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Can the Garden to Table programme improve children's fruit and vegetable consumption?

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

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Abstract

Background

New Zealand children are not meeting fruit and vegetable recommendations. Garden to Table, an in-school cooking and gardening programme, offers a potential solution.

Objective

To evaluate the effects of Garden to Table participation for at least one school year on children's fruit and vegetable consumption and variety of intake, their knowledge of and attitudes towards fruits, vegetables, cooking and gardening, and their cooking- and gardening-related self-efficacy and behaviours.

Design

An epidemiological study comparing the amount and variety of fruit & vegetables consumed, and knowledge, attitudes and self-efficacy related to fruit & vegetables of two groups of children: 158 students aged nine to 11 who had been in the Garden to Table programme for at least one school year, and 128 students from control schools, matched for year level. Quantitative evaluation used adapted versions of the Ministry of Health's 2002 National Children's Nutrition Survey food frequency questionnaire and the children's questionnaire used in the Stephanie Alexander Kitchen Garden evaluation. $P<0.05$ was used to indicate statistical significance.

Outcomes

No significant difference was found in the proportion of children meeting recommended overall fruit & vegetable intake between Garden to Table (38.8%) and control groups (39.8%), $p=0.29$. However, when individual reported fruit & vegetable consumption was summed, fruit & vegetable intakes were significantly greater in the control group ($P=0.02$ for both), but ranged from zero to 16 and from zero to 39.2 serves per day, respectively, indicating unreliable reporting. Significant gender and year-level interactions were present for vegetable & fruit variety, respectively, with boys in the Garden to Table group consuming 2.93 (0.18, 5.69) more vegetables per week than boys in the control group ($p=0.02$), and year 5 control participants consuming 3.43 (1.59, 5.27) more fruit per week than year 5 Garden to Table participants ($p<0.01$). The Garden to Table group had significantly greater scores for attitudes and knowledge. There were no significant differences in cooking- and gardening-related self-efficacy or behaviour scores.

Conclusion

The Garden to Table programme improved children's knowledge and attitudes about cooking, gardening, fruit & vegetables. However, further longitudinal research, using reliable assessment methods, within constraints of school settings is needed to evaluate consumption of fruit & vegetables.

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Abbreviations

BMI	Body Mass Index
BP	Blood Pressure
COPD	Chronic Obstructive Pulmonary Disease
CVD	Cardiovascular Disease
FFQ	Food frequency questionnaire
F&V	Fruit and vegetables
GP	General practitioner
GtT	Garden to Table
HDL	High-Density Lipoprotein
IHD	Ischaemic Heart Disease
MoH	Ministry of Health
NCD	Non-communicable diseases
NCNS	National Children's Nutrition Survey
NSCYPPADBNZ	National Survey of Children and Young People's Physical Activity and Dietary Behaviours in New Zealand
NZ	New Zealand
NZEO	New Zealand European or Other
NZHS	New Zealand Health Survey
OECD	Organisation for Economic Co-operation and Development
PA	Physical Activity
SAKG	Stephanie Alexander Kitchen Garden
SES	Socio-economic Status
SSBs	Sugar-sweetened Beverages
T2DM	Type 2 Diabetes Mellitus
UN	United Nations
WHO	World Health Organisation
YLL	Years of Life Lost

Chapter 1: Introduction

1.1 Introduction

Childhood is an important period of development; it is the time in which dietary preferences are acquired that can shape future habits (Birch, 1998a; DiNubile, 1993; Heimendinger & Van Duyn, 1995; Morgan, 2010). Exposure to and promotion of healthy dietary components, such as the consumption of fruits and vegetables (F&V) is essential, as dietary lifestyle habits learned in childhood, up to the age of approximately 15, have been showed to be sustained into adulthood (Cullen, 2001; DiNubile, 1993; Foerster, 1998; Heimendinger & Van Duyn, 1995; Kelder, 1994; Sandeno, Wolf, Drake, & Reicks, 2000; Singer, Moore, Garrahie, & Ellison, 1995). However, a complex interplay of factors, including innate preferences (Mennella, 1999; Sullivan, 1994), food neophobia (Birch, 1998a, 1982, 1987b; Sullivan, 1994), role-modelling (Birch, 1980a, 1980b; Nicklaus, 2005; Visalberghi, 2000) and parental interactions (Fisher, 2002; Galloway, 2005; Gibson, 1998; Harper, 1975; Oliveria, 1992), complicate the development of healthy dietary patterns in children (Galloway, 2006).

