was undertaken on these factors and subsequently a face

validation using correlations between the factors and parents' concerns for overweight and underweight in their child and their feelings of responsibility.

While this questionnaire is a more comprehensive measure, which could be used to enhance the understanding of the role of feeding practices in children's nutrition and growth, the initial validation was poor. The original analyses occurred in inadequately sized subgroups (n=269 mothers of 3-6 year old children, n=248 fathers of 3-6 year old children, n=152 mothers of 18 month–8 year old children) that comprised a high proportion of well-educated, Caucasian parents of high socio-economic status. The use of small, homogenous samples to validate this questionnaire casts doubt on the robustness of the scales, making its application in diverse populations, such as New Zealand, potentially inappropriate. Because child-feeding practices can be influenced by many factors including ethnicity, maternal weight status, maternal education, concern for child's weight, and socio-economic status (SES) (29, 33, 39, 42, 52, 54, 55, 62, 83, 86, 87) and because factor analyses can be less accurate in smaller samples (less than 5-10 participants per question) (154), a reassessment of the factor structure of the CFPQ is warranted.

The aim of this chapter is to conduct factor analyses on the CFPQ to determine a factor structure that is fit for use in a New Zealand population. To begin with, a confirmatory factor analysis will be undertaken on the twelve-factor structure of the CFPQ in a large, relatively diverse sample of New Zealand children. If this analysis does not indicate good fit, an exploratory factor analysis will be undertaken to ascertain a new factor structure and further tests of model fit will be carried out on this new factor structure. Face validity of the final scales will be assessed by examination of correlations between factors and attitude measures: concern for overweight or underweight and valuing the importance of a healthy diet.

4.2 Methods

4.2.1 Participants and measures

Participants from Phase 1 of the MInT Study contributed to this analysis. Recruitment methods are described in Section 3.2, page 38. Parents completed a questionnaire that included demographic questions and the CFPQ while the children's height and weight were being measured. Missing data in the CFPQ were excluded list-wise.

Parents also responded to questions about how concerned they were about their child's weight, how they rated their child's weight and how important they felt it was to provide their child with a healthy diet. Section 3.3, page 39, covers these attitude measures in more detail.

4.2.2 Confirmatory factor analysis

A confirmatory factor analysis was undertaken on the 12-factor model proposed by Musher-Eizenman & Holub (20) using the mean and variance-adjusted weighted least-squares method in Mplus version 5.21 (Muthen & Muthen, Los Angeles). In this analysis the items (the questions or statements in the questionnaire) were treated as ordinal and were restrained to load only on the specified factor so as to test the hypothesized model. Confirmatory factor analysis compares the covariances between items as predicted by the proposed model with observed covariances and there are several tests that can be used to assess how well these agree. Mplus outputs the following tests of model fit: the χ^2-test, the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA) and the Weighted Root Mean Square Residual (WRMSR). The tests used to indicate the fit for this analysis were the CFI, the TLI (both advised to be more than 0.9) and the RMSEA (recommended to be less than 0.05) (155). The χ^2-test is sensitive to sample size and tends not to be an effective test with sample sizes larger than 200, hence it was

unsuitable for this study (155). It was also decided not to use the WRMSR as it is a relatively new test and rarely used, thus limiting comparisons with the literature.

The RMSEA is an absolute fit index, which compares the sample covariance matrix with the model covariance matrix – a perfect fit would give an RMSEA of zero. The CFI and TLI are relative fit indices, which compare the proposed model to a null model, therefore the closer to 1 they are, the better the model. It is recommended to use more than one test of model fit when undertaking a confirmatory factor analysis to overcome some of the limitations with each index (155). If one test indicates that the model is acceptable and another test does not, then examination of the modification indices and correlation matrix can be undertaken to give an indication of whether the model could be improved.

For this analysis, modification indices and a correlation matrix for the factors were generated to further elucidate how well the model represented the data. Modification indices indicate how the model might be improved by allowing items to load on other factors, thereby suggesting a different structure.

4.2.3 Exploratory factor analysis

If the confirmatory analysis on the original 12-factor model is not deemed to be a good fit in this sample, an exploratory factor analysis will be undertaken using STATA version 12.0 (StataCorp, Texas). The extraction method used will be principal axis factoring. This analysis will determine the factors, which are groups of items that are inter-correlated. Initially, eigenvalues will be calculated for all possible factors (up to the number of variables, in this case 49) by diagonalising the correlation matrix of all the variables. Eigenvalues measure the total variance contributed by a factor and are ordered from highest to lowest, representing potential factors. To determine how many factors should be extracted, a scree plot will be generated, by plotting the eigenvalues (on the y-axis) against the number of potential factors (on the x-axis). The number of factors to select is indicated by the 'elbow' of the curve, where the gradients between factors begin to flatten, and the number of factors to extract is the number preceding the elbow. This method is considered to be more accurate than simply choosing all factors

with an eigenvalue greater than 1 (154). A subsequent test called Horn's Parallel Analysis, which is highly recommended by experts (154), will be used to verify that the number of factors is appropriate. This method contrasts the eigenvalues from the real data with eigenvalues generated from random data of the same size and number of variables (a "parallel analysis"). Eigenvalues can then be adjusted to account for sampling error that might be artificially inflating eigenvalues from the real dataset. Adjusted eigenvalues greater than 1 specify how many factors should be selected.

Once the number of factors is determined, rotation of the factor axes will be undertaken to improve interpretability – where items are made to load more highly on one factor and lower on others. As feeding practices have tended to correlate with each other, an oblique rotation technique will be used in this analysis to allow for this correlation. This means that the factor axes do not have to be orthogonal or independent. The *promax* method will be used to generate a pattern matrix.

The pattern matrix contains the loadings on the factors, which represent correlation coefficients between the items and the factors. Loadings greater than cut-offs of 0.3, 0.4 and 0.5 will each be used to decide which items are included in the factors: the cut-off which produces the least complex items (when items load on more than one factor), and results in optimal Cronbach's alpha scores for the factors, will be used for the final model.

Cronbach's alpha measures the inter-correlation of items in a group – greater reliability of a scale is indicated by a high Cronbach's alpha (up to 1.0). Further items will be removed from each factor if their removal improves the Cronbach's alpha for a particular scale, provided the factor retains at least four items (to ensure the stability of the factor) (154).

4.2.4 Testing of new factor structure

If a new factor structure is proposed, further analyses will be undertaken to test the model's robustness.

First, a confirmatory analysis with the whole sample (n=1013) will be carried out using the new factors extracted from the exploratory analysis, as per the methods for the initial confirmatory analysis. The same tests of model fit will be used (CFI, TLI and RMSEA) and modification indices and a correlation matrix will be generated.

As the sample is large, further exploratory analysis can be undertaken to test the robustness of the final factor structure. For this, the full sample will be split into two samples matched for sex, ethnicity, socio-economic status, weight status and maternal education. This is achieved by ordering the sample according to BMI z-scores, (as weight status is likely to effect feeding practices to a greater extent than other demographic factors) and grouping odd-numbered participants together and even-numbered participants together. This should result in two groups that have similar weight status categories. χ^2-tests with a p-value of less than 0.05 will determine if the resulting groups are significantly different from each other in the criteria to be matched.

In the first group (odd-numbered participants), an exploratory factor analysis will be undertaken as per the methods stated previously, and a factor structure proposed from this. Subsequently a confirmatory factor analysis of this model will be carried out in the second group (even-numbered participants) using structural equation modeling in Stata 12.0 (StataCorp, Texas). How these analyses support or contradict the proposed model from the full sample will be stated.

4.2.5 Face validity

Data were analysed using STATA version 12.0 (StataCorp, Texas). Factor scores for the final set of feeding practices were calculated for each participant by averaging the contributing item scores. To assess face validity, pair-wise correlations (and p-values) were then calculated between the factor scores and age, *concern for overweight*, *concern for underweight* and *importance of a healthy diet*. Face validity investigates whether proposed scales are related to concepts that they are expected to relate to. For this analysis, scales measuring parental control might be expected to decrease with age; restrictive feeding practices to increase with *concern about overweight*; *pressure to eat* to increase with *concern about underweight* (these measures have been used for face

validation in other factor analyses (20, 23, 156)); and teaching, guiding, encouraging and modeling healthy eating would be expected to increase as a parent values a healthy diet more.

4.3 Results

4.3.1 Participant characteristics

In total, 53,463 of 53,557 questions (99.8%) were completed for the CFPQ. However, for this analysis, only those participants with complete CFPQ data were included, which consisted of 1013 children (92.7% of the total sample) with an average age of 6.5 years (SD=1.4). Table 4, page 60, illustrates the diversity and demographics of the sample used for this analysis compared with those that were excluded (n=80). Proportion-tests showed that these two groups did not significantly ($p<0.05$) differ from each other in terms of the demographics shown (data not shown).

4.3.2 Confirmatory factor analysis

The confirmatory factor analysis on the 12-factor model showed that all loadings were greater than 0.4 on the designated factor. However, the goodness of fit statistics (CFI=0.84, TLI=0.90), which ideally have values greater than 0.9, and the RMSEA (0.09), which should be less than 0.05, indicated that the model was not an especially good fit (155). Furthermore, the high modification indices suggested that a large number of items could have substantial loading on several factors if permitted to do so. There were 33 modification indices that indicated 24% (12/49) of the items would load greater than 0.4 on at least one other factor. For instance, statement 18 "I have to be sure that my child does not eat too many high-fat foods" (from *restriction for weight control*) would load greater than 0.4 on **eight** other factors, including *teaching about nutrition* and *emotion regulation*. Item number 45, "I often put my child on a diet to control his/her weight" would load on nine other factors. This cross-loading of items further indicated a poor model fit. Modification indices were not presented in Musher-Eizenman & Holubs' original confirmatory analysis of this model (20).

Table 4: Demographics of the samples with complete and incomplete data for the Comprehensive Feeding Practices Questionnaire

	Sample with complete data n=1013		Sample with incomplete data n=80	
	n	%	n	%
Ethnicity				
New Zealand European	767	75.7	56	70.0
Māori	135	13.3	16	20.0
Pacific Island	39	3.9	3	3.8
Asian	45	4.4	2	2.5
Other	27	2.7	3	3.8
Socio-economic status				
Low	206	20.3	18	22.5
Medium	383	37.8	29	36.3
High	398	39.3	27	33.8
Maternal education				
Some secondary	275	27.2	18	22.5
Completed secondary	68	6.7	5	6.3
Tertiary qualification[1]	206	20.3	18	22.5
University degree	410	40.5	38	47.5
Other	54	5.3	1	1.3
Child weight status				
Normal weight[2]	765	75.5	57	71.3
Overweight[3]	150	14.8	16	20.0
Obese[4]	98	9.7	7	8.8

[1]Not university degree
[2]BMI < 85th percentile
[3]85th percentile ≤ BMI < 95th percentile
[4]BMI ≥ 95th percentile

The correlation matrix for the twelve factors (Table 5, page 62) shows that several factors were strongly correlated with one or more of the other factors. Of particular note are the high correlations between *modelling*, *teaching about nutrition*, *encourage balance & variety* and *environment* (r=0.54-0.81). Also, *restriction for health* and *restriction for weight control* were strongly correlated (r=0.52); as well as *food as a reward* with *emotion regulation* (r=0.48) and *pressure* (r=0.44). These strong correlations indicate that the distinction between the factors is not clear.

The tests of model fit from the confirmatory factor analysis, the many high modification indices, and the strong correlations between the factors indicated that this 12-factor model did not adequately represent the proposed underlying concepts. Therefore, an exploratory factor analysis was carried out to see if the data could be reduced in a more suitable way.

4.3.3 Exploratory factor analysis

A scree plot indicated that five factors should be extracted and this was verified by the Horn's Parallel Analysis. Five factors explained 84% of the total variance. The cut-off for loadings was determined to be 0.4, which optimized Cronbach's alphas and resulted in no complex items. Fifteen items with loadings of less than 0.4 were excluded (items 7, 8, 12, 13, 15-18, 20-22, 32, 37, 42, 43) and two further items excluded because the Cronbach's alpha improved if they were not included in the relevant factor (items 28 & 46). The Cronbach's alpha for the first factor was 0.81 with item number 46 included, which then increased to 0.82 with the removal of it. The third factor had a Cronbach's alpha of 0.71, which increased to 0.72 with the removal of item 28. An improvement in the Cronbach's alpha of the second factor was indicated to the third decimal place by the removal of item 4, however this would have reduced the number of items in this factor to below four, which may have made this factor less stable. Furthermore, it made no difference to the result with two decimal places (α=0.90), thus item 4 was not removed.

The resulting model contained 32 items contributing to the five factors. The items, loadings (from the pattern matrix), and Cronbach's alpha for the five factors are shown

Table 5: Correlations in the twelve-factor model from the confirmatory analysis, n=1013

	1	2	3	4	5	6	7	8	9	10	11
1. Monitoring	-										
2. Emotion regulation	-0.29*	-									
3. Food as reward	-0.18*	0.48*	-								
4. Pressure	-0.05	0.25*	0.44*	-							
5. Child control	-0.38*	0.37*	0.18*	-0.14*	-						
6. Teaching about nutrition	0.34*	-0.16*	-0.03	-0.02	-0.04	-					
7. Environment	0.48*	-0.30*	-0.29*	-0.07	-0.35*	0.54*	-				
8. Restriction for weight control	0.13*	0.09**	0.15*	-0.09**	-0.15*	0.10*	0.03	-			
9. Restriction for health	0.06	0.19*	0.32*	0.19*	-0.09**	0.17*	-0.07**	0.52*	-		
10. Modelling	0.36*	-0.11*	-0.05	0.06	-0.17*	0.65*	0.58*	0.12*	0.22*	-	
11. Involvement	0.20*	-0.15*	-0.18*	-0.16*	0.00	0.46*	0.34*	-0.05	-0.13*	0.32*	-
12. Balance & variety	0.44*	-0.28*	-0.10**	0.09**	-0.22*	0.81*	0.65*	-0.11**	0.09**	0.78*	0.50*

* p<0.01 **p<0.05

in Table 6, page 64, along with the factor that they originated from. The excluded items are shown in Table 7, page 66. The factors are as follows: ***Healthy eating guidance*** (9 items): this factor indicates how much a parent models, teaches and encourages healthy eating for their child. It contains items from the original subscales of *environment*, *encourage balance & variety*, *teaching about nutrition* and *modelling*. ***Monitoring*** (4 items): assesses how much a parent keeps track of the unhealthy foods that their child consumes and replicates the original *monitoring* factor of the CFPQ. ***Parent pressure*** (7 items): investigates how much a parent pressures the child to eat or uses food to control their behaviour and includes some items from three of the original subscales (*emotion regulation*, *food as a reward* and *pressure*.) ***Restriction*** (8 items): assesses how much a parent restricts or controls their child's eating and brings together most of the original items from *restriction for weight control* with one item from *restriction for health*. ***Child control*** (4 items): determines how much the parent allows the child to make decisions around what and when they eat and uses most of the questions from the original *child control* subscale. The only item not fitting this model was question 12 ("Do you allow this child to leave the table when s/he is full, even if your family is not done eating?") which loaded at 0.33 (<0.4) and was subsequently removed.

4.3.4 Investigation of the five-factor structure

The confirmatory factor analysis of the 5-factor model in the whole sample demonstrated good fit according to two of the model tests: CFI=0.90 and TLI=0.93, which are ideally greater than 0.9. However the RMSEA was 0.10 (ideally less than 0.05), which did not indicate good fit. The 5-factor model had two of the three tests of model fit reach recommended cut-offs, while the 12-factor model achieved this in only one of the three tests. However, the potential improvement in the structure of the measure was not overly convincing. Therefore, further examination of the correlations and modification indices was required to determine which model was superior.

The correlations between factors in the new model are shown in Table 8 (page 68) and show only two relatively high correlations (r>0.2): *Monitoring* correlated positively with *healthy eating guidance* and negatively with *child control*.

Table 6: Factors and items from exploratory factor analysis, internal consistency coefficients, means and standard deviations, n=1013

Factors and items	Original Factor	Factor loading or Internal consistency coefficient (α)	Mean (S.D.)
Healthy eating guidance		**α = 0.82**	**4.4 (0.6)**
48. I show my child how much I enjoy eating healthy foods	Modelling	0.79	4.3 (0.9)
47. I try to show enthusiasm about eating healthy foods	Modelling	0.74	4.4 (0.9)
25. I discuss with my child why it's important to eat healthy foods	Teaching about nutrition	0.70	4.6 (0.7)
26. I tell my child that healthy food tastes good	Encourage balance & variety	0.63	4.4 (0.9)
31. I discuss with my child the nutritional value of foods	Teaching about nutrition	0.62	3.9 (1.2)
44. I model healthy eating for my child by eating healthy foods myself	Modelling	0.56	4.1 (1.0)
38. I encourage my child to eat a variety of foods	Encourage balance & variety	0.52	4.8 (0.5)
24. I encourage my child to try new foods	Encourage balance & variety	0.47	4.7 (0.5)
14. Most of the food I keep in the house is healthy	Environment	0.40	4.0 (0.9)
Monitoring		**α = 0.90**	**4.2 (0.7)**
1. How much do you keep track of the sweets that your child eats?	Monitoring	0.97	4.2 (0.8)
2. How much do you keep track of the snack food that your child eats?	Monitoring	0.94	4.2 (0.8)
3. How much do you keep track of the high-fat foods that your child eats?	Monitoring	0.80	4.1 (0.9)
4. How much do you keep track of the sugary drinks that your child drinks?	Monitoring	0.74	4.4 (0.8)
Parent pressure		**α = 0.72**	**2.7**
23. I offer sweets to my child as reward for good behaviour	Food as reward	0.62	2.7 (1.3)
19. I offer my child his/her favourite foods in exchange for good behaviour	Food as reward	0.60	2.2 (1.2)

49. When he/she is finished eating, I try to get my child to eat one more (two more, etc) bites of food	Pressure	0.53	3.3 (1.3)
9. Do you give this child something to eat or drink if s/he is bored even if you think s/he is not hungry?	Emotion regulation	0.50	1.7 (0.7)
39. If my child eats only a small helping, I try to get him/her to eat more	Pressure	0.49	3.4 (1.3)
30. If my child says, "I'm not hungry," I try to get him/her to eat anyway	Pressure	0.45	3.1 (1.3)
36. I withhold sweets/dessert from my child in response to bad behaviour	Food as reward	0.44	2.6 (1.4)
Restriction		**α = 0.75**	**1.9 (0.6)**
29. I give my child small helpings at meals to control his/her weight	Restriction for weight control	0.66	1.5 (0.9)
33. If my child eats more than usual at one meal, I try to restrict his/her eating at the next meal	Restriction for weight control	0.64	1.3 (0.7)
27. I encourage my child to eat less so he/she won't get fat	Restriction for weight control	0.63	1.6 (1.0)
34. I restrict the food my child eats that might make him/her fat	Restriction for weight control	0.53	2.8 (1.4)
35. There are certain foods my child shouldn't eat because they will make him/her fat	Restriction for weight control	0.51	2.5 (1.4)
40. I have to be sure that my child does not eat too much of his/her favourite foods	Restriction for health	0.43	3.0 (1.2)
41. I don't allow my child to eat between meals because I don't want him/her to get fat	Restriction for weight control	0.51	1.5 (0.8)
45. I often put my child on a diet to control his/her weight	Restriction for weight control	0.45	1.1 (0.4)
Child control		**α = 0.63**	**2.3**
6. At dinner, do you let this child choose the foods s/he wants from what is served?	Child control	0.59	2.4 (1.0)
10. If this child does not like what is being served, do you make something else?	Child control	0.50	1.8 (0.8)
5. Do you let your child eat whatever s/he wants?	Child control	0.49	2.5 (0.8)
11. Do you allow this child to eat snacks whenever s/he wants?	Child control	0.42	2.4 (0.9)

Table 7: Excluded items from exploratory factor analysis

Excluded items	Original Factor
7. When this child gets fussy is giving him/her something to eat or drink the *first* thing you do?	Emotion regulation
8. Do you give this child something to eat or drink if s/he is bored even if you think s/he is not hungry?	Emotion regulation
12. Do you allow this child to leave the table when s/he is full, even if your family is not done eating?	Child control
13. Do you encourage this child to eat healthy foods before unhealthy ones?	Encourage balance & variety
16. I keep a lot of snack food in my house.	Environment
22. A variety of healthy foods are available to my child at each meal served at home.	Environment
37. I keep a lot of sweets in my house.	Environment
15. I involve my child in planning family meals.	Involvement
20. I allow my child to help prepare family meals.	Involvement
32. I encourage my child to participate in grocery shopping.	Involvement
46. I try to eat healthy foods in front of my child, even if they are not my favourite.	Modelling
17. My child should always eat all of the food on his/her plate.	Pressure
21. If I did not guide or regulate my child's eating, s/he would eat too much of his/her favourite foods.	Restriction for health
28. If I did not guide or regulate my child's eating, he/she would eat too many junk foods.	Restriction for health
43. I have to be sure that my child does not eat too many sweets.	Restriction for health
18. I have to be sure that my child does not eat too many high-fat foods.	Restriction for weight control
42. I tell my child what to eat and what not to eat without explanation.	Teaching about nutrition

There were only **two** modification indices that showed that one item would have loaded greater than 0.4 on other factors if permitted to do so. These were both from question 45 (now in the *restriction* scale) which would have loaded onto both the second and fifth factor (*monitoring* and *child control*). This is a considerable improvement from the 33 alternative loadings suggested by the 12-factor analysis.

To further investigate the robustness of the new factor structure the sample was split into two groups. These groups were not significantly different in ethnicity, socio-economic status, maternal education, sex and weight status of the child (data not shown). Exploratory analysis was undertaken in Group 1 (n=507) and six factors were indicated by a scree plot. Loadings of 0.4 indicated inclusion to the factor. The results gave identical items for factor two (*monitoring*) and factor five (*child control*). There was one extra item in *parent pressure* and one less item from the *restriction* scale. The extra factor in this analysis appeared to represent a *restriction for health* factor. A confirmatory analysis of these six factors in Group 2 (n=506) showed overall poor model fit with CFI=0.78, TLI=0.76 and RMSEA=0.07. To check if five factors would have fit better, the same analyses were undertaken in the groups with five factors specified. This resulted in the same five factors as proposed by the whole sample, with three items difference in factor one (*healthy eating guidance* – one item fewer and two extra*),* one item difference in factors four (*restriction*) and five (*child control*), and two items extra in factor three (*parent pressure)*. Otherwise the factors were the same. However, this also performed poorly when a confirmatory analysis was carried out in the second group (CFI=0.76, TLI=0.74 and RMSEA=0.07).

