The Development of a Fruit and Vegetable Liking Tool for Preschool Aged Children

A thesis presented in partial fulfilment of the requirements for the degree of

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Abstract

The aim of this research is to develop a fruit and vegetable liking tool for use in caregivers and preschoolers that is a good representation of the preschooler's actual fruit and vegetable intake. Accurate assessment of young children's dietary intake is increasingly important, as evidence has linked diet with future health and wellbeing. Young children's food intake can be difficult to assess, as they lack many skills and concepts to report on their intake. Food liking may provide an indication of dietary intake. A cross-sectional validation study of 101 children, aged 51.40 ± 6.35 months (mean ± SD), and their caregivers, was conducted to assess children's fruit and vegetable liking using a newly developed caregiver's liking tool, and a children's liking tool. A 5-point scale was used for the children, and a continuum scale for the caregivers. The maximum liking and disliking scores were 45 and - 45 respectively. The tools were compared and validated against a fruit and vegetable intake record.

The total mean liking score was 18.53 ± 12.34 out of a possible liking score of 45 for the children's tool compared with 17.46 ± 9.65 for the caregiver's tool. The children's and caregiver's results showed a higher liking of fruit (24.20 ± 15.24 and 29.17 ± 10.73) than vegetables (11.06 ± 18.16 and 6.13 ± 12.84) respectively. The children's daily mean intake of fruits and vegetables was 7.27 ± 3.03 servings, composed of 3.87 ± 1.77 servings for fruit, and 3.39 ± 1.78 servings for vegetables.

The children's and caregiver's tools were moderately correlated with each other ($r=0.284$, $P<0.001$). The caregiver's tool was validated against the intake record ($r=0.350$, $P<0.001$), but the children's tool was not ($r=-0.066$, $P=0.512$). Both the caregiver's and children's tools showed high reproducibility ($r=0.874$, $P<0.001$ and $r=0.691$, $P<0.001$) respectively.

This study provides evidence that a caregiver's fruit and vegetable liking tool may be used to assess liking and intake of fruit and vegetables in preschool aged children. The

children’s fruit and vegetable liking tool may also be useful to assess their liking of fruits and vegetables.

Preface

This validation study was conducted at the Institute of Food, Nutrition and Human Health, Massey University, Auckland, New Zealand. The child's fruit and vegetable liking tool, the caregiver's fruit and vegetable liking tool and the fruit and vegetable intake record were developed by this candidate. Assessment of validity of these tools and intake record (as part of The Development of a Fruit and Vegetable Liking Tool in Preschool Aged Children study) took place between May 2013 and July 2013, and was carried out by one MSc student, this candidate. The candidate's supervisors, Dr Rozanne Kruger and Dr Kathryn Beck were responsible for the concept and overall study design.

Acknowledgements

This research was completed with the help and support of many people, without which it would not have been achieved.

Firstly, I would like to thank the 101 children and their caregivers, who took the time out of their busy lives and were so enthusiastic about this study.

Secondly, I would like to thank my wonderful supervisors, Dr Rozanne Kruger and Dr Kathryn Beck, for their knowledge, guidance and support throughout this research and thesis process.

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Finally, I would like to thank my parents, who have supported me my whole life, without them I would not have been able to achieve what I have.

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List of Abbreviations

BMI	Body Mass Index
CADET	Child and Diet Evaluation Tool
CHD	Coronary Heart Disease
CVD	Cardiovascular Disease
df	Degrees of Freedom
DLW	Doubly Labelled Water
FFQ	Food Frequency Questionnaire
FR	Food Record
ICC	Intra Class Correlation
Kw	Weighted Kappa
MUHECN	Massey University Human Ethics Committee - Northern
n	Number of Participants
NZ	New Zealand
NZEO	New Zealand European and Other
OECD	Organisation for Economic Co-operation and Development
P-value	Probability Value
r	Pearson's Correlation Coefficient
SD	Standard Deviation
t	T-test Statistic
T2DM	Type 2 Diabetes Mellitus
TEE	Total Energy Expenditure
UK	United Kingdom
USA	United States of America

CHAPTER ONE

Introduction

1 Introduction

Growing up involves learning, and developing new skills and habits. Children are constantly learning new things, discovering their likes and dislikes, and are exposed to a wide range of stimuli. Children between the ages of two and 24 months experience a large period of growth and development, this is when children are learning about food, and are developing fine and gross motor skills that are needed for eating (Carruth & Skinner, 2002). These skills include sitting, crawling, reaching for food, using fingers to self-feed, along with oral motor control development (opening mouth for approaching food, lateral movement of the tongue, chewing and swallowing) (Carruth & Skinner, 2002). By the time a child has reached the preschool age (three to five years), these skills have truly developed, and the child will be proficient in self-feeding. Children of this age are also able to express likes and dislikes.

Liking can be described as 'a feeling of fondness towards something'. In theory if a child likes something, they will want more of it. Therefore, if a child likes a certain fruit or vegetable, they will most likely communicate this to their caregiver, and if provided with the opportunity, will consume more of these fruits and vegetables. Out of all foods, vegetables are the hardest for children to like and accept (Brug, Tak, Velde, Bere, & de Bourdeaudhuij, 2008; Dovey, Staples, Gibson, & Halford, 2008; Wardle, Guthrie, Sanderson, Birch, & Plomin, 2001), as some taste bitter and most children experience mild neophobia. Food neophobia is the avoidance of new foods, which is an innate response to protect the child from ingesting potentially harmful foods (Dovey et al., 2008). This can often be linked to bitter or sour foods such as some vegetables and fruits (Dovey et al., 2008). Caregivers are often keen for their children to eat more fruits and vegetables, as they know they are nutritious. Fruit and vegetable intake has been linked to a reduced risk of many diseases, as they contain many nutrients necessary for health (Cooper et al., 2012; Riboli & Norat, 2003; Van Duyn & Pivonka, 2000). Fruit and vegetables may displace unhealthy foods from the diet, which can

have a positive outcome on weight and obesity, in both children and adults (Buijsse et al., 2009; Tohill, 2007).

According to the World Health Organization (1999, 2003), obesity rates worldwide are increasing at an alarming rate. This is of concern, as obesity is a key risk factor for many non-communicable diseases such as type 2 diabetes mellitus (T2DM), cardiovascular disease (CVD), hypertension, some cancers, and also premature death (Dauchet, Amouyel, Hercberg, & Dallongeville, 2006; Joshipura et al., 2001; Van Duyn & Pivonka, 2000; Waters et al., 2011; World Health Organization, 1999). Childhood obesity is the number one health-related problem in the developed world, and is also increasing in the developing world (Ebbeling, Pawlak, & Ludwig, 2002). New Zealand (NZ) has the third highest prevalence of overweight and obesity in adults in the Organisation for Economic Co-operation and Development (OECD) countries (Sassi & Devaux, 2012). Childhood overweight and obesity continues to rise in NZ, with 30 percent of New Zealand and other (NZEO), 48 percent Māori, and 65 percent Pacific children overweight or obese in 2008 (Clinical Trials Research Unit & Synovate, 2010).

Prevention of childhood obesity is extremely important, as obesity can carry on into adulthood, along with all the associated health issues (Mossberg, 1989; Nieto, Szklo, & Comstock, 1992; Waters et al., 2011; World Health Organization, 1999). Several epidemiological and intervention studies in adults (Buijsse et al., 2009; Tohill, 2007) and children (Epstein et al., 2001) have shown an increased intake of fruit and vegetables to be associated with decreased body weight. Epstein et al., (2001) also suggested that an increased intake of fruit and vegetables displaces energy dense foods that are high in fat and sugar from the diet. This may be because fruit and vegetables are high in fibre, and fibre has the ability to satiate, and thereby reduce food intake (World Health Organization, 1999).

Worldwide, fruit and vegetable intake is low, and the majority of children do not meet baseline dietary recommendations for fruit and vegetable intake (World Health Organization, 2003). In the United States of America (USA), Dennison et al., (1998) have shown that as many as 20 percent of preschoolers do not meet the recommendations for fruit intake and 75 percent do not meet their recommendations for vegetable intake. In NZ, 60 percent of children aged five to 14 years did not meet the recommendations for fruit, and 40 percent did not meet the recommendations for vegetable intake in 2002 (Ministry of Health, 2003b). Seventy seven percent of children aged five to 14 years did not meet the recommendations for fruit and vegetable intake in 2008 (Clinical Trials Research Unit & Synovate, 2010).

Habits that are started young have the potential to affect lifelong health, including dietary habits such as fruit and vegetable intake (Birch & Anzman-Frasca, 2011). There are many factors that influence food intake, including food preferences, accessibility and availability, parental preferences, social factors and health and nutrition knowledge (Brug et al., 2008). Food preferences have been shown to be the main influencing factor in choosing foods (Bere & Klepp, 2005; Cooke & Wardle, 2005; Domel et al., 1996; Rasmussen et al., 2006). Food preferences are formed at a young age, and are often transferred through to adulthood (Nicklaus, Boggio, Chabanet, & Issanchou, 2004, 2005). Parental preferences have also been strongly associated with children's preferences (Howard, Mallan, Byrne, Magarey, & Daniels, 2012). Any aversions or dislikes to certain foods that the parents have could possibly be detrimental to the development of food preferences in children (Howard et al., 2012).

Children prefer sweet and often salty foods, but tend to dislike bitter and sour foods (such as many vegetables) (Dovey et al., 2008), this is known as food neophobia. Neophobia can make it difficult to encourage children to increase their fruit and vegetable intake, as they often do not like the taste of some fruits and many vegetables (Brug et al., 2008; Dovey et al., 2008). Aversion to bitter and sour foods is very strong,

peaking between two and six years of age (Dovey et al., 2008), and has been shown to be associated with lower intakes of fruit, vegetables and protein (Cooke, Haworth, & Wardle, 2007; Wardle & Cooke, 2008). However, early familiarisation of foods (with repeated exposure) can change the eating habits and preferences of children (Birch & Anzman-Frasca, 2011; Worobey, Ostapkovich, Yudin, & Worobey, 2010). Cooke (2007) suggested that children "like what they know, and eat what they like", so familiarisation of foods at a young age is crucial in overcoming the normal response of neophobia to food. It is well documented that it can take ten or more exposures to a food to gain acceptance (Resnicow et al., 1997), which is another reason why repeat exposure is so important.

The accurate assessment of dietary intake in children, especially fruit and vegetable intake, is increasingly important, as evidence shows diet can influence future health and wellbeing (Ministry of Health, 2003a; Van Duyn & Pivonka, 2000). Dietary assessment of young children poses a challenge, as children are still developing many skills and processes to be able to answer questions about diet accurately, including the development of recall skills (Baxter, 2009; Livingstone, Robson, & Wallace, 2004). Furthermore, children are not as aware of their dietary intake as adults, and they also lack a concept of time and the attention span to complete dietary assessments accurately (Chambers & Johnston, 2002; Livingstone & Robson, 2000; Livingstone et al., 2004). Young children generally require help from their parent or caregiver to accurately recall intake and quantities of foods eaten (Emmett, 2009). From the age of seven to eight years, a child's awareness of food intake and the concept of time start to develop, and their memory and attention span increase (Chambers & Johnston, 2002; Livingstone et al., 2004). From the age of 12 years, children are able to estimate portion sizes, and recall their intake, with minimal adult help (Livingstone et al., 2004).

Only eleven studies have validated dietary assessment tools in young children, these studies have been summarised in table 1.1, and validate a range of dietary assessment

methods. Due to the lack of validated tools for every population in young children, adult tools are sometimes used instead (Shatenstein, Amre, Jabbour, & Feguery, 2010).

Table 1.1. Summary of dietary assessment validation studies in young children

Study	Population	Tools used
Ball, Benjamin & Ward, 2007	Children 3-6 years, N=96 USA	Observational food record (FR) compared with food recalls and FFQ
Basch et al., 1990	Children 4-7 years, N=46 USA	24-hour recall compared with observational FR
Blum et al., 1999	Children 1-5 years, N=233 USA	FFQ compared with 24-hour recall
Cade, Frear, & Greenwood, 2006	Children 3-7 years, N=180 England	24-hour tick list compared with a 24-hour semi-weighed FR
Cheng, Hilbig, Drossard, Alexy, & Kersting, 2013	Children 10-36 months, N=67 Germany	3-day estimated FR compared with 3-day weighed FR
Davies, Coward, Gregory, While, & Mills, 1994	Children 1.5-4.5 years, N=81 England	4-day FR compared with total energy expenditure (TEE)
Fisher et al., 2008	Infants and toddlers 4-24 months, N=157 USA	24-hour recall compared with 3-day weighed FR
Johnson, Driscoll, & Goran, 1996	Children 4-7 years, N =24 USA	24-hour recall (mean of 3-days) compared with TEE
Kaskoun, Johnson, & Goran, 1994	Children 4-7 years, N=45 USA	1-year FFQ compared with TEE
Parrish, Marshall, Krebs, Rewers, & Norris, 2003	Preschool children 1-3 years, N=68 USA	FFQ compared with 24-hour recall
Walker, Bell, Boyd, & Davies, 2003	Children 3-4.5 years with Cerebral Palsy, N=31 Australia	3-day weighed FR compared with TEE

Twenty-four hour recalls can be difficult, and parents or caregivers are often used as a proxy to provide details of what was consumed (Johnson, Driscoll, & Goran, 1996).

Food frequency questionnaires (FFQ) can overestimate intake significantly, and food intake often changes considerably as the child grows (Serdula, Alexander, Scanlon, & Bowman, 2001). A weighed food record is the gold standard, and is considered the most accurate method; however it requires full caregiver involvement, and takes time and effort to complete (Iannotti et al., 1994; McPherson, Hoelscher, Alexander, Scanlon, & Serdula, 2000). On a population level, there is a need for a simple tool that effectively assesses intake in children, which is easy and practical to conduct.

It has been suggested that determining food liking in preschoolers may provide an indication of their actual food intake (Birch & Sullivan, 1991). Children as young as three years of age can generally report what foods they like and dislike; therefore this can be used to assess food liking (Birch & Sullivan, 1991). Currently there are only two validated tools to assess fruit and vegetable liking in preschoolers (Jaramillo et al., 2006; Vereecken, Vandervorst, Nicklas, Covents, & Maes, 2010). There are no validated tools for fruit and vegetable liking in NZ. The NZ population encompasses many different ethnicities and cultures, and therefore tools that have been validated overseas may not be appropriate to use in NZ.

One study that assessed food liking in preschoolers used the taste testing method, along with a three-point scale to rate their children's preferences (Birch & Sullivan, 1991). There have been two studies that used a computerised program to assess liking of each fruit or vegetable in young children (aged 3-6 years), using a smiley face scale (Jaramillo et al., 2006; Vereecken et al., 2010). As far as methods to assess food liking in children go, Guthrie, Rapoport and Wardle (2000) showed the best way is to let the children taste the food, rather than to assess liking from memory. However, they also reported that high quality photographs are almost as good as taste testing in assessing food liking in children. This provides an alternative method for assessment of liking, which may be more practical and less costly.

Uncertainty remains about the accuracy of information that the child can provide, and whether it is better to obtain the information from their caregivers. This leaves us with the following question: “can the intake of fruits and vegetables in preschool aged children be assessed using a food liking tool?”. With the ability to determine intakes of fruit and vegetables accurately, effective programmes may be developed to improve fruit and vegetable intake and may further contribute to addressing the increasing obesity problem.

Aim:

The aim of this research is to develop a fruit and vegetable liking tool for use in caregivers and preschoolers that is a good representation of the preschooler’s actual fruit and vegetable intake.

Objectives:

- To develop a fruit and vegetable liking tool for use with caregivers to assess fruit and vegetable intake in preschoolers.
- To develop a fruit and vegetable liking tool for use with preschoolers to assess their fruit and vegetable liking.
- To assess the liking and perceived liking of fruit and vegetables by preschoolers and their caregivers respectively.
- To assess fruit and vegetable intake in preschoolers using a fruit and vegetable intake record.
- To determine the validity of the caregivers and preschooler’s fruit and vegetable liking tools in assessing actual fruit and vegetable intake.
- To assess the reproducibility of the caregivers and preschooler’s fruit and vegetable liking tools.

- To determine whether the caregiver's or the preschooler's tool is the most appropriate in assessing reported fruit and vegetable intake in preschool children.

Hypothesis:

A fruit and vegetable liking tool is a valid and reliable way of assessing fruit and vegetable intake in preschool aged children.

Structure of Thesis:

The literature will be reviewed in chapter two. The literature review will cover child health, current fruit and vegetable intakes, associations between fruit and vegetable intake and health and disease, factors influencing food choice, dietary assessment tools, and validity and reproducibility of dietary assessment tools. In chapter three, the methods and materials used in this study will be described. This will be followed by chapter four where the results and outcomes of the study will be reported. The findings will be discussed in chapter five, and finally chapter six will summarise the study, strengths and limitations, and conclusions and recommendations will be made for future studies.

CHAPTER TWO

Review of the Literature

2 Literature Review

Assessment of fruit and vegetable liking in children may be a way to easily evaluate fruit and vegetable intake. In this literature review, childhood health, current fruit and vegetable intake and the association of fruit and vegetables with non-communicable disease will be explored. The factors that are involved with food choice and the various dietary assessment methods currently available for use in children will also be discussed.

2.1 Childhood health and rates of childhood overweight and obesity

Childhood obesity has become the primary childhood health problem in the developed world (Ebbeling et al., 2002; Waters et al., 2011). The body mass index (BMI) is widely used to measure body fat in adults (weight/height^2) (Cole, Bellizzi, Flegal, & Dietz, 2000), the adult BMI cut off for overweight is 25 kg/m^2, and for obese is 30 kg/m^2. The cut offs for overweight and obesity in adults cannot be used in children, as children have very different proportions to adults (Cole et al., 2000). BMI cut offs for children vary by age, as children grow and develop (Cole et al., 2000). In children 3.5 to 5.5 years, overweight is defined as a BMI >17 kg/m^2 and obesity is defined as a BMI >19 kg/m^2 (Cole et al., 2000; Cole & Lobstein, 2012). Childhood overweight and obesity is linked to increased risk of CVD, T2DM, and pulmonary, hepatic, renal and musculoskeletal complications (World Health Organization, 2003). These conditions are also associated with lower quality of life, depression and emotional disorders (Waters et al., 2011). In the USA in 2009 to 2010, twelve percent of children aged two to five years were classified as obese (Ogden, Carroll, Kit, & Flegal, 2012).

In NZ, rates of childhood overweight and obesity are rising rapidly. According to the 2002 National Children's Nutrition Survey (Ministry of Health, 2003b), 31.1% of NZ children (aged five to 14 years) were overweight or obese. This compares with the

National Nutrition Survey data in adults from 1997, where 52% of the NZ population were classed as overweight or obese (Russell, Parnell, & Wilson, 1999). The overweight and obesity rates are the worst for Pacific children, with 62% of Pacific children being overweight or obese (Ministry of Health, 2003b). The prevalence for Māori children is also high, with 41.3% being overweight or obese. New Zealand European and other children have lower rates of overweight and obesity, with 24.3% being overweight or obese (see figure 2.1).

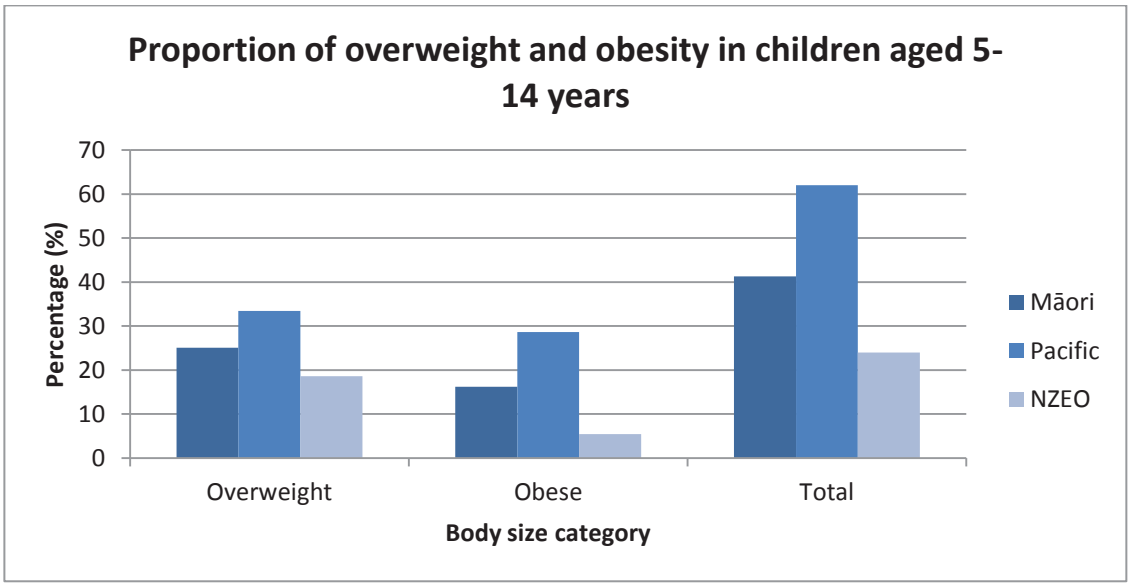

Figure 2.1. National Nutrition Survey - proportion of overweight and obese children, split by ethnicity (Ministry of Health, 2003b)

A 2008/2009 NZ study (Clinical Trials Research Unit & Synovate, 2010) surveyed a nationally representative sample of 2,503 children (five to nine years) and young people (ten to 24 years). They found rates of overweight and obesity have increased since the National Children's Nutrition Survey was undertaken in 2002, with 29.5% NZEO, 48.3% Māori, and 65% Pacific children being overweight or obese (see figure 2.2) (Clinical Trials Research Unit & Synovate, 2010).

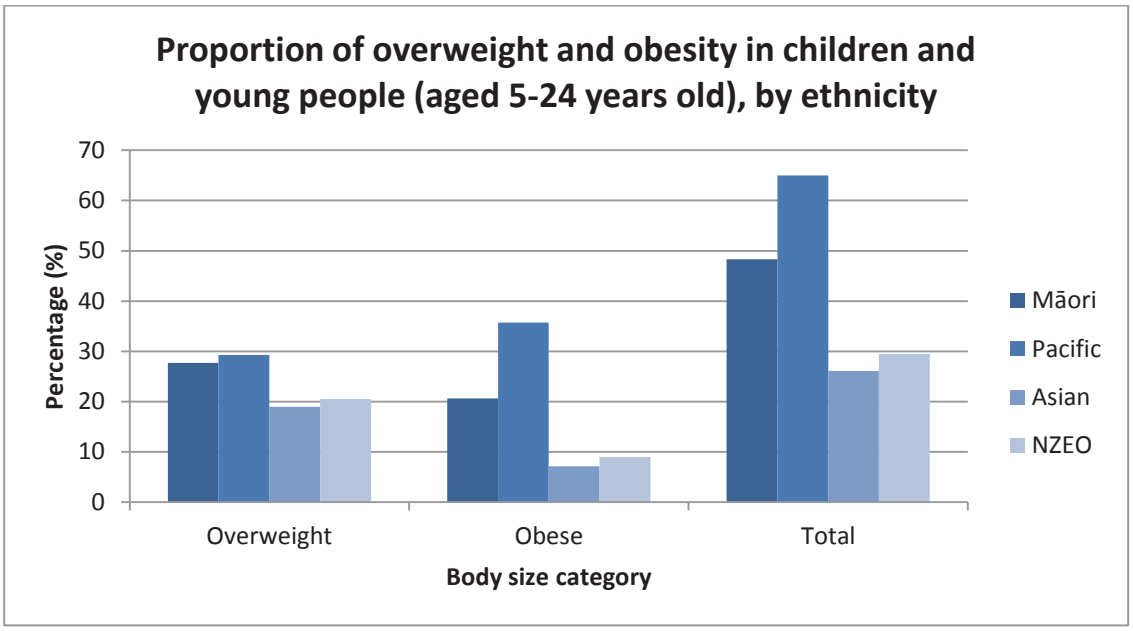

Figure 2.2. Proportion of Overweight and Obesity in NZ Children 2010, split by ethnicity group (Clinical Trials Research Unit & Synovate, 2010)

These figures compare with the adult population in 2008/2009, with a prevalence of 64.8% of New Zealanders aged 15 years and over, being overweight (37%) or obese (27.8%) (Otago University & Ministry of Health, 2011). Pacific adult males and females (aged 15 years and over) have the worst prevalence, with 86.7%, and 86.0% being overweight or obese respectively (Otago University & Ministry of Health, 2011). This was followed by Māori adult males and females (15 years and over), with 75.6% and 77.8% being overweight or obese respectively (Otago University & Ministry of Health, 2011).

The 2008/2009 study also found a high prevalence of overweight and obesity in young children (aged 5-9 years) of 16.9% and 11% respectively (Clinical Trials Research Unit & Synovate, 2010) (see figure 2.3).

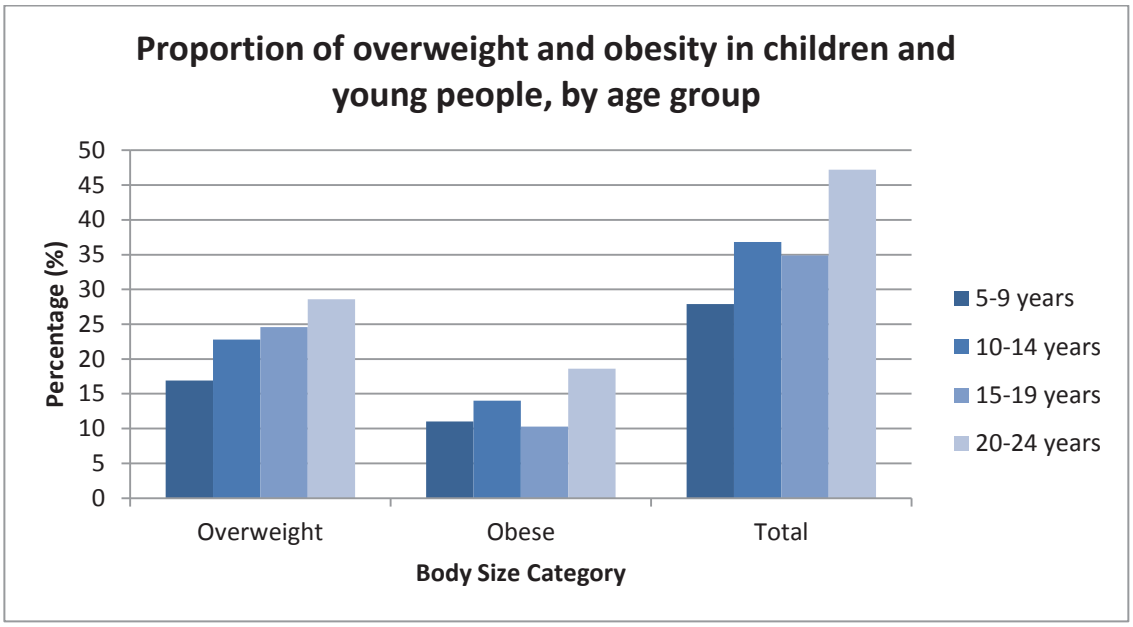

Figure 2.3. Proportion of Overweight and Obesity in NZ Children 2010, split by age group (Clinical Trials Research Unit & Synovate, 2010)

Overweight and obesity in childhood have been linked to overweight and obesity in adulthood (Biro & Wien, 2010; Deshmukh-Taskar et al., 2006; Herbert et al., 2006; Mossberg, 1989; Serdula et al., 1993). A study conducted in Sweden over a 40 year period, showed that the strongest indicators for obesity tracking into adulthood were the degree of obesity in the family and the degree of obesity at puberty (Mossberg, 1989). This heritability has also been found in a study that mapped the genome of 694 adults and children in the National Heart, Lung and Blood Institute - Framingham Heart Study (Herbert et al., 2006). They found a common gene polymorphism that was associated with obesity, and present in ten percent of individuals, from which they concluded that obesity is a heritable trait (Herbert et al., 2006). Another study conducted in the USA showed a positive association between being overweight in childhood and increased risk of long-term mortality (Nieto et al., 1992). Serdula et al., (1993) conducted a review of longitudinal studies, and found that one third of obese preschool children, and one half of obese school children became obese adults. A longitudinal study also conducted in the USA by Deshmukh-Taskar et al., (2006) found

61.9% of children who were in the highest BMI quintile, remained in the highest BMI quintile as an adult. This is why it is so important to assess the dietary intake of young children so that useful interventions may be developed to decrease the risk of overweight and obesity.