Optimising children's dietary patterns is critical for emotional, physical and academic development and maturation (Koch, 2006; Lineberger, 2000; Morris., 2000). Healthy eating for children should include a variety of F&V, as these provide many essential nutrients, including vitamins, minerals, fibre and phytochemicals (Ministry of Health, 2012b). It is also recommended that a diverse range of F&V be consumed, which have been minimally processed (Ministry of Health, 2012a). Such healthy dietary patterns are also important for the prevention of some childhood diseases (Morgan, 2010). Furthermore, improving childhood nutrition, and in particular the intake of F&V, has a protective effect on future disease risk in adulthood (Koch, 2006; Lautenschlager, 2007a, 2007b; Lineberger, 2000; Liquori, 1998; McAleese, 2007; Newell, 2004; O'Brien, 2006; Robinson-O'Brien, 2009; Somerset, 2009), which represents a significant cost saving through the reduced burden of disease and premature death (Beaglehole, 2011; Ministry of Health, 2003b). Healthy dietary patterns that include F&V are also vital to reducing obesity in childhood (Lautenschlager, 2007b), which is pertinent given the high and increasing prevalence of childhood overweight and obesity in New Zealand (NZ) (Ministry of Health, 2003c, 2012d).

While F&V are known to be an important component of a healthy diet, the 2002 National Children's Nutrition Survey (NCNS) showed that the recommendations for at least two servings of fruit and at

least three servings of vegetables per day are met by only 43% and 57%, respectively, of children aged five to 14 years (Maddison, 2010; Ministry of Health, 2003c). However, this figure may be over-inflated, as fried potato was included in vegetable intake (Ministry of Health, 2003c). Information gained from a National Survey of Children and Young People's Physical Activity and Dietary Behaviours in New Zealand (NSCYPPADBNZ) between 2008 and 2009 suggested that 68.6% of NZ youth aged five to 24 years were meeting the recommendations for fruit, 39.7% were meeting the vegetable recommendations, and only 31.7% were fulfilling both recommendations (Maddison, 2010). Furthermore, the proportion of children meeting all recommendations was negatively associated with children's age (Maddison, 2010; Ministry of Health, 2003c).

While there appears to be no link between fruit intake and the level of deprivation in which a child lives, the same is not the case for vegetables (Maddison, 2010; Ministry of Health, 2003c). Both the 2002 NCNS and the 2008/09 NSCYPPADBNZ showed significant negative association between vegetable consumption and deprivation (Maddison, 2010; Ministry of Health, 2003c). International research has also shown these inequalities, with children of low socio-economic status (SES) having lower intakes of F&V (Klemmer, 2005; Koch, 2006; Lautenschlager, 2007a). In addition, there was a trend for children from rural areas being more likely to meet all recommendations for F&V, and urban-dwelling children less likely to meet current recommendations (Maddison, 2010). This makes urban-living low-socio-economic children a particularly disadvantaged population, for which health-promotion activities are warranted. While children living in more deprived areas are at greater risk of having inadequate F&V consumption, this does not mean to imply that other population groups are immune from this inadequacy; the national data shows that approximately half of NZ children are not consuming adequate F&V.

As childhood nutrition is thought to be sustained into adulthood, it is unsurprising then that the F&V intake of adults in NZ has also been inadequate, compared with recommendations (Ministry of Health, 2003b, 2012c). Also of concern are the results of a recent study of NZ children's eating patterns, which showed too few F&V in school lunches (Dresler-Hawke, Whitehead, & Coad, 2009). When included, these were the foods least likely to be consumed (Dresler-Hawke et al., 2009). Lunches frequently had foods high in fat, sodium and sugar, a finding that has been supported in further research (Dresler-Hawke et al., 2009; Ransley et al., 2010). This highlights the potential for school-based nutrition-promotion strategies to improve F&V consumption by NZ children.