4.3.5 Face validity

To test face validity, the five hypothesized factors were correlated against four measures that might be related to feeding practices (Table 9**,** page 70). Parents reporting more *concern for overweight* tended to use more *healthy eating guidance*, with higher levels of *restriction* and lower levels of *parent pressure*. Conversely, parents that were concerned about *underweight* in their child tended to use more *parent pressure* to eat and also had lower scores for *healthy eating guidance*. As age

Table 8: Correlations in the five-factor model from the exploratory analysis, n=1013

	Healthy eating guidance	Monitoring	Parent pressure	Restriction	Child control
1. Healthy eating guidance	-				
2. Monitoring	0.41*	-			
3. Parent pressure	-0.01	-0.18*	-		
4. Restriction	-0.01	0.05	0.09**	-	
5. Child control	-0.15*	-0.37*	0.12*	-0.15*	-

* $p<0.01$ ** $p<0.05$

increased, *parent pressure* decreased and parents who agreed that a healthy diet for their child was important reported higher levels of *healthy eating guidance* and *monitoring* with less *child control*. These associations mostly agreed with expectations and supported the five-factor model.

4.4 Discussion

The original CFPQ that proposed twelve child feeding scales using a 49-item questionnaire was factor analysed in small samples by Musher-Eizenman & Holub (20). Preliminary factor analyses were undertaken on a proposed nine-factor questionnaire in two samples of mothers (n=269) and fathers (n=248). Modifications were then made to the questionnaire resulting in the 49-item, 12-factor measure and a final confirmatory factor analysis and face validation was carried out using a sample of 152 mothers. These samples were predominantly Caucasian (92-93%), with high levels of education (the sample on which the 12-factor model was factor analysed had a median educational level of a Masters degree) and high socio-economic status. There may also have been chain-sampling bias, when acquaintances of the researchers were recruited and then asked to recruit their acquaintances (20). At least 5-10 participants per variable are advised for factor analyses to avoid spurious groupings (45). However, the final sample used to confirm the twelve-factor structure did not meet even this minimum standard (with 49 items, at least 245 participants would have been required).

This current analysis carried out a confirmatory factor analysis in a much larger (n=1013), more diverse sample (only 75% Caucasian, 21% of the sample was of low-SES and 34% of mothers had no tertiary qualification). This investigation showed that the observations did not fit the proposed theoretical structure very well, that several of the factors were strongly correlated with other factors, and many modifications to improve the structure of the model were indicated. A subsequent exploratory factor analysis indicated five parental feeding scales based on 32 of the original items all with loadings of more than 0.4 namely *monitoring*, *child control*, *restriction*, *parent pressure* and *healthy eating guidance*. A confirmatory factor analysis based on these

Table 9: Correlation between the five factors from the exploratory analysis and measures that might influence feeding practices

	n	Healthy eating guidance	Monitoring	Parent pressure	Restriction	Child control
Age	1013	-0.04	0.05	-0.18*	0.03	-0.02
Concern for underweight	159	-0.17*	-0.08	0.35*	0.02	0.04
Concern for overweight	118	0.28*	0.08	-0.24*	0.27*	-0.11
Importance of a healthy diet	1012	0.35*	0.22*	0.02	-0.02	-0.07*

* significantly different from zero ($p<0.05$)

32 items showed that the five factors had a better model fit than the 12-factor model (although still not ideal) as well as lower correlations between factors with considerably fewer modifications indicated. Fewer factors provide a more parsimonious solution for further statistical analysis and may make the results more interpretable (157). Fewer items also reduces participant burden, an important consideration in obesity studies that may investigate a myriad of factors.

Two of the five factors were very similar to factors in Musher-Eizenman and Holubs' original model - *monitoring* and *child control* (20). *Monitoring* is the practice of keeping track of what your child eats and translates directly from the CFQ (23). It has been associated with healthier outcomes for children (61, 69, 158). On the other hand, *child control* has been less explored and results are not in agreement (30, 38, 62, 67, 81, 84). This is most likely due to two separate definitions of *child control*. The first is where the child is allowed to eat the meals provided to him/her without interference from the parent. They are free to eat what and how much they want of what is being served. Allowing children greater control over their eating may encourage better regulation of appetite and the body's responses to food (10, 159-161). The few studies that have used this version of *child control* have shown it relates to better dietary intake and weight status (30, 62). The alternative definition of *child control* is that when the child is allowed to determine what food to eat and when. This version captures a more permissive parenting role where children can snack on the foods they like and parents are more likely to provide the child with foods that they want. This type of *child control* has been associated with less healthy dietary intake and weight status for children (38, 67, 81). It is this second definition of *child control* that is described by the CFPQ in both versions of the questionnaire (12-factor and 5-factor).

Many studies have included a measure of *restriction*. Generally they have shown an association with less healthy diets and higher body weight in children (29, 46, 52-56, 58, 61, 162). However, *concern for overweight* might mediate the relationship with weight (55) and *restriction* might be a useful practice in the treatment of childhood overweight (28). These studies are explored in more detail in Section 2.3.1 (page 12), which concluded that the long-term effects of parental *restriction* are not yet known, although there is evidence to suggest benefits to BMI z-scores when *restriction* is used

in young children. *Restriction* is therefore an important practice to include in this questionnaire as there is still much research needed to fully understand its impact. It should be noted that while much of the current literature uses the *restriction* scale from the CFQ, this new *restriction* factor measures a slightly different version – one that is more focussed around weight control.

Parent pressure is a new construct that combines the well-studied practice of *pressure to eat*, from the CFQ, with the practice of *food as a reward* (whether parents offer or withhold treat food in response to good or bad behaviour) and one question from *emotion regulation*. Together this describes a situation where parents encourage eating in a controlling manner. This controlling practice needs to be investigated further to establish its impact on children's diet, as currently the individual contributing concepts have been associated with less healthy dietary intake and lower weight status (30, 31, 33, 49, 62, 65, 66). While it is likely that parents use less pressure with overweight children, thereby changing the feeding practices they use in response to their child's weight, the relationship with less healthy dietary intake needs closer inspection. It is yet to be determined if *parent pressure* to eat is beneficial or detrimental to children's diets. Moreover, this scale in the form proposed by this analysis has not been explored previously and needs to be further supported by investigating relationships to relevant factors such as diet.

Healthy eating guidance is a new measure consisting of the familiar concepts of *modelling*, *teaching about nutrition*, *environment*, and *encouraging balance & variety*, which were all strongly inter-correlated in the confirmatory analysis. *Modelling* and *encouragement* have previously been associated with healthier eating (30, 42, 49, 66, 69) and this new factor offers a positive feeding practice that could be used as a recommendation to parents and counters the controlling practices that have often been studied.

The two new factors emerging from this analysis, *parent pressure* and *healthy eating guidance*, are supported by data from the original CFPQ analysis by Musher-Eizenman and Holub (20), which showed significant correlations between the subscales *pressure* and *food as a reward* (now *parent pressure*), and *modelling*, *encourage balance & variety* and *teaching about nutrition* (now *healthy eating guidance*). As these

correlations indicated considerable concordance between these subscales, which is replicated in our dataset, combining them as new factors in this analysis was considered very satisfactory.

This analysis has resulted in the loss of some subscales from the 12-factor model (for example *environment*, *involvement*, *modelling*, *emotion regulation* and *restriction for health*). The exclusion of these factors implies that the proposed questionnaire no longer measures these concepts and therefore researchers might miss out on valuable insights to potentially influential feeding practices. In particular, the loss of the *environment* scale means that this questionnaire alone can no longer examine whether *child control* only results in better outcomes in a healthier environment (although the *environment* scale was perhaps not the best way to measure home food environment). However, factors that are excluded by an exploratory analysis indicate that they account for less of the variance and are less reliable. Extracting too many factors may result in minor factors created at the expense of major factors, resulting in a structure that is less likely to be replicated (163). Therefore, five robust factors provide a better measure with which to determine the underlying theories than a questionnaire with a multitude of smaller scales.

As our sample was large, statistically significant correlations between the five subscales were present, but were substantially fewer (and lower) than that observed with the 12-factor model, which had 28 correlations of greater than 0.2 (up to 0.81). The correlation in the new model between *monitoring* and *healthy eating guidance* comes as no surprise as parents who model, teach and encourage healthy eating would be more likely keep track of their child's diet. Furthermore, those parents who keep better track of what their child eats would feasibly reduce the amount of control and freedom that the child has over what they eat, illustrated by the negative association between *monitoring* and *child control*. Thus these correlations support the five-factor model, rather than undermine the structure.

Only one other group (besides the original authors) had published a factor analysis of this questionnaire and this was undertaken with parents of older (10-12 year old), Norwegian children using an adapted version of the CFPQ (156). This exploratory analysis began with the exclusion of the *emotion regulation* and *food as a reward*

subscales because most of the items from these factors were deemed irrelevant to children of this older age bracket. They then proceeded to extract ten factors, since this solution resulted in factors that corresponded well with the original twelve factors proposed by Musher-Eizenman & Holub (20). No confirmatory analysis was undertaken. Therefore, the resultant questionnaire from Melbye *et al* (156), from an analysis in a large, homogeneous Norwegian sample of older children, using an adapted version of the CFPQ, was very similar to the original CFPQ.

The analyses that were carried out here were considerably more thorough than those presented by Musher-Eizenman and Holub (20). Rather than relying solely on the tests of model fit, modification indices and factor correlations were also considered. These illustrated overall poor fit for the 12-factor model in this sample of New Zealand children. Following this, an exploratory factor analysis was carried out using recommended methods to extract the correct number of factors and optimise the reliability of the scales. To further corroborate the new structure, a confirmatory analysis was performed with consideration of model fit tests, modification indices and correlations between factors. While the RMSEA test indicated that the new five-factor model was not a good fit, both the Tucker-Lewis and Comparative Fit indices suggested it was of adequate fit, which was not the case for the twelve-factor model. In addition, considerable improvement in modification indices and correlations also supported the new structure.

Additional analyses were undertaken by first splitting the sample into two groups, and then running an exploratory analysis in one group and a confirmatory in the other. This was only possible due to the large sample used, in that splitting the sample still resulted in at least 10 participants per variable. This was carried out for both five and six factors although neither showed especially good fit from the confirmatory analyses. This illustrates the fragility of factor analyses and the dependence on the sample, in particular the size. Despite this, all five of the new factors were strongly endorsed in both the five and six factor analyses, with only minor variations presented. It is generally agreed that larger sample sizes are better for factor analysis. Indeed it has been shown that a 20:1 ratio of participants to questions more accurately represents the data when conducting an exploratory analysis compared to lower ratios (154). The full

sample used here exhibited a ratio of nearly 21:1, suggesting that the full sample analysis gave the most accurate structure.

Both the CFPQ and the CFQ original analyses reported correlations between feeding practices and concern for child weight as a form of face validity (20, 23, 156). Results concur with this analysis, that *concern for overweight* is positively associated with restrictive feeding practices and that *concern for underweight* is positively associated with pressuring feeding practices (20, 23). Furthermore, in this study *concern for overweight* was positively associated with *healthy eating guidance* and negatively associated with *parent pressure* – outcomes which seem logical and attest to the subscales. Although our results demonstrated that those parents concerned that their child was underweight exhibited less *healthy eating guidance*, which might seem counter-intuitive, it is perhaps feasible given that parents worried about their child's relative thinness may want them to eat anything, regardless of nutritional content. Moreover, Musher-Eizenman & Holub (20) showed that *concern for underweight* had negative correlations with *environment* and *modelling* (two factors that were partially captured by the *healthy eating guidance* factor), supporting this result. Face validity was further evaluated in this analysis with the *importance of a healthy diet* scale and age of the child, which again gave logical associations and endorsed the five-factor model.

A major strength of this analysis was the large, diverse sample (n =1013) resulting in nearly 21 participants per variable (45, 154). Furthermore, as feeding practices are influenced by maternal education (42, 62), socio-economic status (86, 87), ethnicity (29, 54) and maternal weight status (33, 39, 83) these results have greater applicability due to the sample diversity (exhibited in Table 4). There may, however, be country-specific issues that affect the applicability of the revised CFPQ, so the new 32-item questionnaire should be tested in different samples to determine if the subscales are robust in other populations. This analysis has reduced the response burden of the questionnaire from 49 items to 32, by removing 17 items that did not contribute to any one feeding practice. The data were represented by five feeding practices of interest, which need further investigation to determine how they might influence child preferences, eating patterns, dietary intake and weight status. Unlike the original analysis on the 12-factor model, these five practices were not pre-specified and were

allowed to emerge from the data, supported by further analyses, face validation and correlation results.

This study was limited by its lack of information about the person who completed the questionnaire and who was primarily responsible for the feeding in the household. While anecdotally it was mostly mothers who participated, the large sample would have had some fathers who completed the questionnaire, adding to the diversity. It is noted that mean scores for *healthy eating guidance* and *monitoring* were high, exhibiting ceiling effects, which may be indicative of participants answering in a socially desirable way. Additionally, given the design of the CFPQ other potential factors of interest were omitted, such as food as a reward for food ("If you eat your peas, you can have dessert"), which has been shown to increase a preference for the reward food, and repeated exposure of new foods, which increases acceptance and liking of those foods (164).

In conclusion, with modifications suggested by this analysis, the Comprehensive Feeding Practices Questionnaire has been enhanced, resulting in a more robust tool that could be used in many settings to contribute to the understanding of a child's eating environment. The outcome is a five-subscale questionnaire that is highly suitable for use in research studies investigating the feeding practices of parents.

5. Parental feeding practices: associations with home factors and child weight

5.1 Introduction

The previous chapter demonstrated that for this large sample of New Zealand children (n=1093), the most appropriate way to reduce the data from the Comprehensive Feeding Practices Questionnaire (CFPQ) was by producing five factors. These five feeding practices were termed *healthy eating guidance*, *monitoring*, *parent pressure*, *restriction* and *child control*.

Several studies have investigated parental feeding practices using various measures in relation to diet and eating patterns, with a healthy food intake generally characterised by higher fruit and vegetable consumption and unhealthy food intake usually referring to greater consumption of sweet or savoury snack foods or having a high fat intake. Healthier dietary intake has been associated with parts of the *healthy eating guidance* subscale (measuring how much a parent teaches, models and encourages healthy eating) (16, 42, 49, 62, 66) and *monitoring* (keeping track of unhealthy foods consumed by the child) (69). By contrast, less healthy dietary intake has been associated with *restriction* (limiting a child's food intake) (29, 52, 54, 55) and elements of the *parent pressure* subscale (30, 49, 62, 65, 66) – a construct where parents urge their child to eat (for example to finish their plate at dinner) and use food to influence their behaviour (for example as a reward for being good). *Child control* has shown mixed results, most likely due to different interpretations as to what it means (30, 38, 62, 67, 81, 84). In the CFPQ, it represents a permissive approach by parents that allows children to eat when and what they like. To date, this form of *child control* has been associated with less healthy dietary outcomes (38, 67, 81).

A considerable amount of research has also indicated that some feeding practices are related to body weight in children, with restrictive feeding practices often related to

higher body weight and pressuring feeding practices related to lower body weight (18, 29-31, 33, 39, 46, 52, 54, 56, 58, 59, 62, 65). However, very few papers have explored all three pathways between diet, weight and parenting practices, making it unclear whether the relationships observed between feeding practices and weight are mediated by the links with diet (18). The situation is further complicated by the fact that some parents may alter the feeding practices they use in response to a child's weight or eating behaviours (84). For example a parent of an overweight child might employ more restrictive practices in an effort to control the child's weight, whereas a parent of a child that is particularly fussy with fruits and vegetables might use more *pressure to eat* (18, 48, 55, 84).

It has also been suggested that parenting *style* could play a role in children's weight (18, 19, 165, 166). Parenting style represents an overall attitude to parenting and manifests in the different practices that a parent undertakes. However, as parental feeding practices might be influenced by child characteristics, for example body weight or temperament (suggesting that there could be differences between siblings) (63), they might not always typify an overall parenting style adequately. Results linking parenting style with body weight are mixed (18, 19, 60, 165, 166) and a clear pathway between the two could be complicated by relationships with feeding practices, which might be influenced not only by parenting style but also other external factors. Associations between feeding practices and other types of parenting practices, such as discipline strategies, have not been previously investigated and could lend further evidence to whether the style of parenting is related to weight (64, 67, 94, 166). In particular, if different types of parenting practices are related and are also associated to weight in similar ways, this could indicate that overall parenting style, rather than the feeding practices specifically, does have role to play in childhood obesity.

Importantly, parental feeding practices have been shown to vary amongst different demographic groups, such as those of differing SES, ethnicity or maternal education (29, 33, 39, 42, 54, 59, 62, 86, 87), yet many studies have been in small, homogenous samples (29, 46, 52, 54, 57-59, 65, 86). This has led recent reviews to conclude that more studies in diverse samples of children are required to properly examine whether links exist between each of parenting, diet and weight status (16, 18, 19, 167).

While the five feeding practices from the CFPQ have similarities to previous measures, they have never been studied together in this form, and a full examination in relation to factors that influence them and their associated outcomes using large samples is required. This analysis aims to determine associations between the five parental feeding practices from the CFPQ, BMI z-score, demographics, dietary intake, parental discipline practices and weight status of children using a large, diverse sample of New Zealand children.

5.2 Methods

5.2.1 Participants

This analysis used the full sample (n=1093) of parents with children aged 4-8 years from the first phase of the MInT study. Recruitment is covered in Section 3.2, page 38.

5.2.2 Measures

Full details on the measures collected for these analyses are described in Section 3.3, page 39, but will be briefly covered here.

Child body mass index (BMI) was calculated from height and weight measurements. Maternal BMI was also obtained. A comprehensive questionnaire was completed by the parent that included questions on fruit, vegetable and sweet drink intake, feeding practices (CFPQ (20)), parental discipline practices (the Parenting Scale (145)) and demographics.

The five feeding practices were explained in more detail in Section 4.3, page 61. The feeding practice factor scores were calculated for each participant by taking the mean of the contributing items to that factor. Missing items were not included in these means.

An exploratory factor analysis of the Parenting Scale (145) was undertaken using Stata 12.0 (Statacorp, Texas) by the same methods as outlined in Section 4.2.3, page 56. The Parenting Scale is a 30-item questionnaire that measures the dysfunctional disciplining practices of parents (for more detail see Section 3.3.7). Previous studies have generally demonstrated a two- or three-factor model (145-147), although one factor has also been postulated (145, 147). If only one factor was indicated by this analysis, the whole scale would then be used to generate the score. A scree plot identified the number of factors that best represented the data. Cronbach's alpha scores were calculated for the resulting scale(s) and factor scores were determined as means, as for the feeding practice scores.

5.2.3 Associations with feeding practices

Associations between the five feeding practices and the categorical demographic variables (ethnicity, socio-economic status, maternal education and sex), including child's weight status, were obtained using one-way analysis of variance (ANOVA) with an F-test in addition to a Bonferroni test for differences. The ANOVA compared the means of the feeding practices in the different demographic sub-groups (for example the different ethnicities) and tested the hypothesis that the means were equal. If the p-value for the F-test was less than 0.05, this indicated that the means were not likely to be equal. If differences in the means were apparent, the Bonferroni test then determined which of the sub-groups were significantly different from each other ($p<0.05$). Univariate linear regression was also used to test for trends in feeding practices across socio-economic status (SES) and child weight categories. Only the demographic categories of SES and child weight status were tested for trends as they have a graded interpretation across which trends might be expected to occur. A trend was considered present if the regression coefficient was significantly different to zero ($p<0.05$).

Correlation coefficients and p-values were calculated between the five feeding practices and each of maternal BMI, the Parenting Scale factor(s), fruit intake, vegetable intake, and sweet drink intake. These were adjusted for demographic variables (ethnicity,

SES, maternal education and sex), child weight status and clustered sampling from family groups, using the clustered sandwich estimator in Stata 12.0.

5.2.4 Associations with BMI z-score

To explore more fully the relationships that feeding practices, parental discipline practices and diet, along with the other variables, had with the weight of children, further regression analyses were undertaken with BMI z-score as the dependent variable. To begin with, univariate linear regressions were applied for each variable (feeding practices, dietary intake variables, parental discipline practices, ethnicity, SES, maternal education, sex and maternal BMI) with adjustment for clustered recruitment from clinic and clusters of siblings using mixed modelling in Stata 12.0. Regression coefficients, standard errors and 95% confidence intervals, unadjusted for the other variables in the model, were calculated. A p-value less than 0.05 indicated those variables that were significantly associated with BMI z-score.

Subsequently, multivariate linear regression was undertaken adjusting for all variables, using the largest category as the reference for ethnicity, SES and maternal education and female as the reference category for sex. Regression coefficients, standard errors, 95% confidence intervals and p-values were calculated with adjustment for clusters from clinic and siblings using mixed modelling. This analysis illustrated a potential multivariate model for BMI z-scores from which the variables that were identified to significantly associate with BMI z-score could be singled out to include in a more succinct model. While this process would result in a model that represented the sample (as it relied on results from the sample), it may not be robust enough to apply to other populations. Therefore another method, called bootstrapping, was used to determine which variables to include in a final multivariate model for BMI z-score.

The bootstrap procedure carried out regression analyses in 1000 samples that were randomly selected from the data, with replacement. While the pool of participants was limited to the sample, this random selection meant that some of the 1000 resultant samples, each of which were the same size as the original sample, might have been made up of a very different *mix* of participants. In each regression analysis, a variable

was considered significantly associated with BMI z-score if the p-value was less than 0.05. After 1000 repetitions a list of the variables was generated with the number of times each was identified as significantly related to BMI z-score (168).