2.2 Current intakes of fruits and vegetables

The 2002 National Children's Nutrition Survey found that only two out of five NZ children consumed at least the recommended two servings of fruit per day, and three out of five children consumed at least the recommended three servings of vegetables per day (Ministry of Health, 2003b). This shows that many New Zealand children are not consuming enough fruit and vegetables for a healthy diet, and may be lacking in essential nutrients required for health. The most commonly consumed vegetables differed between ethnicities, NZEO children consumed carrots and broccoli most frequently, Māori children consumed silver beet, spinach, puha and watercress most frequently and Pacific children consumed taro, green banana, cassava and tomatoes most frequently (Ministry of Health, 2003b). Commonly consumed fruits were the same for all NZ children, namely apples, pears, oranges, mandarins, kiwifruit and bananas (Ministry of Health, 2003b).

More recently the Clinical Research Trial Unit (2010) showed that only 32.7% of Māori, 35.7% of NZEO, 22.8% of Pacific and 17.3% of Asian children were meeting the recommendations for fruit and vegetable consumption (see figure 2.4)

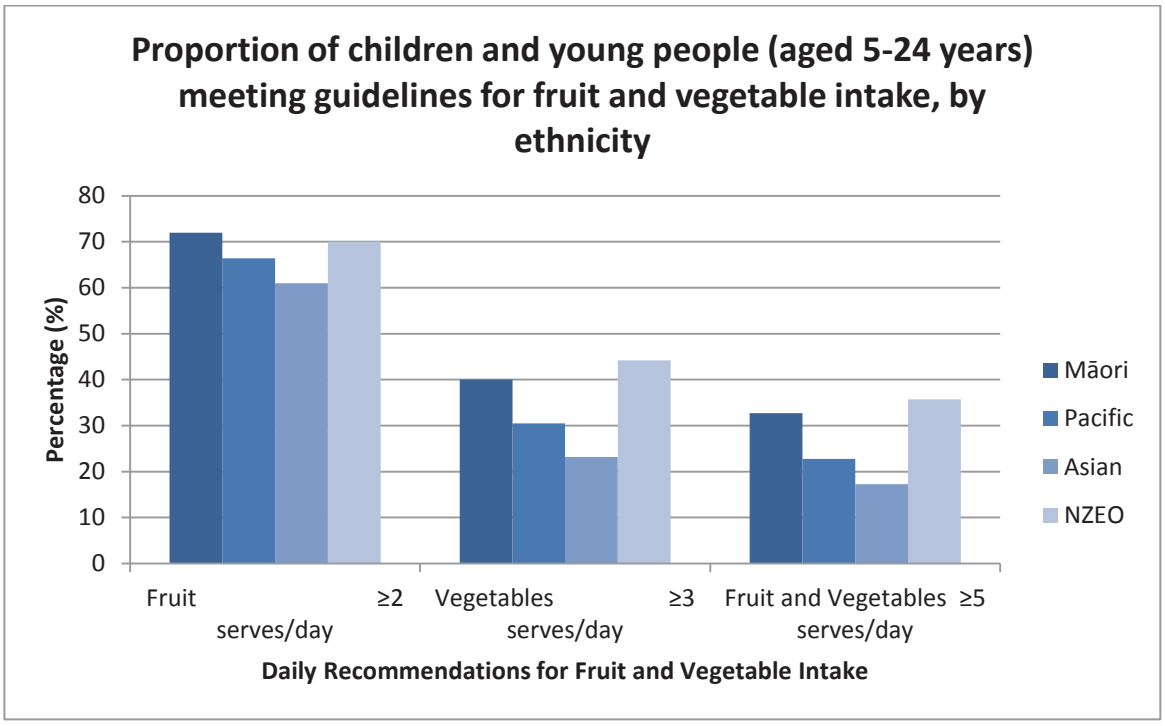

Figure 2.4. Proportion of NZ Children Meeting Fruit and Vegetable Intake Recommendations 2010 (Clinical Trials Research Unit & Synovate, 2010)

They also found that only 30% of five to nine year olds, 37.6% of 10-14 year olds, 27.9% of 15-19 year olds and 26.2% of 20-24 year olds met the recommendations for fruit and vegetable consumption (see figure 2.5).

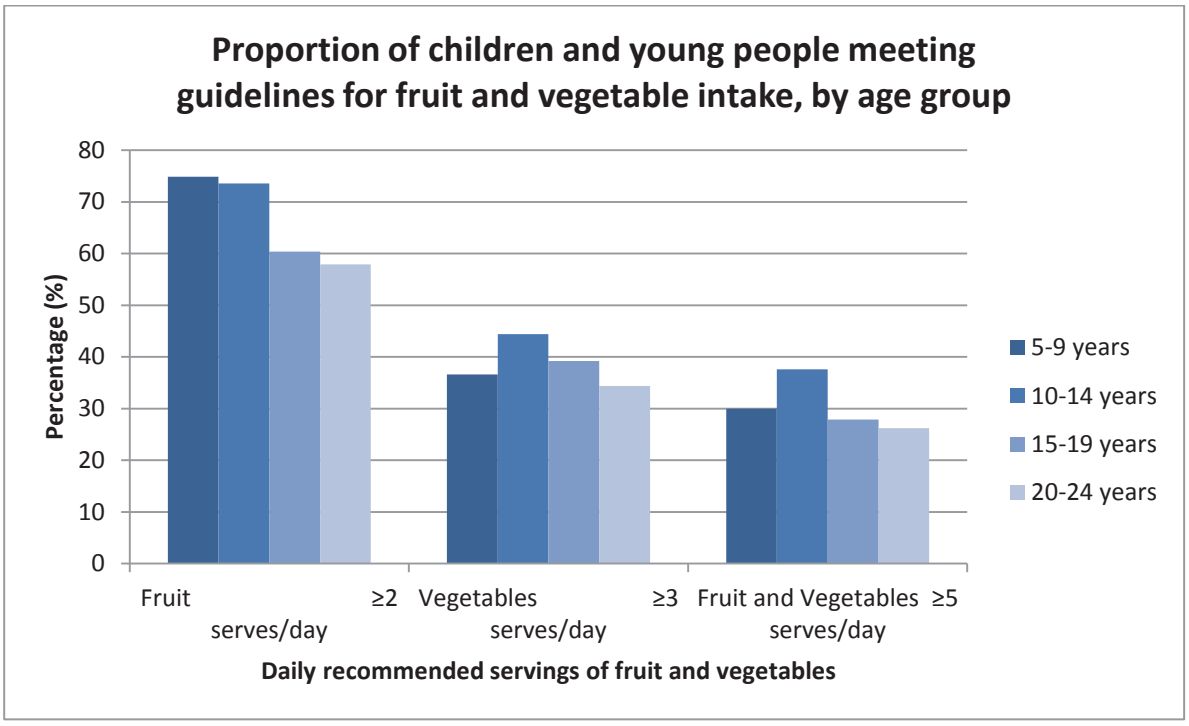

Figure 2.5. Daily Intake of Fruit and Vegetables by NZ Children 2010, split by age group (Clinical Trials Research Unit & Synovate, 2010)

Worldwide, children are not meeting recommendations for healthy eating, with very few children consuming the recommended minimum of five servings of fruit and vegetables daily. In the United Kingdom (UK), 11% of children are consuming no fruits and vegetables daily, however, 20% consume more than five servings daily (Cockroft, Durkin, Masding, & Cade, 2005). The average serves of fruits and vegetables are 4.7 per day (Hughes et al., 2012). In the USA, 40-50% of children consume less than two serves of fruit and vegetables per day, with an average of 4.3 serves daily (Dennison et al., 1998). In NZ, 70% of children consume less than the recommended five servings of fruit and vegetables daily (Clinical Trials Research Unit & Synovate, 2010; Ministry of Health, 2003b). A summary of these studies can be seen in table 2.1.

Table 2.1. Summary of fruit and vegetable intake studies undertaken internationally

Authors	Age group	Location	Results
Cockroft et al., (2005)	3-4 years	Bradford, U.K.	Total fruit and vegetable intake: 10.6% of children ate 0 serves/day, 19.9% ate >5 serves/day. Fruit intake: 50.7% ate >2 serves of fruit/day. Vegetable intake: 10.6% ate >3 serves of vegetables/day.
Dennison et al., (1998)	2-5 years	New York, U.S.A.	Total fruit and vegetable intake: 40% of 2 year olds, and 50% of 5 year olds ate <2 serves of fruit and vegetables/day. Fruit intake: Average daily intake of 2.2 serves. Vegetable intake: Average daily intake of 2.1 serves.
Hughes et al., (2012)	6-7 years	England	Total fruit and vegetable intake: Mean of 4.7 serves/day 59.2% of children ate the recommended >5 serves/day
Clinical Trials Research Unit & Synovate (2010)	5-24 years	NZ	Total fruit intake: 30% of children 5-9 years met the recommended >5 serves/day

2.3 Fruit and vegetable intake and associations with health and disease

Many studies have shown strong associations for increased fruit and vegetable intake and the reduction in risk for many chronic diseases, such as cancer, heart disease, stroke, and T2DM (Van Duyn & Pivonka, 2000). There is also epidemiological evidence that increased fruit and vegetable consumption may reduce the risk for other diseases such as cataracts, diverticulosis, chronic obstructive pulmonary disease and hypertension (Van Duyn & Pivonka, 2000).

Case-control and prospective studies have shown an increase in fruit and vegetable consumption to be strongly linked with the reduction of risk in oesophageal cancer, stomach cancer, coronary heart disease (CHD) and stroke (Van Duyn & Pivonka, 2000). Epidemiological studies have shown increased fruit consumption to be linked with a reduction in risk of lung cancer, while an increase in vegetable consumption was linked with a reduction in risk of colon cancer, and CHD (Van Duyn & Pivonka, 2000).

Increased fruit and vegetable consumption has been associated with reduced risk of some common cancers (Riboli & Norat, 2003). Several meta-analyses have found a significant reduction in risk of oral cancer (Pavia, Pileggi, Nobile, & Angelillo, 2006), colorectal cancer (Aune et al., 2011), gastric cancer (Lunet et al., 2007), and breast cancer (Gandini, Merzenich, Robertson, & Boyle, 2000) with increased fruit and vegetable intake. Therefore, a moderate intake of fruit and vegetables (five servings or more of fruit and vegetables per day) is recommended over a lifetime for health and disease prevention (Riboli & Norat, 2003). More details on these meta-analyses can be found in table 2.2.

Table 2.2. Meta-analysis on fruit and vegetable intake associated with cancer

Reference	Studies (n)	Subjects (n)	Treatment/dietary assessment	Duration (years)	Conclusion
Pavia et al., (2006)	16 (15 case-control, 1 cohort studies)	Fruit: 65,802 Vegetables: 57,993 (men and women, aged 18-91 years) USA, Japan, Uruguay, Switzerland, Italy, Spain, Greece, Poland, Cuba, Brazil, India, Pakistan	Various servings of fruits and vegetables (focus on citrus fruits and green vegetables)	>1 year	With each serving of fruit consumed, decrease in oral cancer by 49% With each serving of vegetables consumed, decrease in oral cancer by 50%
Aune et al., (2011)	19 prospective studies	2,216,553 (men and women, aged 16-82 years) USA, Finland, Netherlands	Various servings of fruits and vegetables	>4.3 years	Weak but statistically significant non-linear association between increased fruit and vegetable consumption and decreased colorectal cancer risk
Lunet et al., (2007)	28 (26 case-control, 2 cohort studies)	4,252 (men and women, aged 18-75 years) USA, Japan, Poland, Italy, Netherlands, China, Sweden, Taiwan, Canada, Mexico	Dietary assessment – intake of fruit and vegetables, and previous dietary habits in years prior to diagnosis	N/A	Increased fruit or vegetable intake was associated with a decreased risk of gastric cancer, regardless of area of cancer (cardia, non-cardia, intestinal, diffuse)
Gandini et al., (2000)	26 (21 case-control and 5 cohort studies)	23,038 (women), USA, Denmark, Italy, Spain, France, Japan, Canada, Sweden, Netherlands, Greece, Poland, China, Australia	Dietary assessment (FFQ) comparing 1 serve of fruit/vegetable against 3, 4, 5 or 6 serves of fruit/vegetable	N/A	Increased vegetable intake associated with a moderate reduction in risk of breast cancer Fruit intake showed a weaker risk reduction

Increased consumption of fruits and vegetables has long been associated with a reduction in the risk of cardiovascular disease (CHD and stroke) (Van Duyn & Pivonka, 2000). Two meta-analyses have demonstrated an increased fruit and vegetable intake was associated with decreased risk of CHD (Dauchet et al., 2006; He, Nowson, Lucas, & MacGregor, 2007), with a stronger protective effect with fruit intake than vegetable intake. Another meta-analysis has demonstrated a decreased risk of stroke with increased intake of fruit and vegetables (Dauchet, Amouyel, & Dallongeville, 2005), again with a stronger effect with fruit intake than vegetable intake. More details on these meta-analyses can be found in table 2.3.

Table 2.3. Meta-analysis on fruit and vegetable intake associated with cardiovascular disease

Reference	Studies (n)	Subjects (n)	Treatment/dietary assessment	Duration (years)	Conclusion
Dauchet et al., (2006)	9 (cohort studies)	221,080 (men and women, aged 25-84 years) USA and Finland	Dietary assessment – by FFQ, FR or diet history	Follow up 5-18 years	With each additional portion of fruit and vegetables consumed, a 4% reduction in CHD risk With each additional portion of fruit consumed, a 7% reduction in CHD risk
He et al., (2007)	12 (cohort studies)	278,459 (mean and women, aged 16-101 years) USA, Finland, France, Northern Ireland, UK	Dietary assessment – by FFQ, FR or diet history	Median follow up 11 years	Both fruit and vegetable consumption had a significant protective effect on CHD Increasing from <3 serve/day to >5 serves/day showed the greatest protective effect
Dauchet et al., (2005)	7 (prospective observational studies)	232,049 (men and women, aged 25-103 years) USA, Europe, Japan	Dietary assessment – by FFQ, FR or diet history	Follow up 3-20 years	With each additional portion of fruit and vegetables consumed, a 5% reduction in stroke risk With every additional portion of fruit consumed, an 11% reduction in stroke risk With every additional portion of vegetables consumed, a 3% reduction in stroke risk

Fruit and vegetable intake has been associated with the reduction in risk of T2DM, although the evidence is not convincing (Cooper et al., 2012). Green leafy vegetable intake appears to have the strongest association with the reduction in risk of T2DM, with two meta-analyses showing this (Carter, Gray, Troughton, Khunti, & Davies, 2010; Cooper et al., 2012). More details on these meta-analyses can be found in table 2.4.

Table 2.4. Meta-analysis on fruit and vegetable intake associated with type 2 diabetes mellitus

Reference	Studies (n)	Subjects (n)	Treatment/dietary assessment	Duration (years)	Conclusion
Carter et al., (2010)	6 (prospective cohort studies)	223,512 (mostly women aged 30-74 years) USA, Finland, China	Dietary assessment – by FFQ, FR or diet history	4.6-23 years	An increase in the consumption of leafy green vegetables reduces risk of T2DM by 14% Summary estimates show no increased benefit from fruit, vegetable, or fruit and vegetable consumption
Cooper et al., (2012)	7 (6 cohort studies, and 1 prospective study – EPIC-InterAct)	179,956 (men and women aged 25-79 years) France, Germany, Netherlands, Italy, Spain, Sweden, Denmark, UK	Dietary assessment – by FFQ, FR or diet history	Median 11.0 years follow up	Green leafy vegetable consumption was inversely associated with T2DM risk Root vegetables were also associated with decreased risk of T2DM

These studies provide evidence that a diet that includes fruit and vegetables is beneficial to reducing the risk of many diseases.

2.4 Factors influencing food choices in young children

Many factors affect food choice for adults, in addition to taste and branding, these include procurement factors (e.g. cost, accessibility, skills to prepare), consequence factors (e.g. healthfulness, nutrient content, satiety, consequences of ingestion) and cultural or social factors (e.g. cuisine, situation, peers or family) (Birch & Sullivan, 1991). For children, food choice is simpler, as many of the factors that affect adults are not experienced by children. Procurement is undertaken by the caregiver and consequences are not yet understood by young children. Hence their food choice is mainly influenced by taste preference (Birch & Sullivan, 1991). Several studies have confirmed the strongest predictor of food choice in children is taste preference (Domel et al., 1996; Rasmussen et al., 2006) Others factors that have been strongly associated with food choice in children include availability and accessibility of food, past food intake and familiarity with food (Bere & Klepp, 2005; Cooke & Wardle, 2005; Krolner et al., 2011).

Gibson, Wardle, and Watts (1998), interviewed mothers and children to establish the factors influencing food choice. It was revealed that the greatest influencing factors on children's fruit consumption were mother's nutritional knowledge, mother's frequency of fruit consumption and the mother's belief that fruit and vegetable consumption could decrease disease risk. The greatest influencing factors on children's vegetable consumption were the child's liking for vegetables and the mother's belief that fruit and vegetable consumption could decrease disease risk (Gibson et al., 1998). A summary of these studies and factors affecting food choice can be seen in table 2.5.

Table 2.5. Summary of studies of factors affecting food choice and consumption

Study	Bere & Klepp, (2005)	Cooke & Wardle, (2005)	Domel et al., (1996)	Gibson et al., 1998	Krolner et al., (2011)	Rasmussen et al., (2006)	Furst et al., (1996)	Eertmans et al., (2001)
Population	Prospective cohort study Norway Children 12-13 years	Cross-sectional study UK Children 4-16 years	Cross-sectional study USA Children 9-11 years	Cross-sectional study UK Children 9-11 years	Review – qualitative studies Children 6-18 years	Review – quantitative studies Children 6-18 years	Review – conceptual model of food choice	Review – conceptual model of food choice
Findings	Past intake was the strongest predictor of food choice, followed by accessibility and preferences	Familiarity, availability and accessibility all key factors in food choice	Preferences and availability strongest factors in food choice	Strongest predictors of food choices are mother's nutritional knowledge, mother's frequency of fruit consumption and the mother's belief that fruit and vegetable consumption could decrease disease risk	Main factors affecting food choice are time costs, lack of taste guarantee, satiety value, appropriate timing/occasion, sensory/physical aspects, variety, visibility, methods of preparation, access, peers, and short-term outcomes	Main factors affecting food choice are age, gender, socioeconomic status, preferences, parental intake, home availability/ access	Many factors influence food choice, such as life course, influences, personal systems, value negotiations, strategies	Taste was the most important factor in food choice

To explore the factors contributing to food choice, Furst et al., (1996) developed a food choice model (figure 2.6). This was based around three main components, namely life course (personal roles, social-cultural and physical environments at each life stage), influences (ideals, personal factors, social frameworks, resources, and food context), and personal systems (value negotiation). Furst et al., (1996) describe these three factors across the life course that generates a set of influences, which inform and shape people's personal systems.

These factors influence the complex food choice process. Life course may involve factors such as upbringing (Furst et al., 1996), for example, a consumer may have been on a restricted budget when they were younger, and this has changed since, however they still buy foods that fit within the old budget. Influences that affect a food choice may include ideals, such as what the consumer should be eating (i.e. food that is healthy), or the ideal of certain foods going together (e.g. potatoes and butter) (Furst et al., 1996). Another influence may be the preferences of the family, accommodating all the different preferences so that everyone is happy (Furst et al., 1996). Personal systems, such as value negotiations may be weighing up the cost of food against the perceived health value, or weighing up the taste of a food against the cost (Furst et al., 1996). All of these factors contribute to a person's choice of food.

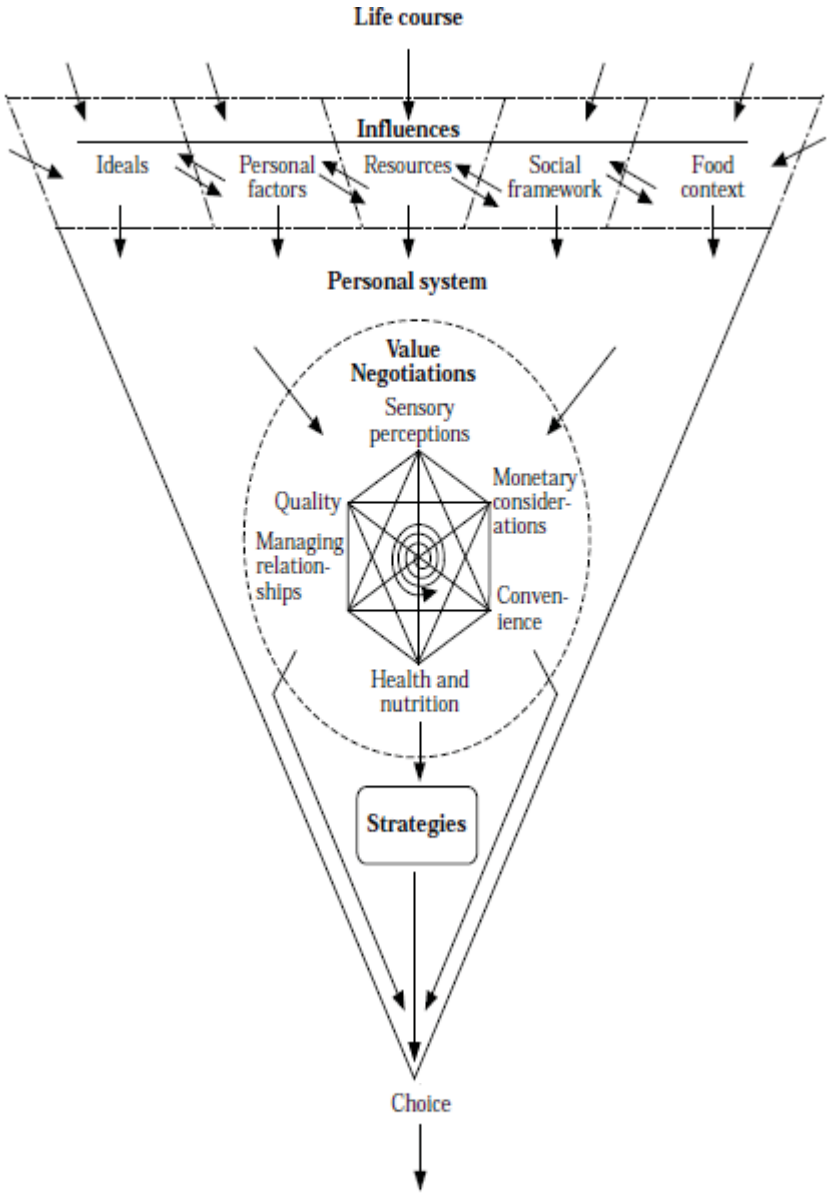

Figure 2.6. Conceptual model of components in food choice process
Reprinted from Appetite, Volume 26, Furst, T., Connors, M., Bisogni, C.A., Sobal, J., & Winter Falk, L., Food choice: A conceptual model of the process, 247-266, © (1996), with permission from Elsevier.

Eertmans, Baeyens, and Van den Bergh (2001) simplified this model to food-internal stimuli (flavour and sensory perceptions) and food-external stimuli (information, social and physical environment), which have an effect on liking, anticipated consequences and ideational factors (society's view of food, what is 'good for you' and your family), leading to eating behaviour (see figure 2.7). From a child's perspective, the flavour of a food and how much they like the food (liking) most heavily influence their food choice

(Bere & Klepp, 2005). Adults, on the other hand, have many more factors that influence their own food choice and the choice of food for their children. They have to think about factors such as information, social and physical environment, as well as anticipated consequences and ideational factors before coming to a decision on what food to choose (Eertmans et al., 2001).

Flavour preferences include all sensory aspects, such as taste, smell, texture and appearance. Information such as nutritional content, knowing that someone in the household likes a certain food over another food and current trends on health can influence a person's food choices (Eertmans et al., 2001). The social environment includes beliefs, culture and family (e.g. what foods are commonly consumed in the house, and the family's beliefs about food) (Eertmans et al., 2001). The physical environment influences what is available for purchase, and may limit food choice if what is preferred is not available (Eertmans et al., 2001). Liking includes preferences for certain foods or flavours, and experiences that have led to liking or disliking (Eertmans et al., 2001). Anticipated consequences may also involve past experiences, as a certain food may have induced nausea, and therefore the anticipated consequence will be nausea again (Eertmans et al., 2001). Ideational factors include the society's view of foods, what is accepted in the household, or group situation, what foods are in the media and are seen to be beneficial or 'the best' (Eertmans et al., 2001). All of these factors interplay together to form the eventual food choice or food behaviour.

As an example, when choosing between a can of peaches in syrup, or fresh peaches, for children, flavour and availability come into play, which then flow on to liking, and then to eating behaviour (Eertmans et al., 2001). The child may like the look and taste of a real peach, and therefore want to eat the fresh peach. For adults/parents, the flavour, nutritional information (e.g. high sugar content of syrup), availability (what they have in the fridge/cupboard), and which form is more highly accepted (ideational

factors - possible that fresh is seen as best) all come into play and they will therefore choose the fresh peach for their child.