1.2 Justification for the study

Schools have been identified as an opportune setting for nutrition promotion to children (Robinson-O'Brien, 2009), not only because of the highlighted lack of F&V consumed while at school, but also because of the volume of time children spend at school and the demonstrated ability of schools to deliver structured education (Lautenschlager, 2007a; Lineberger, 2000; McAleese, 2007; Morris, 2001; Morris., 2000). One strategy employed in schools is garden-based nutrition-education programmes; this strategy is underpinned by the social cognitive theory (Dickinson, 2013) and socio-ecological framework (Dickinson, 2013) to propose influence on dietary behaviour (McLaren, 2005; Ozer, 2007; Walton, Waiti, Signal, & Thomson, 2010). Some of the strengths of these programmes for facilitating dietary behaviour change are their experiential-based learning (Heim, 2009; Koch, 2006; Lautenschlager, 2007a; Lineberger, 2000; Liquori, 1998; Rahm, 2002; Ransley et al., 2010; Somerset, 2009; Thomas, 2003; Waliczek, 2003), peer role-modelling (Ozer, 2007; Ransley et al., 2010) and community involvement (Gibbs, 2013b; McLaren, 2005; Ozer, 2007).

Studies evaluating such strategies are limited by the differences in programme curricula and study designs (Dickinson, 2013; Gibbs, 2013b). Overall, however, nutrition-education programmes that include a gardening component are more successful in affecting predictors of dietary intake than nutrition education alone (Graham, 2005; Lautenschlager, 2007a, 2007b; Parmer, 2009). In general, research has found encouraging results for reduced neophobia (Cason, 1999; Lautenschlager, 2007a; Morgan, 2010; Morris, 2001), increased knowledge, preference (Atkins, 2010; Koch, 2006; Liquori, 1998; Morris, 2002b; Morris, 2001; Newell, 2004; Reinaerts, de Nooijer, Candel, & de Vries, 2007), attitude (Atkins, 2010; Morgan, 2010; Newell, 2004; Reinaerts et al., 2007), self-efficacy (Heim, 2009; Liquori, 1998; Newell, 2004; O'Brien, 2006; Poston, 2005; Somerset, 2009), environmental awareness (Lautenschlager, 2007a; Morris., 2000), academic achievement (Graham, 2005; Klemmer, 2005; Pigg, 2006), enhanced behaviour during class (Graham, 2005) and building positive relationships with peers (Lautenschlager, 2007a); these benefits are in addition to potentially improving F&V intake (Atkins, 2010; Hermann, 2006; McAleese, 2007; Parmer, 2009; Ransley et al., 2010; Somerset, 2009). Furthermore, gardening in childhood encourages the adoption of healthier dietary patterns that may continue into adulthood (Lautenschlager, 2007a).

Garden to Table (GtT) is a curriculum-integrated, in-school cooking and gardening programme that was piloted in 2009 and now operates in 15 NZ schools. In this programme, children are taught to build and maintain gardens, to grow and harvest fruits, vegetables and herbs, and to prepare and

share meals (Block, 2009). Garden to Table is based on the Stephanie Alexander Kitchen Garden (SAKG) programme, which was launched in Australia and has gained substantial national and state government support (The Stephanie Alexander Kitchen Garden Foundation, n.d.-a). The programme focuses on a 'seed to table experience', and its key principle is that setting good examples and engaging children's curiosity, energy and tastebuds creates positive and memorable food experiences, which form the basis for positive lifelong eating habits (Garden to Table, n.d.-a). The objectives of the programme are to increase children's willingness to try unfamiliar foods; increasing skills, knowledge and self-efficacy in cooking and gardening; increasing enjoyment of eating a variety of foods; increasing articulation of those food experiences; increasing children's co-operation, self-esteem and affirmative relationships; and increasing their understanding of sustainability and the environment (Block, 2012; Gibbs, 2013a). A mixed-method evaluation of the SAKG programme showed it to increase willingness to try new foods, and to improve knowledge, attitude and confidence in cooking; it also gave qualitative support for increased F&V consumption (Block, 2012; Gibbs, 2013a, 2013b). These encouraging results prompted the introduction of the SAKG-based GtT programme into NZ. A qualitative process and outcome evaluation of the GtT programme has been completed that supported the implementation into NZ schools, as well as findings for increased knowledge, confidence and willingness to try new foods (Dickinson, 2013). However, there has been no quantitative evaluation measuring the success of the GtT programme on these or other outcomes, including dietary intake.