If a variable was selected in more than half of the bootstrap analyses (>500), then it was chosen for the final model. This cut-off was used because it would identify those variables that were more likely to be significantly associated with BMI z-score than not. This method of selecting variables potentially gives a more robust result than stepwise methods (168). If a variable that was selected by the bootstrap analysis was only one category of a demographic variable and thereby reliant on a shared reference category, all other categories were also included in the final model.

A multivariate regression analysis was then produced with BMI z-score as the dependent variable and the selected variables from the bootstrap analysis, with adjustment for clustering in family groups and clinic by mixed modelling. This was adjusted for all other variables included in the model. Non-standardised regression coefficients, standard errors, 95% confidence intervals and p-values were calculated (169). All analysis was undertaken in Stata 12.0 (Statacorp, Texas).

5.3 Results

5.3.1 Participants

Overall 1093 participants were recruited between the ages of 4.0 and 9.3 yrs (mean = 6.5 yrs; SD=1.4) between March 2010 and August 2011. Table 3, page 50, illustrates the diversity of demographic variables within the sample. This sample of children had a reported usual daily average (SD) of 2.2 (0.8) serves of fruit, 2.1 (0.8) serves of vegetables and 0.5 (0.6) glasses of sweet drinks. The average maternal BMI (n=1050) was 27.0 (5.9) kg/m^2, obtained from measurements in 515 mothers (47.1%) and from self-reported data in a further 535 mothers (48.9%) – mothers could opt to be measured in clinic (this was encouraged) or self-report this information.

5.3.2 Demographics and feeding practices

Table 10, page 84, shows the mean factor scores for the feeding practices in different demographic groups.

Differences in feeding practices were observed by ethnicity: Māori used significantly less *monitoring* than New Zealand European; Pacific Island and Asian families used more *restriction* than NZ European and Māori; and parents of Asian children allowed more *child control* than parents of NZ European children. Level of SES was also associated with variation in feeding practices, with significant trends for increasing *healthy eating guidance* ($p<0.01$) and *monitoring* ($p<0.05$) with higher levels of SES. Mothers who had a university degree reported more *healthy eating guidance* than mothers who had only some secondary education or a different tertiary qualification. Parents also used more *pressure* with boys and more *restriction* with girls.

Feeding practices differed according to weight status: parents of obese children reported more *restriction* ($p<0.01$) and less *healthy eating guidance* ($p<0.05$) and *parent pressure* ($p<0.01$) compared to normal weight children. Furthermore, there were significant trends: as weight status increased, *healthy eating guidance* ($p<0.01$), *monitoring* ($p<0.05$) and *parent pressure* ($p<0.01$) decreased while *restriction* ($p<0.01$) increased.

5.3.3 The Parenting Scale

After removal of missing data, the sample of 1023 indicated only one factor from a scree plot of the Parenting Scale data. This factor explained 69% of the variance and the Cronbach's alpha for all 30 items was 0.86. As the Parenting Scale is a measure of dysfunctional discipline practices (145, 146), the 30-item factor was so named *dysfunctional parenting*. Factor scores were calculated for each participant in the whole sample (n=1093) (with missing values not included in the score calculation) and yielded a mean score of 2.8 (SD=0.6) with a range of 1.0 – 6.2.

Table 10: Comparing feeding practices[1] by demographics

	Healthy eating guidance	Monitoring	Parent pressure	Restriction	Child control
Overall (n=1093)	4.35 (0.6)	4.22 (0.7)	2.70 (0.8)	1.93 (0.6)	2.27 (0.6)
Ethnicity					
New Zealand European (n=823)	4.35 (0.6)	4.27 (0.7)	2.70 (0.7)	1.89 (0.6)	2.24 (0.6)
Māori (n=151)	4.33 (0.6)	**4.02 (0.8)[2]**	2.73 (0.8)	1.90 (0.6)	2.34 (0.6)
Pacific Island (n=42)	4.37 (0.5)	4.03 (0.9)	2.56 (0.9)	**2.31 (0.9)[2,3]**	2.37 (0.6)
Asian (n=47)	4.33 (0.5)	4.10 (1.0)	2.78 (0.7)	**2.32 (0.9)[2,3]**	**2.54 (0.6)[2]**
Other (n=30)	4.46 (0.5)	4.35 (0.5)	2.43 (0.8)	1.92 (0.9)	2.34 (0.6)
	p=0.852	**p<0.001**	p=0.191	**p<0.001**	**p=0.005**
Socio-economic status					
Low deprivation (n=425)	4.42 (0.5)	4.26 (0.7)	2.71 (0.8)	1.95 (0.6)	2.28 (0.6)
Medium deprivation (n=412)	4.35 (0.6)	4.22 (0.7)	2.67 (0.8)	1.89 (0.7)	2.27 (0.6)
High deprivation (n=224)	**4.23 (0.6)[4]**	**4.11 (0.8)[4]**	2.75 (0.7)	1.95 (0.7)	2.23 (0.6)
	p<0.001	**p=0.041**	p=0.457	p=0.363	p=0.623
Maternal education					
Some secondary (n=293)	4.19 (0.6)	4.16 (0.7)	2.66 (0.7)	1.89 (0.6)	2.22 (0.6)
Completed secondary (n=73)	4.32 (0.5)	4.33 (0.6)	2.73 (0.7)	1.85 (0.6)	2.12 (0.6)

Tertiary qualification[5] (n=224)	4.32 (0.6)	4.21 (0.8)	2.71 (0.8)	1.89 (0.6)	2.27 (0.6)
University degree (n=448)	**4.48 (0.5)[6]**	4.26 (0.7)	2.71 (0.8)	1.96 (0.6)	2.34 (0.6)
Other (n=55)	4.32 (0.5)	4.12 (0.8)	2.65 (0.6)	2.12 (0.8)	2.27 (0.5)
	p<0.001	p=0.204	p=0.862	**p=0.048**	**p=0.017**
Sex					
Male (n=543)	4.34 (0.5)	4.23 (0.7)	2.79 (0.7)	1.89 (0.6)	2.26 (0.6)
Female (n=550)	4.35 (0.6)	4.22 (0.7)	**2.61 (0.8)**	**1.97 (0.7)**	2.29 (0.6)
	p=0.958	p=0.794	**p<0.001**	**p=0.043**	p=0.478
Child weight status					
Normal weight[7] (n=822)	4.38 (0.5)	4.24 (0.7)	2.76 (0.7)	1.85 (0.6)	2.27 (0.6)
Overweight[8] (n=166)	4.28 (0.6)	4.19 (0.7)	**2.58 (0.8)[10]**	**2.02 (0.6)[11]**	2.24 (0.6)
Obese[9] (n=105)	**4.23 (0.6)[10]**	4.08 (0.8)	**2.44 (0.8)[11]**	**2.41 (0.8)[11,12]**	2.36 (0.7)
	p=0.007	p=0.063	**p<0.001**	**p<0.001**	p=0.251

[1]Mean (SD)
[2]Significantly different from New Zealand European (p<0.01)
[3]Significantly different from Māori (p<0.01)
[4]Significantly different from low deprivation (p<0.05)
[5]Not university degree
[6]Significantly different from some secondary (p<0.01) and also significantly different from tertiary qualification (p<0.01)
[7]BMI < 85th percentile
[8]85th percentile≤BMI <95th percentile
[9]BMI≥95th percentile
[10]Significantly different to normal weight (p<0.05)
[11]Significantly different to normal weight (p<0.01)
[12]Significantly different to overweight (p<0.01)

Table 11: Correlations between feeding practices and maternal BMI, dysfunctional parenting, fruit, vegetable and sweet drink intake[1] (n=1093)

	Healthy Eating Guidance	Monitoring	Parent Pressure	Restriction	Child Control
Maternal BMI	**-0.20****	-0.06	-0.02	0.07	-0.02
Dysfunctional parenting	**-0.33****	**-0.32****	**0.34****	**0.09***	**0.21****
Fruit serves	**0.18****	**0.17****	**-0.07***	-0.02	**-0.12****
Vegetable serves	**0.20****	**0.22****	**-0.09****	0.02	**-0.29****
Sweet drinks	**-0.20****	**-0.24****	0.05	-0.01	**0.15****

[1]adjusted for ethnicity, SES, maternal education, sex and child weight status and also clusters of siblings
*p<0.05, **p<0.01

5.3.4 Correlations with feeding practices

All feeding practices were significantly ($p<0.05$) associated with *dysfunctional parenting*. As shown in Table 11, page 86, parents who scored highly for this were less likely to use *healthy eating guidance* ($r=-0.33$) or monitor their child's intake ($r=-0.32$) and more likely to let the child control food intake ($r=0.21$). They also tended to use more parental *pressure* to eat ($r=0.34$) and be slightly more restrictive ($r=0.09$). Parents who provided *healthy eating guidance*, monitored their child's intake or allowed less *child control*, had children with higher intakes of fruit and vegetables and lower reported sweet drink intake.

5.3.5 Regression analyses for BMI z-score

The univariate regression analyses (Table 12) identified many associations with child BMI z-score, including most parental feeding practices, sweet drink intake, some ethnicities, maternal BMI and maternal education ($p<0.05$). However, only *parent pressure*, *restriction*, Māori and Pacific Island ethnicity, maternal BMI and some maternal secondary education were still associated with children's BMI z-scores when all variables were combined in the multivariate regression analysis (Table 12). The residuals for the multivariate analysis were plotted and looked normal.

5.3.6 Bootstrap analysis

Bootstrap analysis of all variables demonstrated that maternal BMI, *restriction*, *parent pressure*, Pacific Island and Māori ethnicity, having some maternal secondary education and *healthy eating guidance* had significant associations with BMI z-score in more than half (>500) of the analyses (Table 13, page 90). This indicated that a regression model using these variables might be more robust when used in other data sets. As categories from both ethnicity and maternal education were identified, all categories of these factors (except the reference) were included in the final multivariate regression analysis for BMI z-score. The coefficient of determination (R^2) for the final model was equal to 0.18 ($p<0.0001$) indicating that this model was significant and

Table 12: Univariate and multivariate regression coefficients for child BMI z-score, n=1093

Variable	Univariate regression coefficient (SE)	Confidence intervals	p	Multivariate regression coefficient[1] (SE)	Confidence intervals	p
Feeding practices						
Healthy eating guidance	-0.18 (0.05)	-0.28, -0.08	<0.001	-0.11 (0.06)	-0.22, 0.00	0.047
Monitoring	-0.07 (0.04)	-0.15, 0.00	0.059	-0.06 (0.04)	-0.14, 0.03	0.185
Parent pressure	-0.19 (0.04)	-0.26, -0.11	<0.001	-0.18 (0.04)	-0.25, -0.10	<0.001
Restriction	0.38 (0.04)	0.30, 0.46	<0.001	0.36 (0.04)	0.27, 0.44	<0.001
Child control	-0.05 (0.05)	-0.14, 0.04	0.251	-0.03 (0.05)	-0.13, 0.06	0.492
Dietary intake						
Fruit serves	-0.02 (0.04)	-0.08, 0.05	0.661	0.02 (0.03)	-0.05, 0.09	0.589
Vegetable serves	-0.02 (0.04)	-0.08, 0.05	0.612	-0.03 (0.04)	-0.10, 0.05	0.479
Sweet drinks	0.13 (0.04)	0.05, 0.21	0.003	0.05 (0.04)	-0.03, 0.14	0.208
Dysfunctional parenting	-0.02 (0.04)	-0.10, 0.06	0.669	-0.04 (0.05)	-0.13, 0.06	0.425
Ethnicity						
New Zealand European (n=823)	-0.23 (0.06)	-0.35, -0.10	0.001	Reference	-	-
Māori (n=151)	0.24 (0.08)	0.08, 0.40	0.003	0.23 (0.08)	0.07, 0.39	0.004
Pacific Island (n=42)	0.56 (0.14)	0.27, 0.84	<0.001	0.39 (0.14)	0.11, 0.67	0.007
Asian (n=47)	-0.19 (0.14)	-0.46, 0.08	0.171	-0.17 (0.13)	-0.43, 0.09	0.204
Other (n=30)	0.00 (0.17)	-0.34, 0.33	0.982	0.05 (0.16)	-0.27, 0.36	0.768
Socio-economic status						

High (n=425)	-0.07 (0.06)	-0.19, 0.04	0.210	Reference	-	-
Medium (n=412)	-0.05 (0.06)	-0.16, 0.07	0.410	-0.06 (0.06)	-0.17, 0.06	0.340
Low (n=224)	0.17 (0.07)	0.04, 0.31	0.014	0.02 (0.07)	-0.13, 0.16	0.831
Maternal BMI	0.04 (0.00)	0.03, 0.05	<0.001	0.03 (0.00)	0.02, 0.04	<0.001
Maternal education						
Some secondary (n=293)	0.19 (0.06)	0.07, 0.31	0.003	0.14 (0.07)	0.01, 0.28	0.037
Completed secondary (n=73)	-0.05 (0.11)	-0.28, 0.17	0.626	-0.02 (0.11)	-0.24, 0.20	0.868
Tertiary qualification[2] (n=224)	-0.03 (0.07)	-0.17, 0.11	0.675	0.03 (0.07)	-0.11, 0.17	0.647
University degree (n=448)	-0.17 (0.06)	-0.28, -0.05	0.004	Reference	-	-
Other (n=55)	0.22 (0.12)	-0.03, 0.46	0.079	0.08 (0.13)	-0.17, 0.34	0.530
Sex						
Male (n=543)	-0.08 (0.05)	-0.19, 0.02	0.116	-0.01 (0.05)	-0.11, 0.09	0.861
Female (n=550)	0.09 (0.05)	-0.02, 0.19	0.116	Reference	-	-

[1]Adjusted for all other terms in the model; [2]Not university degree

Table 13: Frequency of significant association with BMI z-score in 1000 bootstrap regression analyses, n=1013

Variable	Frequency
Maternal BMI	1000
Restriction	1000
Parent pressure	1000
Pacific Island ethnicity	913
Māori ethnicity	902
Some maternal secondary education	713
Healthy eating guidance	660
Asian ethnicity	454
Monitoring	449
Sweet drinks	401
Medium SES	300
Child control	213
Vegetable serves	196
Dysfunctional parenting	186
Low SES (high deprivation)	181
Fruit serves	140
Maternal other education	137
Completed maternal secondary education	129
Maternal tertiary qualification[1]	113
Male sex	112
Other ethnicity	94

[1]Not university degree

explained 18% of the variation in BMI z-score. Coefficients for each variable in this analysis are shown in Table 14, page 92.

5.4 Discussion

Parental feeding practices were associated with the diets and weights of these children. Furthermore, relationships with demographics and parental discipline practices were also evident. This analysis adds considerably to the currently available research on the links between parenting, diet and weight by examining all of these factors together with a large and diverse sample of New Zealand children.

The five new factors from the CFPQ, determined in Chapter 4 by careful factor analyses, have not previously been used together in this form. Because of this, it is of interest to examine each practice and its resulting associations.

Healthy eating guidance was utilized more by well-educated mothers with a lower BMI and was associated with better diet indicators (higher fruit and vegetable consumption and fewer sweet drinks). Furthermore, parents who taught, modelled and encouraged healthy eating more scored lower on the *dysfunctional parenting* scale and had children with lower BMI z-scores. While direction of association cannot be assigned because of the cross-sectional nature of the study, it is still possible and indeed logical to recommend the use of *healthy eating guidance*. Future longitudinal research could determine if such an approach can significantly influence children's diet and weight.

Monitoring correlated with *healthy eating guidance* in this sample (Chapter 4, Table 8) and therefore was associated with many similar factors, albeit to a lesser extent with the maternal factors (BMI and education). As *monitoring* is a scale from the highly utilised Child Feeding Questionnaire, there is a large amount of previous research from which to compare results (27, 31, 47, 52, 54, 55, 59-64, 66, 69). Despite this, however, there have been very few significant associations found with *monitoring* (52, 61, 69). This could be because *monitoring* of child food intake genuinely isn't related to what or how much they eat, or because of the smaller sample sizes that have typically been used. This analysis demonstrated links between *monitoring* and higher fruit and vegetable intake and also lower sweet drink intake, which supports a previous analysis in a large

Table 14: Multivariate linear regression model[1] for BMI z-score (n=1093), using variables chosen by bootstrap analysis

Variable	Regression coefficient (SE)	Confidence intervals	p
Maternal BMI	0.03 (0.00)	0.02, 0.04	<0.001
Restriction	0.37 (0.04)	0.28, 0.45	<0.001
Parent pressure	-0.19 (0.03)	-0.26, -0.13	<0.001
Pacific Island ethnicity[2] (n=42)	0.37 (0.14)	0.09, 0.64	0.009
Māori ethnicity[2] (n=151)	0.24 (0.08)	0.11, 0.39	0.002
Some maternal secondary education[3] (n=293)	0.15 (0.07)	0.02, 0.28	0.025
Healthy eating guidance	-0.13 (0.05)	-0.22, -0.03	0.011
Asian ethnicity[2] (n=47)	-0.16 (0.13)	-0.42, 0.09	0.203
Other ethnicity[2] (n=30)	0.02 (0.16)	-0.30, 0.33	0.911
Secondary maternal education[3] (n=73)	0.01 (0.11)	-0.21, 0.20	0.962
Tertiary maternal education[3,4] (n=224)	0.00 (0.07)	-0.14, 0.14	0.966
Other maternal education[3] (n=55)	0.07 (0.13)	-0.18, 0.32	0.590

[1]Adjusted for all other variables in the model; [2] Reference: NZ European (n=823); [3]Reference: Maternal university degree (n=448); [4]Not university degree

sample (n=812) (69). Other studies, in small samples (n=121 and n=109), have indicated that *monitoring* is lower in girls and higher in overweight children (29, 52) but these findings were not supported here. Although there was a trend for *monitoring* to increase as weight status increased, it was not significantly associated with BMI z-score after adjustment for other feeding practices, dietary intake, *dysfunctional parenting* and demographic factors.

Lower levels of *monitoring* were reported in Māori compared with NZ European families. Māori are the indigenous people of New Zealand and are at higher risk of obesity and related health issues (170). Previous research has shown both higher (29) and lower (31) levels of *monitoring* in ethnic minority groups, although the study that showed higher levels was in a small sample (n=121) in an older age group (average age 11 years). As ethnic differences are apparent, this signals the need for recommendations to address feeding practices specifically for these minority groups. It may be that as Māori have traditionally shared the caring of children among extended family (171), monitoring of their child's intake is inherently more difficult. Furthermore, keeping track of a child's unhealthy food intake (*monitoring*) suggests that a parent is motivated to keep an eye on their child's diet and is more likely to value the importance of a healthy diet (Chapter 4, Table 9). These may be the core issues with *monitoring* so that if *monitoring* is proven to be beneficial, then the first step in an intervention might be to improve the parent's understanding of the importance of a healthy diet.

Higher *parent pressure* scores were seen with boys, feasibly because parents wanted to 'feed up' their boys, or perhaps parents used food to influence behaviour in boys more than girls. The latter observation is supported by further analysis of the dataset demonstrating that boys scored significantly higher ($p<0.05$) than girls on all of the *food as a reward* questions (3/3) and higher on only one of the *pressure to eat* (1/3) questions within this subscale (data not shown). The *parent pressure* scale could potentially be measuring a response (or a contribution) to overall non-compliant child behaviour, indicated by the use of food as a reward (to encourage compliance) and lower consumption of fruits and vegetables, despite more pressure to eat. The positive correlation between *parent pressure* and *dysfunctional parenting* suggests that the impact of a parenting intervention might clarify the dynamics here (18, 172).

Pressure to eat and *food as a reward* have both been consistently associated with less healthy dietary intake (30, 42, 47, 49, 62, 66-68), supported in this sample with negative correlations between *parent pressure* and levels of fruit and vegetable consumption. However, these correlations were low in value (r=-0.07 & r=-0.09) and unlikely to be clinically significant. While there has been much research using the *pressure to eat* subscale (27, 30, 31, 33, 42, 47, 49, 52, 60-68) and the results from various samples concur with each other, the long-term impact of this feeding practice is yet to be determined. This is partly because *pressure to eat* has been associated with both *lower* healthy food intake and *lower* BMI, results that might be viewed as conflicting. The current analysis shows that the *parent pressure* subscale was very strongly associated with lower BMI z-scores. This finding casts doubt on the pathway postulation that parental feeding practices influence diet and then diet influences weight, and that these directional pathways explain, at least in part, why parental feeding practices are associated with weight (18). While cause-and-effect cannot be tested with this cross-sectional data, it would be just as reasonable to assume that parents might alter their feeding practices in response to their child's weight – as their child is heavier, they are less inclined to pressure them to eat and/or use food as a reward.

Another feeding practice that is likely to be influenced by child weight is *restriction*, which displayed a strong association with higher BMI z-scores. This relationship has been seen in many studies (52-57) and could be because parents try to limit and regulate the food intake of overweight children more than with normal weight children. This is supported by work showing that controlling feeding, such as *restriction*, increased *after* weight gain and not before it (84). Again a pathway of influence through diet was not indicated, as *restriction* had no association with the dietary intake variables and the potentially bi-directional relationship between weight and feeding practice confounds this theory.

Restrictive feeding practices were more prevalent with girls than with boys and in Pacific Island and Asian ethnicities compared to New Zealand European and Māori. These associations are interesting and require further investigation. Notably, the *restriction* subscale used in this analysis is different to the one used in most other studies and encompasses more of a *restriction for weight control* concept, rather than

just a limiting or regulating role for health from the parent. The higher association seen in girls might then indicate that parents are more concerned about weight gain in daughters than with sons and therefore they restricted more. This idea might further extend to the ethnicities that used more *restriction*. Post-hoc analysis of the dataset supported this theory – a oneway ANOVA with a Bonferonni test was undertaken for weight concern (see Section 3.3.6, page 41, for description of the measure) by sex and then by ethnic group (data not shown). Parents of girls were more concerned about their child's weight than parents of boys ($p<0.05$). Furthermore, Pacific Island parents were more concerned about their child's weight than New Zealand European ($p<0.01$), along with Māori parents ($p<0.05$) and Asian parents ($p<0.05$) who were also more concerned than New Zealand European parents. Webber *et al* showed that the relationship between *restriction* and weight was mediated by a concern for weight (55), which suggests that this concern can influence the feeding practices of parents.