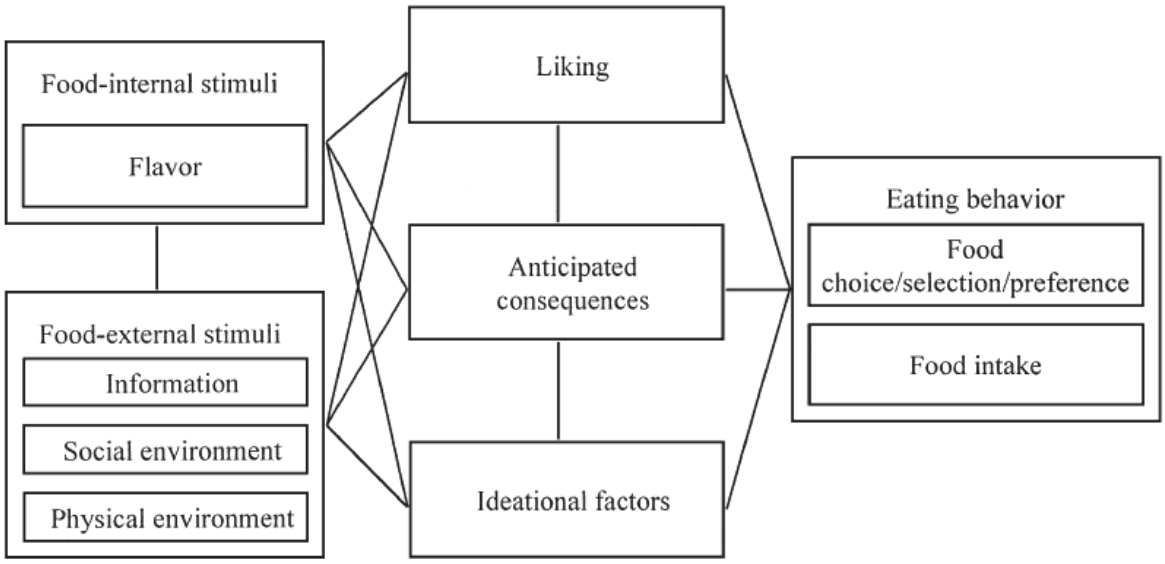

Figure 2.7. Conceptual Food Choice Model.
Reprinted from Health Education Research, Volume 16, no. 4, Eertmans, A., Baeyens, F., & Van den Bergh, O., Food likes and their relative importance in human eating behaviour: review and preliminary suggestions for health promotion, 443-456, © (2001), with permission from Oxford University Press.

Both models show that the factors involved in food choice are complex and heavily integrated. The factors affecting food choice in children will be discussed in detail, these include food preferences, establishment of early eating habits, exposure to fruit and vegetables (including neophobia), and the physical environment.

2.4.1 Food preferences

Food preference is a behavioural mechanism; it is the selection of one food over another (Rozin, 1990). Food preference is a strong factor in food choice, especially when factors are excluded, such as economics or availability (Eertmans et al., 2001). In

children, food preference is the most important factor in food choice (Bere & Klepp, 2005; Rasmussen et al., 2006). Sensory perception appears to be the most important factor for food preference and the least negotiable (Eertmans et al., 2001). Food preference has been associated with food consumption patterns, with foods that are highly liked, consumed more (Birch, 1998).

Food preferences can be influenced by sensory food aspects, which include taste, smell, appearance, texture, temperature, fat content, pain sensation and the sound it makes when chewed. Food preferences can also be influenced by perceived health benefits, food neophobia, enjoyment of food, the social context in which the food is consumed, peer likes, exposure and conditioning or learning (Cooke et al., 2004; Eertmans et al., 2001). Blanchette and Brugg (2005) found that the only factor positively related to fruit and vegetable consumption in children aged six to 12 years was taste preference. Bere and Klepp (2005) also suggest that food preferences are one of the strongest correlates for fruit and vegetable intake in children aged 11 to 12 years. Brug et al., (2008), Domel et al., (1996), and Gibson et al., (1998) found that children (aged between nine and 11 years) who had a positive liking for fruits and vegetables, also had a greater prospect of consuming fruits and vegetables, and therefore had a higher intake (odds ratio 1.97 for fruit, and 1.60 for vegetables).

2.4.2 Establishment of early eating habits

The tracking of food preferences suggests habits can be carried from childhood through to adulthood. Several longitudinal studies have shown that dietary choices (both healthy and unhealthy), as well as other behaviours (e.g. smoking and physical activity), track from a young age (childhood) (Skinner, Carruth, Bounds, & Ziegler, 2002), through into adulthood (Kelder, Perry, Klepp, & Lytle, 1994).

This link between food preferences in early childhood and adulthood was also demonstrated by Nicklaus, Boggio, Chabanet, and Issanchou (2004). In a longitudinal study by Nicklaus et al., (2004), the researchers found the large majority of foods preferred at age two to three years, were also preferred at ages eight to 22 years. They also found that preference for vegetables increased with age, which may be related to increased exposure and sensory development with age, as well as increased knowledge about health benefits of vegetables and weight concerns (Nicklaus et al., 2004). Table 2.6 summarises the studies that have investigated food preference tracking in children.

Table 2.6. Summary of studies on food preference tracking

Study	**Population**	**Outcomes/Findings**
Kelder et al., (1994) Longitudinal study	11-12 year old children, tracked until 18-19 years old n=2376	Physiological risk factors (physical activity and food choices) track from childhood into young adulthood Students identified at high risk of poor food choices, remained high at follow up
Nicklaus et al., (2004) Longitudinal study	2-3 year old children, tracked until 8-22 years old n=341	Preferences of most foods tracked from early childhood to young adulthood, with the exception of puberty Fruit was generally well accepted Preferences for vegetables increased with age
Skinner et al., (2002)	2 year old children, tracked for 6 years n=70 USA	Food preferences did not change significantly over the time period

Maternal exposure, preferences and intake of food is often significantly associated with their children's exposure, preferences and intake of food (Hart, Raynor, Jelalian, & Drotar, 2010; Worobey et al., 2010). However, children may not be exposed to as many different foods as their mothers (Worobey et al., 2010). Often if a mother does not like a certain food, it will not be introduced to the child and therefore the child does not develop a liking for that particular food (Nicklaus et al., 2004). Several studies have

shown a significant association between the preferences of the mother and the child (Breen, Plomin, & Wardle, 2006; Brown & Ogden, 2004; Skinner et al., 2002). This again signifies the importance of habits formed from the environment the child grows up in, with strong influences from caregivers. Studies investigating associations between maternal and child food preferences are referred to in table 2.7.

Table 2.7. Summary of studies investigating associations between maternal and child food preferences.

Study	Population	Findings/Outcomes
Breen, Plomin, & Wardle (2006)	4-5 year old twin children n=214 England & Wales	Moderate effects of shared environment (e.g. non-heritable factors) on fruit (Intra Class Correlation (ICC) =0.46) and vegetable (ICC = 0.36) preference Fruit and vegetable preferences were seen to be heritable (r=0.37 for vegetables, r=0.51 for fruit), as many of the fruits and vegetables were liked by both twins
Brown & Ogden (2004)	9-13 year old children n=112 England	Strong correlations between children and parents with food intake (r_s = 0.317, P<0.001) and eating motivations (r_s = 0.17, P=0.06)
Skinner et al., (2002) Longitudinal	2 year old children, tracked for 6 years n=70 USA	Food preferences did not change significantly over the time period Mother's food preferences significantly correlated to their children's food preferences
Worobey et al., (2010)	3-4 year old children n=83 USA	Mother's preferences significantly associated with the children's preferences Mother's liked 81% of vegetables, and 86% of the fruit they had ever tried. Children liked 55% of vegetables and between 69-76% of fruit they had ever tried

2.4.3 Exposure to fruit and vegetables

Repeated exposure to foods increases the acceptance and liking of a food (Birch & Anzman-Frasca, 2011; Eertmans et al., 2001; Mennella, Nicklaus, Jagolino, &

Yourshaw, 2008; Resnicow et al., 1997; Sullivan & Birch, 1994). Pairing of an unfamiliar food with a familiar and liked food can increase acceptance and can help to overcome initial rejection of the food (Anzman-Frasca, Savage, Marini, Fisher, & Birch, 2012). As previously discussed, maternal preferences are associated with children's preferences, as children are generally exposed to what the mother likes and prefers (Gibson et al., 1998; Howard et al., 2012) (see table 2.8). Early exposure to fruit and vegetables can help to increase liking and preferences later in life, creating healthful habits (Gibson et al., 1998).

Visual exposure to fruits and vegetables may also be associated with increased liking. A study by Houston-Price et al., (2009) investigated visual exposure to photos of fruits and vegetables and if this had an effect on attitudes towards the fruit or vegetables. They conducted three experiments using different sets of picture books and varied repetitions of exposure to a particular item. After the designated exposure period, they measured the amount of time that the toddler spent looking at the photos of the exposed fruit or vegetable (compared to photos of non-exposed fruits or vegetables) (Houston-Price et al., 2009). A longer time spent looking at the photo, indicated greater interest and visual preference for the photo (Houston-Price et al., 2009). Overall they showed that the toddlers spent a significantly longer period of time looking at the photos of exposed fruits and vegetables, as opposed to the photos of the unexposed ones (Houston-Price et al., 2009). They suggest that visual exposure of healthy foods to toddlers and young children may help to increase their willingness to try new foods (Houston-Price et al., 2009).

In a small study by Osborne and Forestell (2012) children (aged four to eight years) were exposed to children's books about healthful foods and eating behaviours over an eight day period. There were four groups of children, they received either food (four selected fruits and vegetables), or books, or both, or none. They found that the group with exposure to both the books and foods had an increased preference for fruits, but

not vegetables (Osborne & Forestell, 2012). The group that had exposure to neither books nor foods did not change in liking for fruits or vegetables (Osborne & Forestell, 2012). This shows that exposure (visual or taste) plays a key role in the determination of food preferences.

Table 2.8 summarises the studies that have investigated fruit and vegetable exposure in children.

Table 2.8. Summary of studies on exposure to fruit and vegetables.

Study	Population	Method used	Findings/Outcomes
Anzman-Frasca et al., (2012)	4-5 year old children n=84 USA	Repeat exposure to unfamiliar vegetables, either alone (repeat exposure) or with a dip (associated conditioning) Liking was measured on a 3 point scale (yummy, okay, yucky)	Increased liking for vegetables was found after the 6th exposure. Liking of vegetables was not significant when tried with a dip, although this may have encouraged initial trialling of the vegetable.
Birch & Anzman-Frasca (2011)	Opinion piece on children's preferences for the familiar USA	N/A	Familiar foods tend to be liked and preferred, while unfamiliar foods are disliked, avoided or even feared. Liking can be encouraged with repeat exposures, or by pairing with a familiar food. Early familiarisation with energy dense, nutrient poor foods can encourage a poor diet in the future.
Eertmans et al., (2001)	Belgium	Review – psychological determinants of human eating behaviour	Mere exposure can help to overcome initial rejection of unfamiliar food, and can help to shape relationship between sensory factors, social context, and physical environment.

Study	Population	Method used	Findings/Outcomes
Gibson et al., (1998)	9-11 year olds n=92 England	Mother's questionnaire on social economic status, education level, nutrition knowledge, health and diet related beliefs and attitudes Mother's diets were assessed with FFQ Children's diets assessed with a 3-day food diary	Early exposure to fruit and vegetables is critical to form healthful behaviours. Nutritional knowledge and maternal intake were the strongest indicators of child intake.
Houston-Price et al., (2009)	1-2 year olds n=25 England	Children given a picture book about fruit or vegetables, and parents read to them every day over 1, 2 or 3 week period. Time spent looking at an exposed or non-exposed picture book was measured	Exposure to fruit and vegetables through picture books may increase wiliness to try new foods.
Howard et al., (2012)	2 year old children n=245 Australia	Food preference questionnaires of mother's and children's preferences Child neophobia assessed on a Child Neophobia Scale Novel food exposure questionnaire	Maternal preferences corresponded with children's preferences. Stronger food neophobia was linked with liking of fewer fruits and vegetables, and less trialling of new fruits and vegetables. Number of repeat exposures was not significantly associated with liking at this age.
Mennella et al., (2008)	4-9 month old children (early stages of weaning) n=74 USA	8 day exposure to a particular food or a variety of foods, in between meals or within meals	Repeat exposure of one fruit or vegetable associated with increased acceptance of that fruit or vegetable. Variety of fruits given associated with increased acceptance of any fruits (not vegetables). Variety of vegetables given with meal or as snack showed a higher acceptance of vegetables with meals than as snack.

Study	Population	Method used	Findings/Outcomes
Resnicow et al., (1997)	8-9 year old children n=1398 USA	Exploration of SCT on food preference and intake Measured factors include self-efficacy, outcomes and expectations, social norms, health knowledge and asking behaviour, Dietary intake was assessed with a 7-day FR	Fruit and vegetable intake strongly correlated with food preferences, and to a lesser degree with outcome expectations. Exposure was also correlated with intake.
Sullivan & Birch (1994)	4-6 month old children (early weaning) n=36 USA	Infants fed either salted or unsalted peas or green beans every day for 10-day period Intake was measured before the 10-day exposure period, immediately after the exposure period, and after a 1-week period of delay	Acceptance of vegetables (peas or green beans) with repeat exposure. Exposure in presence of respected other (i.e. parent or peer) may help to increase acceptance and liking of food. >10 exposures associated with increased intake of the vegetable Breastfed infant's liking of the vegetable was indicated to be greater than formula fed, with a greater increase in intake.

2.4.3.1 Neophobia

Infancy to adolescence is the greatest growth and development period of our lives (Savage, Fisher, & Birch, 2007). Infants are born with very few innate instincts and most things have to be learned by observing others in a social context (Savage et al., 2007). Infants have an innate aversion to bitter and sour foods and a preference for sweet, and later on, salty foods (Birch, 1998; Dovey et al., 2008). The acceptance of foods is learned and often new foods have to be presented between 10 and 16 times to overcome the innate aversion (Savage et al., 2007).

Neophobia is an innate response to new objects; this is to protect the infant or child from potentially harmful dangers. Food neophobia usually occurs with bitter (e.g. brassicas) or sour (e.g. citrus fruits) foods (tastes that are often linked with vegetables) (Dovey et al., 2008). Food neophobia is regarded as “the reluctance to eat”, or “the avoidance of new foods”, which differs from picky or fussy eaters that consume an inadequate variety due to rejection of familiar and unfamiliar foods (Dovey et al., 2008). It has been reported that food neophobia reaches a peak between the ages of two and six years (Wardle et al., 2003), then decreases between the ages of seven and 20 years (Nicklaus et al., 2005). The duration of food neophobia may be influenced by factors such as pressure to eat, personality, parental practices and social influences (Dovey et al., 2008). Food neophobia is balanced out by the need to seek variety in the diet to gain all the required energy, vitamins and minerals, and food seeking variety increases with age (from age 17 years and older) (Nicklaus et al., 2005).

Russell and Worsley (2008) found a strong link between food preferences and food neophobia. The higher the neophobia, the lower the food preference was for a particular food, and the more limited the child’s diet was as they had tried less items (Russell & Worsley, 2008). Strong neophobia was also significantly linked to a lower liking of certain food groups, especially vegetables (Russell & Worsley, 2008). This was also shown in a study by Howard et al., (2012), who found that food neophobia in toddlers was associated with liking fewer fruit and vegetables, and trying fewer vegetables.

Food neophobia can be overcome with repeated exposure to the food. This can be encouraged if a role model (parent or peer) is eating the same food or if the unfamiliar food is linked with a familiar food (Addessi, Galloway, Visalberghi, & Birch, 2005; Birch & Anzman-Frasca, 2011). Interventions that focus on behavioural changes with neophobia, such as early introduction of fruits and vegetables, may help to increase food acceptance, and limit neophobia (Dovey et al., 2008).

2.4.4 Physical environment

Accessibility and availability of foods is a large factor in food choice, as a child will only become familiar with a food if he or she has access to this at home (Bere & Klepp, 2005). Access and exposure to a range of fruits and vegetables in the home environment is important for developing preferences for fruits and vegetables (Campbell & Crawford, 2001). Studies have shown that accessibility and availability is one of the strongest predictors of fruit and vegetable intake (Bere & Klepp, 2005; Blanchette & Brug, 2005). Research suggests that the earlier and broader the exposure, the more readily these foods are accepted by the child, as familiarity helps to convey the food as being safe (Cooke, 2007).

We currently live in an obesogenic environment where cheap, tasty and energy dense food is easily accessible (Birch & Anzman-Frasca, 2011). Familiarisation of less healthy foods at an early stage can lead to excessive weight, obesity and increased disease risk in the future (Birch & Anzman-Frasca, 2011). There has been a shift in the number of meals eaten away from home and the increase in time spent in front of the television (Hare-Bruun et al., 2011). In NZ, 27% of children aged five to 14 years had more than two hours of screen time (watching television, computer, or video games) per day in 2002 (Ministry of Health, 2003b), and this has increased to 40% of children aged five to nine years in 2008 (Clinical Trials Research Unit & Synovate, 2010).

A prospective epidemiological study conducted in Denmark showed an inverse association between number of hours watching television and healthy food preferences and habits (Hare-Bruun et al., 2011). Television watching is inversely associated with fruit and vegetable consumption (Blanchette & Brug, 2005). The increase in screen time for children, and the decrease in fruit and vegetable consumption may contribute to the increasing prevalence of overweight and obesity.

2.5 Dietary assessment in young children

2.5.1 Issues with dietary assessment in young children

There are many issues with dietary assessment in young children. In addition to under-reporting, children's attention span and cognitive development required to complete questionnaires is lacking (Livingstone et al., 2004). Skills such as memory, recall skills and estimation of portion size are still developing (Livingstone et al., 2004). Often, dietary assessments for young children are completed by the caregiver (usually the mother), however, children may spend many hours in a childcare facility. During this time, a member of staff of the childcare facility may observe what and how much their child consumes (Ball, Benjamin, & Ward, 2007).

2.5.1.1 Cognitive Development

During the 1920's, Swiss psychologist Jean Piaget developed a model to explain the cognitive development of humans, from childhood through to adulthood (Gelman & Baillargeon, 1983). This model involves four stages of development – sensorimotor (birth to two years), preoperational (two to seven years), concrete operational (seven to 11 years) and formal operational (11-15 years) (Gelman & Baillargeon, 1983). The preoperational stage includes the child's acceptance of stable concepts and magical beliefs, but the child is lacking in logical ability to complete complex tasks. The concrete operational stage shows development in the use of logic to solve problems and an improvement in classification (Gelman & Baillargeon, 1983). This model can be used in nutrition education, by introducing children at the preoperational stage, to unfamiliar foods (Baskale, Bahar, Baser, & Ari, 2009). At the concrete operational stage, children may be able to classify familiar and unfamiliar foods into groups (such as fruits or vegetables, foods that help us grow, foods that we eat every day) (Baskale et al., 2009). This model of cognitive development explains why the dietary assessment

of young children may be more difficult than in older children, or adults, as they may not be able to answer the assessment questions in the appropriate way. This is why photographs of food may be an ideal way of asking children questions about food. If they can see it in front of them, it is much easier for them to understand the concept.

Social cognitive development is the development of socially relevant mental representations and mental processes (Olson & Dweck, 2009). These processes are shaped by social factors, such as culture or parental practices, and influence the child's wellbeing and relationships. Children as young as six months can distinguish between good and bad. Several studies have explored this by using cartoons and puppets (Olson & Dweck, 2009), providing evidence that children are able to distinguish between good and bad, and therefore like and dislike. They may therefore be able to accurately answer questions about their likes and dislikes, in dietary assessments.

2.5.1.2 Accuracy of reporting

Prior to the age of seven to eight years of age, awareness of intake has not yet developed and parental input may be needed to assess the intake of younger children (Chambers & Johnston, 2002; Livingstone et al., 2004). Parents can be a reliable source of intake information for their young children, although they may not be with the child 24-hours a day (for example, when the child attends a day care or play centre) (Livingstone et al., 2004). According to Livingstone and Robson (2000), cognitive development for memory, concept of time and attention span does not develop until after eight years of age. After this age, children can report their dietary intake reliably, and these skills increase with age. However, using parental reports may be useful to compare with the child's dietary reporting to confirm actual intakes. After the age of 12 years, a child has developed recall skills and has the ability to estimate portion sizes (Livingstone et al., 2004).

2.5.1.3 Attention span

Attention span is another factor that may affect a child's ability to answer questions, especially if the assessment is long, or does not interest them. A study that investigated the attention span of young children (aged one to four and a half years) during free play showed that the attention span tends to be relatively short, decreasing over a two minute period (Ruff & Lawson, 1990). This increases after the age of two and a half years which is thought to be a developmental increase in attention due to increasing complexity in play (i.e. from simply looking at the toy to building or interacting with the toy) (Ruff & Lawson, 1990).

2.5.1.4 Child-guardian interaction

An interesting study by Sobo and Rock (2001) assessed the child-guardian interaction during a 24-hour recall face to face interview, where both the child (aged seven to 11 years) and the guardian were present. They showed three main themes of child-guardian interaction: interview format and demands, guardian assistance and children's awareness, which were all present in the interview process. The interview format involved the child being the focus. The guardian was instructed to assist when necessary, but to allow the child to answer as much as possible. The guardian mainly interjected to prompt the child to add something that was missing, or to expand on the details provided. They showed, contrary to other studies, that the children were quite aware and knowledgeable about their intake, and able to identify portion sizes as well as details of brands. It was apparent that some children were reporting what they thought they should be saying instead of the truth, as the guardian was present. For example, one child was told that she was not eating enough, so then she reported that she had eaten all her breakfast when she had not. The study also showed that both the guardians and the children's reporting had some errors, which is to be expected with

dietary assessment that relies on memory. Although the sample size was relatively small (N=34), and the authors did not use a control group to compare to, this study still provides some interesting insight into the guardian-child relationship and provides evidence that having the guardian present during the interview does still provide some useful information (Sobo & Rock, 2001).

2.5.1.5 Reporting by parents or caregivers

In Canada, a parent-administered nutrition screening tool was developed by Randall Simpson, Keller, Rysdale, and Beyers (2008), in which they compared the nutrition risk (malnutrition and obesity), identified by the screening tool that the parent's filled out, with the assessment from a registered dietitian. They showed that the screening tool was reliable, with most items having adequate ($\kappa > 0.5$) or excellent ($\kappa > 0.75$) agreement with the dietitian's assessment (Randall Simpson et al., 2008). This indicates that parents are aware of issues relating to their children, and are adequate at providing information about their children.

The ability of mothers to recall what their children have been eating was tested by Basch et al., (1990), who compared the intake recalled by the mother, with the unobtrusive observed intake of the child. They showed that the mother's recall appeared to be useful for grouping the children by intake of macronutrients, micronutrients and energy intake, but less useful for the amount of actual foods eaten and portion sizes. While this study used food models, food packages and various household utensils and equipment to increase accuracy of portion size reporting, portion sizes were acknowledged as often being difficult to estimate (Basch et al., 1990).

2.5.1.6 Appropriate dietary assessment tools

Tools that are used to assess dietary intake in adults are not always suitable for use in children. Young children lack the ability of memory and recall, and may be unable to report their intake accurately. There have been many studies conducted in children to find the best ways of assessing dietary intake. In a review of dietary recalls, records, FFQ, diet histories and observations of children, recalls and records showed a higher accuracy than the other methods of dietary assessment (McPherson et al., 2000). They showed that FFQ's overestimated energy intake, while food records underestimated energy intake (McPherson et al., 2000).

When choosing a dietary assessment method for use in young children (preschool aged), a review by Serdula, Alexander, Scanlon, and Bowman (2001) stated that as well as considering the accuracy and validity of the method, practicality and the purpose must also be considered. There is no gold standard for dietary assessment in young children. The accepted way to validate a method is to compare it with another validated method, such as a FR or recall (Serdula et al., 2001).

This review investigated three methods of dietary assessment, namely food recalls, and FFQ's (Serdula et al., 2001). They showed that food recalls (mostly 24-hour recalls) largely underestimated intake and that caregiver's were relied upon to provide details such as brand, ingredients and portion sizes. Main meals were more likely to be recalled than snacks and other smaller meals such as desserts (Serdula et al., 2001). When compared to observed intake, the difference in energy intake for food recalls was less than ten percent (Serdula et al., 2001). Food records relied on the caregiver's recording of the intake of the child (either weighed or visually estimated) (Serdula et al., 2001). The results showed that food records underestimate intake by three to seven percent when compared to total energy expenditure (TEE) (using the doubly labelled water (DLW) method) (Serdula et al., 2001). This shows that there are multiple reasons

why dietary assessment, especially in young children, is susceptible to many errors, and results must be considered with that in mind.

2.5.2 Comparison of dietary assessment tools

Recording intake by way of observation is considered the gold standard for measuring food intake in young children, as shown by Ball, Benjamin, and Ward (2007). However, this method is time consuming and impractical to conduct in most settings.

In order to find out the best tool for assessing preschool children's intake, Iannotti, Zuckerman, Blyer, O'Brien, Finn, and Spillman (1994) conducted three dietary assessment methods on 17 preschool children, nine cared for at home, and eight in childcare centres. They performed a three day measured food record, and a recall on each of those days for the previous 24-hour period, and conducted a FFQ at the end of the data collection period. They showed good correlation between the food record and the food recall ($r = 0.61$, $P<0.01$), but less so with the FFQ ($r = 0.49$, $P<0.05$) (Iannotti et al., 1994), demonstrating that the food record and food recall were better at dietary assessment. However, the FFQ was designed to be used in adults, so this may have been a contributing factor to the discrepancy with the other tools; furthermore, the sample size was also limited (N=17).

In another study in children, FFQ's were compared against food records and food recalls to assess their validity (Serdula et al., 2001). They showed that FFQ's consistently overestimated intake when compared to food records, food recalls, and DLW (Serdula et al., 2001). Therefore, in dietary assessments of children, food records or food recalls are more valid methods to use than FFQs.

Dietary assessment methods that are used in children include food records (food is recorded at the time of consumption, including quantity and other details), food recalls (food and drink consumed over a period of time is recalled), and FFQ's (frequency that

food items are consumed over a period of time). These will be discussed in detail below.

2.5.3 Food records

Food records require the participant, or in the case of a child, the caregiver, to record each item of food and drink that they consume, as they consume it. The record can either be estimated (visually, using household measurements), or be weighed (each individual food and beverage component weighed). There are many advantages to using this method, as it is considered the most accurate; however it can be time consuming and requires a lot of effort from both the participant and researcher (see table 2.9).

Table 2.9. Advantages and disadvantages of use of food records to assess dietary intake (Cade, Frear, & Greenwood, 2006; Cheng, Hilbig, Drossard, Alexy, & Kersting, 2013)

Advantages	**Disadvantages**
Most accurate way of recording food intake	Difficulty with estimating portion sizes
Usually done at the time of consumption, so less chance of forgetting items	May forget to record snacks, or sauces/condiments used
Can be completed by a caregiver (as a proxy)	Can be time consuming, especially if weighed method used
	Data entry for analysis can be time consuming
	Participants may change diet due to having to record what they are eating or to impress the investigator

Many studies have used a food record to gain accurate information on children's dietary intake and habits (Davies et al., 1994; Szymlek-Gay, Ferguson, Heath, & Fleming, 2010). Although this is a time consuming method, a weighed food record is more accurate than an estimated food record (Szymlek-Gay et al., 2010). However, the validity of weighed food records in young children is often disputed, as there are many

factors that may affect their accuracy. Davies et al., (1994), assessed the intake of preschool aged children (one and a half to four and a half years) with a four day weighed food record. They compared this with TEE calculated using the DLW method. They showed good correlation between these two methods (Davies et al., 1994). This has also been shown by several other studies in different populations (Cheng et al., 2013; Walker, Bell, Boyd, & Davies, 2013).