Difficulties in such an evaluation derive from there being no widely accepted gold standard for measuring dietary intake in children (Ku, 1998), as challenges arise from the level of comprehension for recall, portion-size estimation and food knowledge (Achterber, 1991; Emmons, 1973; Haraldsdóttir, 1995; Lytle, 1993; Sobo, 2000; Van Horn, 1990), discrepancies in the recall of different caregivers (Baranowski, 1991) and a lack of cost-efficient and accurate biomarkers for validation. A variety of dietary-assessment methods have been used to evaluate school cooking and gardening programmes, including food recalls (Gibson, 2005a; Lineberger, 2000; McAleese, 2007; Ransley et al., 2010), food frequency questionnaires (FFQ) (Baranowski, 1994; Blom, 1989; Eck, 1991; Frank, 1992; Gibson, 1990, 2005a; Hebden, 2012; Jenner, 1989; Magarey, 2009; Rockett, 1997; Watson, 2009; Wilson, 2008), observations (Liquori, 1998; Parmer, 2009), interviews and food diaries (Gibson, 2005b; Thompson, 1994); each with own strengths and limitations. While the accuracy of these methods may be improved with visual aids (Baranowski, 1994; Chambers, 2000; Huenemann, 1942; Matheson, 2002; Meredith, 1951), portion-size training (Weber, 1999), repeated measurement (Livingstone, 2004) and the use of multiple methods (Livingstone, 1992), it is also

important to align the selected method with the research objectives, participant requirements and study setting.

Other outcomes that authors have used in their evaluations of school cooking and gardening programmes have been measured, with methods based on the specifics of the programme. These assessment methods have included true or false questions (Baranowski, 2000; Koch, 2006; Morgan, 2010; Morris, 2002b; O'Brien, 2006; Poston, 2005), visual identification (Morris, 2001; Robinson-O'Brien, 2009), Likert-type scales (Somerset, 2009), tasting (Heim, 2009; Koch, 2006; Liquori, 1998; Morris, 2002b), short- and long-answer open-ended questions (Liquori, 1998; Parmer, 2009), and hedonic scales with facial expressions (Baranowski, 2000; Domel, 1993; Lineberger, 2000; Morgan, 2010; Morris, 2001; Parmer, 2009; Robinson-O'Brien, 2009). While most of these methods have reported adequate validity, the inconsistency between studies complicates a comparison of their results.

The GtT programme may improve NZ children's F&V consumption patterns and offers a potential strategy to address current levels of childhood obesity and future health implications, by encouraging the adoption of healthy eating habits (Block, 2009). Although qualitative research has lent some support to the programme, further quantitative research is required to evaluate whether the programme extends a benefit to dietary behaviour. This, in turn, may justify expanding the level of funding to allow the programme to be introduced into more schools and to continue improving the dietary intake of NZ children.

1.3 Purpose of the study

1.3.1 Aim

To evaluate the effects of Garden to Table participation for at least one school year on children's fruit and vegetable consumption and variety of intake, their knowledge of and attitudes towards fruits, vegetables, cooking and gardening, and their cooking- and gardening-related self-efficacy and behaviours.

1.3.2 Objectives

1.3.2.1 Primary objective

To investigate whether participation in the Garden to Table programme for one school year has resulted in a greater proportion of year 4 and 5 children meeting the recommendations for fruit and vegetable consumption – that is, at least two servings of fruit and at least three servings of vegetables per day.

1.3.2.2 Secondary objectives

To assess the variety of fruit and vegetable intake in children involved in this study.

To assess the knowledge of fruits, vegetables, cooking and gardening of the children involved in the study.

To assess the attitudes of the children involved in this study towards fruits, vegetables, cooking and gardening.
To assess the cooking- and gardening-related self-efficacy of the children involved in the study.