The dietary correlations with *child control* indicated that children that controlled their food intake consumed a less healthy diet, which is consistent with previous research (67, 80). The relationship between *child control* and vegetable intake appeared to be the strongest ($r=-0.29$), suggesting that the children that were 'allowed' to *not* eat vegetables ate fewer vegetables than children that did not have as much control of their food environment, although this cross-sectional data cannot prove this direction of association. Despite correlations with fewer fruits and vegetables and more sweet drinks, *child control* was not related to the weight of children in any way. It should be made clear that this *child control* subscale assesses how much a child is allowed to eat what and when they like in a broad sense, rather than assessing only how much a child is allowed to eat a meal without interference from a parent.

The Parenting Scale was used in this study, which was designed as a clinical measure of the dysfunctional discipline practices of parents. Different factor analyses of the Parenting Scale have yielded either two or three factors, termed *laxness*, *over-reactivity* and *verbosity* (145-147). Only one factor was indicated in this analysis so all items were used, identifying parents that used more dysfunctional discipline practices overall. This total score has been used by others and has demonstrated some validity (145, 147). *Dysfunctional parenting* was associated with higher levels of *parent pressure*, *restriction* and *child control* and lower levels of *healthy eating guidance* and

monitoring. However, it was not associated with BMI z-score. As the disciplining practices and the feeding practices of parents were associated, this lends more evidence that these practices might represent constructs of particular parenting styles. Indeed, *dysfunctional parenting* appeared to have been related to feeding practices that might be described as *lax* (*child control*) or *over-reactive* (*restriction* and *parent pressure*), two of the original factors that the questionnaire was designed to measure. However, as *dysfunctional parenting* was not associated with BMI z-score, this suggests that overall parenting style is not related to weight, or it might be that feeding practices are simply more likely to be influenced by child weight than discipline practices. Longitudinal results could indicate which practices have more of an influence on weight change. Moreover, as the Parenting Scale is a clinical measure, it could feasibly be used to identify those parents of overweight children who might benefit from a more intensive parenting intervention, whereas the Comprehensive Feeding Practices Questionnaire would currently be unable to do this.

There were three pathways investigated by this analysis: parenting practices – diet; parenting practices – weight; diet – weight. All feeding practices were associated with the dietary variables (fruit; vegetable; and sweet drink consumption), except for *restriction*. *Restriction*, *parent pressure* and *healthy eating guidance* were robustly associated with weight. Despite these links, the dietary intake variables were not associated with BMI z-score. Sweet drink consumption was associated weakly in the univariate analyses but this became non-significant when adjustments were made for the other variables. Ventura *et al* recommended, as part of a review article, that all three pathways between parenting, diet and weight be examined in one paper, using a large, diverse sample to test a model of mediation from parenting, through diet, to weight (18). This was recommended to attempt to disentangle the bi-directional relationship between parenting practices (specifically feeding) and weight. However, with this cross-sectional dataset, the model fails due to the lack of a pathway between diet and weight. Furthermore, when considering *parent pressure*, the associations with diet were the inverse of what would be expected according to the associations with weight (higher weight with less healthy food). Also the very strong relationship between *restriction* and BMI z-score was not backed by any dietary association. These results may be because the dietary measures used for this analysis were relatively crude. It could be that a more comprehensive measure of dietary intake would have

revealed additional links, however more in-depth dietary assessment methods are highly burdensome and often not very accurate for obtaining data in this age group (153). Therefore, for this large sample of parents at the weight-screening stage of the study that were undergoing extensive assessment for a variety of outcomes, it was decided to keep the dietary assessment brief – hence the three question measure. It may also be that for some feeding practices (in particular *restriction* and *parent pressure*), the influence of weight is stronger than any influence the feeding practice might have back on weight through the dietary pathway. It should also be noted that the measures of feeding practices and dietary intake were reported by parents, and were therefore subjective measures, open to the bias of perception and social desirability.

The large, diverse sample used in this analysis is an important strength when looking at feeding practices, as demographic variations exist. While the results represent a range of New Zealanders, further research in other populations could confirm the stability of these associations. The feeding practices examined are practical and comprehensive, and were determined by a thorough factor analysis in this large sample (Chapter 4). Exploration of all pathways between the measures of parenting, diet and weight was undertaken, which had been identified as a weakness in the field currently (18). Additionally, the associations with parental discipline practices suggest that overall parenting style might not be related to children's weight. Instead it was the parental feeding practices, which are likely to be a construct of parenting style, that were related to weight.

Determination of the variables that were associated with BMI z-score using bootstrap analyses suggests that the resulting multivariate model proposed might be robust in other samples (168). The fact that only 18% of the variance in BMI z-score was explained by the multitude of factors examined in this study highlights the multi-factorial nature of weight status during growth and potentially the lack of comprehensive physical activity and dietary measures, which were not undertaken in this sample. This analysis would have been enhanced by using a better dietary measure and by longitudinal results. Currently, longitudinal measures in the overweight children of this sample are being undertaken, with a more detailed dietary questionnaire, and future analysis of this might provide a better understanding of the feeding practices that are most beneficial in this group.

This analysis has illustrated the importance of feeding practices by the many associations with demographics, diet, dysfunctional parenting and child weight. As a large and varied sample was used, the results add considerably to the body of evidence on parental feeding practices, for which evidence-based recommendations are needed for use in preventive and treatment interventions for childhood obesity and public health resources.

6. Associations between parental feeding practices and problem food behaviours in overweight children

6.1 Introduction

A healthy diet is an important factor in the treatment and prevention of obesity in childhood (9, 10), yet parents report many issues with providing healthy food to their children (101, 103-105). They describe child resistance and picky eating as challenges they find hard to overcome (101, 104-107). Parents want to know how to feed their children in a way that brings these problem behaviours under control and results in a healthier diet (103, 106, 112).

Before recommendations for parental feeding practices can confidently be given to the public, the influences on weight, diet and problem behaviours need to be well understood. Preliminary associations with weight and diet have been determined for some feeding practices, although consensus is yet to be reached (Section 2.3, Chapters 5 & 6). Moreover, further research is required to ascertain how particular feeding practices might be related to problem food behaviours, for example hiding or stealing food, comfort eating and fussiness. In particular, emotional eating and secretive eating might correlate with disordered eating in young people (96) so the impact of feeding practices on these issues must be clear. To date, there is evidence to suggest that restrictive feeding practices might be related to emotional eating, although results are not all in agreement (90, 94). There is also concern that *restriction* might encourage secretive eating behaviours such as food hiding (99). Additionally, *child control* is of interest, as there might be benefits to allowing a child to regulate their own eating (159), however allowing children control over their food may also lead to overeating (78) and could cause or exacerbate food fussiness (173). Fussy eating has been linked with various feeding practices, but results have, in most cases, not been replicated (89-94).

Parents want to know *how* to feed their children healthily (Section 2.5, page 24). Recommendations are available (9, 10, 114) but lacking good evidence (Section 2.6, page 26) because clear links with desirable and non-desirable outcomes have not yet been determined. In particular, parents want to know which feeding practices will assist them in overcoming the challenges they identify in achieving a healthy diet for their children. The aim of this analysis is to examine the associations between parental feeding practices, dietary intake and a range of problem food behaviours, with a focus on fussy eating, in an overweight sample of 4-8 year old New Zealand children.

6.2 Methods

6.2.1 Participants

Data from Phase 2 of the MInT Study was used in this analysis. The sample consists of 203 overweight children. See Table 3 (page 50) for demographic data. All had a BMI greater than or equal to the 85th percentile, as per US reference data (143).

6.2.2 Measures

Parental feeding practices were assessed with the Comprehensive Feeding Practices Questionnaire (CFPQ) (20) using the five factors determined for these analyses (Chapter 4), namely *healthy eating guidance*, *monitoring*, *parent pressure*, *restriction* and *child control*.

The Children's Dietary Questionnaire (CDQ) was employed to evaluate dietary intake and the two scores that had demonstrated suitable reliability and relative validity were used – the *fruit and vegetable* score and *non-core food* score (150). Non-core foods consisted of items such as confectionery, biscuits, chips and takeaways. The *fruit and vegetable* score is recommended to be equal to or greater than 14 and *non-core food*

score is recommended to be less than 2 (150). Section 3.4.2, page 48, describes this dietary measure in more detail and the full questionnaire is in Appendix C.

Problem behaviours in overweight children were measured using the Lifestyle Behaviour Checklist (LBC) (88). Only the questions related to problem food behaviours were used in this analysis (questions 1-15) and included such things as whinging about food, refusing to eat food, requesting food continuously, sneaking food and eating food to comfort themselves. The behaviours are presented in Table 16, page 104, and more detail on the questionnaire can be found in Section 3.4.3.

To further investigate associations with resistance and picky eating, which have been identified as major barriers for parents to feed their children a healthy diet, a score was developed using the average of questions 4-8 of the LBC. These questions assessed the behaviours associated with fussy eating – that is refusing to eat foods and exhibiting resistance or difficult behaviour around food (whinging, yelling, arguing or having a tantrum). This score was named *fussy eating* and participants were then grouped into two groups: fussy eaters (having a *fussy eating* score greater than the mean) and non-fussy eaters (having a *fussy eating* score less than or equal to the mean). The mean was used to split the groups rather than the median so that only those participants who were exhibiting greater than average fussy behaviour would be classed as fussy.

6.2.3 Analysis

Means, standard deviations, medians and ranges were calculated for each of the dietary intake scores and the problem food behaviours. Pair-wise correlations were then calculated between the food behaviour problem questions and parental feeding practices and dietary intake.

Means and standard deviations for the five feeding practices, dietary intake scores and BMI z-scores were calculated for both fussy eaters and non-fussy eaters and two-tailed t-tests determined if the means were significantly different, with a significance level of $p<0.05$. All analyses were undertaken with Stata 12.0 (Statacorp, Texas).

Table 15: Descriptive statistics for dietary intake and problem food behaviours (n=203)

Variable	Mean (std dev)	Median	Range
Fruit and vegetable intake score	13.7 (4.1)	14.1	2.4 – 23.1
Non-core food intake score	2.5 (1.0)	2.4	0.0 – 6.0
Whinges or whines about food	3.5 (1.9)	3	1 – 7
Yells about food	1.6 (1.1)	1	1 – 6
Throws a tantrum about food	1.8 (1.2)	1	1 - 7
Refuses to eat certain foods	2.9 (1.9)	2	1 – 7
Argues about food	2.6 (1.6)	2	1 – 7
Demands extra helpings	1.9 (1.3)	1	1 – 7
Requests food continuously between meals	2.9(1.8)	2	1 – 7
Demands food when on outings	2.4 (1.5)	2	1 – 7
Sneaks food	1.8 (1.2)	1	1 – 7
Hides food	1.2 (0.6)	1	1 – 6
Steals food	1.0 (0.3)	1	1 – 4
Eats food to comfort themselves	1.3 (0.8)	1	1 – 6

Responses to the Lifestyle Behavior Checklist problem scale: 1= not at all; 7=very much

As it is possible that associations between feeding practices and dietary intake might differ between children who are fussy eaters and those who are not, univariate (unadjusted) regression analyses were undertaken between each feeding practice and each dietary intake score for the whole overweight sample and then separately for both fussy eaters and non-fussy eaters. Non-standardised (B) regression coefficients, standard errors, 95% confidence intervals and p-values were calculated. To determine if any differences in these associations between fussy eaters and non-fussy eaters were significant, regression analyses were repeated with the inclusion of an interaction term between the feeding practice and fussy eating and p-values less than 0.05 indicated a significant moderation effect.

6.3 Results

6.3.1 Dietary intake and problem food behaviours in this sample

In this sample of overweight children 55% were female and the average age was 6.4 years (SD=1.4) with a range of 4.1 – 9.0 years.

Table 15 demonstrates descriptive statistics for the dietary intake and problem food behaviours in this sample. The mean *fruit and vegetable* score was just below the recommended score of at least 14 (150) and more than half of the sample achieved this (53%). The mean *non-core food* intake score was above the recommendation of less than or equal to two (150) and 76 participants (37%) consumed non-core foods within this guideline.

Different problem food behaviours had different distributions, with whinging and arguing about food, refusing foods, requesting and demanding food having higher means than the other problem behaviours. As only three participants scored greater than 1 on the stealing food question, this question was removed from subsequent analysis.

Table 16: Correlations between problem food behaviours, parental feeding practices and dietary intake (n=203)

	Parental feeding practices					Dietary intake	
	Healthy eating guidance	Monitoring	Parent pressure	Restriction	Child control	Fruit and vegetable	Non-core food
Eats too quickly	.02	.09	**-.23****	**.25****	-.02	.01	**-.17***
Eats too much	-.06	-.03	**-.21****	.48**	.03	-.01	-.08
Eats unhealthy snacks	**-.22****	**-.33****	.12	.02	**.39****	**-.40****	**.30****
Whinges or whines about food	-.06	**-.22****	**.22****	.13	**.18***	-.07	.13
Yells about food	-.06	**-.19****	.12	**.17***	**.17***	-.08	**.16***
Throws a tantrum about food	.01	**-.15***	.11	**.15***	.10	**-.15***	.11
Refuses to eat certain foods	-.03	**-.28****	**.27****	.01	**.34****	**-.30****	.10
Argues about food	-.07	-.13	.11	**.16***	**.16***	-.11	.01
Demands extra helpings	-0.01	-0.06	-0.07	0.12	0.13	-0.01	-0.02
Requests food continuously between meals	**-.14***	**-.15***	.04	**.20****	**.16***	-.10	**.16***
Demands food when on outings	-.02	-.04	.08	.14	.06	-.11	-.05
Sneaks food	-.03	-.09	**.14***	.12	.06	-.03	**.14***
Hides food	.02	-.06	.05	.10	-.01	.05	.00
Eats food to comfort themselves	-.05	-.09	-.11	**.19****	-.03	-.05	-.08

*p<0.05 **p<0.01

6.3.1 Problem food behaviours, feeding practices and dietary intake

As shown in Table 16, eating too quickly or eating too much were both linked with lower levels of *parent pressure* and higher levels of *restriction*. Eating unhealthy snack foods was related to less *healthy eating guidance* and *monitoring* and more *child control*. Fussy eating behaviours such as whinging, yelling or refusing food were associated with less *monitoring* and more *parent pressure*, *restriction* and *child control* and also with the consumption of fewer fruits and vegetables. More frequent food requests from the child were associated with lower levels of *healthy eating guidance* and *monitoring* from the parent and more restrictive or child controlled feeding practices. Sneaking food was related to greater *parent pressure* and *non-core food* intake by the child, but hiding food related to none of the variables. Meanwhile children that were more likely to eat to comfort themselves when feeling let down or depressed were also subjected to greater levels of restrictive feeding practices from parents.

6.3.2 Fussy eating

The reliability coefficient (Cronbach's alpha) for the *fussy eating* scale (questions 4-8 from the LBC) was 0.84, indicating good internal consistency. The mean score for *fussy eating* was 2.44 (S.D.=1.2) with a range of 1-6.8. Parents reported higher levels of *parent pressure* and *child control* with fussy eaters and also less *monitoring* of food intake (Table 17, page 106). Fussy eaters also consumed less *fruits and vegetables* than non-fussy eaters, although reported *non-core food* intake did not differ.

Table 18, page 108, presents the dietary intake regression coefficients for feeding practices in the overweight sample and stratified for both fussy and non-fussy children. The unadjusted regression coefficients for the whole sample (Table 18) showed that *healthy eating guidance* was associated with higher *fruit and vegetable* consumption and lower *non-core food* consumption, while *child control* had the opposite associations. Lower levels of *monitoring* and higher levels of *parent pressure* were

Table 17: Parental feeding practices, dietary intake scores and BMI z-scores in fussy compared with non-fussy eaters

	Non-fussy eaters[1] n=129	Fussy eaters[1] n=74	p
BMI z-score	1.58 (0.5)	1.70 (0.4)	.094
Healthy eating guidance	4.32 (0.5)	4.17(0.6)	.079
Monitoring	4.29 (0.7)	3.92 (0.8)	**<.001**
Parent pressure	2.40 (0.8)	2.69 (0.8)	**.009**
Restriction	2.10 (0.7)	2.28 (0.6)	.067
Child control	2.16 (0.6)	2.48 (0.7)	**<.001**
Fruit and vegetable intake[2]	14.5 (4.0)	12.3 (3.9)	**<.001**
Non-core food intake[2]	2.43 (1.0)	2.59 (0.9)	.288

[1]Mean (standard deviation)

[2]Scores from the Children's Dietary Questionnaire

also related to greater *non-core food* intake. Significant associations between feeding practices and fruit and vegetable consumption in the fussy/non-fussy sub-groups were limited only to fussy eaters, with higher levels of both *healthy eating guidance* and *restriction*. This was not seen in the non-fussy eaters. Associations between feeding practices and *non-core food* intake were similar between fussy eaters and non-fussy eaters – *parent pressure* and *restriction* having no relationship. *Healthy eating guidance* was related to lower *non-core food* intake to a greater extent in fussy eaters, however the interaction here was not significant (p=0.091), indicating that the regression coefficients were not significantly different from each other. The only interaction term that showed significance was that between *restriction* and *fussy eating* for *fruit and vegetable* consumption, indicating that the contrasting associations seen between fussy eaters and non-fussy eaters were significantly different. This was not the case for the other variances seen between the groups.

6.4 Discussion

This analysis provides new evidence that problem food behaviours are related to the parental feeding practices and dietary intake of overweight children. In particular parents of children that were fussy eaters – those who refused, resisted or fussed about food – reported differences in feeding practices from those with children that weren't fussy eaters.

Parents with fussy children didn't keep track of the unhealthy food their child consumed as much and allowed their child more freedom in their food intake than parents of non-fussy eaters. These results generally agree with previous research (92, 94). However, parents that have reported lower levels of *monitoring* and higher levels of *child control*, also valued the importance of a healthy diet less than parents who used *monitoring* more and *child control* less (Chapter 4). This suggests that parents with fussy children might not regard a healthy diet as important for their child as much as those parents with non-fussy children and that perhaps this reduced level of concern has *resulted* in fussy eating. Alternatively the fussiness has resulted in parents 'giving up'. A post hoc two-sided t-test supported the hypothesis that parents with fussy children

Table 18: Regression coefficients for dietary intake scores and feeding practices in overweight children and stratified for fussy and non-fussy eaters

	Full overweight sample (n=203)			Non-fussy eaters (n=129)			Fussy eaters (n=74)			Interaction p-value[1]
	B (SE)	Confidence intervals	p	B (SE)	Confidence intervals	p	B (SE)	Confidence intervals	p	
Fruit & vegetable intake										
Healthy eating guidance	**1.49 (0.5)**	**0.52, 2.47**	**.003**	0.59 (0.7)	-0.70, 1.88	.370	**2.24 (0.7)**	**0.84, 3.64**	**.002**	.091
Monitoring	0.37 (0.4)	-0.39, 1.14	.340	-0.55 (0.5)	-1.58, 0.47	.288	0.77 (0.6)	-0.37, 1.92	.183	.090
Parent pressure	-0.21 (0.4)	-0.94, 052	.579	0.13 (0.5)	-0.78, 1.04	.783	-0.11 (0.6)	-1.32, 1.10	.857	.757
Restriction	0.46 (0.4)	-0.36, 1.28	.271	-0.05 (0.5)	-1.03, 0.94	.922	**2.24 (0.7)**	**0.90, 3.59**	**.001**	**.009**
Child control	**-1.28 (0.4)**	**-1.15, -0.41**	**.004**	-0.67 (0.6)	-1.91, 0.57	.288	-1.21 (0.6)	-2.46, 0.04	.057	.545
Non-core food intake										
Healthy eating guidance	**-0.42 (0.1)**	**-0.66, -0.18**	**.001**	**-0.36 (0.2)**	**-0.70, -0.03**	**.033**	**-0.47 (0.2)**	**-0.81, -0.13**	**.008**	.677
Monitoring	**-0.41 (0.1)**	**-0.59, -0.22**	**<.001**	**-0.48 (0.1)**	**-0.74, -0.22**	**<.001**	**-0.31 (0.1)**	**-0.58, -0.04**	**.024**	.386
Parent pressure	**0.22 (0.1)**	**0.04, 0.40**	**.017**	0.21 (0.1)	-0.03, 0.45	.080	0.20 (0.1)	-0.09. 0.48	.177	.938
Restriction	-0.19 (0.1)	-0.40, 0.01	.059	-0.20 (0.1)	-0.46, 0.05	.122	-0.23 (0.2)	-0.58, 0.11	.176	.886
Child control	**0.48 (0.1)**	**0.27, 0.68**	**<.001**	**0.60 (0.2)**	**0.29, 0.91**	**<.001**	**0.34 (0.1)**	**0.05, 0.64**	**.023**	.248

B – non-standardised regression coefficient; (SE) –standard error; [1]Test for an interaction between fussy eating and feeding practices for the dietary intake score

did not think that having a healthy diet for their child was as important as did parents with non-fussy children (p=0.001). (See Section 3.3.6, page 41, for description of this measure). Although the mean rating for *importance of a healthy diet* for both of these groups was high (9.0 for the fussy group and 9.1 for the non-fussy group, with a maximum of 10), these results imply that if fussiness is to be overcome, one strategy may be to improve the understanding of the importance of a healthy diet for some parents.

Higher levels of *parent pressure* (urging the child to eat and/or using food as a reward) was reported by parents of fussy children and it is logical that parents would urge their child to eat if they refused food and also that parents might use food as a reward to overcome resistant behaviour. This is consistent with the currently available literature (90-92).

Perhaps a surprising result was the positive association between *restriction* and *fruit and vegetable* consumption seen only in fussy eaters. As *restriction* is a controlling practice where parents limit consumption of unhealthy foods and also the amount of food consumed, this could understandably elicit a resistive response from the child. This was illustrated by the higher reported levels of *restriction* in the parents of children classed as fussy. However, the positive relationship with *fruit and vegetable* intake suggests that if an overweight child that is a picky eater has a parent that limits food intake, then that child's *fruit and vegetable* consumption is higher than a picky child with a parent that does not limit food intake. Fussy eating is a problem for parents and the associations presented here highlight a lack of structure and control from the parent – given the cross-sectional nature of these analyses it is unknown whether this occurs as a response or a contribution to the fussy eating.