Other methods can be used rather than a food record if less detail is required, and only a general indication of intake is needed. In the Child and Diet Evaluation Tool (CADET) study, researchers developed a 24-hour food tick list tool to be used in children aged three to seven years, which assessed diet with a focus on fruit and vegetable intake (Cade et al., 2006) (refer to table 2.11). They compared the tick list with a 24-hour semi-weighed food diary for the same day as the tick sheet. They showed that the tick sheet performed well compared to the semi-weighed record (r=0.44-0.89 for food items). The Child and Diet Evaluation Tool was also used to asses fruit and vegetable intake in another group of preschoolers in the UK, and it was concluded to be a good indicator of actual intake (Cockroft et al., 2005).

While a food record (weighed or estimated) is the most accurate form of dietary assessment, it is time consuming, and places a large burden on participants. A tick sheet may be an easy and appropriate way to assess exposure to fruits and vegetables.

Table 2.10 summarises the studies that have assessed the validity and accuracy of food records in young children.

Table 2.10. Studies that have assessed the validity and accuracy of food records to assess dietary intake in young children

Study	Population	Tools used	Outcomes
Ball et al., 2007	Children aged 3-6 years n=96 USA	Observational food record	Recording of the observed food intake is the best method available, compared to food recalls and FFQ (ICC = 0.99 between observation and weighed records)
Cade et al., 2006	Children aged 3-7 years n=180 England	24 hour tick list (with a focus on fruit and vegetables) compared with 24 hour semi-weighed food diary	24 hour tick list successful compared to food diary (r = 0.44 - 0.89 for foods)
Cheng et al., 2013	Children aged 10-36 months n=67 Germany	3-day estimated food record compared with 3-day weighed food record (FR)	Estimated FR was comparable to a weighed FR (r = 0.35 – 0.80 for foods)
Davies et al., 1994	Children aged 1.5-4.5 years n=81 England	Weighed food record (4 days) compared with TEE (DLW)	Weighted FR was comparable to TEE (r = 0.41, P<0.01)
Walker et al., 2003	Children aged 3-4.5 years with cerebral palsy n=31 Australia	Weighed food record (3-days) compared with TEE (DLW)	3-d food record is accurate when compared to TEE (r = 0.83)

2.5.4 Food recalls

Food recalls involve an interviewer asking a participant to recall all the items and quantities of food they consumed, usually from the previous 24-hours. Food recalls are generally used for dietary intake assessment, as they are quick and easy to complete, although they can be limited as they rely on the memory of the participant and the interview skills of the researcher (see table 2.11). The day being recalled may not be a typical day for the participant and may not accurately represent their usual eating habits.

Table 2.11. Advantages and disadvantages of using food recalls to assess dietary intake (Baxter et al., 2009; Fisher et al., 2008; Johnson et al., 1996)

Advantages	**Disadvantages**
Quick and easy to complete	Relies on memory
Can use portion size models to estimate intake	Can be difficult to remember portion sizes and ingredients
Can be conducted in an interview style, where a trained researcher can ask for more detail if deemed necessary	Trained researcher needed to conduct interview
	Difficult to conduct in young children, parent or caregiver needed as a proxy
	Snapshot of a person's intake, may not represent their usual intake

The multiple pass 24h-recall method is a method to obtain a full diet history. This is where the food and drinks consumed on the previous day are recalled by the participant, and then the interviewer will then go back through the day, to obtain more details in further passes through the recall period. This method allows details that may have been missed in the initial run-through, to be explored further. This may include quantities of foods, brands of foods, sauces, condiments or other details. Several studies have used this method to gain a more complete picture of the participant's intake (Johnson et al., 1996; Wroten, O'Neil, Stuff, Liu, & Nicklas, 2012). One study showed that a multiple-pass food recall underestimated energy intake, when compared to TEE, measured by the DLW method (Johnson et al., 1996). However, it was acknowledged that children may not be in energy balance, as they undergo large periods of growth and development (Johnson et al., 1996).

Fisher et al., (2008), conducted a study with children four to 24 months of age, comparing a single pass 24-hour dietary recall with a three day weighed food record as completed by the caregiver. They showed that the 24-hour dietary recall significantly overestimated the energy intake of both infants and toddlers compared to the three day weighed record. They did note that weighing the food may have influenced how much the children were given to eat over the three-day period. Also, portion sizes were noted

to be difficult for the caregiver's to estimate, and may have influenced the results (Fisher et al., 2008).

The time between the recall period and the interview taking place may have an effect on accuracy of the information being recalled. The least amount of time between the recall period and the interview provides the most accurate answers (Baxter et al., 2009), as it is generally easier to recall details that happened in the short-term rather than the long-term. Table 2.12 summarises the studies that have assessed the validity and accuracy of food recalls in young children.

Table 2.12. Studies that have assessed the validity and accuracy of food recalls to assess dietary intake in young children

Study	Population	Tools used	Outcomes
Johnson et al., 1996	Children aged 4-7 years n=24 USA	24 hour recall (mean of 3 days) compared with TEE	Recall was comparable when compared to TEE (DLW) (97%)
Baxter et al., 2009	Children aged 9-10 years n=374 USA	Food recall	Most accurate if time between recall period and interview is minimal
Fisher et al., 2008	Infants and toddlers aged 4-24 months n=157 USA	24 hour recall compared with 3-day weighed food record	24 hour recall overestimated energy intake compared to the 3 day weighed food record (by 13% in infants, and 29% in toddlers)
Basch et al., 1990	Children aged 4-7 years n=46 USA	24 hour recall (evening meal section)	Recall overestimated energy intake when compared to the evening meal observation

2.5.5 Food frequency questionnaires

Food frequency questionnaires assess the frequency in which the participant consumes each food, over a period (ranging from one week to one year). Although this method is quick in collecting data, there are limitations to this method (see table 2.13).

The concept of thinking about how much you would consume a food over a long period, such as one year, is difficult. This can be especially difficult as some foods, such as fruits and vegetables, are seasonal.

Table 2.13. Advantages and disadvantages of use of a food frequency questionnaire to assess dietary intake (Lillegaard, Overby, & Andersen, 2012; Parrish et al., 2003)

Advantages	**Disadvantages**
Quick to administer, only one occasion required	Intake may change over the time period being assessed
Can be pre-coded for analysis	Can be long, and the participant may fatigue
Can be conducted by someone with minimal training	Complex concept – estimation of frequency of intake
Can identify food groups that are inadequate in the diet	Participant may not fill out the questionnaire correctly
	No extra information can be gathered, such as food preparation methods

Byers et al., (1993) compared the dietary intake of children from a FFQ completed by the children's parents (N=97), with the serum nutrient levels (vitamins C, A & E) in children, to assess the accuracy of the parental reporting. They showed a modest correlation between the dietary intake from the FFQ, and the serum nutrient levels (r= 0.30 for serum carotenoids, r=0.34 for serum vitamin C). This may be due to errors in parental reporting, but it may also be due to non-dietary determinants of nutrient levels in the blood. They concluded that although the correlation was not very strong, the findings do indicate that the parental reported FFQ is a good way to estimate children's dietary intake (Byers et al., 1993). This, along with other studies previously mentioned, indicates that parents are an adequate resource for obtaining dietary intakes of children.

Food frequency questionnaires that have been validated in children are rare. One study assessed the accuracy of using a FFQ that was designed for adults, in children aged 13-18 years (Shatenstein et al., 2010). The parents completed the FFQ for their

children and the children completed their own FFQ. They showed that the FFQ adequately ranked the children on their nutrient intake.

In another study, a semi-quantitative FFQ designed for adults significantly overestimated energy intake when compared against TEE (using DLW) in children aged four to seven years (Kaskoun et al., 1994). This may be due to the portion sizes in the FFQ relating to adult's portions, rather than children's (Kaskoun et al., 1994). However, it may also have been due to errors in reporting by the caregivers and the fact that dietary intake often changes as the child grows and develops (Kaskoun et al., 1994) (see table 2.15). FFQ's assess dietary intake over a period of time, which requires the intake to be reasonably constant. With growth and development in childhood, intake often changes substantially, with the introduction and acceptance of new foods, and an increase in quantities consumed. This may lead to inaccurate results obtained from the FFQ, and may not represent the full intake over the questionnaire period.

Blum et al., (1999) assessed the validity of a FFQ against 24-hour recalls. Their study assessed this in both Native American and Caucasian children aged one to five years. They conducted the FFQ on the caregiver's of the children, on two occasions and they compared this against the average 24-hour recall, which was completed three times over one month. A good correlation ($r=0.52$, $N=233$) was observed between the two methods in both populations. The authors do acknowledge some limitations, such as the caregivers' accuracy in reporting, as they might not be present when their child eats something away from home (Blum et al., 1999).

In another study that compared a 111-item FFQ against 24-hour recalls, Parrish et al., (2003), used a one year FFQ to assess the energy and nutrient intake of children aged one to three years, completed by the parents. They compared this with three to four 24-hour recalls, completed by the parents and any other caregiver involved in feeding the

child. As with many other studies, they showed the FFQ to overestimate energy and nutrient intakes, with a mean caloric difference of up to 70% between the FFQ and food recall. The authors note that the large difference may be due to the parents not accurately estimating the portion sizes their children were consuming (Parrish et al., 2003). Overall, the authors found the FFQ showed modest agreement with the multiple 24-hour recalls, and biomarkers (Parrish et al., 2003).

Lillegaard, Overby, and Andersen (2012), found a FFQ overestimated most foods when compared to a weighed food record in children aged nine to 13 years. This large study (N=1637) used a short FFQ of 23 items (focused on fat, sugar, fruit and vegetables), and compared it with the intake from a four day food diary, which was conducted two weeks after the FFQ. Although the FFQ overestimated most foods, it had good correlation with beverage, fruit and vegetable consumption (Lillegaard et al., 2012).

Gibson et al., (1998), also used a FFQ to assess the mother's intake and compared this with a three day food diary in children aged nine to 11 years. As with other studies of this nature, they showed the FFQ overestimated fruit and vegetable consumption (Gibson et al., 1998).

A summary of these studies that use FFQ in children can be seen in table 2.14.

Table 2.14. Studies that have assessed the validity and accuracy of the FFQ for dietary assessment

Study	**Population**	**Tools used**	**Outcomes**
Byers et al., 1993	Children aged 6-10 years n=97 USA	FFQ compared with serum nutrient levels	Moderate agreement between FFQ and serum nutrient (vitamins C, A and E) levels
Shatenstein et al., 2010	Children aged 7-18 years n=65 Canada	FFQ compared with a 3-day non-consecutive food record	FFQ overestimated energy intake when compared with the 3-day food record.

Study	Population	Tools used	Outcomes
Kaskoun et al., 1994	Children aged 4-7 years n=45 USA	1-year FFQ compared with total energy intake (DLW)	No significant difference found between FFQ and TEE (DLW)
Blum et al., 1999	Children aged 1-5 years n=233 USA	Mean of 2x 1-month FFQ's compared with 3x 24-hour recalls	Mean 2x FFQ's overestimated energy intake compared with the mean of 3x 24 hour recalls
Gibson et al., 1998	Children aged 9-11 years n=92 UK	FFQ compared with 3-day food record	FFQ overestimated fruit and vegetable intake compared with 3-day food record
Lillegaard et al., 2012	Children aged 9 & 13 years n=1637 Norway	FFQ compared with weighed food record	FFQ overestimated fruit and vegetable intake compared with weighed food record
Parrish et al., 2003	Preschool children aged 1-3 years n=68 USA	FFQ compared with 24-hour recall	FFQ overestimated total energy intake compared with 24-hour recall

2.5.6 Food preference or liking

Food preference or liking has been used to assess dietary intake in some studies (Birch & Sullivan, 1991; Guthrie et al., 2000; Wardle et al., 2001), however few studies have investigated the validity of food liking tools for dietary intake (Jaramillo et al., 2006; Vereecken et al., 2010). As with the other dietary assessment methods, there are advantages and disadvantages (see table 2.15) with using food preference or liking to assess dietary intake. There are several different strategies available to assess food liking, which include parent reporting, tasting methods, age-appropriate scales and visual exposure. Parent reporting uses the parent's perceptions of their child's liking to assess intake. Tasting methods allow the child to taste multiple foods and either rank them or eliminate the foods they like in order to create a preference order. Age-appropriate scales can be used to ask the children directly, how much they like or dislike an object. And finally, visual exposure involves either showing the child a real

food item, or a picture or a model of a food item, and asking them if they liked or disliked the food item.

Table 2.15. Advantages and disadvantages of use of food liking or preference tools to assess dietary intake (Birch & Sullivan, 1991; Chen, Resurreccion, & Paguio, 1996; Vereecken et al., 2010)

Advantages	Disadvantages
Young children can usually report liking and disliking themselves, no proxy needed	May not equate to intake
Time efficient for participant and researcher	Children may report extremes of liking, which may not be accurate
Low participant burden	There are few validated tools available
Use of liking scale allows direct comparison between foods	Tasting methods are best to assess preference, although these are impractical and time consuming

2.5.6.1 Strategies for assessing food liking or preference

Parent reporting

Vereecken et al., (2010) developed a short computerised program to assess fruit and vegetable preferences in young children aged four to six years. They compared the answers from the children with the answers from the parents and validated these with a short FFQ that focused on fruit and vegetable intake. They showed that the children were more likely than parents to report that they had never tried an item, and more likely to report extremes (really like or really dislike). Parents reported that children liked 74% of the fruit, and 65% of the vegetables in the tool. This compared strongly (ICC = 0.48 for fruit, 0.41 for vegetables) with the children's reporting of 68% of the fruit and 64% of the vegetables were liked. The parent's tool was moderately validated with the FFQ (r=0.38 for fruit, and r=0.39 for vegetables, P<0.001). The children's tool was weakly validated with the FFQ (r=0.19 for fruit, r=0.25 for vegetables, P=0.017).

However, the authors did acknowledge that their study did not use a 'gold standard' tool to compare with (e.g. a weighed food record) and the results may not be generalisable to other populations as they used a convenience sample from a Flemish population. They also suggest these results are promising, but more validation studies with better power are necessary. In addition, they found a low-moderate agreement between the test-retest reliability of responses from parents and children, although the low agreement came mostly from mothers that had a low level of education (Vereecken et al., 2010).

A study conducted in England and Wales, used maternal reporting to assess food preferences, intake and activity preferences in children aged four to five years (twins) from lean and obese families (Wardle et al., 2001). Mothers were asked to report their children's liking of three high fat foods (sweet - chocolate, savoury - cheese, and bland - butter biscuits), and three low fat foods (sweet - jelly babies, savoury - carrots, and bland - Ryvita), and to record their children's intake on a short FFQ. They showed that children from obese families ranked the high fat foods more highly, and ranked the lower fat foods at a lower level. The mothers were asked to report on behalf of their children, as the children were too young to report their intake and activity levels (Wardle et al., 2001).

Tasting methods

Non-verbal methods can also be used to determine food preferences or liking. Birch and Sullivan (1991) used the tasting of seven items of food to assess preferences in three to four year old children. The first part of the study involved the children tasting the foods, and rating them on a scale. The second part of the study involved them ranking the foods in order of preference within the categories (like, neutral and dislike). They showed excellent stability in preferences in children aged four (80% significant

tau value), but much less stability in children aged three (35% significant tau value) over successive occasions (Birch & Sullivan, 1991). This demonstrates the increase in cognitive development between the ages of three and four years, and the increase ability to report reliable food preferences.

A study by Leon, Couronne, Marcuz, and Koster (1999) examined three non-verbal methods: paired comparison, ranking by elimination and hedonic categorisation (rating of a food by liking). Biscuits with five different flavoured jam toppings were used to compare liking in this study. Reproducibility and reliability was tested in all three methods by the Kendall correlation coefficient (W). For paired comparison, they gave the children two biscuits (a pair) and asked them which one they preferred, and then they repeated this with the next pair, and so on. For the ranking by elimination, they gave the children all five flavours of biscuits and asked them to identify which flavour they liked best, and that was then eliminated. They were then asked which flavour they liked best out of the remaining biscuits, and so on. For the hedonic categorisation method, they were given a simple scale, and asked to rate their liking for each biscuit flavour. They showed that biscuits with familiar flavours were preferred to biscuits with unfamiliar flavours. They also showed that the hedonic categorisation method was slightly more repeatable than the other two methods (W=0.18) (Leon et al., 1999). They also noted that results were much more reliable in children over five years of age (W>0.20), than the younger group (four to five years) where the results were not so reliable (W=0.17-0.18) (Leon et al., 1999).

Age appropriate

Chen, Resurreccion and Paguio (1996) showed that if an age appropriate scale is used, accurate and reliable information can be gained from young children. In this study, they used three hedonic scales (three-point, five-point and seven-point) to

evaluate the children's liking of ultra-high temperature (UHT) milk against pasteurised milk. They showed that the age appropriate scale for three to four year olds is the three-point scale, for four to five year olds is the five-point scale, and for five to six year olds is the seven-point scale (Chen et al., 1996).

Birch and Sullivan (1991) used a three point scale in children aged three and four years, the scale comprised of three cartoon faces, displaying liking, neutral and disliking. Prior to the study being conducted, the children were involved in a group session, which introduced the scale, and described the faces, to enhance understanding. They concluded that the children had a good understanding of the faces, and could use them accurately to describe their preferences (Birch & Sullivan, 1991). This study did not assess validity or reproducibility.

Jaramillo et al., (2006) assessed liking of fruit, fruit juice, and vegetables in children aged three to five years, with a computerised food preference tool. They used a three-point scale, with a yucky face, a neutral (okay) face, and a yummy face. Reproducibility was tested with the correlation of the tools, administered seven days apart. Predictive validity was assessed by categorising the fruit and vegetable preferences into low and high (split by median point). They showed that preference for fruit ranged from 48-66% liking, vegetables ranged from 37-63%, and juice ranged from 37-65%. The tool was found to be strongly reproducible with $r=0.73$ ($P<0.001$, $N=50$). Predictive validity showed that fruit and vegetable consumption was higher in children that reported a higher preference for fruit and vegetables. They concluded that this scale was appropriate for this age group, as they were assessing liking and disliking, and not the degree of liking (Jaramillo et al., 2006).

Visual exposure

Food tasting methods to evaluate food preferences in young children are not always practical and easy to conduct (Guthrie et al., 2000). In a study by Guthrie et al., (2000), they investigated two alternative methods, food photographs and food models, and compared them against taste testing in 96 children between the ages of three and five years. The study used three faces for the children to rate their liking on, a smiley face (yummy), a neutral face (okay), and a frowning face (yucky). They explained each of the faces to the children and then asked them to identify the faces and then for them to make the faces, to ensure they understood them. The authors showed that food photographs were almost as good as taste testing for validity (correlation) and reliability, especially in older children (correlation of 0.80 in test-retest). They also showed that food models were not a good alternative to taste testing, especially in the younger children, as they associated these models more with toys than food (Guthrie et al., 2000). Table 2.16 summarises the studies that have used food liking or preferences to assess intake.

Table 2.16. Studies using food liking or preferences to assess dietary intake.

Study	Population	Tools used	Outcomes
Birch & Sullivan, 1991	Preschool children 3-4 years	Tasting of 7 items of food, and ranking on a 3-point smiley face scale	4 year olds (r=0.80) showed higher reproducibility than 3 year olds (r=0.35) at reporting their liking of foods
Guthrie, Rapoport & Wardle, 2000	Preschool children 3-5 year olds N=92	3 methods were used to assess food preferences – tasting, photographs and food models.	Tasting method produced the highest correlation – 0.81, followed by photographs – 0.75, then food models – 0.52.
Jaramillo et al., (2006)	Preschool children 3-5 years N=198	Computerised assessment in children of their fruit and vegetable preferences compared against observed intake	Good reproducibility (r=0.73), and good validity (P=0.02). 69% liking of fruits, 59% liking of vegetables.

Study	Population	Tools used	Outcomes
Leon et al., 1999	Children aged 4-10 years N=169	Non-verbal methods of food liking including hedonic categorisation, paired comparison and ranking by elimination	Hedonic categorisation is more accurate than paired comparison and ranking by elimination
Vereeken et al., 2010	Preschool children aged 4-6 years N=139	Computerised assessment of fruit and vegetable preferences in children compared against their caregivers reports of children's food preferences	Moderate agreement found when comparing children's answers to the caregiver's (ICC: 0.41-0.48). Good test-retest correlations between children's tools.
Wardle, 2001	Children 4-5 years (twins from lean and obese families) N=428 UK	Maternal reporting of children's preferences of meats, sweet desserts, fruits and vegetables. Taste testing in the children for liking of 6 foods (chocolate, cheese, biscuits, jelly babies, carrots, ryvita).	Children from lean families had a greater liking for fruit and vegetables than children from obese families (t=2.3, P=0.02).

2.6 Assessment of validity and reproducibility of dietary assessment tools

2.6.1 Validity

All dietary assessment methods need to be validated to ensure the information gained from the dietary assessment is accurate. A dietary assessment method is usually validated against either another dietary assessment tool or a biochemical marker, although neither may be 100% accurate (Cade, Thompson, Burley, & Warm, 2002). In order to validate a tool, the population groups used for the validation must be the same as the population group that the tool is intended to assess (i.e. same age group, ethnicity, socioeconomic status), or the population must be representative of the group (Cade et al., 2002). The most accepted method for validating dietary assessment tools against another dietary assessment tool in young children is a weighed food record

(Serdula et al., 2001), as this gives the most accurate data for the assessment of dietary intake.

2.6.2 Reproducibility

Reproducibility of dietary assessment tools should be established. This assesses whether the tool will produce the same or similar results after administering it again on the same participants, at another point in time (Cade et al., 2002). This is usually done by administering the same tool, four to eight weeks apart, to prevent recall of the answers from the previous administration (Cade et al., 2002).

2.6.3 Statistical analysis

A range of statistical methods should be used to establish the validity and reproducibility of dietary assessment tools, including food liking tools (Cade et al., 2002). Previous studies have assessed validity of dietary assessment tools using mean differences (Chen et al., 1996), Pearson's correlation coefficients (r) (Basch et al., 1990; Skinner et al., 2002; Vereecken et al., 2010), and paired t-tests (Basch et al., 1990; Chen et al., 1996; Vereecken et al., 2010) to assess similarities and differences between the tools. Correlations are significant if r >0.3, and paired t-tests are significant if the effect size was >0.3 (Field, 2009). Agreement from cross-classification and weighted Kappa has also been used to assess validity of dietary assessment tools, with values of >0.61 indicating good agreement (Vereecken et al., 2010). These tests have also been used to assess the reproducibility of dietary assessment tools, with Pearson's correlation coefficients to assess how closely the tools align (Blum et al., 1999; Skinner et al., 2002), paired t-tests to assess whether there are any differences between the tools (Basch et al., 1990), and cross-classification and weighted Kappa to assess agreement between the tools (Vereecken et al., 2010).

2.7 Conclusion

Children are not consuming the recommended servings of fruit and vegetables, and this may have an impact on their future health and wellbeing, leading to obesity, illness and disease later in life.

There are many factors that affect food preferences and intake. Understanding these will enable public health efforts to be targeted in the right places. Social and environmental factors also play a large part in the development of children's food preferences and habits. Children usually experience some degree of food neophobia, however this can be overcome with repeat exposure and positive social experiences. Children prefer foods that they are familiar with, and are influenced by their parents, and peers. Studies have shown food preferences and likings to be strong determinants of food intake.

Dietary assessment can be difficult in young children, as they are still developing cognitively, and their memory and recall skills are also still developing. It is often necessary for the caregiver to become involved in dietary assessment, as they are usually responsible for the child's food and eating. The best method for collecting dietary assessment data is using a weighed food record. This may not be practical, as a weighed food record requires time and effort by both the caregiver and researcher. FFQ's tend to overestimate intake and recalls underestimate intake. Assessing food preference or liking may be an easy and practical way of assessing intake in young children. Only a few tools have been developed and validated to determine whether assessing food liking is an appropriate way to assess dietary intake. Therefore, further research is required to substantiate whether food liking is associated with food intake.

CHAPTER THREE

Methods

3 Methods

3.1 Study design

This cross-sectional study was designed to validate two fruit and vegetable liking tools, for use in a) caregivers of preschool aged children, and b) preschool children (aged 3.5 to 5.5 years), to assess the level of liking and intake of selected fruits, vegetables and non-food items. Exclusion criteria included children outside of defined age bracket (3.5-5.5 years), and those with serious medical issues.

The caregiver's tool was completed independently, and the children's tool was completed interview style with the researcher, independently from the caregiver. These two tools were used to ascertain the caregiver's perception of the child's liking, and the child's liking (as perceived by the child).

Validation was achieved by the caregivers completing a fruit and vegetable intake record to compare against both the caregiver's and children's tools. Reproducibility was assessed by both the caregivers and children completing their tools on two visits, 4-8 weeks apart. The conceptual design of the study is described in Figure 3.1.

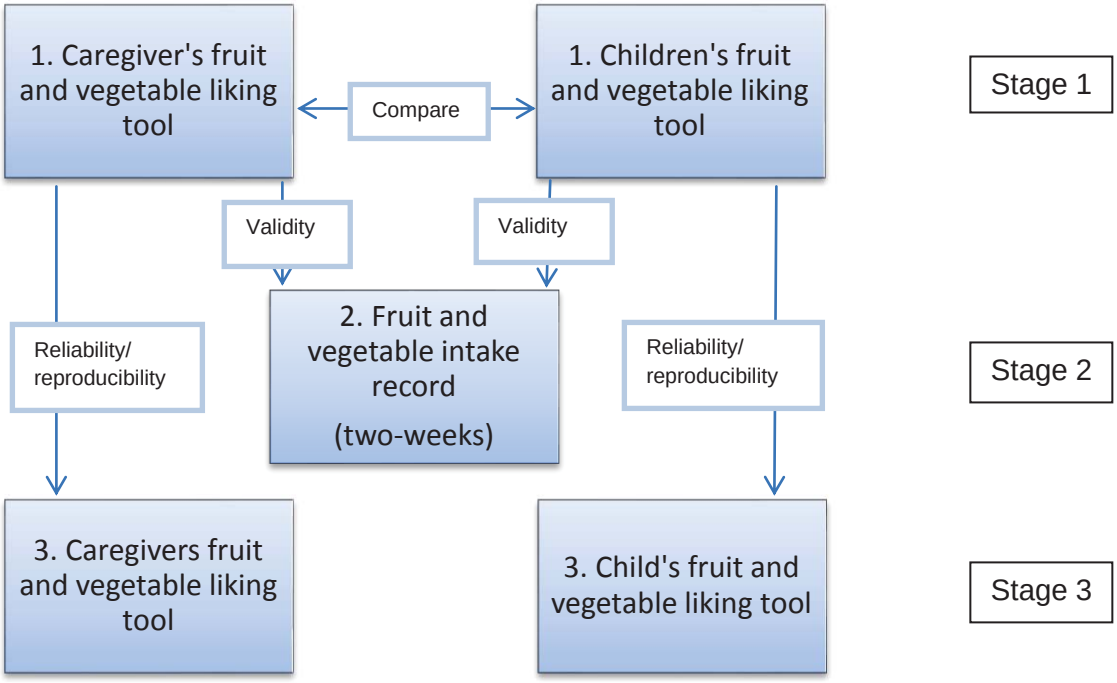

Figure 3.1 – Conceptual design of study

3.2 Ethical approval

The study was conducted by researchers from the Institute of Food, Nutrition and Human Health, Massey University. The Massey University Human Ethics Committee Northern granted ethical approval for the study (MUHECN 12/100) (see Appendix 1). Māori, Asian and Pacific Island consultation was undertaken, and written informed consent was obtained from all primary caregivers at the first visit.

3.3 Design and development of the fruit and vegetable liking tools

The caregiver's tool was designed to obtain information about the children's liking of fruits and vegetables (Appendix 7). The scale that was used was a continuum between extreme liking, and extreme disliking. The children's tool was designed to obtain

information about their liking of fruit and vegetables. The scale used was a five-point smiley face scale (Appendix 9). The caregiver's tool was compared with actual intake of the child, and so a fruit and vegetable intake record was also designed (to assess validity) (Appendix 10). This was based on a 24-hour tick sheet designed by Cade, Frear, & Greenwood (2006) to assess intake in children. The children's tool and the caregiver's tool were repeated twice (to assess reproducibility) at least one month apart to ensure that no recall was possible, but also that dietary habits had not changed substantially (Block & Hartman, 1989). This study used colour photographs of fruits and vegetables, along with a 5-point smiley face scale to assess fruit and vegetable liking in children (Chen et al., 1996; Guthrie et al., 2000; Vereecken et al., 2010).

3.3.1 Initial design of the caregiver's fruit and vegetable tool

The caregiver's tool was designed first, so that the design and content could be replicated for the children's tool. The scale that was used on the caregiver's tool was designed to also fit the children's tool, to ensure that both tools would be comparable. Commonly consumed fruits and vegetables included in the tool were chosen based on results from the 2002 National Children's Nutrition Survey (Ministry of Health, 2003b). Non-food items such as a toothbrush and toothpaste (activity – brushing teeth), and toys (activity – playing with toys) were also included, to gain an overall understanding of like versus dislike. Photographs of vegetables were obtained from the resources available on the www.vegetables.co.nz website. Photographs of fruit, and non-food items were obtained from Google Images, using royalty-free images. Several versions of the tool were created and tested until the researchers were satisfied with the final tool.

The first version of the caregiver's tool had a scale that consisted of two baby faces, one where the baby was eating something it did not like and the other where the baby was obviously enjoying their food. There was a line between the two faces on which the caregivers could mark their child's liking of that particular food (see figure 3.2).

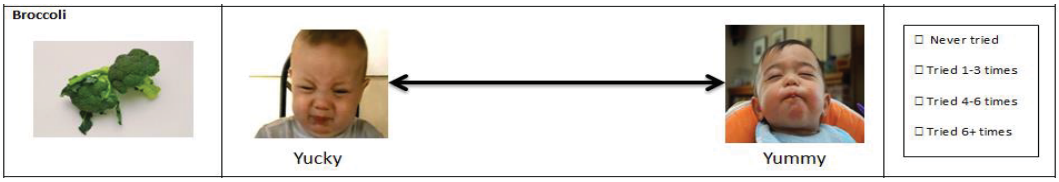

Figure 3.2 – Version 1 of caregiver's tool

For ease of understanding by both caregivers and children, it was decided to use smiley faces instead of real faces. The full Likert scale (five smiley faces) was used, as it gave the caregiver's the full range of options of liking (see figure 3.3). The caregivers had an additional section to the children's tool; with a question about how many times the child had tried the food items, with options of never tried, tried 1-3 times, tried 4-6 times, and tried 6+ times.

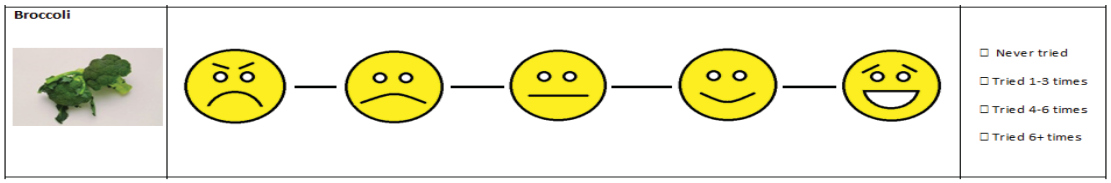

Figure 3.3 – Version 2 of caregiver's tool

3.3.2 Initial design of the children's fruit and vegetable tool

The same items were used on the children's tool as on the caregiver's tool (food and non-food), to allow for direct comparisons to be made between the two tools. The scale

was designed with the children's understanding in mind, (i.e. by using smiley faces) as they would be the group more likely to have difficulty understanding the tool. A children's tool was created to be compared with version 1 (see figure 3.4) and version 2 (see figure 3.5) of the caregiver's tool. As the researcher would be filling out the children's tool, it was decided to print separate photographs of the food and non-food items for the children to look at, then to condense the recording scales, with a smaller picture of the item beside it (refer to figure 3.5).

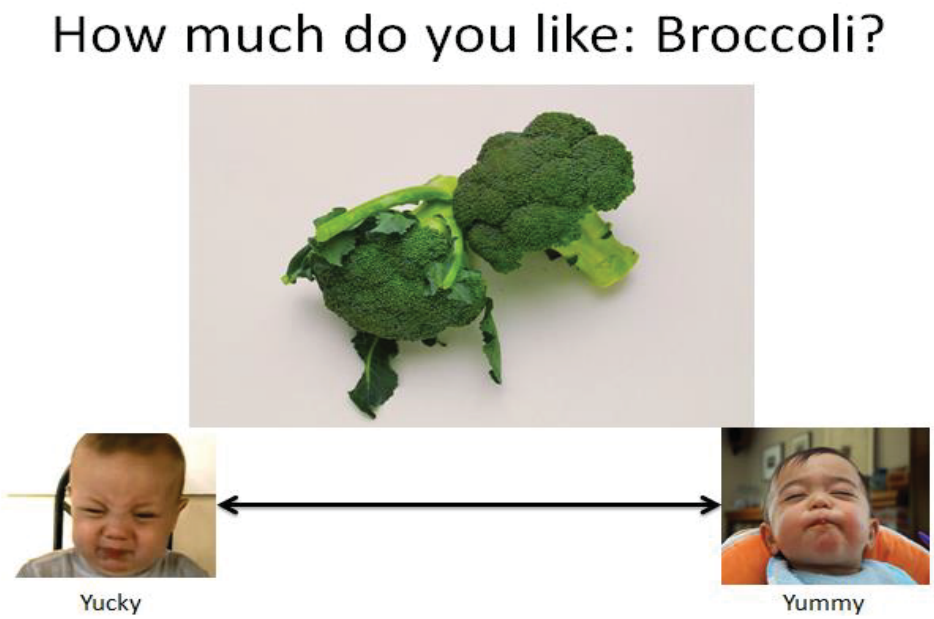

Figure 3.4 – Version 1 of children's tool

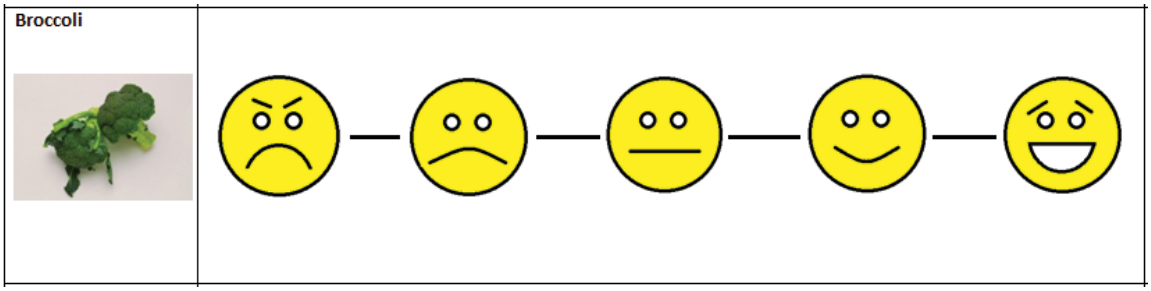

Figure 3.5 – Version 2 of children's tool

3.3.3 Fruit and vegetable intake record

A fruit and vegetable intake record was created in a tabular format for the caregivers to complete over the two week period (see figure 3.6 and Appendix 10). A fruit and vegetable intake record was decided on, instead of the gold standard weighed record, as this study was not assessing the quantities of foods consumed. The intake record was made simple and achievable, so that the caregiver's could easily fill it out, and so that it was not a burden. Fruits and vegetables available in New Zealand were taken from the Turners & Growers website (Turners & Growers, 2010). There was room at the bottom of the fruit and vegetable intake record for caregivers to add any additional fruits or vegetables consumed that were not on the list. The final version of the fruit and vegetable intake record can be seen in Appendix 10

Fruit and Vegetable Intake Record		**Name:**						
Please tick each fruit or vegetable that your child has had at least one serve of each day (see example column)								
Fruit or Vegetable	**Example**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
Apple	✓							
Apricot								
Asparagus								
Avocado								
Banana								
Bean sprouts								
Beetroot								
Blackberry								
Blackcurrant								
Blueberry								
Bok Choy								
Broad beans								
Broccoli	✓							
Brussels sprouts								
Cabbage								
Cantaloupe								
Capsicum								
Carrot	✓							

Figure 3.6 – Sample of the final version of the fruit and vegetable intake record

3.3.4 Pilot study and final design of tools

A pilot study was conducted with five participants (children aged between 3 and 3.5 years) and their caregivers, to test both the children's tool and the caregiver's tool. This pilot study was necessary to test the understanding of the tool by the children, and also to test the most appropriate way to ask the questions. The tool was further refined after completion of the pilot study.

The first child of the pilot study took a long while to warm up to the questions and it was difficult to obtain accurate answers from him. He also did not understand all the smiley faces, which made it challenging for him to answer the questions. For the second child, the researcher explained the smiley faces to the child prior to conducting the children's tool. This enabled the child to use more of the smiley faces to respond to the questions. For the third child, the researcher carried out an activity with some coloured blocks, prior to explaining the smiley faces. This allowed the child to warm up to the researcher, and focus more on the task. This initial activity made the explanation of the smiley faces easier, and the child perceived it as a game. This made conducting the children's tool easier, as the child understood the connection between liking and the smiley faces. Using this new strategy, the fourth and fifth children answered the questions much more readily after completing the initial activity, and they were also less distracted during the session.

The different phrases used to ask the questions about the children's tool were also tested. The researcher tested various ways, such as "How much do you like broccoli? Point to the face" or "Which face are you when you eat broccoli" or "Do you like broccoli? Which face are you when you eat broccoli". It was found that t the best combination was "Do you like broccoli? Which face are you when you eat broccoli?" The child could then answer if they liked or did not like broccoli, and could then point to the face which they felt like when they ate broccoli. The children seemed to easily link

the faces with emotions, and if they really did not like broccoli (confirmed by the caregiver), they typically pointed to the grumpy (maximum dislike) face.

The information from the pilot study was used to refine both the caregiver's and children's tools.

Changes to caregiver's tool (see figure 3.7) included the following:

- Simplifying the Likert scale, to include just the two extreme (like and dislike) faces, to prevent from leading the caregiver to a specific face when they may have answered in between faces.
- Extending the number of times tried options to never tried, tried 1-3 times, tried 4-6 times, tried 7-9 times and tried 10+ times. This was extended because it may take 10-15 tries of a food before it is accepted (Barends, de Vries, Mojet, & de Graaf, 2013; Mennella et al., 2008; Wardle et al., 2003)
- It was also decided to include additional items in the caregiver's tool, so that it could be compared against both the children's tool and more extensively with the fruit and vegetable intake record. These were based on commonly consumed fruits and vegetables from the National Nutrition Survey 2008/2009 and the National Children's Nutrition Survey 2002 (Ministry of Health, 2003b; Otago University & Ministry of Health, 2011).

The final version of the caregiver's tool can be seen in Appendix 7.

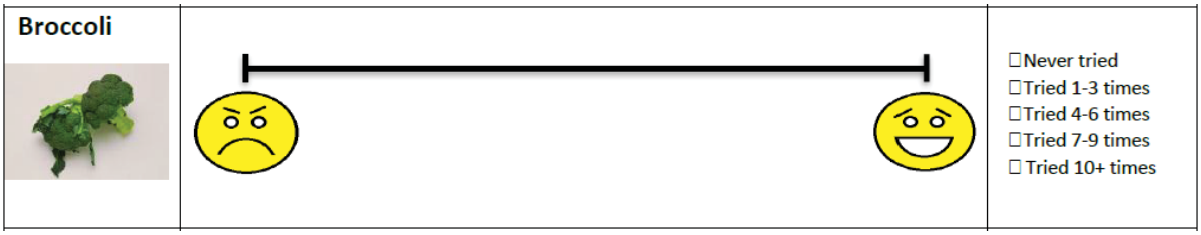

Figure 3.7 – Sample of the final version of the caregiver's tool scale.

Table 3.1 – Items included in the caregiver's tool

Items in Original Caregiver's Tool (n=12)	**Items in Updated Caregiver's Tool (n=39)**
Brushing teeth	Brushing teeth
Broccoli	Broccoli
Carrots	Carrots
Peas	Peas
Brussels sprouts	Brussels sprouts
Kumara	Kumara
Asian Greens	**Lettuce**
Toys	Toys
Apples	Apples
Bananas	Bananas
Kiwifruit	Kiwifruit
Oranges	Oranges
	Going to bed
	Courgette
	Capsicum
	Tomato
	Spinach/Silverbeet
	Watercress
	Pumpkin
	Green beans
	Frozen mixed vegetables
	Corn
	Potato
	Avocado
	Cauliflower
	Cabbage
	Grapes
	Pears
	Mandarin
	Strawberry
	Berries
	Apricot
	Canned peaches
	Plum
	Peaches
	Raisins/sultanas
	Canned fruit salad
	Dried fruit
	Canned pears

Updated items in bold font

Changes to the children's tool (see figure 3.8) included the following:

- Changing the vegetables from Brussels sprouts to spinach/silver beet, the removal of Asian greens and the addition of lettuce. All of the children that we piloted the children's tool on did not recognise and had never tried Brussels sprouts or Asian greens. As we wanted to establish like and dislike, it was decided to include vegetables that were well recognised and consumed.
- The addition of a bed (activity - going to bed). The addition of the extra non-food item of going to bed was to further establish like and dislike. All care givers agreed that 'going to bed' was an activity their child did not enjoy.

The final version of the children's tool is presented in Appendix 8 and 9.

Table 3.2 – Items in the Children's Tool

Items in Original Children's Tool (n=12)	**Items in Updated Children's Tool (n=13)**
Brushing teeth	Brushing teeth
Broccoli	Broccoli
Carrots	Carrots
Peas	Peas
Brussels sprouts	**Lettuce**
Kumara	Kumara
Asian greens	**Spinach/Silver beet**
Toys	Toys
Apples	Apples
Bananas	Bananas
Kiwifruit	Kiwifruit
Orange	Orange
	Going to bed

Updated items in bold font

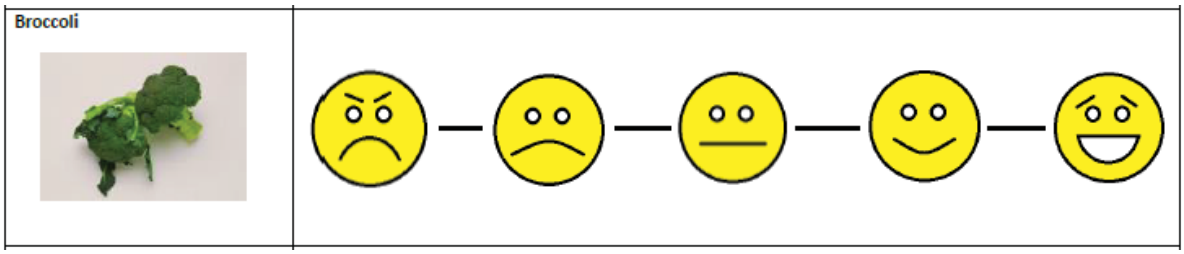

Figure 3.8 – Sample of the final version of the children's fruit and vegetable liking tool.

3.4 Study population

A required sample size of 100 was based on recommendations for validation studies of dietary assessment tools by Serra-Majem et al., (2009). Participants were healthy preschool aged children between 3.5 and 5.5 years, and their primary caregivers, who were living in Auckland. Preschool aged children were used as there have only been two food liking studies on this age group (Jaramillo et al., 2006; Vereecken et al., 2010), and at this age they are old enough to understand what is required of them. Most previous studies have looked at fruit and vegetable intake in toddlers, or older children (Domel et al., 1993; Baxter et al., 2009; Byers et al., 1993; Fisher et al., 2008; Leon et al., 1999; Szymlek-Gay et al., 2010).

3.5 Recruitment and sampling

Participants were recruited from around the Auckland area, from a variety of sources. Posters and flyers were given to 20 kindergartens on the North Shore, Jumping Beans North Shore, Mainly Music North Shore, and the Albany library for distribution to caregivers (refer to Appendix 5). Advertisements were placed on the Oh Baby Facebook page, and in the Little Treasures Magazine (refer to Appendix 6). Caregivers of eligible children were asked to phone or email the researcher for further details.

Once primary caregivers indicated interest, they were emailed an information sheet, and were asked to make a booking for their first visit. Written consent was gained during the first visit from the primary caregiver.

3.6 Data collection

Caregivers were asked to visit the Institute of Food, Nutrition and Human Health research facility at Massey University in Albany, twice, with their preschool aged child to complete the caregiver's tool and for the children's tool which was conducted by the researcher. All data collected for the children's tool was collected by the same researcher, to minimise errors in data collection. The timeline for the study is shown in Figure 3.9 below.

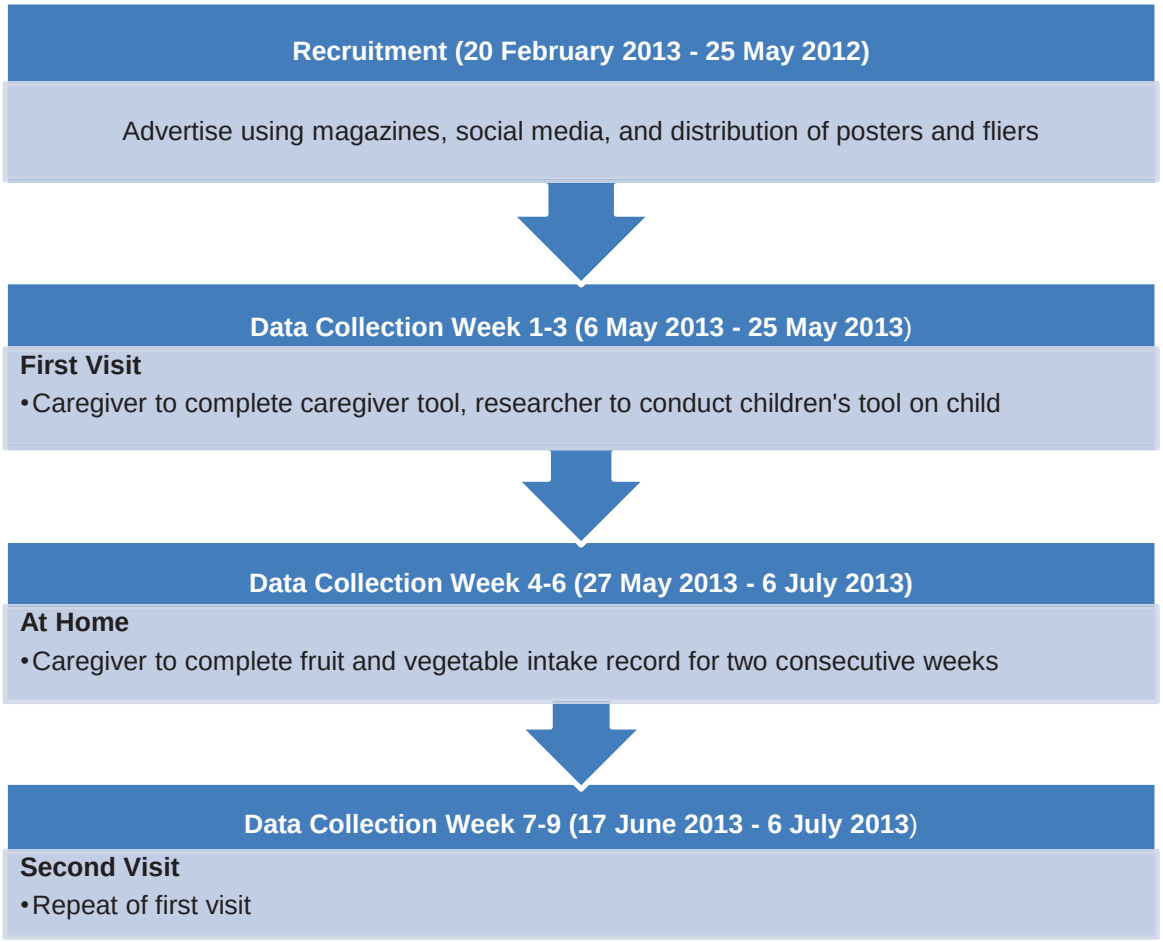

Figure 3.9 – Timeline of study

3.6.1 First visit

During the first visit, the caregivers were presented with a hard copy of the information sheet (Appendix 2) (that had previously been emailed to them), and were asked to fill out contact details and a health questionnaire (see Appendix 4), and to sign a consent form (Appendix 3). The researcher then provided the caregiver with a detailed explanation as to what was required of them, and how to fill out the tool on their perception of their child's liking of the items on the tool. While the caregiver completed these forms, the researcher conducted two warm up activities, as well as the children's tool with the child. The first activity involved playing a game using six coloured blocks, asking the child to identify colours of the blocks, and then to build a tower. This activity

helped to engage the child, and to gauge their general understanding of the questions being asked, and their ability to respond. After this activity, the researcher then asked the child various questions about the smiley face scale, to gauge understanding of the faces to ensure accurate responses to the tool. The children's tool was then conducted, which involved the researcher asking the child to identify what the item was, and then asked them how much they liked the item by pointing to one of the smiley faces. The smiley face identified by the child was then recorded on the tool by the researcher.

At the end of this visit, the caregivers were given an appointment time for the second visit four to eight weeks later. Email reminders were sent out two weeks before the second visit, to ensure the caregivers availability.

3.6.2 At home

After the caregiver's tool and the children's tool were completed, the researcher provided the caregiver with the two-week fruit and vegetable intake record, and a detailed explanation of how to complete the record. Portion sizes of the servings were described as the size of the child's cupped hand being a single serve. Therefore large pieces of fruit or servings of vegetables were considered as multiple servings, depending on the size of the child's hand. The fruit and vegetable intake record was completed for two consecutive weeks between the two visits. Caregivers were asked to return the intake records at the second visit.

3.6.3 Second visit

The purpose of this visit was to assess the reproducibility of both the caregiver's and the children's tool. During this visit, the exact sequence of activities used in the first visit

was repeated. At the end of this visit, the caregivers received a petrol voucher to cover travel expenses, and the children received a fun fruit and vegetable pack (consisting of two fruit and vegetable posters, a fruit drink, and some toys). The caregivers were advised that they would receive a summary of the results from the study via email at on completion of data analysis.

3.7 Data handling and analysis

Caregiver's fruit and vegetable liking tool: the scale for each item was measured from the middle (which was coded as 0 - neutral), the right hand side of the scale (like) was coded as a positive number (45 to 1), with 45 being the maximum like, and 1 being the minimum like. The left hand side of the scale (dislike) was coded as a negative number (-1 to -45), with -1 being the minimum dislike and -45 being the maximum dislike. For ease of measurement, the codes corresponded to millimetres on the scale. If the child had never tried an item, the caregiver was asked to mark the scale in the middle (0 - neutral) as it was not known if the child liked or disliked the particular item. Each fruit and vegetable item on the tool therefore received a number ranging from -45 to 45, according to the caregiver's perception of the child's liking. The tool was coded as a whole (all items together), then all vegetables were coded and all fruits were coded separately.

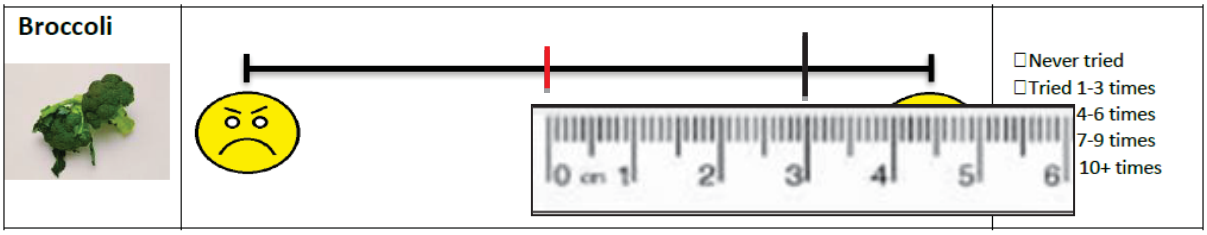

Figure 3.10 – Example of coding of caregiver's fruit and vegetable liking tool. Caregiver has indicated a line on the scale, which was then measured from the middle point of the scale, with liking being positive and disliking being negative. In this example, the liking of broccoli is +30.

Children's fruit and vegetable liking tool: coding was matched to the coding of the caregiver's tool. The 'grumpy' face was given a value of -45, the 'sad' face was given the value of -22.5, the 'OK' face was given a value of 0, the 'happy' face was given the value of +22.5, and the 'really happy' face was given the value of +45. This gave the right hand side of the scale (like) a positive number, and the left hand side of the scale (dislike) a negative number. Each fruit and vegetable item on the tool therefore received a number of either -45, -22.5, 0, 22.5 or 45, according to the child's liking. The tool was coded as a whole (all items together), then split into vegetables and fruits separately.

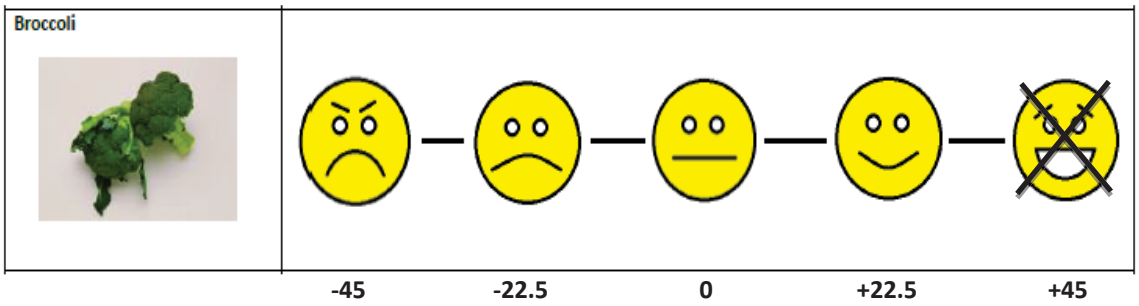

Figure 3.11 – Coding of the children's tool. Example indicates maximum liking of broccoli, with a score of +45.

Fruit and vegetable intake record: The fruit and vegetable intake record was coded by totalling the number of serves consumed of each item over the two-week period. This was then calculated into a mean daily and a mean weekly serve of fruit and vegetables both separately and combined.