The relationships between *child control* and *fruit and vegetable* intake in the fussy eaters and between *parent pressure* and *non-core food* intake in the non-fussy eaters require further investigation. While the associations here did not reach statistical significance, the p-values were still small (p=0.057 and p=0.080) and the effect sizes were suggestive of clinical significance. Similarly, differences between fussy eaters and non-fussy eaters in terms of the relationships between *healthy eating guidance* and *monitoring* with *fruit and vegetable* intake are apparent, however the interaction p-

value was higher than 0.05 (p=0.091 and 0.090 respectively). If these relationships do exist, this suggests that *healthy eating guidance* and *monitoring* may have a greater positive effect on the diets of fussy children than non-fussy children.

Eating too quickly and eating too much were related to more *restriction* and less *pressure* from parents. It seems feasible that parental feeding practices could both be a *response* to this child eating behaviour or a *cause*. For example, a parent that restricts food might groom a child to eat quickly and to then be perceived to eat too much. Or it could be that a child that eats too quickly and/or too much requires more restriction from a parent. It was validating to note that eating more unhealthy snacks was associated with lower *fruit and vegetable* and higher *non-core food* consumption. Furthermore, eating unhealthy snacks was related to those parental feeding practices that might make the household more conducive to consuming more unhealthy snacks – that is, less *healthy eating guidance* and *monitoring*, and more *child control*.

Children that requested food continuously between meals ate more *non-core foods* and understandably the constant requesting was also associated with a higher degree of perceived *restriction* by the parent. However, there was also less guidance and *monitoring*, and more *child control*, suggesting limited structure in the feeding environment, which might leave a child unsure about when and what food will be allowed, leading to more asking and then to more regulation by the parent. An overweight child that continuously asks for food is likely to be stressful for a parent and strategies to reduce this would be helpful, such as having set eating times that the whole family is aware of and adheres to; not having highly desirable food available in the home; and having healthy foods available to direct the children towards. Supporting parents in how to respond to these continual requests might also be advantageous.

An unusual result is the correlation between *parent pressure* and sneaking food, however the correlation isn't strong and it might be picking up a rebellious response by the child to the overt control exhibited by the parent. Again, this could be picking up non-compliant behaviour from the child (as postulated in Chapter 5), where parents might report higher levels of *parent pressure* with non-compliant children. Non-complaint children might be more likely to sneak food when they know they are not supposed to. Future research could explore links between children's behaviour (such as

non-compliance) and feeding practices to clarify this theory. Indeed, it may be that training parents in behaviour management techniques results in changes in parental feeding practices and improvement in other aspects, including diet, problem food behaviours and ultimately weight in children (167, 174).

Eating for comfort was associated with *restriction*, which has been seen previously (94). This might indicate that children who comfort-eat are in more need of restrictive feeding practices. While longitudinal evidence has suggested that girls eat more in the absence of hunger if their parents exhibit more *restriction* at home (27, 46), this observation was from an experimental setting where the restriction was removed and therefore is not directly comparable to a parental report of comfort eating in the home environment. Furthermore, *restriction* was not related to secretive eating behaviours, such as food hiding, stealing or sneaking in this sample.

This analysis of problem food behaviours and feeding practices responds to the need for evidence-based recommendations for how parents feed their children, given that child behaviour is cited as a major barrier. Reasonable sized samples were used to examine associations between problem food behaviours, dietary intake and parental feeding practices, so that for each analysis there was greater than ten participants per variable. This sample consisted of only overweight children so the results are not generalisable to other populations; however they may be used to inform intervention studies looking to treat overweight in children of this age. Replication of this study in a sample of children of all sizes (not just overweight) might offer a deeper understanding of how feeding practices are related to problem food behaviours and whether these have greater or lesser associations in overweight children. While further longitudinal and experimental research is needed, this study has revealed interesting associations and put forward theories that require testing. Hypotheses to examine include: If fussy eating is treated, does this improve the diets and weight of children? Does more *child control* of feeding cause or exacerbate fussy food behaviour in overweight children? Does a more structured feeding environment result in fewer requests for food? Is fussy eating related to weight status and/or weight gain? Is child non-compliance related to feeding practices and dietary intake? Further research should also look at whether feeding practices are related in any way to eating disorders later in life, to ensure that they are safe.

To conclude, this sample of overweight children has provided evidence that there are associations between parental feeding practices, dietary intake and problem food behaviours indicating potential causal pathways for future testing.

7. Home food availability, parental feeding practices and the dietary intake of overweight children

7.1 Introduction

As New Zealand children obtain most of their food from home (11, 115), home food availability is likely to be highly influential to a child's dietary intake. Although this premise is supported by research (116, 136, 138-140), most of these studies have focused solely on fruits and vegetables and few have measured the wide range of foods that can be regularly available in the household (139). Furthermore, much of the research undertaken on home food availability has used very crude measures, such as "How often are fruits and vegetables available in your home?" (135, 175-177) This type of measure has been shown to be highly subjective, with children perceiving availability quite differently to parents (133, 135). These measures are also rarely differential, meaning that most people score highly for fruit and vegetable availability with only a narrow range of results.

As the home food environment is likely to have an impact on children's diet, improvement in the measurement of the foods available in the home is needed. A comprehensive measure of food availability could be used not only to determine associations with diet but also, in a clinical setting, to identify targets for change within the home environment, particularly in families with overweight children.

Parental feeding practices have also demonstrated associations with the dietary intake of children (Section 2.3 & Chapter 5), however in the large sample of children from Phase 1 of the MInT Study, crude dietary measures were used to show this. A more thorough dietary questionnaire, albeit still with some limitations (the Children's Dietary Questionnaire (CDQ) (150)), was used in the Phase 2 sample of overweight children. Examination of associations using the CDQ data and the five parental feeding practices

from the Comprehensive Feeding Practices Questionnaire (CFPQ) may add further support to the relationships identified in Chapter 5 between feeding practices and diet.

Parental feeding practices might also interact with the home food environment, although this effect on diet has not been fully explored before. The exception is a study by Young *et al* (120), who demonstrated that fruit and vegetable availability moderated the effect of both *parental support* and *parental modelling* on fruit and vegetable consumption. This was further investigated to show that *parental support* was associated with greater fruit and vegetable consumption only if there was low availability of fruits and vegetables in the home, and that only when availability was high was *parental modelling* associated with greater fruit and vegetable consumption. Moderating effects of home food availability were not found with other feeding practices (*parent control* and *authoritative parenting*) and have not been explored with the practices from the Child Feeding Questionnaire (CFQ) (23) or the CFPQ.

Of particular interest are two theories that arise from the contradictory results with two feeding practices: *child control* and *restriction* (Sections 2.3.5 & 2.3.1). The first theory to investigate is whether allowing the child more control of their food intake in different food environments results in divergent dietary patterns. Allowing the child to self-regulate their food intake in an environment of healthy food may have benefits not seen in a less healthy food environment. Further to this, more restrictive parental feeding practices might have better dietary outcomes in a more obesogenic environment compared to those in a healthy home food environment. Research on *restriction* has had mixed results with some suggesting benefits and some suggesting detrimental effects (Section 2.3.1, page 12). The relationships between parental feeding practices and home food availability, and the potential effect on diet, need further exploratory investigation to determine if there are interactions between these home factors.

This analysis will use a detailed, relatively objective measure of home food availability, the five factors from the Comprehensive Feeding Practices Questionnaire, and a more extensive dietary measure than that used in Phase 1 of the MInT Study. These measures will be used to examine the associations between home food availability,

parental feeding practices and dietary intake in an overweight sample of 4-8 year old New Zealand children.

7.2 Methods

7.2.1 Participants

The sample used for this analysis consisted of the overweight children recruited for Phase 2 of the MInT Study. Recruitment is detailed in Section 3.2, page 38.

7.2.2 Measures

Parental feeding practices were measured with the five factors from the Comprehensive Feeding Practices Questionnaire (CFPQ) (20), determined in Chapter 4: namely *healthy eating guidance*, *monitoring*, *parent pressure*, *restriction* and *child control*.

The Children's Dietary Questionnaire (CDQ) (150) was used to assess dietary intake. See Section 3.4.2, page 48, for further detail on this measure. Scores for *non-core food intake* and *fruit and vegetable consumption* were calculated using methods outlined by Magarey *et al* (150).

Home food environment was assessed using the Home Food Inventory (HFI) from Fulkerson *et al* (21), which was adapted for use in a New Zealand population. Three scores were calculated for use in this analysis: an *obesogenic home food availability* score (from the original HFI – capturing high fat and/or high sugar foods, see Appendix F for details), a *non-core foods score* and a *fruit and vegetable score* (to enable comparison with the dietary scores). These were determined by adding up the foods present in the home that were from these categories. More detail on this questionnaire is provided in Section 3.4.1, page 45, and the final questionnaire that was used in the

MInT Study is in Appendix E, with details of the modifications made to the questionnaire in Appendix F.

7.2.3 Analysis

Pair-wise correlation coefficients and p-values were calculated between home food availability scores, parental feeding practices and dietary intake scores.

In regression analyses, a rough rule of thumb states that at least ten participants per variable is advised to have the power to detect appropriate associations (178). With the current sample of n=203, multivariate regression analyses would then be limited to twenty independent variables. Because of this limitation, hierarchical regression analyses were used to examine the associations between the dietary intake of children and demographics (five variables), home food availability (two variables) and parental feeding practices (five variables). Added to this regression was an exploratory level to see whether interactions between home food availability and parental feeding practices (ten variables) might be associated with diet.

Hierarchical regression analyses were calculated for each of the dietary variables – *fruit and vegetable intake* and *non-core food intake*. The first level contained the demographic variables (ethnicity, maternal education, socio-economic status, sex and maternal BMI). This would then give an indication as to how much these demographic factors were related to dietary intake. The second level contained the home food availability scores (*obesogenic* and *fruit and vegetable*) and the parental feeding practices (*healthy eating guidance*, *monitoring*, *parent pressure*, *restriction* and *child control*) with the inclusion of the demographic variables.

The third level would add interaction terms to the regression model but as the number of variables would then exceed ten per participant (variables = 22), this would be seen as an exploratory analysis and not a test of actual association. Scores for home food availability and parental feeding practices were centred around the mean (by subtracting the mean from each score) before the interaction terms were calculated. This accounted for collinearity so that if any of the variables were correlated, effects would not be inflated when they were multiplied together. The final interaction terms

were determined by multiplying each centred home food availability score with each centred parental feeding practice. If an interaction terms were found to be significant, further exploratory analysis would be undertaken to clarify any potential moderation effect. This would be determined by splitting the moderating variable into three levels (high: mean + std dev; low: mean – std dev; medium: between high and low) and undertaking a univariate regression analysis for each level.

Non-standardised (B) regression coefficients were calculated along with standard errors, 95% confidence intervals and p-values. R^2 values and p-values were determined for each level of the regression analyses. All analysis used Stata 12.0 (Statacorp, Texas).

7.3 Results

7.3.1 Participants

The children had a mean age of 6.4 years (SD=1.4) and 45% were male. The average BMI z-score (from US reference data (143)) was 1.62 (SD=0.47) from a range of 1.0 – 3.6. The sample is described in Table 3, page 50.

7.3.2 Home food availability

The average *obesogenic food availability* score was 20 (SD=7) with a range of 3-43. *Fruit and vegetable availability* had a mean of 30 (SD=9) and a range from 11 to 61, while *non-core food availability* averaged 14 (SD=6) from a range of 3 to 36. Table 19 (page 118) shows that all three availability measures correlated strongly with each other. This was especially so for the *obesogenic* and *non-core foods* scores, which were measuring many of the same foods. Availability scores were positively associated with their matching dietary scores and *obesogenic* and *non-core* scores yielded similar results.

Table 19: Pair-wise correlations between home food availability, parental feeding practices and dietary intake (n=203)

		1.	2.	3.	4.	5.	6.	7.	8.	9.
Availability										
1.	Obesogenic									
2.	Fruit and vegetable	.43**								
3.	Non-core	.91**	.40**							
Feeding practices										
4.	Healthy eating guidance	-.19**	.14	-.19**						
5.	Monitoring	-.08	.12	-.09	.40**					
6.	Parent pressure	.10	.03	.10	-.11	-.15*				
7.	Restriction	-.09	-.06	-.09	.09	.08	-.02			
8.	Child control	.08	.03	.06	-.16*	-.32**	.10	-.06		
Dietary intake										
9.	Fruit and vegetable	-.05	.24**	-.05	.21**	.07	-.04	.08	-.20**	
10.	Non core	.24**	-.06	.26**	-.24**	-.30**	.17*	-.13	.30**	.01

* $p<0.05$ ** $p<0.01$

7.3.3 Parental feeding practices

Healthy eating guidance (mean=4.3, SD=0.6) was the only feeding practice associated with availability (Table 19, page 118). Both *healthy eating guidance* and *monitoring* of food intake (mean=4.2, SD=0.7) were related to healthier dietary intake scores whereas *parent pressure* (mean=2.5, SD=0.8) and *child control* (mean=2.3, SD=0.6) were both positively associated with *non-core food intake*. *Restriction* (mean=2.2, SD=0.7) had no relationships with any of the other variables in Table 19.

7.3.4 Regression analyses for dietary intake

As *obesogenic* and *non-core availability* scores constituted many of the same items, only the *obesogenic* variable was used in regression analysis as it was the more comprehensive measure and had been subject to previous validation (21). The results from the first and second levels of the hierarchical regression analysis are presented in Table 20 along with the interaction terms from the third level.

Main effects were seen for *fruit and vegetable intake* by *fruit and vegetable availability* (positive) and *child control* (negative), corresponding to the correlations shown in Table 19. Sex also had an effect on *fruit and vegetable intake*, as girls had a significantly higher average intake than boys ($p<0.01$). Higher *obesogenic home food availability* and more *child control* were associated with *non-core food intake*.

The third level of the regression models showed that the only significant interaction term was for *obesogenic home food availability* and *healthy eating guidance* on *fruit and vegetable intake*, indicating a possible moderating effect. Further exploratory analysis split home food availability into three levels of obesogenicity and found that when the availability of obesogenic foods at home was low (≤12.5) or medium (12.5 – 27.1) there were positive associations between *healthy eating guidance* and *fruit and vegetable intake* (B=3.3, β=.36, p=.04; B=1.9, β=.28, p=.001 respectively), however when the availability of obesogenic foods at home was high (>27.1), there was a

Table 20: Hierarchical regression model for dietary intake with demographics, home food availability, parental feeding practices and interaction terms (n=203)

Variable	Fruit and vegetable intake				Non-core food intake			
	Regression coefficient (SE)	Confidence intervals	p	R^2	Regression coefficient (SE)	Confidence intervals	p	R^2
Demographics								
Ethnicity	-.33 (.26)	-0.85, 0.19	.206		.10 (.09)	-0.08, 0.29	.256	
Maternal education	.38 (.19)	0.00, 0.76	.050		.01 (.05)	-0.10, 0.12	.846	
Socio-economic status	.13 (.41)	-0.67, 0.93	.750		-.01 (.09)	-0.19, 0.18	.198	
Sex	1.66 (.62)	0.44, 2.87	**.008**		-.19(.15)	-0.47, 0.10	.198	
Maternal BMI	-0.01 (.05)	-0.10, 0.08	**.**851		.01 (.01)	-0.02, 0.03	.503	
Home food environment and parental feeding practices				.0601*				.0210
Fruit and vegetable availability	.13 (.03)	0.06, 0.20	**<.001**		-.01 (.01)	-0.03, 0.00	.085	
Obesogenic food availability	-.06 (.04)	-0.14, 0.02	.163		.04 (.01)	0.02, 0.06	**<.001**	
Healthy eating guidance	.99 (.59)	-0.18, 2.16	.097		-.12 (.12)	-0.36, 0.12	.325	
Monitoring	.03 (.61)	-1.16, 1.23	.958		-.22 (.13)	-0.48, 0.04	.092	

Parent pressure		-.31 (.42)	-1.13, 0.51	.458		.14 (.09)	-0.04, 0.32	.123	
Restriction		-.04 (.38)	-0.78, 0.71	.925		-.16 (.10)	-0.36, 0.04	.125	
Child control		-1.20 (.54)	-2.27, -0.13	**.028**		.26 (.12)	0.03, 0.48	**.028**	
Interaction terms (Block 3)					.1998**				.2626**
Fruit and vegetable availability and:	Healthy eating guidance	.12 (.08)	-0.04, 0.27	.143		.00 (.02)	-0.03, 0.04	.812	
	Monitoring	-.03 (.08)	-0.19, 0.12	.679		-.01 (.02)	-0.04, 0.03	.711	
	Parent pressure	-.04 (.06)	-0.16, 0.08	.517		-.02 (.01)	-0.05, 0.01	.190	
	Restriction	-.04 (.05)	-0.15, 0.06	.415		.01 (.01)	-0.02, 0.03	.657	
	Child control	-.02 (.06)	-0.13, 0.09	.731		-.01 (.01)	-0.04, 0.02	.462	
Obesogenic food availability and:	Healthy eating guidance	-.23 (.09)	-0.42, -0.05	**.015**		.00 (.02)	-0.04, 0.04	.897	
	Monitoring	.04 (.10)	-0.16, 0.24	.687		-.01 (.02)	-0.05, 0.03	.666	
	Parent pressure	.00 (.06)	-0.13, 0.13	.995		.01 (.01)	-0.02, 0.03	.548	
	Restriction	-.02 (.05)	-0.13, 0.08	.671		-.01 (.02)	-0.05, 0.03	.526	
	Child control	.01 (.08)	-0.15, 0.17	.940		-.01 (.02)	-0.05, 0.03	.534	
					.2326**				.2861**

* p<0.05, ** p<0.01

negative association between *healthy eating guidance* and *fruit and vegetable intake* (B=-2.7, β=-.38, p=.033).

Home food availability, parental feeding practices and demographics together explained 20% ($p<0.01$) of the variance in *fruit and vegetable intake* and 26% ($p<0.01$) of the variance in *non-core food intake*. However, the R^2 values were not significant for the first levels that contained only demographic variables suggesting that alone, demographics do not explain any of the variance in dietary intake. While the interaction terms were included as an exploratory addition and not intended to add to the multivariate model, it is noted that the increases in R^2 values from the inclusion of the interaction terms were not significant. Residuals for this multivariate model were plotted and looked normal.

7.4 Discussion

This analysis, which used comprehensive measures, showed that availability of food in the home was associated with the dietary intake of overweight children.

The three availability scores (*obesogenic*, *fruit and vegetable* and *non-core food*) were all significantly correlated with each other, which indicated that those homes that had more obesogenic foods also had more fruits and vegetables. This suggests that some families generally had a wider variety of food in their homes than others. When beginning this analysis, consideration was given whether to generate and use a relative measure of home food availability to account for this phenomenon. A possible approach would have been to calculate the proportion of the food scores (*obesogenic*, *fruit and vegetable* or *non-core*) from all the foods available in the home – for example, by taking the *fruit and vegetable score* and dividing it by the *total* number of foods in the house. This might then account for differences between homes with high or low overall food availability. However, it was decided to use the *absolute* measures, where no adjustment for overall food availability was taken, to capture the true relationship between the availability and consumption of each of obesogenic foods, non-core foods

and fruits and vegetables. Targets for behaviour change, in terms of what foods to make available in the home, could more easily be developed from these types of results than proportional ones.

Obesogenic and *non-core food availability* were very highly correlated (r=0.91) which comes as no surprise as the latter score was basically a sub-scale within the *obesogenic* scale, with 41 out of the 44 non-core foods (93%) also classed as *obesogenic*. The three foods that differed were ice-blocks, frozen milk treats and sorbet/frozen yoghurt, which did not meet the criteria to be *obesogenic* (21, 151) but were included in the *non-core food dietary intake* score in the CDQ (150). The *obesogenic* score captured a wider variety of foods (63 in total) that included sweetened beverages and high fat dairy foods that the *non-core food* score did not. It should be noted that the home food inventory did not measure the *amount* of food available so in essence was capturing a measure of the variety of available foods. For example a household that had three chocolate biscuits in the house would have the same contribution to their *obesogenic* score as did a household with three *packets* of chocolate biscuits. Furthermore, a home with a fruit bowl overflowing with apples and oranges would only contribute two points to the *fruit and vegetable* score compared with a household that might have one apple, one orange, one kiwifruit and half a banana, that would get four points. This may, however, account for different sized households, where the *amount* of food (but not necessarily the variety) would likely be relative to the number of people living in the house.

Importantly, availability and intake scores were correlated (r=0.24-0.26) supporting the hypothesis that home food environment is related to the diets of children. This is one of only a few studies to show this with both healthy and less healthy foods (127, 128) or by using a more objective measure of home food availability (179). If fruit and vegetable availability is higher, regardless of how much obesogenic food there is available, more fruits and vegetables are consumed. The same relationship applies for non-core food availability and intake. There is likely to be a bi-directional relationship here, in that the food in the house was probably there *because* it is the food that is generally eaten. However, as most people get the majority of food from their homes, children in particular might be more likely to eat certain foods *because* they are in the home. Longitudinal research is currently being undertaken in this group of children,

which may improve understanding of whether these variables (dietary intake and home food availability) change together or if change in one can occur without change in the other. It is of interest to know whether weight status can be improved by targeting only home food availability instead of dietary intake, as this could be an achievable first step in the treatment of obesity.

Parental feeding practices did not show any relationship to home food availability, with the exception of *healthy eating guidance* which was negatively correlated with both *obesogenic* and *non-core food* availability, as might be expected. However, there were many associations between feeding practices and the dietary intake of the children. As Phase 2 of the MInT Study used a more thorough dietary measure than Phase 1, albeit in a smaller sample of only overweight children, it is of interest to see if the associations determined in Chapter 5 are supported by this analysis. Table 11 (page 86) gives correlations between the feeding practices and *fruit and vegetable intake* in the large Phase 1 sample (there was no comparable non-core food variable in Phase 1 except for sweet drinks, which were not included in the CDQ measure of *non-core foods*). Only some of these associations were supported by this current analysis.

Healthy eating guidance correlated with higher *fruit and vegetable intake* in both these samples and was also positively associated in the multivariate model in Table 20, therefore this relationship was well-supported. Similarly for *child control* – all associations agreed that increased *child control* related to lower *fruit and vegetable intake*. *Restriction* had no significant associations with dietary intake in both the Phase 1 sample and Phase 2 sample. Otherwise, the positive link between *fruit and vegetable intake* and *monitoring* and the negative link with *parent pressure*, seen in the larger sample, were not indicated by this analysis. However, it should be recalled from Chapter 5 that *parent pressure* was used at significantly lower levels in the overweight categories and this current analysis used only overweight child participants.

In terms of *non-core food intake*, this was correlated with lower levels of *healthy eating guidance* and *monitoring* and higher levels of *parent pressure*, *child control* and *obesogenic home food availability*. However, after adjustment for other variables in the regression model, these relationships with *non-core food intake* were reduced to correlations only with higher *child control* and higher *obesogenic food availability*. By

this analysis, overweight children that were allowed more freedom to eat what and when they like tended to eat more non-core foods and less fruits and vegetables. However, *child control* was not related to home food availability, which might suggest that children that have more control over their feeding do not extend a significantly greater influence over the provision of food to the home compared to children that do not have as much control of their feeding.

To examine whether parental feeding practices and home food availability might interact to affect dietary intake, an exploratory moderation analysis was undertaken. Of particular interest was whether *restriction* of unhealthy foods moderated the association between an obesogenic home food environment and dietary intake. Also whether *child control* in differing food environments altered any association with diet, as increased *child control* in a healthier food environment is thought to result in better dietary intake (10, 86). As no such interactions existed, these theories were not supported by this analysis. The only significant interaction was that between *healthy eating guidance* and *obesogenic food availability* on *fruit and vegetable intake*. In an environment of low-medium obesogenicity, *fruit and vegetable intake* was positively associated with more modelling, teaching and encouragement of healthy eating. However, in an environment of high obesogenicity this association was inversed. It may be that when a child has access to a lot of non-core foods and eats few fruits and vegetables that a response by parents is to increase their encouragement of healthy eating. This is an unusual result that requires replication in a sample that is powered to determine these associations adequately.

As this analysis has used a sample of overweight children, any associations are not generalisable to the general population. Future research should investigate how home food availability and dietary intake change in relation to each other, in particular to investigate if improving the home food environment with no targeted change to children's dietary intake results in any improvement in diet and/or weight. It would also be of interest to explore the associations with home food availability using proportional scores such as *obesogenic* by *fruit and vegetable availability*. This might indicate that reducing *obesogenic food availability* AND increasing *fruit and vegetable availability* has beneficial effects above and beyond targeting only one area of food in the home.

With a reasonably diverse, overweight sample of 4-8 year old New Zealand children, associations were determined between home food availability, parental feeding practices and child dietary intake, using comprehensive measures. This is one of the first studies to thoroughly investigate the relationships between these variables, including moderating effects. In general, *fruit and vegetable availability*, *healthy eating guidance* and *monitoring* were associated with healthier dietary outcomes while *obesogenic food availability*, *parent pressure* and *child control* were linked to less healthy dietary intake. Interestingly, an obesogenic environment might completely override and reverse the association between good parental modelling and guidance and fruit and vegetable consumption, although this needs further investigation. The feeding practice that seemed to have the most robust relationships with dietary intake was *child control*, and longitudinal research could indicate the long-term impact of this feeding practice on diet and weight. Home food availability was also strongly related to the dietary intake variables, which is a valuable result, as relatively thorough measures were used in an adequately sized sample. As stated, these results have given direction for future research and provided good evidence for the relationships between these three important facets of the home food environment – availability, parental feeding practices and intake.

8. Conclusion

This thesis examined parental feeding practices in a sample of New Zealand children aged 4-8 years. Associations with diet, weight, problem food behaviours and home food availability were determined, and the implications of these results are discussed here.

8.1 Key findings

Initially, factor analyses were undertaken on the Comprehensive Feeding Practices Questionnaire (CFPQ), from which five feeding practices were proposed to best represent the data. These were named *healthy eating guidance*, *monitoring*, *parent pressure*, *restriction* and *child control*.

8.1.1 Healthy eating guidance

Healthy eating guidance is a feeding practice measured by questions that originated from the original scales of *modelling*, *teaching about nutrition*, *environment* and *encourage balance and variety*. It represents a positive, guiding attitude to healthy eating by the parent.

This thesis showed that *healthy eating guidance* was linked to healthier dietary intake patterns and lower levels of obesity. It was associated with increased fruit and vegetable consumption in both samples and was significantly correlated with lower sweet drink intake and lower non-core food intake. *Healthy eating guidance* was robustly associated with lower BMI z-scores and was reported at significantly lower levels in obese children compared with normal weight children.

Parents that reported lower levels of *healthy eating guidance* reported using more dysfunctional disciplining practices and were also subject to more requests for food

between meals. While greater obesogenic food availability in the home was linked to less *healthy eating guidance*, it might also be that high availability of less healthy food reverses the positive association between *healthy eating guidance* and fruit and vegetable consumption.

Although these results are from cross-sectional data, the correlational evidence presented consistently points to *healthy eating guidance* being a feeding practice that results in better outcomes for children. Longitudinal research could confirm this theory. Hence the following practices, which represent the contributing questions to the *healthy eating guidance* scale, could be recommended to parents in interventions to treat and/or prevent overweight in children:

- Eat healthy foods in front of your child often, and tell your child that they taste good
- Show enjoyment of and enthusiasm for eating healthy foods to your child
- Discuss with your child why healthy foods are good for them
- Encourage your child to eat a variety of foods and to try new things
- Have fruits and vegetables available in your home
- Reduce the amount of obesogenic food in the home – a definition of obesogenic food would need to be provided

8.1.4 Monitoring

Monitoring is the practice of keeping track of the unhealthy foods that a child may eat, specifically sweets, snack food, high-fat foods and sugary drinks. This scale was very robust in all factor analyses and originates from the Child Feeding Questionnaire, the most utilised measure of feeding practices.

Monitoring was generally associated with healthier dietary intake behaviours. It was correlated with higher fruit and vegetable intake in the large sample of children of all sizes but not in the smaller, overweight sample. Monitoring of less healthy food intake was also associated with fewer sweet drinks and less non-core food intake, however the latter was not significant after adjustment for demographics in the overweight sample.

While a decreasing trend in the use of *monitoring* was seen with increasing weight status of the child, it was not significantly associated with BMI z-scores after adjustment for demographic factors.

Lower levels of *monitoring* were associated with more requests for food from children and more fussy eating behaviour in overweight children, as well as the use of more dysfunctional disciplining practices from parents. Māori parents monitored their child's food intake less often than New Zealand European parents and a trend of decreasing *monitoring* with decreased socio-economic status was also demonstrated.

Both *monitoring* and *healthy eating guidance* were correlated with each other and also with how much a parent thought a healthy diet was important for their child. Therefore, it may be that increasing a parent's understanding of why a healthy diet is important, and tapping into their own motivation to improve their child's diet might have a flow-on effect to increased *healthy eating guidance* and *monitoring* and with that, a healthier diet. From the results of this thesis the following recommendations might be used for child dietary intervention studies:

- Parents: keep track of and monitor the sweets, snack foods, high-fat foods and sweet drinks that your child eats
- Health professionals: improve parents' belief and understanding of why healthy diets are important for children and encourage monitoring (this might be particularly important in Māori families)

8.1.5 Parent pressure

Parent pressure combined two feeding practices: *pressure to eat*, where the parent urges their child to eat, and *food as a reward*, where the parent gives or withholds treat foods in response to good or bad behaviour. There was also one question that asked if the parent gave food or drink to their child if s/he were bored. Together this assessed a situation where parents pressured their child to eat food in the absence of hunger and used food in a controlling manner.

Parent pressure was weakly associated with less healthy dietary patterns. Negative correlations with fruit and vegetable intake in the large sample were small and no association was seen in the smaller, overweight sample, which used a more comprehensive dietary measure. A correlation with non-core food intake was no longer significant after adjustment for demographics in the overweight sample. However, *parent pressure* was robustly associated with reduced BMI z-scores and the use of *parent pressure* decreased as child weight status increased.

More dysfunctional parenting practices were associated with more *parent pressure*. This, and the fact that *parent pressure* was utilised more in children that sneaked food and were fussy eaters, raised the possibility that *parent pressure* may be related to non-compliant behaviour in children. Interestingly, parents also used more *parent pressure* with boys than with girls. The link with child behaviour warrants further investigation and it may be that parents that use more *pressure* would find a behaviour management intervention useful.

From these results, and logically, *parent pressure* would not be advised, however there is little to suggest in these analyses that it should be advised against, other than the links with problem food behaviours.

- To researchers it is suggested that possible links between non-compliant child behaviour, feeding practices and dietary intake be investigated and that child behaviour management be explored as a potential treatment for dietary and/or weight issues in children.

8.1.6 Restriction

The *restriction* subscale used in this thesis measures how much a parent limits or regulates their child's eating in an effort to control his/her weight. This is slightly different to the *restriction* subscale used in much of the previous literature, which measures how much a parent limits and regulates unhealthy foods to sustain a healthy diet for their child. Restrictive feeding practices have been advised against as they are thought to corrupt a child's ability to self-regulate their own food intake.

In these analyses *restriction* was strongly related to greater child body weight but was not associated with any dietary variable. With an association with parental concern for child overweight, and the fact that this version of *restriction* specifically asks about restrictive *weight control* practices, it is reasonable to assume that parental *restriction* may well be a response to the concern they have about their child's weight.

Demographic variation in the use of *restriction* was apparent. Parents of Pacific Island and Asian children were more restrictive than those of Māori and New Zealand European children, and parents used *restriction* more with girls than with boys. These groups all had higher levels of concern for overweight as well.

There were associations with the problem food behaviours of overweight children; links between *restriction* and increased fussy behaviours, requests for more food, and comfort eating were shown. However, it was also seen that increased *restriction* with children who were fussy eaters was associated with greater consumption of fruits and vegetables. This result suggests that there may be benefits of restrictive feeding practices in overweight children that exhibit fussy behaviour around food. Furthermore, requests for food and comfort eating may indeed elicit more perceived *restriction* from the parent and *restriction* may then elicit a fussy response from the child. Parents might need added support around these problem behaviours.

The fact that there were no relationships with home food availability indicated that no matter how obesogenic the home food situation was, parents did not alter their restrictive feeding practices. This could suggest that parental *restriction* starts at the grocery store.

The results from this thesis certainly do not suggest that restrictive feeding practices be avoided. Indeed, in certain overweight children benefits to diet were indicated. However, links with weight and comfort eating need further clarification with longitudinal research – as is being currently undertaken in the overweight sample. It is likely that the strong relationship between *restriction* and weight is caused by the concern that parents have for their child's increased weight and the *restriction* itself may not have a detrimental effect. The following recommendation could be included in interventions to treat overweight in children:

- Parents: limit the *amount* of less-healthy food your child consumes, especially if your child exhibits fussy behaviour (arguing, yelling, throwing tantrums) around food – a definition of less-healthy food would need to be determined for the family

8.1.7 Child control

This scale measured how much the parent allowed the child to be in charge of what and when they ate. *Child control* correlated negatively with *healthy eating guidance*, *monitoring* and *restriction*, which indicated a lack of parental control and influence of feeding. Furthermore, a positive correlation with *parent pressure* might mean that non-compliant children were allowed more control over their feeding (or that children with more control were non-compliant). This potential relationship was further supported by higher levels of *child control* with children that were fussy eaters. *Child control* was also strongly correlated with food refusal in overweight children and more requests for food between meals. A positive association with dysfunctional disciplining practices was also apparent.

Child control had strong links to poorer dietary intake in both samples. It was associated with lower fruit and vegetable intake, higher sweet drink intake and greater non-core food consumption. However, despite a trend of increasing child control with increasing weight status, there was no overall association with child body weight after adjustment for other factors.

With strong associations with less healthy dietary patterns, a lack of a positive parental influence, and problem food behaviours, *child control* seems a feeding practice to avoid. Longitudinal research could confirm this, but even from this cross-sectional data, there is evidence here to recommend more parental control of feeding. However, current recommendations urge parents to allow their children to self-regulate their feeding for the prevention and treatment of overweight, therefore, whether this is sound or not, a clear distinction must be struck between the two. Based on the questions from the *child control* scale, perhaps the following recommendations to parents could be trialled:

- If your child does not like what is being served, do not make something else. Allow them to eat what is served.
- You (the parent) determine the selection of foods that your child is allowed to eat and when they are allowed to eat them (while being responsive to your child's needs).

To then make a clear distinction between allowing a child to eat whatever they want and self-regulation of appetite, something similar to the following recommendation could accompany this:

- At mealtimes, allow your child to stop eating when they feel full. Encourage your child to notice their feelings of fullness and hunger. If your child still feels hungry after finishing their meal, allow them to eat more of a healthy food that you determine (eg more salad, vegetables, a piece of fruit or a small glass of low-fat milk).

Finally, a parenting intervention with a behaviour management portion could well benefit families that report high levels of *child control*. This could address dysfunctional parenting, possible non-compliant behaviour and problem food behaviours.

8.2 Strengths

The analyses in this thesis were undertaken in large, reasonably diverse samples. The sample used in Chapters 4 and 5 was one of the largest samples to explore parental feeding practices to date, and the only analysis undertaken in a New Zealand sample. Varied population characteristics make the results readily applicable to the general New Zealand public.

The initial determination of the feeding practices from factor analyses in this sample ensures that these scales were appropriate to use for the subsequent analyses. Furthermore, exploration of the relationships between all three of parental feeding practices, dietary factors, and body weight of children, responded to the need for more investigation of all three pathways together.

Extensive statistical techniques were used to give more robust results, for example the various factor analyses undertaken in Chapter 4 and the bootstrap analysis used in Chapter 5. Additionally, where possible, comprehensive measures were used. An example is the use of the Home Food Inventory to measure home food availability – this is a relatively objective and thorough measure of the food available in the homes of children. Also, the Children's Dietary Questionnaire offered a more robust measure of dietary intake in the overweight sample in contrast to the simple questions used in the full sample of children. The associations with these different dietary measures were then compared and offered further support to some relationships.

To contribute to a greater understanding of the underlying relationships between parental feeding practices and their potential outcomes, an investigation of the links with dysfunctional disciplining practices, problem food behaviours and home food availability was also undertaken. These indicated those practices that might be related to poor child behaviour management by parents, or behaviour difficulties in children. Importantly, these analyses responded to the reported challenges for parents when feeding their child a healthy diet – in particular fussy eating behaviour – and their desire for guidance on how to overcome these. Very few studies to date have examined the links between fussy eating, parental feeding practices and dietary intake previously.

Overall, this thesis contains strong analyses in more than adequate samples, investigating areas that are lacking in the current literature.

8.3 Limitations

The conclusions made in this thesis were limited by the cross-sectional nature of the data. As such, direction of influence could not be determined. However, because the MInT Study includes a two-year intervention that is currently ongoing, longitudinal analysis will be possible in the future. As they stand, these analyses have created a strong base, revealing important associations, and generating questions and theories to explore with that future data.

Despite the large sample and comprehensive exploration into the factor analyses, the scale of *parent pressure* seemed to contain two concepts – *pressure to eat* and *food as a reward*. This made associations difficult to interpret, with a theory arising that it was capturing non-compliant child behaviour. Child behaviour was measured in Phase 2 of the MInT Study but this did not cover child compliance and therefore this theory could not be tested. Although this mixed concept provided some challenges in interpretation, the resulting theories that arose from its associations have provided clear direction for future research and intervention.

Residual confounding could explain some of the associations found. An example of this could be the associations with *parent pressure* that were theorised to have some relation to non-compliant behaviour in children. Indeed, child temperament and behaviour may have confounded other relationships. It must also be noted that while p-values less than 0.05 indicate a very low probability of chance accounting for the resulting associations, this is still a possibility.

Although it would have been useful to have more comprehensive dietary intake data and home food availability measures completed in the full sample of children, there had to be a balance with respondent burden. Fortunately, these measures were available with the smaller sample of overweight children.

When investigating the problem food behaviours of the overweight children, a measure of restrained eating might have given an indication of whether any parental feeding practice could be encouraging unhealthy weight control behaviours in these young children. As this was not included as a measure in this study, it remains unknown. However, as the development of eating disorders in the young is likely to be a complicated process, future research to determine any links with parental feeding practices would ideally be part of a larger stock of measures chosen to enable an accurate understanding of this process. Unfortunately, such examination was well beyond the scope of this thesis.

8.4 Implications and future direction

The results from this thesis contribute important knowledge and deepen the understanding of how parental feeding practices relate to a variety of feeding outcomes in children. Any recommendation to increase *healthy eating guidance* would be supported by these analyses. However, the recommendation to avoid restrictive feeding practices for the prevention and treatment of overweight is not supported; if anything, it is contra-indicated by some of the results. Furthermore, *child control* of feeding was related to many adverse behaviours, thus the encouragement of parental control of feeding would be supported. As *child control* may have such detrimental effects (yet to be determined through longitudinal research), the current recommendations to encourage self-regulation of food intake by children, particularly in the treatment of overweight, must be clearly stated so as not to imply increased child freedom of the whole feeding environment. The specific details of how to encourage self-regulation in this population need to be clarified for parents along with clear demonstration of the benefits to children.

The Ministry of Health in New Zealand has recently released a new set of guidelines for healthy eating in children aged 2-12 years (180) (Appendix G). *Healthy eating guidance* is clearly recommended here, with many examples of how to do this. The guidelines also advise against using *food as a reward* and pushing the child to eat. However, under the section "Picky or fussy eating", this advice is given: *Let your child control how much food they eat*. While this is probably referring to the encouragement of self-regulation and only alludes to *how much* food (and not what food and when), the results presented in this thesis do not support this recommendation. Indeed it was shown in children that were fussy eaters that restrictive feeding practices were related to improved dietary intake, and that more parental control and structure of feeding might be beneficial in this group of children, particularly if overweight.

Future analysis can be undertaken in the MInT Study two-year intervention sample to examine long-term effects of these feeding practices, which would lend more evidence to use in the development of recommendations. Factor analyses of the Comprehensive Feeding Practices Questionnaire should be carried out in other populations to confirm

whether the five-factor structure is robust enough to use in other studies. Replicating the analyses undertaken in the overweight sample in a wider sample of children of all sizes could lend support to the associations presented here.

This thesis indicated areas for researchers to investigate, including the possible relationship between fussy eating and weight gain in children. Interventions for fussy eating could look at improving the structure of the home feeding environment. As parents find fussy eating particularly challenging, determining how to improve this could have many benefits. Another area of interest is to ascertain if changing the home food environment alone results in positive change to diet and/or weight. Finally, assessment of whether feeding practices are linked to future eating disorders or precursor behaviours – such as restrained eating – could improve confidence in how to guide parents appropriately.

Parental feeding practices are an integral part of a child's home food environment and have an important role in the development of children's eating behaviours. Furthermore, appropriate guidance on parental feeding practices could be a valuable element to include when treating overweight in children. Parents *want* more information on how to feed their children and any recommendations given should ideally be supported by evidence. This thesis has considered aspects of the current literature that are lacking and addressed them with analyses in a sample of New Zealand children. These analyses have shown how parental feeding practices are related to diet, weight, problem food behaviours, home food availability and demographics, giving much needed information that can be considered and utilised in the development of recommendations.