When comparing tools (children's, caregiver's and intake record), comparisons were only made between items that were included on both tools. For example, the ten items in the children's fruit and vegetable liking tool was compared with the same ten items from the caregiver's fruit and vegetable liking tool, for direct comparison. The ten items in the children's fruit and vegetable liking tool was compared with the same ten items

from the fruit and vegetable intake record. The same was done for the 30 items in the caregiver's fruit and vegetable liking tool, compared with the same 30 items from the fruit and vegetable intake record. The caregiver's tool had a total of 36 fruit and vegetables, but only 30 fruit and vegetables were also in the fruit and vegetable intake record. To check for validity of the caregiver's tool, the full tool (30 items) was compared against the intake record, and a shortened version (ten items) was also compared against the intake record. This was to assess whether the children's tool was long enough (ten items) to be validated.

3.8 Statistics

Standard statistical software, Statistical Package for the Social Sciences (SPSS) v.20 (SPSS Inc. Chicago, Il, U.S.A.), was used for all statistical analysis of data. The variables were tested for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests, along with the examination of the Normal Q-Q, box, and stem and leaf plot. Normally distributed data are presented as mean ± SD (standard deviation). A P-value (P) of <0.05 was considered to be statistically significant. Two sided tests were used for all analysis.

A range of statistical methods were used to assess the validity and reproducibility of the caregivers and children's tool, and to compare the caregiver's versus the children's tool. These included Pearson's Correlation Coefficients to determine significant relationships ($r \geq \pm 0.3$). Cut offs for correlations were ±0.1 (weak), ±0.3 (moderate), and ±0.5 (strong) (Field, 2009). Paired t-tests were used to assess differences between groups. Effect size was calculated for significant differences between groups to obtain an objective measure of the effect's importance (≥0.3). The following formula was used: effect size $r = \sqrt{t2/ (t2 + df)}$ (where t = t-statistic produced by paired t-test

and df=degrees of freedom). An effect size of 0.1 indicates a small effect, 0.3 a medium effect and ≥0.5 a large effect (Field, 2009).

Finally continuous scale data, (caregiver's scores and the fruit and vegetable intake) were divided into tertiles to assess whether the dietary assessment methods classified participants into the same third or the opposite third. Masson's et al., (2003) criteria were used to assess levels of agreement and misclassification between the caregiver's tool and the intake record, and then the two separate visits for the caregiver's tool (in theory, >50% participants should be correctly classified in the same third and <10% of participants classified into opposite third). The level of agreement between the caregiver's tool and the intake record was determined using the weighted κ-statistic. A weighting of one was used for participants classified into the same third by each dietary assessment method; and zero for opposite thirds. Values of κ greater than 0.80 indicate very good agreement, between 0.61 and 0.80 good agreement, 0.41-0.60 moderate agreement, 0.21-0.40 fair agreement and <0.20 poor agreement (Altman, 1991).

In summary, validation of the caregiver's tools was assessed using Pearson's Correlation Coefficients, the Weighted Kappa Statistic and Masson's Cross-Classification (Masson et al., 2003). Reproducibility of the caregiver's tools was assessed using Pearson's Correlation Coefficients, paired t-tests, the Weighted Kappa Statistic and Masson's Cross-Classification. Validation of the children's tool was assessed using Pearson's Correlation Coefficients. Reproducibility was assessed using Pearson's Correlation Coefficients and paired t-tests. The caregiver's tool and the children's tool were compared using Pearson's Correlation Coefficients, and paired t-tests.

CHAPTER FOUR

Results

4 Results

This research investigated the liking and intake of fruits and vegetables in preschool children, as reported by caregivers and their children. The characteristics of the children will be reported, followed by the liking from the caregiver's and children's tools, the fruit and vegetable intake of the children, the validity and reproducibility of the caregiver's tool and the children's tool, and the comparison between the children's and caregiver's tools. Both the children's and the caregiver's tools were assessed for validity against the fruit and vegetable intake record and assessed for reproducibility between visit one and visit two.

4.1 Characteristics of study children

One hundred and one children (between ages 3.5 and 5.5 years) and their caregivers were recruited for this study. Characteristics of the children are presented in table 4.1. The tools that were inaccurately completed were excluded from analysis. All the children answered the children's tool, on both visits however, only 99 (98%) of the caregivers accurately completed the caregiver's tool on the first visit, and 100 (99%) on the second visit. This was due to those caregivers misunderstanding of what was required. All but one (99%) of the caregivers completed the fruit and vegetable intake record, as one caregiver did not return the intake record.

Table 4.1 Characteristics of children participating in fruit and vegetable liking study

	Mean ± SD
Age (months)	51.4 ± 6.35
Age (years)	4.25 ± 0.42
Age groups	**n (%)**
3.5-4.4 years	64 (63.4%)
4.5-5.5 years	37 (36.6%)
Gender	
Male	47 (46.5%)
Female	54 (53.5%)
****Ethnicity**	
NZEO	85 (83.3%)
Maori	10 (10%)
Pacific Island	7 (7%)
Asian	11 (10.9%)
Other European	2 (2%)
***Medications**	8 (7.9%)
***Supplements**	29 (28.7%)
***Allergies**	6 (5.9%)

n, number of participants; SD, standard deviation
*Use of medications, supplements and the presence of allergies questions only answered by 75% of the caregivers
**Participants may identify with more than one ethnicity.

The mean age of the children participating in this study was 4.25 ± 0.42 years, of which 46.5% were male, and 53.5% were female. The majority of the children were of NZEO ethnicity (83.3%), although other major ethnicities found in NZ were also represented. No children were excluded from the study, as none had any serious medical conditions. Out of the 76 caregiver's who answered the questions on supplements, medications and allergies, 29 (38%) of the children were found to be taking supplements (mainly vitamin C and multivitamins), eight (11%) were on medications (mostly asthma inhalers), and six (8%) had allergies (mainly peanut, some dairy and kiwifruit).

4.2 Caregiver's fruit and vegetable liking tool

One caregiver was male (the father), the rest of the caregivers were female (the mother). Each caregiver completed the caregiver's tool on two separate occasions, four to eight weeks apart. They were required to rate their child's fruit and vegetable liking on a line between extreme like and dislike, ranging from -45 (the minimum score) to 45 (the maximum score), with zero indicating a neutral response. The results were presented as total scores, and were further categorised into fruit, and vegetable liking respectively (see table 4.2), as well as age categories (see table 4.3). Caregiver's were also required to indicate how many times the child had tried each fruit and vegetable (see table 4.4). According to the caregiver's assessment, their children generally liked fruit (29.17 ± 10.73) more than vegetables (6.13 ± 12.84). Both fruit and vegetables were rated higher than neutral (0), indicating that both food groups were liked. Out of a possible liking score of 45, fruits were liked 65%, and vegetables were liked 14%.

Table 4.2. Caregiver's fruit and vegetable liking tool scores.

	Fruit score (mean ± SD)	**Vegetables score (mean ± SD)**	**Total score (mean ± SD)**
Caregiver's liking scores	29.17 ± 10.73	6.13 ± 12.84	17.46 ± 9.65
Percentage of liking	64.8%	13.6%	38.8%

SD, standard deviation
Scale: +45 = maximum like, -45 = maximum dislike, 0 = neutral

There was no significant difference in liking between age groups, for fruit (2.75 ± 0.87), vegetables (0.06 ± 0.59), and total fruit and vegetables (1.54 ± 0.82) for the caregiver

tool liking scores (P>0.05).The younger children seemed to like fruit more, and the older children liked vegetables slightly more according to the caregivers.

Table 4.3. Caregiver's fruit and vegetable liking scores, by age group.

Age group	Fruit score (mean ± SD)	Vegetables score (mean ± SD)	Total score (mean ± SD)
3.5-4.4 years	30.14 ± 11.0	6.09 ± 12.63	17.86 ± 9.44
4.5-5.5 years	27.39 ± 10.13	6.15 ± 13.22	16.32 ± 10.26
Mean difference	2.75 ± 0.87	0.06 ± 0.59	1.54 ± 0.82
Independent t-test (P-value)	0.225	0.982	0.452

SD, standard deviation
Scale +45 = maximum like, -45 = maximum dislike, 0 = neutral

The children had tried the majority (72%) of the 36 fruit and vegetables in the caregiver's tool, more than 10 times. Of these, 11 were fruit (apples, oranges, bananas, kiwifruit, pears, grapes, mandarins, strawberries, berries, raisins/sultanas, and dried fruit), and 15 were vegetables (carrots, broccoli, potatoes, peas, lettuce, green beans, kumara, capsicum, tomato, spinach/silverbeet, pumpkin, frozen mixed vegetables, corn, and cauliflower). Several fruits and vegetables had been tried less than10 times, indicating that parents were less inclined to present these to the children. These included canned peaches, canned pears, canned fruit salad, plums, apricots, cabbage, avocado and courgette. Finally, two (7%) of the fruit and vegetables had been tried zero times, these were both vegetables (watercress and Brussels sprouts). There was no significant differences in exposure to fruit and vegetables between the younger (3.5-4.4 years) age group and the older (4.5-5.5 years) age group (P>0.05).

Table 4.4. Fruit and vegetable exposure

	Number of fruits and vegetables tried >10 times (mean ± SD)	Number of fruits and vegetables tried 0 times (mean ± SD)	Total number of fruits and vegetables in tool (N)
All ages	26.26 ± 5.45 (72%)	2.51 ± 1.81 (7%)	36 (100%)
3.5-4.4 years	25.83 ± 5.44 (72%)	2.74 ± 1.93 (8%)	36 (100%)
4.5-5.5 years	27.16 ± 5.44 (75%)	2.03 ± 1.45 (6%)	36 (100%)
Mean difference	1.33 ± 0.00	0.71 ± 0.48	N/A
Independent t-test (P-value)	0.100	0.071	N/A

SD, standard deviation
N=36

4.3 Children's fruit and vegetable liking tool

Each child completed the children's fruit and vegetable liking tool on two separate visits, four to eight weeks apart. The tool was conducted by the researcher, and required the children to rate their liking on a 5-point scale between extreme dislike and extreme like, ranging from -45 (the minimum score) to 45 (the maximum score). The results were presented as total scores, and were further categorised into fruit, and vegetable liking respectively (see table 4.5), as well as age categories (see table 4.6).

The children liked fruit more than vegetables, with mean liking scores of 24.20 ± 15.24 and 11.06 ± 18.16 for fruits and vegetables respectively. Out of a possible score of 45, fruits were liked 54%, and vegetables were liked 25%.

Table 4.5. Children's fruit and vegetable liking tool scores.

	Fruit score (mean ± SD)	Vegetables score (mean ± SD)	Total score (mean ± SD)
Children's liking scores	24.20 ± 15.24	11.06 ± 18.16	18.53 ± 12.34
Percentage of liking	53.7%	24.5%	41.2%

SD, standard deviation
Scale +45 = maximum like, -45 = maximum dislike, 0 = neutral

There was no significant difference in the children's liking scores for fruits and vegetables between the age groups, although the older group liked fruit slightly more (55.1% vs. 52.3% out of the total possible liking score of 45), and the younger group liked vegetables slightly more (24.8% vs. 24.3% out of the total possible liking score of 45).

Table 4.6. Children's fruit and vegetable liking tool scores, split by age.

Age groups	Fruit score (mean ± SD)	Vegetables score (mean ± SD)	Total score (mean ± SD)
3.5-4.4 years	23.55 ± 16.19	11.19 ± 17.67	18.17 ± 12.39
4.5-5.5 years	24.78 ± 13.49	10.95 ± 18.80	18.85 ± 12.17
Mean difference	1.23 ± 2.70	0.24 ± 1.13	0.68 ± 0.22
Independent t-test (P-value)	0.698	0.948	0.790

SD, standard deviation
Scale +45 = maximum like, -45 = maximum dislike, 0 = neutral

4.4 Fruit and vegetable intake record

Each caregiver completed a fruit and vegetable intake record in the form of a tick sheet, over a 14-day period at home, between visit one and visit two. The total numbers of serves were calculated, and a mean number of serves from the sample was obtained. The mean daily intake of fruit and vegetables was calculated (see table 4.7). The fruit and vegetable intake record was used to compare the caregiver's tool, and the children's tool, to assess the validity of both the tools.

The intake of fruits per day (3.87 ± 1.77) was slightly higher than vegetables 3.39 ± 1.78), and total intake (7.27 ± 3.03) was higher than Ministry of Health (2012) recommendations (4 servings per day). The intakes of the most commonly consumed fruits and vegetables are shown in tables 4.8 and 4.9 respectively.

Table 4.7. Daily and total fruit and vegetable intake.

	Fruit servings (mean ± SD)	**Vegetables servings (mean ± SD)**	**Total servings (mean ± SD)**
Daily mean	3.87 ± 1.77	3.39 ± 1.78	7.27 ± 3.03
Total mean over 14-day period	54.28 ± 24.85	44.92 ± 24.38	97.92 ± 40.24

SD, standard deviation

Apples, mandarins and bananas were the most frequently consumed fruits (see table 4.8). Carrots, potatoes and broccoli were the most frequently consumed vegetables (see table 4.9).

Table 4.8. Most frequently consumed fruit from fruit and vegetable intake record.

	Fruit	Per 14-day Intake period Mean ± SD	Per week Mean ± SD	Per day Mean ± SD
1	Apples	12.00 ± 6.62	6.00 ± 3.31	0.85 ± 0.47
2	Mandarin	9.19 ± 7.19	4.60 ± 3.60	0.66 ± 0.51
3	Banana	8.40 ± 6.39	4.20 ± 3.20	0.60 ± 0.46
4	Pear	4.79 ± 5.07	2.40 ± 2.54	0.34 ± 0.36
5	Kiwifruit	4.42 ± 4.85	2.21 ± 2.43	0.32 ± 0.35
6	Grapes	4.23 ± 4.20	2.12 ± 2.10	0.30 ± 0.30
7	Feijoa	2.48 ± 6.05	1.24 ± 3.03	0.18 ± 0.43
8	Orange	2.25 ± 3.60	1.13 ± 1.80	0.16 ± 0.26
9	Peach	0.97 ± 2.34	0.49 ± 1.17	0.07 ± 0.17
10	Pineapple	0.88 ± 1.59	0.44 ± 0.80	0.06 ± 0.11

SD, standard deviation

Table 4.9. Most frequently consumed vegetables from fruit and vegetable intake record.

	Vegetables	Per 14-day Intake period Mean ± SD	Per week Mean ± SD	Per day Mean ± SD
1	Carrot	8.43 ± 5.30	4.2 ±2.65	0.60 ± 0.38
2	Potato	5.65 ± 3.79	2.83 ± 1.89	0.40 ± 0.27
3	Broccoli	4.35 ± 3.98	2.18 ± 1.99	0.31 ± 0.28
4	Tomato	3.91 ± 4.43	1.96 ± 2.22	0.28 ± 0.32
5	Peas	2.63 ± 2.92	1.32 ± 1.46	0.19 ± 0.21
6	Onion	2.44 ± 3.02	1.22 ± 1.51	0.17 ± 0.22
7	Cucumber	2.16 ± 3.94	1.08 ± 1.98	0.15 ± 0.28
8	Corn	1.94 ± 2.12	0.97 ± 1.06	0.14 ± 0.15
9	Pumpkin	1.42 ± 1.99	0.71 ± 1.00	0.10 ± 0.14
10	Cauliflower	1.32 ± 1.93	0.66 ± 0.97	0.09 ± 0.14

SD, standard deviation

4.5 Comparison of caregiver's and children's liking tool, and intake record

There was a similar trend in ranking between the three tools, with apples being the most liked, and frequently consumed fruit, and carrots being the most liked and frequently consumed vegetable (see table 4.10). The top five ranked fruits and vegetables were the same for both the caregiver's and children's tool (apple, banana, orange, carrots, kiwifruit). All of these fruits and vegetables, with the exception of oranges, had the highest number of servings consumed according to the fruit and vegetable intake record.

Table 4.10. Comparison of ranked fruits and vegetables between shortened caregiver's and full children's tools, and shortened intake record.

	Intake Record 10 items (number of servings over 14-days)		**Children's tool scores 10 items**		**Caregiver's tool scores 10 items**	
	Mean ± SD	**Rank**	**Mean ± SD**	**Rank**	**Mean ± SD**	**Rank**
Apple	12.03 ± 6.62	1	31.63 ± 17.19	1	38.79 ± 7.05	1
Banana	8.40 ± 6.39	2	22.05 ± 27.00	4	34.08 ± 17.38	2
Carrots	8.43 ± 5.30	3	23.84 ± 25.22	2	30.35 ± 16.56	4
Kiwifruit	4.42 ± 4.85	4	19.16 ± 27.81	5	26.77 ± 22.64	5
Broccoli	4.35 ± 3.98	5	10.69 ± 33.46	7	12.84 ± 27.64	7
Peas	2.63 ± 2.92	6	12.03 ± 33.31	6	13.59 ± 27.86	6
Orange	2.25 ± 3.60	7	23.17 ± 28.54	3	32.50 ± 17.97	3
Kumara	1.27 ± 2.21	8	9.35 ± 25.90	9	6.65 ± 27.07	8
Silverbeet/ Spinach	1.13 ± 1.90	9	0.223 ± 33.60	10	-7.84 ± 24.99	10
Lettuce	0.54 ±1.79	10	10.47± 33.00	8	4.26 ± 25.39	9

SD, standard deviation
Scale +45 = maximum like, -45 = maximum dislike, 0 = neutral

4.6 Validation of caregiver's fruit and vegetable liking tool

Thirty items from the caregiver's fruit and vegetable liking tool were validated with the same 30 items from the fruit and vegetable intake record. When the caregiver's tool was compared with the intake record, it showed significant correlations for all sections (fruit (r=0.294), vegetables (r=0.527), and total (r=0.350)) (see table 4.11).

Table 4.11. Validation of full caregiver's fruit and vegetable liking tool against fruit and vegetable intake record, for the full 30 fruit and vegetable items, using Pearson's correlations

	Mean Caregiver's tool scores for 30 items (mean ± SD)	**Mean Intake Record servings for 30 items (mean ± SD)**	**Pearson's Correlations**		
			r	**n**	**P-value (2-tailed)**
Fruit	31.48 ± 10.00	3.23 ± 1.40	0.294	98	0.003
Vegetables	6.68 ± 12.79	2.09 ± 1.03	0.527	99	<0.001
Total	15.92 ± 10.16	6.16 ± 2.39	0.350	99	<0.001

SD, standard deviation; r, correlation coefficient; n, number of participants
Scale +45 = maximum like, -45 = maximum dislike, 0 = neutral

The weighted Kappa showed fair agreement (0.24) for the caregiver's fruit and vegetable liking tool and fruit and vegetable intake record. Over forty percent of responses (fruit and vegetable liking versus intake) were classified into the same third, and just over ten percent of the responses were classified into the opposite third (see table 4.12).

Table 4.12. Validation of the caregiver's fruit and vegetable liking tool against fruit and vegetable intake record using cross-classification and weighted κ-coefficient.

	Proportion (%) classified in		Weighted Kappa Coefficient
	Same third	Opposite third	
Caregiver Tool vs. Intake Record	44.6	11.9	0.24

The shortened caregiver's fruit and vegetable liking tool (with the same ten items as on the children's tool), was compared with the same ten items from the fruit and vegetable intake record. This showed that the shortened fruit section of the caregiver's tool was not validated against the intake record (P=0.202). The shortened mean and vegetable sections showed validity against the shortened intake record (P<0.05) (see table 4.13).

Table 4.13. Validation of shortened caregiver's fruit and vegetable liking tool against shortened fruit and vegetable intake record using ten items from children's tool, using Pearson's correlations

	Mean Caregiver's tool scores for 10 items (mean ± SD)	Mean Intake Record servings for 10 items (mean ± SD)	Pearson's Correlations		
			r	n	P-value (2-tailed)
Fruit	35.34 ± 12.60	6.78 ± 3.31	0.130	98	0.202
Vegetables	10.47 ± 16.46	3.06 ± 1.61	0.383	99	<0.001
Total	20.38 ± 12.25	4.55 ± 1.96	0.209	99	0.038

SD, standard deviation; r, correlation coefficient; n, number of participants
Scale +45 = maximum like, -45 = maximum dislike, 0 = neutral

4.7 Reproducibility of caregiver's tool

The mean difference of the caregiver's tool scores between visits was very small and non-significant. The scores from both tools were highly significantly correlated (r=0.875). This was also the case when the tools were split by fruits (r=0.887) and vegetables (r=0.883) (see table 4.14).

Table 4.14. Reproducibility of full caregiver's fruit and vegetable liking tool using Pearson's correlations and paired t-test

	Visit one scores 30 items (mean ± SD)	Visit two scores 30 items (mean ± SD)	Mean difference scores (mean ± SD)	Pearson's Correlation			Paired t-test		
				r	n	P-value	t	df	P-value
Fruit	29.17 ± 10.73	28.51 ± 11.29	0.66 ± 5.27	0.887	99	<0.001	1.253	98	0.213
Vegetables	6.13 ± 12.84	6.73 ± 13.83	0.62 ± 6.48	0.883	100	<0.001	-0.953	99	0.343
Total	17.46 ± 9.65	17.44 ± 10.30	0.15 ± 5.02	0.875	100	<0.001	-0.292	99	0.771

SD, standard deviation; r, correlation coefficient; n, number of participants; t, t-test statistic; df, degrees of freedom
Scale +45 = maximum like, -45 = maximum dislike, 0 = neutral

The cross-classification showed good agreement for the caregiver's tool between visits (see table 4.15). Over seventy percent of responses were classified into the same third and less than one percent of responses were classified into the opposite third. The weighted K-coefficient was 0.71, which also demonstrated good agreement (see table 4.15).

Table 4.15. Reproducibility of the caregiver's fruit and vegetable liking tool using cross-classification and weighted κ-coefficient.

	Proportion (%) classified in		Weighted Kappa Coefficient
	Same third	Opposite third	
Caregiver's Tool: first and second visit	74.2	0.9	0.71

4.8 Validation of children's fruit and vegetable liking tool

The children's fruit and vegetable intake record was not validated against the fruit and vegetable intake record. There was no significant correlation when the ten items of the children's fruit and vegetable liking tool was compared with the same ten items of the fruit and vegetable intake record (r=-0.066) (see table 4.16).The same was found when the fruit (r=-0.017), and vegetable sections (r=-0.010) were compared (see table 4.16).

Table 4.16. Validation of the children's fruit and vegetable liking tool using Pearson's correlations

	Mean Children's Tool scores for 10 items (mean ± SD)	Mean Intake Record servings for 10 items (mean ± SD)	Pearson's Correlations		
			r	n	P-value (2-tailed)
Fruit	24.00 ± 15.20	6.78 ± 3.31	-0.017	100	0.864
Vegetables	11.10 ± 18.00	3.06 ± 1.61	-0.010	100	0.924
Total	16.26 ± 13.94	4.55 ± 1.96	-0.066	100	0.512

SD, standard deviation; r, correlation coefficient; n, number of participants
Scale +45 = maximum like, -45 = maximum dislike, 0 = neutral

4.9 Reproducibility of children's tool

The mean difference of the children's tool scores between visits was very small, and showed no significant differences between visits. The scores from both tools were highly significantly correlated (r=0.691). This was also the case when the tools were split by fruits (r=0.558) and vegetables (r=0.600) (see table 4.17).

Table 4.17. Reproducibility of children's fruit and vegetable liking tool using Pearson's correlations and paired t-test

	Visit one scores 10 items (mean ± SD)	Visit two scores 10 items (mean ± SD)	Mean difference of scores (mean ± SD)	Pearson's Correlation			Paired t-test		
				r	n	P-value	t	df	P-value
Fruit	24.20 ± 15.24	23.98 ± 16.14	0.11 ± 14.23	0.558	101	<0.001	0.079	100	0.937
Vegetables	11.06 ± 12.65	12.65 ± 17.06	1.45 ± 15.64	0.600	101	<0.001	-0.930	100	0.354
Total	18.53 ± 12.34	18.74 ± 12.91	0.09 ± 9.89	0.691	101	<0.001	-0.087	100	0.931

SD, standard deviation; r, correlation coefficient; n, number of participants; t, t-test statistic; df, degrees of freedom
Scale +45 = maximum like, -45 = maximum dislike, 0 = neutral

4.10 Comparison between the children's tool and the caregiver's tool

The mean total scores of the caregiver's and children's tools were significantly correlated (r=0.284) and were not significantly different. This was also found when comparing the vegetable scores (r=0.245). The fruit scores showed a significant correlation (r=0.394), but were significantly different between the caregiver's and children's tool (see table 4.18).

Table 4.18. Comparison of shortened caregiver's and children's fruit and vegetable liking tools using correlations and paired t-tests

	Children's Tool scores 10 items (mean ± SD)	Caregiver's Tool scores 10 items (mean ± SD)	Mean Difference of scores (mean ± SD)	Pearson's Correlations			Paired t-test			
				r	n	P-value	t	df	P-value	Effect size
Fruit	24.00 ± 15.20	35.34 ± 12.60	11.34 ± 2.60	0.394	99	<0.001	5.798	98	<0.001	0.51
Vegetables	11.45 ± 19.59	10.47 ± 16.46	0.98 ± 3.31	0.245	100	0.014	-0.588	99	0.558	N/A
Total	17.03 ± 14.49	20.38 ± 12.25	3.35 ± 2.24	0.284	100	0.004	-1.810	99	0.073	N/A

SD, standard deviation; r, correlation coefficient; n, number of participants; t, t-test statistic; df, degrees of freedom
Scale +45 = maximum like, -45 = maximum dislike, 0 = neutral

CHAPTER FIVE

Discussion

5 Discussion

The main purpose of this study was to develop and investigate whether a fruit and vegetable liking tool could accurately assess fruit and vegetable intake in preschool children. The first stage involved developing a fruit and vegetable liking tool to be used with children, and an expanded fruit and vegetable liking tool to be used with the caregiver's of the children. Next, a fruit and vegetable intake record was also developed to assess fruit and vegetable intake of the children. The validity of these tools was determined by comparing the children's tool and the caregiver's tool with the intake record. Reproducibility of these tools was assessed by having the children and the caregivers complete the tools on two separate occasions, four to eight weeks apart.

5.1 Characteristics of the participating children

The participants were aged between 3.5-5.5 years at the time of the first visit, with a mean age of 51.4 months (4.25 years). The majority (83.3%) of children were NZEO. Other ethnicities represented were Maori (10.0%), Pacific Island (7.0%), and Asian (10.9%). This compares similarly to the NZ population distribution by ethnicity (67.6% NZEO, 14.6% Maori, 9.2% Asian and 6.9% Pacific) (Statistics New Zealand, 2006).

5.2 Caregiver's fruit and vegetable liking tool

According to Skinner et al., (2002), mothers judge if their children like a food after only 2.5 offerings, and if their child dislikes a food after 2.6 offerings. This is far less than the recommended number of tries (greater than ten offerings) that a child needs to accept a novel food (Resnicow et al., 1997). The results of the present study indicated that the majority of fruits and vegetables had been tried more than ten times. Food liking or

disliking is generally judged by the reaction of the child to the food, and the acceptance or rejection of the food (Skinner et al., 2002). In the present study, the caregiver's perception of the children's liking showed a greater mean liking for fruit (29.17) than vegetables (6.13), with a mean total liking of 17.46 (out of a possible score of 45). This compares to a liking of 65% for fruit, 14% for vegetables, and 39% for total fruit and vegetables, and is comparable to other studies that assessed children's liking of fruit and vegetables (Skinner et al., 2002; Vereecken et al., 2010). Skinner et al., (2002) showed that mother's reported a liking of 67% for fruits, and 44% for vegetables. Vereecken et al., (2010) showed a liking of 74% for fruit, and 65% for vegetables, as reported by the mothers. Another study found that the children had a 79% liking of fruit, and a 57% liking of vegetables, as reported by the mother (Wardle et al., 2001). These studies have shown much higher liking of both fruits and vegetables than the present study, although this may be due to the studies comparing the liking of different fruits and vegetables. The caregivers in our study appeared to have no trouble completing this tool, and generally knew if their child liked or disliked a fruit or vegetable.