9. References

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APPENDICES

Appendix A: Literature review table

Authors and title	Sample	Relevant measures & variables	Study design	Significant results of relevance	Comments
LONGITUDINAL STUDIES					
Birch L, Fisher J & Davison K (2003). *Learning to overeat: maternal use of restrictive feeding practices promotes girls' eating in the absence of hunger.* (27)	n=182 girls Aged 5 years (baseline) American (Caucasian)	- Eating in the absence of hunger (lab) - Restriction, pressure & monitoring (CFQ) - Weight status	Longitudinal: follow-up at 2 and 4 years	- Mothers who used more restriction with overweight daughters were the most concerned about their daughter's weight - Pressure to eat was used more in the non-overweight group - At age 5 there were no effects of restriction on eating in the absence of hunger. At ages 7 & 9 restriction was positively associated with eating in the absence of hunger.	- Birch sample at 4 years
Fisher J & Birch L (2002). *Eating in the absence of hunger and overweight in girls from 5 to 7 y of age.* (46)	n=192 girls Aged 5 years then 7 years American Caucasian	- Restriction (CFQ) - BMI - Measure of hunger - Snack food intake (kJ)	Longitudinal: Follow-up at 2 years	- Girls who ate in the absence of hunger were more likely to be overweight (OR=4.6) - More parental restriction at age 5 was associated with more eating in the absence of hunger at age 7 (OR=2.1)	- Birch sample at 2 years
Lee Y, Mitchell D, Smiciklas-Wright H, & Birch L (2001). *Diet quality, nutrient- intake, weight status, and feeding environments of girls meeting or exceeding recommendations for total dietary fat of the American Academy of Pediatrics.* (47)	n=192 girls Aged 5 yrs (baseline) American Caucasian	- Restriction, pressure & monitoring (CFQ) - BMI - 3 x 24 hr recalls	Longitudinal: follow-up at 2 years	- Higher levels of restriction & pressure seen in girls with a high fat intake. - Restriction & pressure correlated with fat intake (r= 0.16 & 0.17) and BMI (0.20 & -0.20)	- Birch sample at 2 years - Cross-sectional results for CFQ
Rhee K, Coleman S, Appugliese D, Kaciroti N, Corwyn R, Davidson N, Bradley R & Lumeng J (2009). *Maternal feeding practices become more*	n=789 Aged 4 years (baseline) Amercian (ethnically diverse)	- BMI - Controlling feeding practice: "Do you let your child eat what he/she feels like eating?"	Longitudinal: follow up at 3 and 5 years	- More controlling feeding associated with decreased risk of increased BMI z-score in boys (OR=0.52). - Increased BMI z-score in girls between 4-7 years was associated with an increase in controlling feeding practices between 7-9	- Large sample >500 - Controlling increases after weight gain - One question measure

controlling after and not before excessive rates of weight gain. (84)				years (OR=1.72).	
Campbell K, Andrianopoulos N, Hesketh K, Ball K, Crawford D, Brennan L, Corsini N & Timperio A (2010). *Parental use of restrictive feeding practices and child BMI z-score. A 3-year prospective cohort study.* (28)	n=204, 5-6 year old children n=188, 10-12 year old children Med-high maternal education Australian	- Restriction (CFQ) - BMI - Mother's BMI (self-reported)	Longitudinal: follow-up at 3 years	- Baseline restriction a significant predictor of follow-up BMI z-score in 5-6 year old children (B=-0.013). Not in 10-12 year olds.	
Spruijt-Metz D, Li C, Cohen E, Birch L & Goran M (2006). *Longitudinal influence of mother's child-feeding practices on adiposity in children.* (29)	n=121 Mean age 11 years at baseline	- Restriction, pressure & monitoring (CFQ) - Body composition (DXA)	Longitudinal: follow-up average 2.7 years	- African-American parents used more pressure, restriction & monitoring - Parents used less monitoring with girls - No relationships between time and feeding practices with change in fat mass.	
Faith M, Berkowitz R, Stallings V, Kerns J, Storey M & Stunkard A (2004). *Parental feeding attitudes and styles and child body mass index: prospective analysis of a gene-environment interaction.* (61)	n=57 Aged 3 years (baseline)	- Restriction, pressure & monitoring (CFQ) - BMI	Longitudinal: follow-up 2 and 4 years later	- Children with low risk for obesity, monitoring was negatively associated with BMI z-score 2 years later (r=-0.48) - Children with high risk for obesity, restriction positively and pressure negatively predicted with BMI z-score 2 years later	- Small sample
Farrow C & Blissett J (2008). *Controlling feeding practices: Cause or consequence of early child weight?* (181)	n=62 Aged 1 year	- Restriction, pressure & monitoring (CFQ) - Weight	Longitudinal: follow-up 1 year	- Restriction and pressure at age 1 both predicted child weight at age 2 (β=-0.31 & -0.34)	- Small sample - Infants
CROSS-SECTIONAL STUDIES					
Birch L & Fisher J (2000). *Mothers' child-feeding practices influence daughters' eating and weight.* (48)	n=197 girls Aged 5 years American (Caucasian)	- Restriction & Monitoring (CFQ & Restricted access questionnaire) - short-term control of	Cross-sectional	- Restriction was positively related to daughters' short-term control of energy intake (β=0.26) but negatively related to daily energy intake (β=-0.28) -Maternal perceptions of overweight risk	- Birch sample - Positive and negative results for restriction

		energy intake (lab) - 3 x 24 hr diet recalls - weight-for-height		associated with restriction (β=0.30)	
Fisher J, Mitchell D, Smiciklas-Wright H & Birch L (2002). *Parental influences on young girls' fruit and vegetable, micronutrient, and fat intakes.* (49)	n=191 girls Aged 5 years American (Caucasian)	- Pressure (CFQ) - Parents' fruit & vegetable intake (FFQ) - 3 x 24hr diet recalls	Cross-sectional	- Pressure associated with fruit & vegetable intake and micronutrient intake (β=-0.18 & -0.12). - Low levels of pressure with high levels of parental fruit & vegetable intake were associated with highest amount of girls' fruit & vegetable intake.	- Birch sample - Pressure
Vereecken C, Legiest E, De Bourdeaudhuij I & Maes L (2009). *Associations between general parenting styles and specific food-related parenting practices and children's food consumption.* (67)	n=1614 Mean age 11 years Belgian	- Feeding practices: pressure, rewarding, negotiation, catering on demand, permissiveness, avoiding negative modelling & verbal praise -Dietary habits (FFQ) -BMI	Cross-sectional	- Pressure associated with less fruit and more sweets intake (OR=0.80 & 1.37). - Negotiation associated with more vegetable intake (OR=1.23). - Catering on demand associated with less breakfast and vegetable consumption (OR=0.80 & 0.82). - Permissiveness associated with less breakfast, fruit & vegetable consumption and more soft drink and sweets consumption (OR=0.51, 0.79, 0.69, 2.84 & 1.59).	- Very large sample >1500 - Permissiveness & catering on demand
Faith M, Heshka S, Keller K, Sherry B Matz P, Peitrobelli A & Allison D (2003). *Maternal-child feeding patterns and child body weight.* (81)	n=1000+ Aged 3-6 years Ethnically diverse (American)	- Child food choice; child eating compliance; child eating obedience - Child & mother BMI	Cross-sectional	- The lowest categories of child food choice and child eating compliance were associated with lower BMI z-scores	- Very large sample >1000 - Child control construct
Van Strien T, van Niekerk R & Ouwens M (2009). *Perceived parental food controlling practices are related to obesogenic or leptogenic child life style behaviors.* (56)	n=943 Aged 7-12 years Dutch	- Restriction & pressure (KCFQ) - Frequency of fruit, breakfast, and snack consumption	Cross-sectional	- Restriction was related to less snacking (r=-0.28), more breakfast & fruit consumption (r=0.07 & 0.09) and higher BMI (r=0.08). - Pressure was related to lower BMI (r=-0.10) - Both restriction and pressure were associated with leptogenic lifestyle factors	- Large sample >500 - Restriction & pressure leptogenic
Arredondo E, Elder J, Ayala G, Campbell N, Baquero B & Duerksen S (2006). *Is parenting style related to children's healthy eating and physical*	n=812 Mean age 6 years Mexican	- Dietary intake (FFQ) - Monitoring, limit setting, reinforcement, discipline & control - Child & parent BMI	Cross-sectional	- Monitoring, reinforcement & discipline positively associated with healthy eating (β = 0.45, 0.32 & 0.20) - Monitoring, reinforcement & control associated with unhealthy eating (β = -0.17, -0.08 & 0.10)	- Large sample >500 - Identified differences in boys and girls

activity in Latino families? (69)				- Control positively associated with unhealthy eating only in girls (β=0.17) - Limit setting negatively associated with unhealthy eating only in boys (β = -0.15)	
Robinson T, Kiernan M, Matheson C & Haydel K (2001). *Is parental control over children's eating associated with childhood obesity? Results from a population-based sample of third graders.* (83)	n=792 Mean age 8.5 years American, ethnically diverse	- Parental control of feeding (restriction & pressure – PCI) - BMI	Cross-sectional	- Parental control negatively correlated with BMI in girls but not boys (r=-0.12)	- Large sample >500 - Differences in boys and girls
Vereecken C, Rovner A & Maes L (2010). *Associations of parenting styles, parental feeding practices and child characteristics with young children's fruit and vegetable consumption.* (38)	n=755 Mean age 3.5 years Belgian	- Fruit & vegetable intake (FFQ) - Parenting (PS) - Feeding: parent-centred & child-centred (CFSQ) - Child's reactions to food (RFS)	Cross-sectional	- Parent-centred & child-centred feeding practices associated with negative reactions to food (r=0.44 & 0.30) - Parent-centred related to vegetable intake (r=-0.22) - Parent-centred & child-centred positively correlated (r=0.50)	- Large sample >500 - Parent/child-centred
Wardle J, Carnell S & Cooke L (2005). *Parental control over feeding and children's fruit and vegetable intake: How are they related?* (82)	n=564 Aged 2-6 years British	- Fruit & vegetable intake (FFQ) - Parental control of feeding (restriction & pressure - PCI) - Child's eating style (CFNS)	Cross-sectional	- Parental control negatively associated with fruit & vegetable consumption (r=-0.17)	- Large sample >500 - Parental control
Campbell K, Crawford D & Ball K (2006). *Family food environment and dietary behaviors likely to promote fatness in 5-6 year old children.* (66)	n=560 5-6 year old children SES diverse Australian	- Dietary intake (FFQ) - Restriction, pressure & monitoring (CFQ) & modelling	Cross-sectional	- Pressure positively associated with energy intake (kJ/day), high-energy drink consumption and both savoury & sweet snack consumption (B= 458, 1.1, 0.6 & 1.1). - Modelling positively associated with vegetable consumption (B=1.1).	- Large sample>500, diverse - Pressure & modelling
Kroller K & Warschburger (2009). *Maternal feeding strategies and child's food intake: considering weight*	n=556 Aged 1-10 years	- Restriction, pressure & monitoring (CFQ), rewarding, child's control & modelling	Cross-sectional	- Rewarding related to child weight and unhealthy food (β=-0.14 & 0.24). - Restriction & pressure related to child weight (β=0.19 & -0.29).	- Large sample >500 - Restriction, pressure, rewarding & child control

and demographic influences using structural equation modelling. (30)		- Healthy & unhealthy food intake (FFQ) - BMI		- Modeling related to healthy food unhealthy food (β=0.60 & -0.22). - Child's control related to child weight (β=-0.32)	
Brown K, Ogden J, Vogele C & Gibson E (2008). *The role of parental control practices in explaining children's diet and BMI.* (68)	n=518 Aged 4-7 years British	- Pressure (CFQ) - Overt & covert control (meal & snack) - Healthy & unhealthy snack intake (FFQ) - neophobia - BMI	Cross-sectional	- Pressure associated with unhealthy snack intake, neophobia & fruit & vegetable intake (B=0.11, 0.30 & -0.21) - Covert practices associated with unhealthy snacks, neophobia & fruit & vegetable intake (B=-0.27, -0.17 & 0.16) -Overt meal control associated with fruit & vegetables (B=0.11) -Overt snack control positively associated with BMI	- Large sample >500 - Pressure, covert/overt
Carnell S & Wardle J (2007). *Associations between multiple methods of parental feeding and children's adiposity in United Kingdom preschoolers.* (31)	n=439 Aged 3-5 years SES diverse British	- Restriction, pressure & monitoring (CFQ), pushing to eat (PFQ), prompting to eat, emotional feeding & instrumental feeding (PFSQ) -BMI	Cross-sectional	- Monitoring was higher and pressure, pushing to eat, emotional feeding & instrumental feeding were lower in White British. - Pressure & pushing to eat negatively associated with BMI z-score (r=-0.15 & -0.12).	- Good sample - Pressure - Ethnic differences
Vereecken C, Keukelier E & Maes L (2004). *Influence of mother's educational level on food parenting practices and food habits of young children.* (42)	n=316 Aged 2-7 years Belgian	- Eating habits (FFQ) - permissiveness, pressure, reward, praise, negotiation, encouragement, discouragement, catering on demand& avoiding negative modelling - maternal education	Cross-sectional	- Higher educated mothers are less permissive, praise, negotiate and avoid negative modelling more and discourage less. - Permissiveness, catering on demand & reward were associated with less healthy food habits - Pressure, praise, negotiation, encouragement & avoiding negative modelling were associated with healthier food habits	- Permissiveness, catering on demand. - Pressure positive
Ogden J, Reynolds R & Smith A (2006). *Expanding the concept of parental control: A role for overt and covert control in children's snacking behaviour?* (32)	n= 297 & n=61 Aged 4-11 years British	- Overt & covert control - Restriction, monitoring & pressure (CFQ) - Unhealthy & healthy snack intake (FFQ)	Cross-sectional	- Overt & covert control both correlated positively with all of the CFQ practices - Covert control predicted unhealthy snack intake (B=-0.36) - Overt control predicted healthy snack intake (B=0.19)	- Covert/overt control

		- BMI			
Powers S, Chamberlain L, van Schaick K, Sherman S & Whitaker R (2006). *Maternal feeding strategies, child eating behaviors, and child BMI in low-income African-American preschoolers.* (33)	n=296 Aged 2-5 years Low-income African-American	- Restriction & pressure (CFQ) & parental control (PFSQ) - BMI - Maternal BMI (self-reported)	Cross-sectional	- Pressure negatively correlated with BMI z-score (r=-0.16) - Restriction positively associated with BMI z-score with obese mothers (r=0.20) and negatively with non-obese mothers (r=-0.16) - Parental control positively associated with child BMI z-score with obese mothers only (r=0.24)	- Maternal obesity as moderator
Kroller K & Warschburger P (2008). *Associations between maternal feeding style and food intake of children with a higher risk for overweight.* (62)	n=219 Aged 3-6 years Higher representation of low-SES, low education and overweight German	- Restriction, pressure & monitoring (CFQ), rewarding, child's control & modelling - Consumption of problematic foods and fruit & vegetables (questionnaire) - Mother & child BMI	Cross-sectional	- Mothers with higher education used more monitoring. - Mother's used less child control & pressure with overweight children. - Pressure associated with intake of problematic food (B=0.12). - Child's control and rewarding associated with fruit and vegetable intake (B=0.25 & -0.26).	- Child control, pressure, rewarding
Webber L, Hill C, Cooke L, Carnell S & Wardle J (2010). *Associations between child weight and maternal feeding styles are mediated by maternal perceptions and concerns.* (55)	n= 213 Aged 7-9 years Diverse sample (although lower representation of overweight/obese children)	- Restriction, pressure & monitoring (CFQ) - Maternal perception & concern of weight - BMI	Cross-sectional	- As weight category increased, pressure showed a negative trend (r=-0.23) while restriction showed a positive trend (r=0.16). - Restriction mediated the association between concern for overweight and overweight.	- Weight concern a mediator
Spruijt-Metz D, Lindquist C, Birch L, Fisher J & Goran M (2002). *Relation between mothers' child-feeding practices and children's adiposity.* (54)	n=120 Aged 7-14 years Caucasian & African-American	- Restriction, pressure & monitoring (CFQ) - 3 x 24hr recalls - Body composition (DXA)	Cross-sectional	- Pressure correlated to total fat mass (r=0.26) - African-American parents undertook more monitoring, restriction & pressure - Parents monitored boys' eating more than girls' - Pressure was a predictor of total fat mass (β=-0.18)	- Pressure - Sex & ethnic differences
Montgomery C, Jackson D, Kelly L & Reilly J (2006). *Parental feeding style, energy intake and weight status in young Scottish children.* (59)	n=117 Aged 3-5 years Scottish	- Restriction, pressure & monitoring (CFQ) - 3 x 24 hr diet recalls - BMI	Cross-sectional	- Restriction was positively associated with energy intake in boys (r=0.35), not in girls	- Differences in boys and girls

Costa F, Del Pino D & Friedman R (2011). *Caregivers' attitudes and practices: Influence on childhood body weight.* (52)	n=109 Aged 6-10 years Brazilian	- Restriction, pressure & monitoring (CFQ) - BMI - Parent BMI (self-reported)	Cross-sectional	- Higher levels of restriction & monitoring in overweight children. - Higher levels of restriction from overweight parents. - Restriction & pressure associated with overweight (OR= 1.36 & 0.71).	
Hennessy E, Hughes S, Goldberg J, Hyatt R & Economos C (2010). *Parent behavior and child weight status among a diverse group of underserved rural families.* (60)	n=99 Aged 6-11 years Ethnically diverse (Caucasian, African-American, Hispanic)	- Parenting (PDI-S) - Authoritative, authoritarian, indulgent & uninvolved feeding styles (CFSQ) - Restriction, pressure & monitoring (CFQ) - Parent & child BMI	Cross-sectional	- Indulgent feeding style & pressure associated with BMI z-score (B=0.76 &-0.33) - Association between restriction and BMI z-score was moderated by uninvolved feeding style: With an involved feeding style higher restriction was associated with lower BMI z-score (B=-0.63).	
Fisher J & Birch L (1999). *Restricting access to foods and children's eating.* (53)	n=70 Aged 3-5 years American (mixed ethnicity)	- Restriction (mothers' & children's perceptions) - BMI - Snack food consumption (lab)	Cross-sectional	- Restriction associated with weight-for-height in boys (r=0.56) and snack food intake in girls (r=0.59)	- Differences in boys and girls
Blissett J & Haycraft D (2008). *Are parenting style and controlling feeding practices related?* (64)	n=48 Aged 2-5 years British	- Restriction, pressure & monitoring (CFQ) - Parenting style (PSDQ) - BMI	Cross-sectional	- Paternal pressure was negatively associated with child BMI z-score (r=-0.45) - Permissive parenting was negatively associated with monitoring & positively associated with restriction & pressure	
Keller K, Pietrobelli A, Johnson S & Faith M (2006). *Maternal restriction of children's eating and encouragements to eat as the 'non-shared environment': a pilot study using the child feeding questionnaire.* (63)	n=15 pairs of 3-7 year old siblings American (Caucasian, African-American & Hispanic)	- Restriction, pressure & monitoring (CFQ) - BMI	Cross-sectional	- Restriction & pressure were not correlated within the family, but monitoring was - Within families there was less pressure to eat with heavier child (r=-0.8)	- Very small sample
EXPERIMENTAL STUDIES					
Jansen E, Mulkens S & Jansen A (2007). *"Do not eat the red food!" Prohibition of snacks leads*	n=74 Aged 5-6 years European (German, Belgian	- Restriction (CFQ) - Snack food intake (kcal) - Desire to eat, taste &	Experimental: prohibition and no-prohibition of snack-food	-Children in the prohibition group consumed more of the forbidden food -Children with more parental restriction at home consumed more kilocalories	

to their relatively higher consumption in children. (58)	& Dutch)	satiety (VAS) - Controlled for BMI	eating		
Galloway A, Fiorito L, Francis L & Birch L (2006). *'Finish your soup': Counterproductive effects of pressuring children to eat on intake and affect.* (65)	n=27 Aged 3-5 years American Caucasian, Asian & Hispanic	- Weight of food - Pressure (CFQ) - Positive & negative behavioural observations - BMI	Experimental: Pressure and no pressure	- Greater increases of intake in the no-pressure condition - Those with low parental pressure at home consumed more in the pressure condition and less in the no-pressure condition - Higher levels of parental pressure were negatively associated with BMI percentile - More negative (& positive) comments made by children in pressure condition	- Small sample

FFQ – food frequency questionnaire; CFQ – child feeding questionnaire; lab – assessed in a laboratory setting; PSDQ – parenting styles and dimensions questionnaire; PFQ – preschooler feeding questionnaire; PFSQ – parenting feeding style questionnaire; PDI-S – parenting dimensions inventory-short form; CFSQ – caregivers' feeding styles questionnaire; VAS – visual analogue scale; PCI – parental control index; DXA – dual energy x-ray absorptiometry; KCFQ – kids' child feeding questionnaire; PS – the parenting scale; RFS – reactions to food scale; CFNS – child food neophobia scale.

Appendix B: The Comprehensive Feeding Practices Questionnaire

1 How much do you keep track of the sweet foods (lollies, icecream, cake, biscuits, pastries) that your child eats?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

2 How much do you keep track of the savoury snack foods (potato chips, Cheezels, Rashuns, Burger Rings etc) that your child eats?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

3 How much do you keep track of the high-fat foods that your child eats?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

4 How much do you keep track of the sugary drinks (fizzy, cordials, energy drinks) this child drinks?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

5 Do you let your child eat whatever s/he wants?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

6 At dinner, do you let this child choose the foods s/he wants from what is served?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

7 When this child gets fussy, is giving him/her something to eat or drink the *first* thing you do?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

8 Do you give this child something to eat or drink if s/he is bored even if you think s/he is not hungry?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

9 Do you give this child something to eat or drink if s/he is upset even if you think s/he is not hungry?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

10 If this child does not like what is being served, do you make something else?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

11 Do you allow this child to eat snacks whenever s/he wants?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

12 Do you allow this child to leave the table when s/he is full, even if your family is not done eating?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

13 Do you encourage this child to eat healthy foods before unhealthy ones?

○	○	○	○	○
Never	Rarely	Sometimes	Mostly	Always

14 Most of the food I keep in the house is healthy

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

15 I involve my child in planning family meals

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

16 I keep a lot of snack food (potato chips, cheezels) in my house

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

17 My child should always eat all of the food on his/her plate

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

18 I have to be sure that my child does not eat too many high-fat foods

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

19 I offer my child his/her favourite foods in exchange for good behaviour

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

20 I allow my child to help prepare family meals

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

21 If I did not guide or regulate my child's eating, s/he would eat too much of his/her favourite foods

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

22 A variety of healthy foods are available to my child at each meal served at home

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

23 I offer sweet foods (lollies, ice cream, cake, biscuits) to my child as a reward for good behaviour

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

24 I encourage my child to try new foods

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

25 I discuss with my child why it's important to eat healthy foods

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

26 I tell my child that healthy food tastes good

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

27 I encourage my child to eat less so he/she won't get fat

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

28 If I did not guide or regulate my child's eating, s/he would eat too many junk foods

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

29 I give my child small helpings at meals to control his/her weight

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

30 If my child says, "I'm not hungry," I try to get him/her to eat anyway

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

31 I discuss with my child the nutritional value of foods

Disagree	Slightly disagree	Neutral	Slightly agree	Agree
○	○	○	○	○

32 I encourage my child to participate in grocery shopping

Disagree	Slightly disagree	Neutral	Slightly agree	Agree
○	○	○	○	○

33 If my child eats more than usual at one meal, I try to restrict his/her eating at the next meal

Disagree	Slightly disagree	Neutral	Slightly agree	Agree
○	○	○	○	○

34 I restrict the food my child eats that might make him/her fat

Disagree	Slightly disagree	Neutral	Slightly agree	Agree
○	○	○	○	○

35 There are certain foods my child shouldn't eat because they will make him/her fat

Disagree	Slightly disagree	Neutral	Slightly agree	Agree
○	○	○	○	○

36 I withhold sweets/dessert from my child in response to bad behaviour

Disagree	Slightly disagree	Neutral	Slightly agree	Agree
○	○	○	○	○

37 I keep a lot of sweets (lollies, ice cream, cake, biscuits) in my house

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

38 I encourage my child to eat a variety of foods

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

39 If my child eats only a small helping, I try to get him/her to eat more

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

40 I have to be sure that my child does not eat too much of his/her favorite foods

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

41 I don't allow my child to eat between meals because I don't want him/her to get fat

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

42 I tell my child what to eat and what not to eat without explanation

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

43 I have to be sure that my child does not eat too many sweets (lollies, ice cream, cake, biscuits)

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

44 I model healthy eating for my child by eating healthy foods myself

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

45 I often put my child on a diet to control his/her weight

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

46 I try to eat healthy foods in front of my child, even if they are not my favourite

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

47 I try to show enthusiasm about eating healthy foods

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

48 I show my child how much I enjoy eating healthy foods

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

49 When he/she says he/she is finished eating, I try to get my child to eat one more (two more, etc.) bites of food

○	○	○	○	○
Disagree	Slightly disagree	Neutral	Slightly agree	Agree

Appendix C: The Children's Dietary Questionnaire

1 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	

2 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)	○ Corn	○ Kumara/sweet potato
○ Peas and beans	○ Spinach/Silverbeet	○ Lettuce
○ Tomato	○ Cucumber	○ Celery
○ Capsicum	○ Mushroom	○ Eggplant
○ Zucchini/Courgette	○ Squash	○ Parsnip/Taro/Yams
○ Mixed frozen vegetables	○ Other vegetables	

○ Legumes (chickpeas, lentils, kidney beans, baked beans)

○ Vegetables in mixed dishes (soups and stews)

Questions 3 to 13 ask about the <u>past 24 hours</u> only. How often has your child had each of the following food/drink items in the <u>past 24 hours</u>?