5.3 Children's fruit and vegetable liking tool

As expected, children had a much higher liking for fruit than for vegetables. The children's mean total liking for fruit and vegetables was 18.53 out of a possible score of 45, a liking of 41%. In agreement with the literature (Hertzler, 1983), the children liked fruit (mean of 24.20 (54% liking)) more than vegetables (mean of 11.06 (25% liking)). This is may be attributed to greater acceptance of fruit over vegetables, due to the bitter taste of some vegetables (especially brassicas) which are less liked compared with fruit which has a sweeter taste (Dovey et al., 2008). The present study included broccoli, which may have been a reason why the children liked the vegetables to a lesser amount than the fruit. The mean liking of fruit is similar to the study by Jaramillo

et al., (2006) which showed a mean liking of 1.38 out of a maximum liking of 2 (69% liking), and also similar to Vereecken et al., (2010) who showed a 68% liking of fruit as reported by the children. However, the mean liking of vegetables is much less than the Jaramillo et al., (2006) study of 1.19 out of 2 (59% liking) and the Vereecken et al., (2010) study of 64% liking of vegetables.

The caregiver's score for fruit was higher than the children's score. The caregiver's score for vegetables was lower than the children's score. This means that the caregivers thought that the children liked fruit more than they do, and liked vegetables less than they do.

5.4 Fruit and vegetable intake record

The average intake of fruit and vegetables was 7.27 servings per day. Fruit is often consumed more than vegetables, a study in children aged 6-18 months, showed fruit was consumed 2.45 times, and vegetables 1.63 times a day (Hart et al., 2010). In the present study, the average mean intake per day for fruit (3.87) and vegetables (3.39) was well over the NZ Ministry of Health's recommended intake of two servings of vegetables, and two servings of fruit per day for preschool aged children (Ministry of Health, 2012). This was surprising, as NZ data suggests only 50-56% of children ages 5-6 years, consumed quantities greater than the recommended five servings of fruit and vegetables per day (Ministry of Health, 2003b). Ninety five percent of the children in the present study consumed greater than four serves of fruit and vegetables per day, and 18% consumed greater than 10 servings per day. Another NZ study found only 30% of children aged five to nine years consumed greater than two serves of fruit and greater than three servings of vegetables per day (Clinical Trials Research Unit &

Synovate, 2010). There is little data available in NZ regarding the fruit and vegetable intake in children under five years of age.

Studies conducted overseas have also shown children to have a lower intake of fruit and vegetables than what was shown in the present study, with 50% of 2-5 year olds in the USA consuming greater than two servings of fruit and vegetables per day (Dennison et al., 1998). In England, 6-7 year olds consumed a mean intake of 4.7 serves of fruit and vegetables per day (Hughes et al., 2012), and 59.2% consumed greater than five servings per day (Hughes et al., 2012).In another study in England, only 19.9% of 3-4 year olds consumed greater than five servings of fruit and vegetables per day (Cockroft et al., 2005), The present study's intake is also higher than was found in the Vereecken et al., (2010) study, who observed a daily average intake of three serves of fruit (120g), and 2.5 serves of vegetables (100g), a total of 5.5 serves of fruit and vegetable per day.

The most frequently eaten vegetables were carrots (0.60 serves/day), potatoes (0.40 serves/day), broccoli (0.31 serves/day), tomatoes (0.28 serves/day) and peas (0.19 serves/day). This equates to 4.2 serves of carrots, 2.8 serves of potatoes, 2.2 serves of broccoli, 2.0 serves of tomatoes and 1.3 serves of peas per week. This compares well with the National Children's Nutrition Survey, with the highest number of vegetables consumed per week being potatoes (consumed by 87% of children), carrots (consumed by 79% of children), broccoli (consumed by 60% of children), peas (consumed by 59% of children) and lettuce/salad (consumed by 56% of children) (Ministry of Health, 2003b). It also compares well with a NZ study, that showed the most commonly consumed vegetables were carrots and potatoes in children aged 12-24 months over a three day period (Szymlek-Gay et al., 2010).

The most frequently eaten fruits were apples (0.85 serves/day), mandarins (0.66 serves/day), bananas (0.60 serves/day), pears (0.34 serves/day) and kiwifruit (0.32

serves/day). This equates to 6.0 serves of apples, 4.6 serves of mandarins, 4.2 serves of bananas, 2.4 serves of pears and 2.2 serves of kiwifruit per week. This also compares well with the National Children's Nutrition Survey, with the highest number of fruits consumed per week being apples/pears (consumed by 83% of children), oranges/mandarins (consumed by 67% of children), and bananas (consumed by 63% of children) (Ministry of Health, 2003b). Similarly, Szymlek-Gay et al., (2010) found the most commonly consumed fruits by NZ toddlers were apples and bananas over a three-day period.

The high intake (7.27 servings per day) of fruits and vegetables observed in the present study may indicate the over-reporting of fruit and vegetables by the caregivers, which has been found in many other studies (Blum et al., 1999; Gibson et al., 1998; Lillegaard et al., 2012; Parrish et al., 2003; Shatenstein et al., 2010). The high intake of fruits and vegetables may have also been due to incorrect estimation of serving sizes by the caregivers (Basch et al., 1990), or changes from usual fruit and vegetable intake as the intake was being recorded (Livingstone et al., 2004). Basch et al., (1990) showed that when fruit and vegetable intake was over-reported, it was often due to overestimation of portion sizes of fruits and vegetables. There is also the possibility that having the fruit and vegetable intake record as a tick list, may have led to overestimation of fruit and vegetable intake, because the caregiver's did not have to record everything themselves, they could just tick the fruits and vegetables that were consumed. This was also found by Cade et al., (2006) who observed higher nutrient intakes from their CADET 24-hour tick list, than from a one-day food diary. The caregivers that participated in this study appeared to be well educated (although this was not surveyed), and seemed to have a reasonable knowledge about healthy eating, including the importance of fruit and vegetable intake. The caregiver's may have reported high levels of fruit and vegetable intake, to impress the researcher, as greater fruit and vegetable intake is seen as healthier. Also, the caregiver's were volunteers,

and they may have been more health conscious than the general population, thereby explaining why the children had been exposed to the majority of the fruits and vegetables. The children had tried 72% (27 fruits and vegetables) of the fruit and vegetables more than ten times, and had never tried only 7% (2 vegetables) of the fruit and vegetables.

5.5 Comparison of caregiver's and children's liking tool, and intake record

For direct comparison of all three tools and ranking of the fruits and vegetables in order of liking or consumption, only the ten fruits and vegetables that were in the children's tool, were used to compare the caregiver's tool and the intake record (apple, banana, carrots, kiwifruit, broccoli, peas, orange, kumara, silverbeet/spinach, and lettuce). This was so that the same fruits and vegetables were being compared from each tool (refer to table 4.10).

When the caregiver's tool was compared with the intake record, four items were ranked the same (apple, banana, peas, and kumara), and four were within one rank (carrots, kiwifruit, silverbeet/spinach, and lettuce). This shows an 80% agreement of ranks for those ten items and further indicates that caregiver's provide the fruits and vegetables they think their children like.

When rankings were compared between the children's tool and the intake record, two items were ranked the same (apple and peas), and four were within one rank (carrots, kiwifruit, kumara and silverbeet/spinach), showing a 60 percent agreement of ranks for those ten items. This indicates that the fruits and vegetables that were consumed the most frequently, were also the most liked.

When the children's tool and the caregiver's tool were compared, six out of the ten fruits and vegetables were ranked the same (apple, kiwifruit, oranges, broccoli, peas,

and spinach/silverbeet), and two items were ranked within one rank (lettuce and kumara), indicating an 80 percent agreement. This indicated strongly that the caregivers generally knew which fruits and vegetables their children liked and disliked, and by how much.

Only a few studies have compared reported food liking between parents and children (Skinner et al., 2007; Vereecken et al., 2010) and these will be discussed in the comparison of the children's and caregiver's tool section below. There have however, been studies which have compared food intake in children and their parents. A study conducted in the USA in children aged two to five years, showed the caregiver's reports had 85-93% agreement with observed intake of fruits and vegetables (Linneman et al., 2004). Burrows et al., (2013) compared a FFQ completed by 8-11 year old children with a FFQ completed by their mothers. They showed a 76% agreement between the two FFQ's (Burrows et al., 2013). These studies have shown good agreement between reports from the parent and reports from the children.

5.6 Validity of the caregiver's fruit and vegetable liking tool

Validation of dietary assessment tools involves using another method of dietary assessment to assess whether the tool is measuring what it is intended to measure (Cade et al., 2002). A range of statistical approaches (Pearson's correlations, paired t-tests) showed the caregiver's tool to have good validity when compared against the fruit and vegetable intake record. This was further evidenced by conducting a weighted Kappa, and cross-classification on the caregiver's liking tool and the intake record (Masson et al., 2003).

A significant moderate correlation was observed between the full caregiver's tool (30 items) and the intake record ($r=0.350$, $P<0.05$), indicating the caregiver's tool was validated against the intake record. Cross classification shows the impact of

measurement error, by the percentage of items classified correctly or misclassified (Masson et al., 2003). Weighted Kappa is a stronger statistic, as it allows for agreement by chance, and the degree of misclassification (Masson et al., 2003). The weighted kappa (Kw = 0.24) and cross classification demonstrated fair agreement, with 44.6% of liking scores and intakes being classified in the same third, and 11.9% being classified in the opposite third (misclassified). These tests show further evidence of validation of the caregiver's tool against the intake record.

When broken down into fruit and vegetables, the correlation between the full caregiver's tool and intake record was strong for vegetables ($r=0.527$, $P<0.05$) and moderate for fruit ($r=0.294$, $P<0.05$). This shows that the caregiver's are providing the children with fruit and vegetables that they think they like. Preschool children's access to fruit and vegetables is largely controlled by their caregiver's (Campbell & Crawford, 2001). Hence, a reasonable level of agreement between the caregiver's tool and intake record was expected. This was also displayed by Vereecken et al., (2010) who demonstrated significant moderate correlations of 0.38 for fruit ($P<0.05$), and 0.39 for vegetables ($P<0.05$) when a fruit and vegetable liking tool completed by the caregiver's was compared with a FFQ of the children's intake.

There is limited data that has compared caregiver's reports on liking with intake. Other studies have shown good validity of a dietary assessment tool completed by a caregiver with other methods of dietary assessment. However, these studies have not investigated food liking, they have used dietary assessment methods (such as FFQs and food recalls). For example, Parrish, Marshall, Krebs, Rewers, and Norris (2003), showed a strong correlation for vitamin C (0.51) and vitamin E (0.48) between a FFQ and biomarkers. Basch et al., (1990) showed good association between a mother's recall of her child's intake, and the observed child's intake, with 66% of vitamin C containing foods and 44% of vitamin A containing foods in the same third, when cross-

classified. These are similar levels found in the present study (44.6% same third for the caregiver's tool against the intake record).

When the caregiver's tool was shortened to include only the ten items that were in the children's tool, and compared with the same ten items from the intake record, the caregiver's tool was still validated (P=0.038), but not as strongly as it was with 30 items (P<0.001). A significant correlation was observed when the vegetable (six items) sections were compared (P<0.001), but not for the shortened fruit (four items) section (P=0.202).

The weaker validation of the shortened caregiver's tool, but strong validation of the full caregiver's tool leads to the conclusion that the shortened version is too limited to produce good results. This may also be the case with the children's tool, which only contains ten items.

5.7 Reproducibility of the caregiver's fruit and vegetable liking tool

Reproducibility is assessed by the dietary assessment method being repeated, at another occasion (between 6-8 weeks apart) (Cade et al., 2002), and assesses how reliable the dietary assessment tools are (Cade et al., 2002). The caregiver's tools from both visits were tested for reproducibility with Pearson's correlations, paired t-tests, weighted Kappa and cross-classification. The caregiver's tool was highly reproducible, with very small mean differences between visits (P>0.05). The caregiver's tools showed a strong and significant correlation of r=0.875 between visits. Weighted kappa further showed that the caregiver's tool was extremely reproducible between visits, with a good Kw = 0.71, and 74.2% of scores classified in the same category, and only 0.9% classified in the opposite category. These statistics show that the caregiver's tool is highly reproducible, and therefore reliable. There is no data from other studies that test caregiver's liking tools for reproducibility, however, this is consistent with a study

conducted on nutrition screening in preschool children, where reports by caregiver's were reproducible and reliable between visits (Randall Simpson et al., 2008).

5.8 Validity of the children's fruit and vegetable liking tool

The validity of the children's fruit and vegetable liking tool was assessed using Pearson's correlations between the children's tool and the fruit and vegetable intake record. The children's tool did not validate well against the food intake record, showing a weak, inverse and non-significant correlation ($r=-0.066$, $p=0.512$). When divided into fruits and vegetables, weak, inverse and non-significant correlation's were observed between the tool and the intake record for both fruit ($r=-0.017$, $p=0.864$) and vegetables ($r=-0.010$, $p=0.924$). As previously mentioned, this may be due to the children's tool only containing ten items, and therefore may have been too limited to demonstrate good validity. This may also be due to the children consuming fruit and vegetables that they might not necessarily like (Bere & Klepp, 2005), or the fact that the caregivers filled out the fruit and vegetable intake record. In comparison with a similar study, Vereecken et al., (2010) demonstrated significant weak-moderate correlations of 0.19 for fruit ($p<0.05$), and 0.25 for vegetables ($p<0.05$) when a fruit and vegetable liking tool completed by the children (aged 4-6 years old) was compared with a FFQ completed by caregivers of the children's intake. These results do not agree with the present study, and may be due to the difference in number of items on the children's tool, with the present study having ten items, while Vereecken et al., (2010) used 46 items. The tool with more items on it would have more variables to compare to the intake record.

There are also issues around cognitive development, and whether this age group has enough recall ability to remember a fruit or vegetable that they have tried previously (Livingstone et al., 2004). During this stage of life (3-5 years), children also lack logical ability and may not answer the questions correctly (Gelman & Baillargeon, 1983). For

example, the children would often answer the questions with a random reason, some answered “dislike” to playing with toys, because their brother or sister would not share with them, rather than answering “liking” to playing with toys because they are fun. There may also be seasonal reasons why these are very different. For example, children may like summer fruit (stone fruit, berries, melon), but as the study took place in winter, they have only received fruits typically available in winter (for example, apples, oranges and kiwifruit). There is a lack of data on seasonal variation of intake, although this is reduced with globalisation and the importation of fruit and vegetables from the Northern Hemisphere (Pomerleau, Lock, McKee, & Altmann, 2004).

5.9 Reproducibility of the children’s fruit and vegetable liking tool

The children’s tool was also very reproducible, with a strong correlation co-efficient ($r=0.691$, $p<0.05$) and a paired t-test showing no significant difference between the first and second visit ($p>0.05$). This demonstrates that the children were accurate in their consistency of reporting liking and disliking of fruits and vegetables. This result is also similar to results from the Vereecken et al., (2010) study, who showed a correlation of 0.74 for fruit, and 0.75 for vegetables between visits for children’s tools ($p<0.05$). Jaramillo et al., (2006) also showed similar correlations, with 0.49 for fruit, 0.73 for vegetables, and 0.73 total ($p<0.001$).

5.10 Comparison of the caregiver’s and children’s fruit and vegetable liking tool

The caregiver’s fruit and vegetable liking tool was compared with the children’s fruit and vegetable liking tool, using correlations and paired t-tests to assess similarities and differences between the caregiver’s report and the children’s report. A moderate,

positive correlation was found (r=0.284, p<0.05) between the caregiver's and the children's tool, which indicates that the reports from both the caregivers and the children were similar. This similarity was further evidenced by a paired t-test which showed no significant difference found between the two tools (p=0.07). When the vegetable sections of both tools were compared, a moderate significant correlation (r=0.245, p<0.05) and no significant difference was observed (p>0.05), indicating that the caregivers and children agree moderately on how much the children like vegetables. When the fruit sections were compared, a moderate significant correlation was found (r=0.394, p<0.05), however, a significant difference was found (p<0.05). This indicates that the caregivers and children moderately agree on the children's liking of fruit. This was similar to what was observed in the Vereecken et al., (2010) study, with a significant moderate to strong correlation of 0.48 for fruit, and a significant moderate to strong correlation of 0.41 for vegetables (p=0.05). Skinner et al. (2002) also found a significant correlation (p<0.0001) between food preferences as reported by mother and child (aged eight years).

5.11 Summary of validation and reproducibility of tools

In summary, the caregiver's tool demonstrated reasonable validity when compared with the intake record and high reproducibility when compared between visits. The correlations between the caregiver's tool and intake record were moderately significant (r=0.350), with a fair agreement of weighted Kappa (Kw=0.24), both indicating a fair-good agreement between the caregiver's tool and intake record. The vegetable sections correlated strongly (r=0.527), indicating that the tool was very accurate when the vegetable section of the caregiver's tool was compared to the intake record. The fruit sections correlated moderately (r=0.294), indicating that the tool was moderately accurate when the fruit section was compared to the intake record. The correlations between the caregiver's tool from the first and second visit were very strong (r=0.875)

and weighted Kappa also had good agreement (Kw=0.71), showing that the caregiver's reported consistently for the likes and dislikes of their children. This suggests that caregiver's are a relatively reliable source of information on their children's preferences and eating habits, and that this tool is a fairly accurate way of assessing young children's preferences, and therefore intake.

The children's tool demonstrated poor validity and high reproducibility, as it did not compare well to the intake record, although it did compare well between visits. This means that the children's liking did not correlate with the fruit and vegetables consumed, however, the children were accurate in their consistency with reporting their liking. As previously discussed, the children's tool (which consisted of ten items) may be too limited to be validated, which was observed when the children's tool did not correlate with the intake record (r=-0.066). The children's tool only contained ten fruit and vegetables to be compared against the fruit and vegetable intake record, while the caregiver's tool had 30 fruits and vegetables for the intake record to be compared to. This may in part, explain why the caregiver's tool was validated and the children's tool was not. This lack of validation may also be due to the lack of control that the children have over what they consume, and also seasonal factors of fruit and vegetable availability. As the children were relatively young (3.5-5.5 years), there may be an element of misreporting of liking, if the children did not fully understand the scale, or they wanted to impress or rebel against the interviewer or caregiver. Children's preferences can also go through stages, as some children that liked a vegetable in the first visit, did not like it in the second visit (e.g. broccoli). These factors all contribute to the errors associated with dietary assessment in children (Livingstone et al., 2004; McPherson et al., 2000).

The comparison between the caregiver's tool and the children's tool showed a significant moderate correlation (r=0.284), which was also reflected when split into vegetables (r=0.245), and fruit (r=0.394), indicating that the liking and disliking scores

reported by both the children and the caregiver's are very similar. However, the paired t-test showed a significant difference between the two tools for the vegetable section ($P<0.05$), which suggests there is a discrepancy, and therefore the children's tool needs to be used with care. This difference can be seen with the caregiver's reporting that the children like vegetables to a lesser degree than the children actually report. As the children's tool correlates well with the caregiver's tool, it can be used to indicate general liking of children, however as it is not validated, it cannot be used to assess intake.

This study compares well with similar studies conducted by Vereecken et al., (2010) and Jaramillo et al., (2006), as the tools show similar levels of validation and reproducibility, and similar trends can be observed, as discussed previously in this chapter. Similar results are also found in other studies regarding the liking of fruit more than vegetables (Dovey et al., 2008; Skinner et al., 2002), the accuracy of the caregiver's reporting (Basch et al., 1990; Hart et al., 2010; Linneman et al., 2004; Vereecken et al., 2010), and the reproducibility of the tools (Jaramillo et al., 2006; Randall Simpson et al., 2008; Vereecken et al., 2010)

The children's and the caregiver's tool also fit well with the conceptual model of food choice developed by Eertmans, Baeyens & Van den Bergh (2001) (see figure 2.7). This model encompasses the psychological determinants of eating behaviour. The children's tool and caregiver's tool mainly focus on the liking factor in food choice, which leads to eating behaviours (food preference and food intake). The children mainly focus on flavour (food-internal stimuli), which flows on to liking (or disliking), which the tool assesses, and then onto food intake (or in the case of disliking – no intake). For the adults using the caregiver's tool, many more factors come into play, such as nutritional information and the environmental stimuli / factors (food-external stimuli), while they assess their child's liking or disliking, and therefore intake. Most studies focus on the end of the model (the eating behaviour), and do not assess any of

the middle sections of the model (liking, anticipated consequences and ideational factors). However, the present study focuses on the liking, which leads to eating behaviour. Identifying foods that are liked and foods that are disliked may enable public health interventions to focus on modifying the perception of the foods that are not liked, so that eating behaviour can be changed. For example, kiwifruit is a fruit that has many beneficial nutritional properties, as described in the Master's thesis by Aselle Adaim (Adaim, Kruger, Stonehouse, Wohlers, & Skinner, 2009). Kiwifruit can be sour, and this was indicated in the present study by kiwifruit not being liked as much as apples or bananas. The study by Adaim et al., (2009) showed that increased exposure to kiwifruit (20 days) increased the liking of kiwifruit (as evidenced by the liking scores at baseline and after the exposure) as it broke down the perceived barriers towards the fruit.

CHAPTER SIX

Conclusion

6 Conclusion

6.1 Introduction

Fruit and vegetables are part of a healthy diet; however, recommendations for intake are not frequently met (Clinical Trials Research Unit & Synovate, 2010; Ministry of Health, 2003b). Fruit and vegetables have been linked to a decreased risk in disease (Van Duyn & Pivonka, 2000), and have been shown to have an inverse relationship to obesity (Epstein et al., 2001). To develop useful public health interventions, it is helpful to know what the population's current intake is, as well as what the many contributing behavioural factors are.

Dietary assessment can be difficult in young children (Livingstone et al., 2004), food liking may be a good way to approximate intake, and may give good insight into new ways to tackle food neophobia by using likes and dislikes to improve exposure. There are currently only three studies that investigated liking of fruit and vegetables in preschool aged children (Birch & Sullivan, 1991; Jaramillo et al., 2006; Vereecken et al., 2010), with two of them validating the liking tool (Jaramillo et al., 2006; Vereecken et al., 2010), and none that have investigated fruit and vegetable liking in NZ.

The aim of this research was to develop a fruit and vegetable liking tool for use in caregivers and preschoolers that is a good representation of the preschooler's actual fruit and vegetable intake.

6.2 Summary of results

This study showed that the caregiver's fruit and vegetable liking tool is a valid way ($r=0.350$, $P<0.05$) of assessing both fruit and vegetable liking as well as intake in their children. Caregiver's spend a lot of time with their children, and know what foods they

accept and reject. They also control the purchasing and delivery of the food, and therefore have a good understanding of their children's intake. Although the children's tool was not validated against the intake record (r=-0.066, P=0.512), it did show a good comparison with the caregiver's tool (r=0.284, P<0.05), and can therefore be useful in establishing children's likes and dislikes, which may help with developing interventions around fruit and vegetable liking. Both tools (caregiver's and children's) were highly reproducible (r=0.875, P<0.05 and r=0.691, P<0.05 respectively). The children that participated in this study had an intake of fruit and vegetables (7.27 servings per day) which was higher than the recommendations for this age group; however, this may be attributable to over-reporting on the intake record, or a change in eating habits during the recording period.

6.3 Conclusions

The final conclusions of this study will be presented according to the research objectives as they were stated in chapter 1.

- The first objective stated was to develop a fruit and vegetable liking tool for use in caregivers to assess fruit and vegetable intake in preschoolers.
    - A fruit and vegetable liking tool was developed for use in caregiver's to assess fruit and vegetable liking in preschool aged children.

- The second objective was to develop a fruit and vegetable liking tool for use with preschoolers to assess their fruit and vegetable liking.
    - A fruit and vegetable liking tool was developed for use in children to assess fruit and vegetable liking in preschool aged children.

- The third objective was to assess the liking and perceived liking of fruit and vegetables by preschoolers and their caregivers respectively.
    - Caregiver's reported that children liked fruit 65% (mean 29.17) of total liking, vegetables 14% (mean 6.13) of total liking, and total fruit and vegetables 39% (mean 17.46) of total liking. This compared to the children's reported liking of fruit 54% (mean 24.20) of total liking, vegetables 25% (mean 11.06) of total liking, and total fruit and vegetables 41% (mean 18.53) of total liking. Caregivers thought that the children liked fruit more than they reported, and thought that they liked vegetables less than they reported.

- The fourth objective was to assess fruit and vegetable intake in preschoolers.
    - Children's daily mean intake of fruit and vegetables was high, with 7.27 serves of fruit and vegetables consumed per day. Fruit was consumed an average of 3.87 serves per day, and vegetables were consumed an average of 3.39 serves per day.

- The fifth objective was to determine the validity of the caregivers and preschooler's fruit and vegetable liking tools in assessing actual fruit and vegetable intake.
    - The full caregiver's tool (30 items) was significantly moderately validated against the fruit and vegetable intake record ($r=0.350$, $P<0.05$) ($Kw=0.24$, cross-classification: 44.6% same third, 11.9% opposite third). The children's tool (ten items) was not validated against the fruit and vegetable intake ($r=-0.066$, $P=0.512$).

- The sixth objective was to assess the reproducibility of the caregivers and preschooler's fruit and vegetable liking tools.

- Both the caregiver's tool (r=0.875, P<0.001) (t=-0.292, P=0.771) (Kw=0.71, cross-classification: 74.2% same third, 0.9% opposite third) and children's tool (r=0.691, P<0.001) (t=-0.087, P=0.931) were highly reproducible.

- The seventh objective was to determine whether the caregiver's or the preschooler's tool is the most appropriate in assessing fruit and vegetable intake in preschool children.
    - From these results, it can be concluded that the caregiver's fruit and vegetable liking tool is a more valid and reliable tool than the children's fruit and vegetable liking tool to assess fruit and vegetable intake in preschool aged children. This indicates that parents are aware of issues relating to their children, and are adequate at providing information about their children. However, the children's fruit and vegetable liking tool is a good way to assess fruit and vegetable liking in preschool aged children.

- The main aim of this research was to develop a fruit and vegetable liking tool for use in caregivers and preschoolers that is a good representation of the preschooler's actual fruit and vegetable intake.
    - This was achieved, with the development and validation of a fruit and vegetable liking tool for use in caregivers, to assess children's liking and intake of fruit and vegetables.

6.4 Strengths of the study

The advantage of these tools is that fruit and vegetable liking can be assessed quickly and easily, at a population level. The results can help developers of public health initiatives to understand what fruits and vegetables are liked and disliked, which may identify areas that need to be focused on. If preference can be changed, this may help

increase the intake of fruits and vegetables, leading to a healthier diet and decreased risk of future health problems.