3 Fruit juice / fruit drink

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

4 Water

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

5 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

6 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

7 Cheese and / or cheese spreads

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

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

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

9 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

10 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

11 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

12 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

13 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 14 to 29 asks about the <u>past 7 days</u>. How often has your child had each of the following food/drink items in the <u>past 7 days</u>?

14 Peanut butter or Nutella

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

15 Pre-sugared or "fancy" cereals (eg Coco Pops, Fruit Loops)

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

16 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 <u>past 7 days</u>?

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

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

18 Lollies, muesli or fruit bars

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

19 Chocolate (bar/block/coated biscuits)

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

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

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

21 Ice-cream or Ice-blocks

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

22 Cheese and/or cheese spreads

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

23 Pie, pastry, sausage roll or spring roll

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

24 Pizza

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

25 Hot chips or French fries

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

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

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

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

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

28 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

29 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

Appendix D: The Lifestyle Behaviour Checklist

To what extent has this behaviour been a problem for you with your child in the last month? *Please circle the appropriate number.*

1 Eats too quickly

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

2 Eats too much

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

3 Eats unhealthy snacks

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

4 Whinges or whines about food

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

5 Yells about food

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

6 Throws a tantrum about food

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

7 Refuses to eat certain foods (ie. fussy eating)

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

8 Argues about food (eg. when you say “no more”)

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

9 Demands extra helpings at meals

1	2	3	4	5	6	7
Not at all		A little	Somewhat	Much		Very much

To what extent has this behaviour been a problem for you with your child in the last month? *Please circle the appropriate number.*

10 Requests food continuously between meals

1	2	3	4	5	6	7
Not at all		A little	Somewhat	Much		Very much

11 Demands food when shopping or on outings

1	2	3	4	5	6	7
Not at all		A little	Somewhat	Much		Very much

12 Sneaks food when they know they are not supposed to

1	2	3	4	5	6	7
Not at all		A little	Somewhat	Much		Very much

13 Hides food

1	2	3	4	5	6	7
Not at all		A little	Somewhat	Much		Very much

14 Steals food (eg. from other children's lunchboxes)

1	2	3	4	5	6	7
Not at all		A little	Somewhat	Much		Very much

15 Eats food to comfort themselves when feeling let down or depressed

1	2	3	4	5	6	7
Not at all		A little	Somewhat	Much		Very much

16 Watches too much television

1	2	3	4	5	6	7
Not at all		A little	Somewhat	Much		Very much

17 Plays too many computer games

1	2	3	4	5	6	7
Not at all		A little	Somewhat	Much		Very much

18 Complains about doing physical activity (eg. this is boring, I'm too tired, my leg hurts)

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

To what extent has this behaviour been a problem for you with your child in the last month? *Please circle the appropriate number.*

19 Refuses to do physical activity

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

20 Complains about being unfit or feeling low in energy

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

21 Complains about being overweight

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

22 Complains about being teased

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

23 Complains about not having enough friends

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

24 Complains about being unattractive

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

25 Complains about not fitting into clothes

1	2	3	4	5	6	7
Not at all	A little		Somewhat	Much		Very much

Appendix E: The Home Food Inventory

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

Appendix F: Modifications to the Home Food Inventory

As the Home Food Inventory (HFI)(21) was designed for use in the United States, the checklist required modification for use in a New Zealand population. With assistance from two New Zealand dietitians, alterations were made to the list of foods to ensure that it represented the majority of foods that would be found in the homes of New Zealand families. Furthermore, changes to the order and categories of food were made to improve ease of completion of the checklist, such as grouping canned foods together, and also to address any obvious 'bad food' versus 'good food' category perception. To limit the items on the checklist to a reasonable number, variety within food types was reduced; for example the number of oils was reduced to just one item described as: *Oil (such as olive, canola, vegetable)*. However, for the food groups described in the Children's Dietary Questionnaire (CDQ)(150) as *fruit and vegetables*, *non-core foods*, *fat from dairy,* and *sweetened beverages* the variety of choices was expanded so that reasonable comparisons between the HFI and the CDQ could be made.

The candidate and a New Zealand dietitian visited three main supermarkets in Dunedin (New World, Woolworths and PAK'nSAVE) throughout October 2009, to establish that all relevant foods were represented in the checklist. The following table shows the difference in the categories, with additional notes explaining the variation between the original HFI (21) and the modified version.

Comparison between original and modified versions of the Home Food Inventory	
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) *Not so many cheese varieties included.* *Includes coconut cream (and lite), soy milks and some frozen desserts.* *Oils moved to 'meal ingredients'.*
Salad dressing (2 items) **Condiments** (4 items + 'others') Total (6 items)	**Other meal ingredients** (8 items) *Includes salad dressings, oils, cake mixes, sauces and pasta sauces.*
Vegetables (20 items)	**Vegetables** (34 items) *Extra: baked beans, brussel sprouts, chickpeas, courgette/zucchini, eggplant/aubergine, kidney beans, lentils, onions, other legumes, parsnip, radish, sprouts, taro, yams.*
Fruit (26 items)	**Fruit** (27 items) *Dried fruit now as a separate option.*
Deli, Luncheon, sandwich meat and sausage (6 items) **Meats and other protein** (10 items) Total (16 items)	**Meat** (14 items) *Eggs, tofu and legumes now in other categories.*
Frozen desserts (7 items) **Microwave or Quick-cook frozen foods** (8 items) Total (15 items)	**Other chilled/frozen foods** (14 items) *Includes eggs, tofu, prepared salads, fresh pasta, fresh sauces, fresh soups, frozen snacks, iceblocks, and sweet pies*
Bread (12 items)	**Bakery** (13 items) *Includes cakes, scones, biscuits, desserts, slices.* *Reduced bread options to two.*
Prepared desserts (8 items) **Chips, crackers and other snack foods** (18 items + 'others') **Candy** (5 items) Total (31 items)	**Snacks** (17 items) *Most of 'prepared desserts' is now in 'bakery'.* *Did not include any low-fat options for chips (not really an option in NZ).*
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) *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)*
Total (167 items)	**Total (192 items)**

Scoring of the modified Home Food Inventory

In most cases, the obesogenic scoring for the HFI was kept consistent with the original – that is, giving an obesogenic score to foods that are high in fat and/or sugar and foods that are the regular fat version of which there are lower fat alternatives (eg milk and cheese) (21). However, to represent nutritional recommendations aimed at New Zealand children, the Food and Beverage Classification System for Years 1-13 (151) was also consulted. From this, if a food were categorised as an *everyday food*, an obesogenic classification would be negated. The following foods were affected by this and were no longer classed as obesogenic: cottage cheese, nuts and seeds, popcorn, soy or rice milk.

Foods that were not in the original HFI were considered obesogenic if they were i) considered a *non-core food* in the CDQ (150) or ii) categorised as an *occasional food* in the Food and Beverage Classification System (151). The only exception to these rules was that in the modified HFI margarine and oils were considered not obesogenic, contrary to the original HFI, due to their *better choice* (to butter and other cooking fats) classification in the Food and Beverage Classification System (151).

Foods with an obesogenic classification	
Original HFI (Fulkerson *et al's* criteria) Regular fat versions of cheese, milk, yoghurt, other dairy, frozen desserts, prepared desserts, savoury snacks, added fats; regular-sugar beverages; processed meat; high-fat quick, microwavable foods; candy. Range: 0-71	**Modified HFI** Regular fat versions of cheese, milk, cream, butter, yoghurt, ice-cream; desserts; regular sugar beverages; processed (and canned) meat; high fat quick cook microwavable food (including instant noodles); biscuits, cakes (and mixes); sweet or high fat breads; high fat or high sugar snacks; hazelnut spread & peanut butter; mayonnaise; lard or cooking fat. Range: 0-63

Appendix G: Eating for healthy children aged 2-12 years

(FROM: https://www.healthed.govt.nz/resource/eating-healthy-children-aged-2-12ng%C4%81-kai-t%C5%8Dtika-m%C5%8D-te-hunga-k%C5%8Dhungahunga)

Food information for children aged 2 to 12. Includes healthy eating, daily physical activity, good eating behaviours, food groups and variety, healthy food including fruit and vegetables, vitamins and protein, vegetarian options, healthy snacks, drinking plenty of fluids, and limiting takeaways.

Everyone needs to be active and eat well to be healthy. Being healthy increases your quality of life and your sense of wellbeing.
This booklet gives advice for parents, whānau and caregivers on the types of food children need to eat to be healthy. It also describes how children can be active in everyday life.

Teach children to make healthy food choices

Do more of these

Make mealtimes fun – where family/whānau can catch up and share their day.
Have meals together as a family (when possible) and turn off the TV and cellphones.
Have meals at times that suit children – this may mean having meals earlier than you are used to.
Provide three healthy meals every day, including breakfast.
Provide a wide variety of healthy foods for children to choose from.
Take your children food shopping and encourage them to choose healthy foods, such as fruit and vegetables, for the trolley.
Encourage children to try new foods.
Make preparing food fun – involve children from an early age and let them do more as they get older.
Make children's serving sizes smaller than an adult's – most children don't need to eat as much as adults.
Encourage family members to stop eating when they feel full.
Offer healthy snacks (low in fat, salt and sugar) between meals.

Do less of these

Keep takeaways for occasional meals only (less than once a week), not as everyday foods.
Limit fruit juice and dried fruit – they contain a lot of sugar.

Don't do these

Don't use rewards or force or push a child to eat.
Don't encourage continuous eating or grazing – stick to set meal and snack times.
Be a positive role model – if you make healthy food choices, then your children are more likely to do the same.

Offer many different foods

Children need to eat many different foods to be healthy and to grow. The four main food groups contain a mixture of carbohydrate, fat, protein, vitamins and minerals – all of which children need as they grow.
Choose a variety of foods from the four food groups every day:
vegetables and fruit
breads and cereals
milk and milk products
lean meats, chicken, seafood, eggs, legumes,* nuts and seeds.
* Legumes include cooked dried beans, peas and lentils.

Note that the serving sizes in this booklet may be too big for younger children to eat in a single meal. You can divide one serving into several smaller amounts for your child to eat throughout the day.

Vegetables and fruit

Vegetables and fruit provide carbohydrate, fibre, vitamins and minerals and are low in fat. They should be eaten with most meals and are good snack foods.

Choose fresh, frozen or canned vegetables and fruit. Buying "in season" vegetables and fruit keeps their costs down.

Offer a mixture of raw and cooked vegetables and fruit with the meal or snack.

Provide many different coloured vegetables and fruit; for example, tomato or strawberry, broccoli or kiwifruit, carrot or mandarin, eggplant or plum, potato or pear.

Dried fruit and fruit juice are not recommended because they contain a lot of sugar. If used, only offer children up to one serving each day. One serving is 25g of dried fruit (eg, 3 dates or 2 tablespoons of raisins) or 1 cup of diluted fruit juice (1⁄2 cup of water plus 1⁄2 a cup of juice).

What is one serving?

Vegetables

1 medium potato, taro or kūmara (135 g)
1⁄2 cup of cooked vegetables (50–80 g)
1⁄2 cup of salad (60 g)
1 tomato (80 g)

Fruits

1 apple, pear, banana or orange* (130 g)
2 small apricots or plums (100 g)
1⁄2 cup of fresh fruit salad (120 g)
1⁄2 cup of stewed or canned fruit (135 g)

* Some raw vegetables and fruit may be too hard for young children to chew and grind up well. See the Young children and choking section.

How much do they need?

Preschoolers (from 2 years until their 5th birthday): At least 2 servings of vegetables and 2 servings of fruit each day.

Schoolchildren (5–12 years): At least 3 servings of vegetables and 2 servings of fruit each day.

Breads and cereals

Children need to eat breads and cereals every day, as these are the best source of energy for the body.

These foods include breads, breakfast cereals, rice, noodles and pasta. They provide carbohydrate (which can be an important source of energy and fibre) and some vitamins and minerals.

Breads and cereals are healthy snack foods for schoolchildren.

Include wholegrain varieties (eg, rolled oats, brown rice or bread with whole grains), as they are higher in fibre, vitamins and minerals.

What is one serving?

1 roll (50 g)
1 medium slice of bread (26 g)
1 medium slice of rēwena bread
1 cup of cornflakes or rice bubbles (30 g) or 2 breakfast wheat biscuits (34 g)
1⁄2 cup of cooked cereal (eg, porridge) (130 g)
1 cup of cooked pasta, noodles or rice (150 g)
1 cup of cassava or tapioca
2 plain sweet biscuits (14 g)

How much do they need?

Preschoolers: At least 4 servings every day.

Schoolchildren: At least 5 servings every day.

Milk and milk products

Milk provides energy, protein, and many vitamins and minerals, including calcium. Children and preschoolers need milk and milk products to help build strong bones and teeth.

When children are 2 years of age, you can choose to gradually introduce reduced-fat (light blue lid) and low-fat (yellow or green lid) milk and milk products.
Encourage children who don't drink milk to eat other milk products such as yoghurt, low-fat home made fruit smoothies, custard, milky soups, and cheese.

What is one serving?

1 cup of reduced- or low-fat milk (250 ml)
1 pottle of reduced- or low-fat yoghurt (150 g)
2 slices or 1⁄2 cup of grated cheese, eg edam (40 g)

How much do they need?

Preschoolers and schoolchildren: At least 2–3 servings every day.

Lean meats, chicken, seafood, eggs, legumes, nuts and seeds

These foods all contain protein, which is important for children's growth. They also contain fat and many different vitamins and minerals – especially iron, which is important for the blood and brain. The body absorbs iron from lean meats, chicken and seafood (ie, from animals) more easily than iron from plants such as legumes.*
To help absorb iron, include foods rich in vitamin C with meals. Fresh fruits and vegetables, especially oranges, kiwifruit, tomatoes and broccoli, are rich sources of vitamin C.
To reduce the amount of fat, buy lean meat (when possible), cut off any fat you can see from meat and chicken, and remove the chicken skin after cooking. Children need to eat some fat, but too much can lead to health problems later in life.
Limit processed meats, such as luncheon, salami, bacon and ham, as they are usually high in fat and/or salt.
* Legumes include cooked dried beans, peas and lentils.

What is one serving?

2 slices of cooked lean meat (100 g), eg roast lamb, chicken, beef or pork
3⁄4 cup of mince or casserole (195 g)
1 medium fillet of fish or steak (100–120
2 chicken drumsticks or 1 chicken leg
1 medium pāua or kina (100–120 g)
1 egg
3⁄4 cup of cooked dried beans (eg, baked beans)
1/3 cup of nuts or seeds† (50 g)
3⁄4 cup of tofu (200 g)

How much do they need?

Preschoolers and schoolchildren: At least 1 serving every day.
Vegetarian preschoolers: At least 1–2 servings of legumes, nuts or seeds†.
Vegetarian schoolchildren: At least 2 servings of legumes, nuts or seeds†.

Vegetarians

Well balanced vegetarian diets need to include a range of vegetables and fruit, breads, cereals, legumes (dried peas, beans and lentils), milk products, eggs, nuts and seeds†. If your child does not drink cow's milk, offer soy milk with added calcium and vitamin B12. If you are concerned that your child isn't getting a balanced diet, ask a dietitian or registered nutritionist for advice. For more information, see the Ministry of Health booklet Eating for Healthy Vegetarians).
† To reduce the risk of choking, do not give small hard foods – such as whole nuts and large seeds – until children are at least 5 years old. See the Young children and choking section.

Small meals and snacks

Children need to eat regularly during the day. To meet their growth and energy needs, provide three meals and two or three snacks during the day. Snacks should not take the place of a meal, but think of them as a mini-meal that supplies energy, protein, vitamins and minerals.
Choose healthy snacks that are low in fat, salt and sugar.

Healthy snack suggestions

Vegetable sticks* – keep these in the fridge. Serve with cottage cheese or hummus.
Cold cooked vegetables – cook a few extra potatoes, kūmara and taro at mealtimes.
Fresh fruit* – serve whole or cut up with yoghurt.
Frozen fruit – bananas, oranges, canned unsweetened pineapple or peaches.

Sandwiches – banana, yeast- based spread, cheese, cottage cheese, baked beans or jam. Spread margarine or butter thinly. You can also use bread, bread rolls, rēwena bread, crackers, rice cakes, crumpets, pita bread, toasted muffins and baked bread fingers.
Toasted English muffins, crackers, fruit buns, scones, fruit bread, pancakes.
Cereals – choose cereals that are low in fat and sugar.
Popcorn – pop using a little oil, margarine or butter or use a microwave. Don't give popcorn to children under 3 years of age.*
Yoghurt, milk or slices of cheese.
* The size or texture of some foods may need changing. See the Young children and choking section.

Picky or fussy eating

Picky or fussy eating is common in young children – but most will eat when they are hungry. Try the ideas listed at the beginning of this resource. You may need to offer new foods many times before your child will eat them. Young children can have up to 2 cups (500 ml) of milk a day – if they have too much milk they may not eat enough food to keep them healthy.
Let your child control how much food they eat – make mealtimes fun rather than a battleground.
Talk to your doctor if you are worried about your child's picky eating.

Young children and choking

It's quite easy for young children to choke on food. This is because they are still learning how to chew and grind food well.
To reduce the risk of choking:
always make sure young children sit down to eat and that an adult is with them while they are eating or drinking
offer food that matches their ability to chew and grind
if you need to make chewing and grinding easier, change the texture of the food – grate, cook, finely chop or mash it
remove the high-risk parts of the food – peel off the skin or remove any strong fibres
avoid giving small hard foods, such as whole nuts and large seeds, until children are at least 5 years old.

Having plenty to drink

Children need plenty of water to keep their bodies working. They need to drink more when they are active and when it's hot.
Children need lots of small drinks through the day. Keep offering drinks, as they may forget to drink when they are active and become dehydrated (lose too much water), which can be serious for young children.

Give more of these

Water is best – it's cheap and easy to get. Keep a jug of cold water in the fridge.
Milk is also a good drink for children because it contains energy, protein and many vitamins and minerals. Serve milk after meals or as part of a healthy snack between meals.

Give less of these

Fruit juice is not recommended as it is high in sugar, which can cause tooth decay. If using, dilute juice with water (at least 1⁄2 a cup of water to every 1⁄2 a cup of juice) and have it with a meal rather than on its own. This may help to protect teeth from the sugar.
Soft drinks are high in sugar and and sometimes contain caffeine. They should be 'occasional' drinks (less than once a week).

Don't give these

Don't give tea or coffee to children. The caffeine in tea and coffee can affect children's sleep and cause dehydration. Other substances in tea and coffee can reduce the amount of iron children can absorb from food.
Don't give energy drinks, energy shots or drinks containing guarana. They contain caffeine and many are high in sugar.

Foods that are high in fat, sugar or salt

Children need healthy food most of the time. It's all right to eat foods that are high in fat, sugar or salt occasionally (less than once a week), but not every day. Too much of these foods can cause health problems such as obesity (being very overweight), diabetes and high blood pressure.
Foods that are high in fat, sugar or salt include muesli bars, sweets/lollies, fruit leathers and roll-ups, potato chips, chocolates, sweet biscuits, meat pies, takeaways and soft drinks.

Choose healthier takeaways

Most takeaways are high in fat and salt. Have them on special occasions and not as an everyday food. Some lower fat takeaways include:
kebabs and wraps
pizza with more vegetables than cheese
sushi
pasta with tomato-based sauces
thick chunky chips or wedges instead of thin chips
rice- and noodle-based takeaways (not fried) with lots of vegetables
baked potatoes with meat, beans and salad.

Reading food labels

Food labels have a lot of information on them, some of which may help you to make healthy food choices. To find out more about reading food labels, see the Ministry for Primary Industries' web page.

Food allergies and intolerances

Food allergies and intolerances may affect 4–8 percent of children, although many children outgrow them over time. For more information, see the Ministry for Primary Industries' resource Eating Safely when you have Food Allergies and Allergy New Zealand's website. If you suspect your child may have a food allergy or intolerance, it's important you talk to your doctor about it.

Children should be active every day

Regular physical activity keeps children healthy. Children should do at least 60 minutes of moderate to vigorous activity per day. Sixty minutes a day will help your child:
develop strong muscles, bones and joints
improve their balance and flexibility
develop and maintain a healthy heart and lungs
maintain a healthy weight
have fun, make friends and feel good about themselves.
Aim for lots of moderate and some vigorous activities.

Moderate activities	**Vigorous activities**
Children are breathing faster and their hearts are beating a bit more. They can still talk!	Children are puffing and their hearts are beating faster. They can only say a few words without taking a breath.
Walking the dog Biking on the flat Playing at the park or pool Ballet, modern dance Kapa haka Skateboarding	Running games Mountain biking Uphill tramping Fast lap swimming Summer and winter sports Waka ama

Look for ways to encourage activity

Provide opportunities for children to be active in everyday life, through play, cultural activities, dance, sport, recreation, jobs, household tasks and moving from place to place (eg, on a bike, walking, scooting or skateboarding).
Try different activities to find the ones that they enjoy. Support children in their activities and give feedback and praise.
Do activities as a family and involve everyone in deciding what to do.

Turn off the TV and the computer

As well as encouraging children to be active in as many ways and as often as possible, reduce 'screen time' to less than 2 hours per day.

Be a role model

If you are active in everyday life, your children are more likely to be active too.

For more information

Talk to your:

doctor, practice nurse or public health nurse
local District Health Board and ask for the Public Health Service or a dietitian
dietitian (in the Yellow Pages) or registered nutritionist
marae-based health services and/or Māori health workers
Pacific health workers.