This study had a very high compliance, with only one caregiver not returning the fruit and vegetable intake record, and no dropouts. The caregiver's that volunteered for this study appeared very health conscious and interested in finding out how their reports aligned with their children's reports, although this may be considered a limitation, as it is not necessarily a representative sample of the population.

The study design allowed the children to report their preferences independently of their caregiver's, as the caregivers were on the other side of the room filling their own tool out. The sample size was adequate to validate a dietary assessment tool of this nature. The length of time between the visits was sufficient so that the caregivers and children could not recall what they answered at the previous visit. Reliability of data collection was optimised, as the same researcher collected all the data from the children (Interrater reliability). The same researcher also explained the caregiver's tool to all the caregivers, to ensure the same instructions were given.

6.5 Limitations of study

One limitation of this study was the participants were mostly of NZEO descent, and based on the North Shore of Auckland. Care must be taken when generalising these results outside of this population. Other limitations include the portion size estimation when filling out the intake record, as the caregiver's may have overestimated the children's intake. This possible overestimation of fruit and vegetable intake may have also been a reason why the children's tool did not validate with the intake record.

Although the children seemed to answer the questions accurately, it appeared as if some could not differentiate between the happy face and the really happy face, and

either answered all of the liked foods with one or the other (not a mixture of both to indicate degree of liking).

The children also gave answers with unexpected reasons, for example, some children answered the grumpy face for oranges and kiwifruit even though they reported liking them after questioning. On further investigation, this was due to these fruits being sour, and causing their faces to ‘screw up’ and they related this to the grumpy face.

Also, for some of the food items, the children were not used to seeing them in the raw state (e.g. kumara), and so did not know what the vegetable was, and this had to be further described. This may also lead to the child answering that they have never tried the food, or that they dislike them as they are not familiar with that particular food item. Kumara was also mistaken for a sausage, which further showed that the photos used should show the food in the raw and cooked state.

There appeared to be a learned effect between the visits, although the visits were at least six weeks apart. Most of the children could answer what all the faces were, without any further explanation. They completed the block activity very quickly and easily. The children also answered the questions faster, and were less distracted. Although the children could remember what to do, this does not necessarily mean that they remembered what they answered in the first visit, so this may not have an effect on the results.

It is also possible that the children may have been trying to please the interviewer, as they reported that they liked vegetables more than the caregiver’s did, which may indicate that they reported liking vegetables more than they really do.

One of the caregivers did not follow instructions for completing the caregiver’s fruit and vegetable liking tool correctly. They indicated how many times their child had tried each food item, but did not rate their child’s liking on the liking scale. In this situation, the fruit and vegetable liking tool was excluded from the analysis.

The fruit and vegetable intake record on the whole was filled out well. The caregivers were told to estimate a portion of fruit or vegetable as what fits in their child's cupped hand. However, this may have led to overestimation of intake, which was evident by the high intake of fruit and vegetables reported. As with most dietary assessment tools, there is the possibility that the caregiver overestimates the intake of fruit and vegetables, especially as these are seen as 'healthy' and the caregiver's may want to impress.

The intake record was not a gold standard, as it was not a weighed food record. The intake record was adapted from an estimated food record, as the estimated fruits and vegetables consumed were recorded on a tick sheet, instead of in a diary form. The limitation of this is the exact quantity could not be calculated, and the children may have not consumed the whole portion.

6.5 Recommendations for future research

- For validation of the children's tool, it is recommended for future studies to compare against a biomarker.
- As there is very little research done on this area, especially in NZ, additional research needs to be conducted to assess the generalisability of this method, with a larger sample, in other populations and areas of NZ.
- Increasing the amount of fruit and vegetables on the children's tool, to assess validity of this method with a larger number of variables (a balance between children's attention spans, and enough data for validity needs to be achieved).
- Using photographs of foods in various states (e.g. raw, cooked, chopped) as the children did not recognise some of the vegetables (mainly kumara).

- Using polarising fruits and vegetables, ones that are commonly liked, and commonly disliked. This is a hard balance between disliked and actually having tried (e.g. Brussels sprouts, which none of the children in the pilot knew). This study found that spinach/silverbeet was not disliked enough by all children, to give a good indication of extreme dislike.
- Using the same scale for both the children's and caregiver's tools, for direct analysis.
- Providing the caregiver's with food portion photographs, to increase the accuracy of the recording on the fruit and vegetable intake record.
- Increasing the scale for the children's tool, to establish a greater degree of liking. For example, having seven smiley faces instead of five.
- Further questions could be developed to gain further information from the children, such as finding out why they like or dislike a food (e.g. do not like kiwifruit, as it is sour).
- As lettuce, frozen mixed vegetables and silverbeet were missed off the intake record (although the caregiver's added it on if they were consumed), it is recommended to make sure that all the fruits and vegetables included in the children's and caregiver's tool, were indeed listed on the intake record.

In summary, it is study showed that a caregiver's fruit and vegetable liking tool is a valid way to assess fruit and vegetable liking and intake in preschool children. Although the children's fruit and vegetable liking tool was not validated, it is still a useful tool to assess fruit and vegetable liking in preschool children.

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Appendices

Appendix One - Human Ethics Approval Letter

MASSEY UNIVERSITY
ALBANY

20 December 2012

Sara Bodel
c/- Dr K Beck
College of Sciences
Massey University
Albany

Dear Sara

HUMAN ETHICS APPROVAL APPLICATION – MUHECN 12/100

Fruit and Vegetable Liking in Pre-School-aged Children to Assess Fruit and Vegetable Intake

Thank you for your application. It has been fully considered, and approved by the Massey University Human Ethics Committee: Northern.

Approval is for three years. If this project has not been completed within three years from the date of this letter, a reapproval must be requested.

If the nature, content, location, procedures or personnel of your approved application change, please advise the Secretary of the Committee.

Yours sincerely

Dr Dianne Gardner
Deputy Chair
Human Ethics Committee: Northern

cc: Dr K Beck
College of Sciences

Te Kunenga ki Pūrehuroa
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Appendix Two - Information Sheet

MASSEY UNIVERSITY
COLLEGE OF HEALTH
TE KURA HAUORA TANGATA

The Fruit & Vegetable Liking Study

INFORMATION SHEET

We are looking for children aged between 3.5 to 5.5 years old and their caregivers to take part in the Fruit & Vegetable Liking Study. With this study, we aim to assess the fruit and vegetable liking and intake of preschool-aged children by involving both the children and their caregivers.

Please read this information sheet carefully before deciding whether to participate.

Researcher(s) Introduction

Sara Bodel, the principle researcher, is studying a Master of Science in Nutrition and Dietetics at Massey University, and this research project is part of her studies. This study is co-supervised by Dr. Rozanne Kruger and Kathryn Beck, two leading researchers in Nutrition and Dietetics at Massey University. Both Rozanne and Kathryn are registered dietitians and have extensive experience in designing and conducting research using dietary assessment tools.

Why is this research important?

You and your child are invited to participate in this interesting new research project in which we seek to validate a fruit and vegetable liking tool to assess fruit and vegetable intake in young children. This is important because it can be very difficult to assess young children's intake due to their days being split between childcare and home. Many habits are formed early, so providing ways to change these habits at a young age may provide health benefits.

If we have a validated fruit and vegetable liking tool that accurately describes fruit and vegetable intake in children, we would be able to develop fruit and vegetable initiatives to increase fruit and vegetable consumption, which will increase health and reduce the risk for disease and health conditions.

Who are we looking for?

We are looking for 100 caregivers and their children to participate in this study.

To take part in this study you should:

Te Kunenga ki Pūrehuroa Institute of Food, Nutrition and Human Health
Private Bag 102 904, North Shore, Auckland 0745, New Zealand T 64 9 443 9770 F 64 9 443 9640 http//:ifnhh.massey.ac.nz

- Have a child between 3.5 and 5.5 years of age,
- Be responsible and committed to the project, and
- your child should have no known fruit or vegetable allergies.

What is going to happen?

You will be required to attend two sessions, one between 6th May and 25th May, and one after 17th June. During your **first visit** you will be given the opportunity to ask any questions and to complete a consent form as well as a brief questionnaire with questions on age, ethnicity, medical history, medication and supplement use. Following this your child will participate in a fruit and vegetable liking activity whilst you will be completing the fruit and vegetable liking tool.

At home, during the time up until your next visit we ask that you maintain your normal daily routine with your child e.g. eating patterns, physical activity etc. You (caregiver) will also be required to complete a fruit and vegetable intake record of your child's intakes for the period of two weeks using a simple recording tool (this will occur in two consecutive pre-allocated weeks prior to your second visit).

During your **second visit** your child will again participate in a fruit and vegetable liking activity whilst you will be completing the fruit and vegetable liking tool.

What are the benefits and risks of taking part in this study?

You will receive information regarding your child's fruit and vegetable liking and intake. You will also receive a brief report summarising the main findings of the project via mail or email.

The principal benefit of taking part in this study is that you will contribute to a study and our understanding of how caregivers and children's fruit and vegetable liking compares as well as an assessment of the fruit and vegetable intake of preschool children. The validation of this tool will provide the unique information to allow the capability to collect food intake data from young children that could inform nutrition education regarding fruit and vegetable intakes.

You and your child will remain in the same room whilst completing the activity for comforting and support purposes, but we will ask that you do not participate at all in the child's activity and provide no assistance.

The total time that you will have to invest in this research project is approximately 1 hour and 35 minutes. This will include 30 minutes for the initial session and 30 minutes for the consecutive session. The fruit and vegetable intake record will take approximately 5 minutes per day (approximately 35 minutes over the one week period). All caregivers will be provided with $20 worth of petrol vouchers for completing the study as well as a small gift pack for the child.

Project Procedures

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The data will be used only for the purposes of this project and no individual will be identified. Only the investigators and administrators of the study will have access to personal information and this will be kept secure and strictly confidential. Participants will be identified only by a study identification number. Results of this project may be published or presented at conferences or seminars. No individual will be able to be identified. All identifiable data will be kept secure.

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any time
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- be given access to a summary of the project findings when it is concluded;
- Completion and return of the questionnaire implies consent. You have the right to decline to answer any particular question.

Project Contacts

If you have any further questions or concerns about the project, either now or in the future, please contact any of the researcher and/or the supervisors:

- Researcher:
  - Sara Bodel
  - s.l.bodel@massey.ac.nz
  - T: 021 024 00347
- Primary supervisor:
  - Dr Rozanne Kruger
  - r.kruger@massey.ac.nz
  - T: 09 414 0800 x 41209
- Secondary supervisor:
  - Kathryn Beck
  - k.l.beck@massey.ac.nz
  - T: 09 443 9649.

Committee Approval Statement

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application 12/100. If you have any concerns about the conduct of this research, please contact Dr Ralph Bathurst, Chair, Massey University Human Ethics Committee: Northern, telephone 09 414 0800 x 43404, email humanethicsnorth@massey.ac.nz

Thank you for considering participating in this study!

The Fruit & Vegetable Liking study research team

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Appendix Three - Participant Consent Form

MASSEY UNIVERSITY
COLLEGE OF HEALTH
TE KURA HAUORA TANGATA

Fruit and vegetable liking in preschool aged children to assess fruit and vegetable intake

PARTICIPANT CONSENT FORM

I have read the Information Sheet and have had the details of the study explained to me.

My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree to participate in this study, and for my child to participate in this study, under the conditions set out in the Information Sheet.

Signature: ..... **Date:** .....

Full Name - printed .....

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Appendix Four - Contact Details and Health Questionnaire

Project title: **Fruit and vegetable liking in preschool aged children to assess fruit and vegetable intake**

Your Child's first name: _____

Your Child's last name: _____

Legal guardian's first name: _____

Legal guardian's last name: _____

Relationship to child: _____

Contact address:

(**Note;** *the contact details provided will be merely used to post out a brief general overall findings of the study*)

Postal address: _____

_____

_____

Contact Phone number: _____

Email address: _____

General health and demographics questionnaire

Your child's date of birth: _____day/_____month/_____year

Current age of child: _____

You child's sex O male O female

Ethnicity: _____

1. **Does your child take any medication?**

O Yes O No

(If yes, please list with as many details as possible)

Medication 1 Name : _____Dose_____ How often_____

Medication 2 Name : _____Dose_____ How often_____

Medication 3 Name : _____Dose_____ How often_____

Medication 4 Name : _____Dose_____ How often_____

2. **Does your child take any supplements?**

O Yes O No

(If yes, please list with as many details as possible)

Supplement 1 Name : _____ Dose_____ How often_____

Supplement 2 Name : _____ Dose_____ How often_____

Supplement 3 Name : _____ Dose_____ How often_____

Supplement 4 Name : _____ Dose_____ How often_____

3. **Does your child have allergies to food?**

O Yes O No

If yes please identify _____

Who diagnosed his/her allergy? _____

Appendix Five - Study Recruitment Poster

MASSEY UNIVERSITY
COLLEGE OF HEALTH
TE KURA HAUORA TANGATA

Do you have a child between the age of 3.5 and 5.5 years?

We are recruiting children between 3.5 and 5.5 years and their caregivers to take part in this exciting study by assessing their fruit and vegetable liking and intake.

The Fruit and Vegetable Liking Study

What you would need to do:

- Answer two short questionnaires at Massey University in Albany
- Allow your child to answer two short questionnaires
- Complete a fruit and vegetable intake record (one week at home)

What you will gain from taking part:

- $20 petrol voucher
- A fun fruit and vegetable pack for your child

Interested? Contact us:

Sara Bodel **Email** s.l.bodel@massey.ac.nz

Phone 021 024 00347

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Private Bag 102 904, North Shore, Auckland 0745, New Zealand **T** 64 9 443 9770 **F** 64 9 443 9640 **http//:ifnhh.massey.ac.nz**

Appendix Six - Recruitment Advertising Letter and Blurb

Advertising Letter:

Dear Editor,

My name is Sara Bodel and I am currently studying a Master of Science, majoring in Nutrition and Dietetics, at Massey University in Albany.

I am conducting a research project on fruit and vegetable liking in toddlers (3.5 – 5.5 year old children) for my Master's degree.

For this research project, I need to invite children of this age along with their caregivers to participate in this study. Specifically I am aiming to recruit Auckland mothers who are able to come to Massey University in Albany on two occasions. They will be asked to complete a questionnaire each, on both occasions, as well as a food intake record.

We will compensate each caregiver with a $20 petrol voucher and the children will each receive a fun fruit and vegetable pack in appreciation of their participation.

Is there any possibility that you would be able to advertise for my research project in your magazine/website or even in your email newsletter at no cost?

I am happy to send you a poster and an advertisement blurb if you can do this for me.

Many thanks,
Sara Bodel (BSc)

Advertising Blurb:

Fruit and Vegetable Liking and Intake Study

We are running a study here at Massey University and are looking children between the ages of 3.5 and 5.5 years and their caregivers to take part. The study will involve completing two questionnaires for both the child and the caregiver, and a fruit and vegetable intake record. You will be compensated with a $20 petrol voucher, and a fun fruit and vegetable pack for your child.

If you would like further information or would like to take part contact Sara Bodel on (021) 024 00347 or email s.l.bodel@massey.ac.nz to register your interest. Please pass on this information to any one you know that might be interested in participating. We look forward to hearing from you.

Appendix Seven - Caregiver's Fruit and Vegetable Liking Tool

Caregiver report on food liking in child:

Please indicate on the lines adjacent to each vegetable or fruit, how much you think your child likes (Yummy) or dislikes (Yucky) the item, and how many times throughout their lives they have tried each item (by itself).

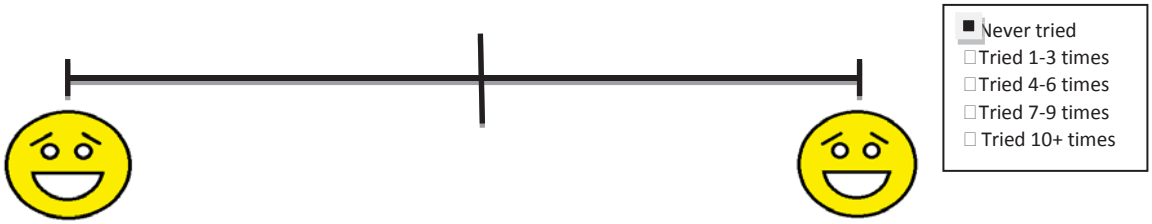
Instructions:

1. Please mark in the box on the right, how many times your child has tried this item.
2. Please mark each line below using the like-dislike scale. The ends of the scale represent the strongest liking or disliking of any kind. Place a vertical mark (line) anywhere through the line.

An example is shown below.

Example:  Yoghurt

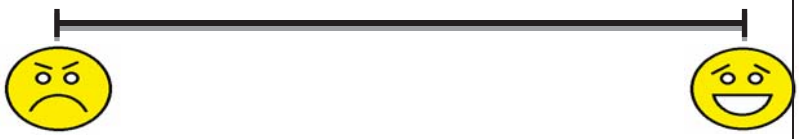
Or: Olives 



Brushing teeth 		N/A
Broccoli 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Carrots 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Going to bed 		N/A
Peas 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Brussels sprouts 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Kumara 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Lettuce 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times

Courgette 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Capsicum 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Tomato 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Spinach/ Silverbeet 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Watercress 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Pumpkin 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Green Beans 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Frozen Mixed Vegetables 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times

Corn 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Potato 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Avocado 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Cauliflower 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Cabbage 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Toys 		N/A
Apple 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Bananas 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times

Kiwifruit 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Oranges 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Grapes 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Pears 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Mandarin 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Strawberry 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Berries 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Apricot 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times

Canned Peaches 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Plum 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Peaches 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Raisins/ Sultanas 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Canned fruit salad 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Dried Fruit 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times
Canned Pears 		☐Never tried ☐Tried 1-3 times ☐Tried 4-6 times ☐Tried 7-9 times

Images courtesy of vegetables.co.nz

Appendix Eight - Children's Fruit and Vegetable Liking Tool - Pictures

Fruit and Vegetable Liking Tool

Sara Bodel MSc Research Project –
Fruit and vegetable liking in
preschool children

Images courtesy of vegetables.co.nz

How much do you like: Brushing your teeth?

How much do you like: Broccoli?

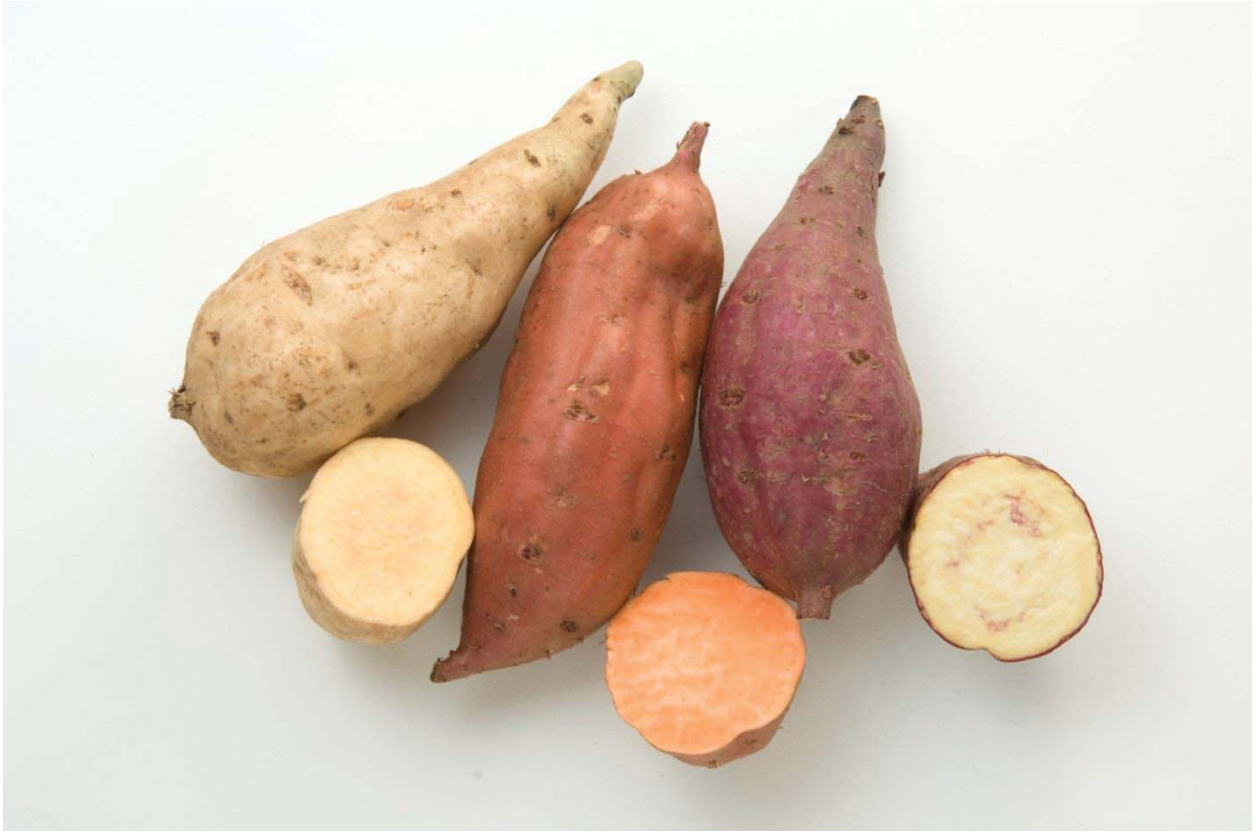
How much do you like: Carrots?

How much do you like: Going to bed?

How much do you like: Peas?

How much do you like: Spinach/Silverbeet?

How much do you like: Kumara (sweet potato)?



How much do you like: Lettuce?

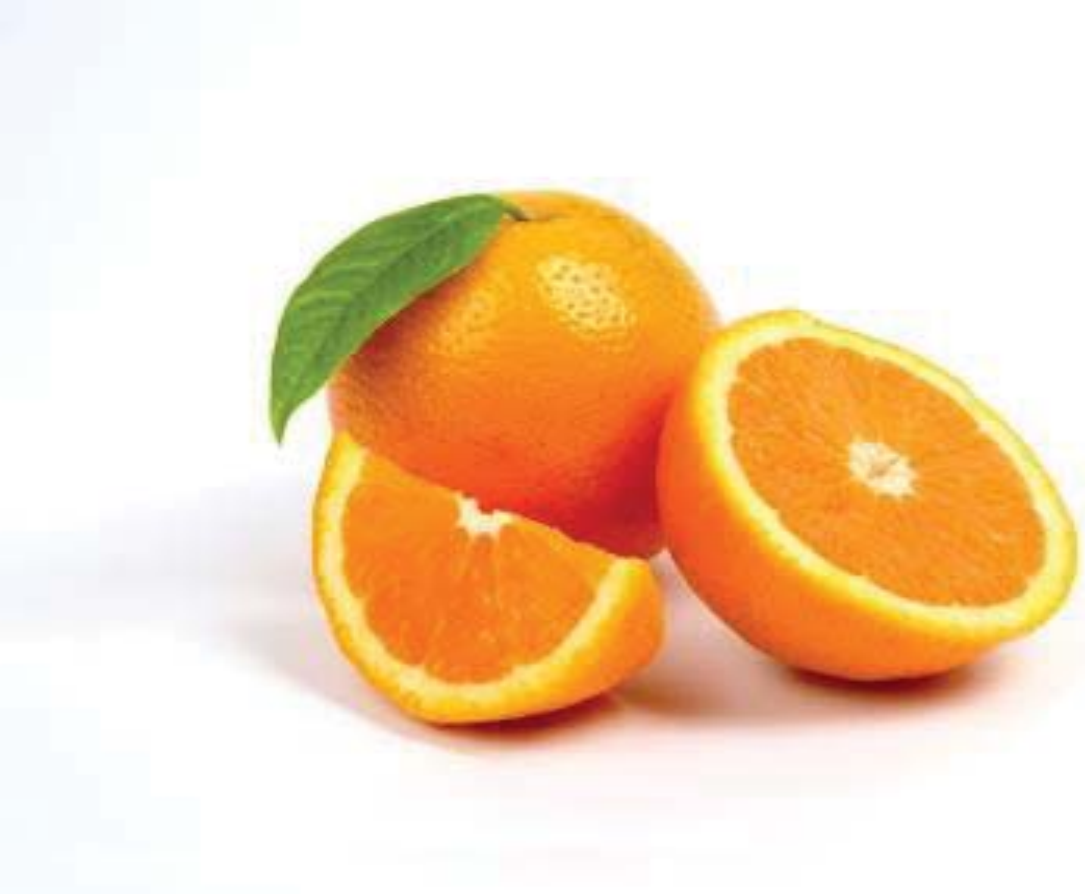
How much do you like: Toys?

How much do you like: Apples?

How much do you like: Bananas?

How much do you like: Kiwifruit?

How much do you like: Oranges?

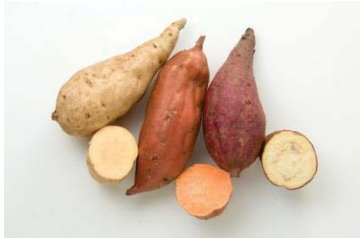


Appendix Nine - Children's Fruit and Vegetable Liking Tool Recording Sheet

Child's Fruit and Vegetable Liking Tool **Participant Code:**_____

Brushing teeth 	
Broccoli 	
Carrots 	

Going to bed 	
Peas 	
Spinach/Silverbeet 	

Kumara **(Sweet potato)** 	
Lettuce 	
Toys 	

Apples 	
Bananas 	
Kiwifruit 	

Oranges 	

Appendix Ten - Fruit and Vegetable Intake Record

Fruit and Vegetable Intake Record							
Week starting:				**Participant Code:**			
Please place a tick in the column for every serve of fruit or vegetable your child has throughout the day							
Fruit or Vegetable	**Mon**	**Tue**	**Wed**	**Thurs**	**Fri**	**Sat**	**Sun**
Apple							
Apricot							
Asparagus							
Avocado							
Banana							
Bean sprouts							
Beetroot							
Blackberry							
Blackcurrant							
Blueberry							
Bok Choy							
Broad beans							
Broccoli							
Brussels sprouts							
Cabbage							
Cantaloupe							
Capsicum							
Carrot							
Cauliflower							
Celery							
Cherry							
Corn							
Courgette							
Cucumber							
Date							
Eggplant							
Feijoa							
Grape							
Grapefruit							
Green beans							
Guava							
Honeydew melon							
Kale							
Kiwi fruit							
Leek							
Lemon							
Lime							
Lychee							
Mandarin							
Mango							
Melon							
Mung beans							
Mushrooms							
Nectarine							
Okra							

Fruit or Vegetable	Mon	Tue	Wed	Thurs	Fri	Sat	Sun
Onion							
Orange							
Parsnip							
Peach							
Pear							
Peas							
Pineapple							
Plum							
Pomegranate							
Potato							
Pumpkin							
Radish							
Raspberry							
Rhubarb							
Rock melon							
Runner beans							
Satsuma							
Shallot							
Snap peas							
Soy beans							
Spinach							
Spring onion							
Strawberry							
Swede							
Kumara							
Tangerine							
Taro							
Tomato							
Turnip							
Watercress							
Watermelon							
Yam							