To assess the cooking- and gardening-related behaviours of the children involved in the study.

1.3.3 Hypothesis

H_1: It is hypothesised that a greater proportion of children who have participated in the Garden to Table programme will be meeting fruit and vegetable intake recommendations compared with children who have not participated in the Garden to Table programme.

H_2: It is hypothesised that children who have participated in the Garden to Table programme will consume a greater variety of fruit and vegetables than children who have not participated in the Garden to Table programme.

H_3: It is hypothesised that children who have participated in the Garden to Table programme will have greater knowledge of fruits, vegetables, cooking and gardening than children who have not participated in the Garden to Table programme.

H_4: It is hypothesised that children who have participated in the Garden to Table programme will have more positive attitudes towards fruits, vegetables, cooking and gardening than children who have not participated in the Garden to Table programme.

H_5: It is hypothesised that children who have participated in the Garden to Table programme will have greater gardening- and cooking-related self-efficacy than children who have not participated in the Garden to Table programme.

1.4 Structure of the thesis

The literature regarding development of dietary habits and patterns in childhood, the importance of childhood nutrition, current recommendations and dietary patterns of NZ children, and the evidence and methodology for school gardening and cooking programmes as a strategy to address these patterns are reviewed in Chapter 2. Following this, in Chapter 3, is a description of the methods and materials utilised in the present study. Chapter 4 includes the results of the present study, which are discussed in greater detail in Chapter 5. Finally, Chapter 6 summarises the present study, including its strengths and limitations, and concludes with the recommendations for future studies.

1.5 Researcher's contribution

The candidate was responsible for:

- applying for ethics approval, with supervision from Dr Pamela von Hurst and Associate Professor Welma Stonehouse, and cultural advice from Dr Lily George, Ben Faufua, PC Tong and Cherie Wong
- developing study protocols and adapting the research questionnaires, with supervision from Dr Pamela von Hurst and Associate Professor Welma Stonehouse, and in consultation with primary school teachers Kerry Lee, John Lee, Natalie Larson, Maya McCarrer and Phil Margetts
- recruiting schools and participants, with assistance from Nicole Curin-Birch, Garden to Table Executive Officer
- collecting data, with the assistance of Allie Towgood, research assistant
- coding and entry of questionnaire data, with supervision from Associate Professor Welma Stonehouse

- statistical analysis and interpretation of the data, with supervision from Associate Professor Welma Stonehouse.

Chapter 2: Literature Review

2.1 Introduction

Childhood is an important time for developing dietary patterns (DiNubile, 1993; Heimendinger & Van Duyn, 1995; Morgan, 2010), including the consumption of fruit and vegetables (F&V), which may extend a protective effect against obesity and other diseases (Calvert, 1997; Lautenschlager, 2007a, 2007b; Liquori, 1998; McAleese, 2007; Munoz, 1997; Newell, 2004; O'Brien, 2006; Potter, 2000; Ransley, 2007; Robinson-O'Brien, 2009; Somerset, 2009; Van Duyn, 2000). However, the diets of New Zealand (NZ) children have been demonstrated to lack F&V (Ministry of Health, 2003c), and school-based nutrition-promotion strategies have focused on improving this aspect of their diets (Ministry of Health, 2003b; Parmer, 2009; Ransley, 2007; Ransley et al., 2010; Somerset, 2009). Such strategies have included school cooking and gardening programmes, such as the NZ Garden to Table (GtT) programme (Garden to Table, n.d.-a). This programme is yet to be evaluated, and undertaking such an evaluation is complicated by challenges in dietary assessment and measures of other outcomes in children.

The current literature review encompasses how dietary habits are obtained in childhood and the influences on these, which may form the basis for lifelong patterns. Following on from this is a discussion of the importance of childhood nutrition, with a focus on F&V, and the consequences for obesity and disease in NZ. This is implicit, given the current intake of F&V and other associated dietary behaviours by NZ children, as will be discussed.

The lack of F&V in NZ children's diets and the importance of improving this has created the need for effective health-promotion strategies, one of which is the introduction of school-based nutrition-education programmes that involve gardening and or cooking. The details of these programmes are reviewed, followed by information about the GtT programme. However, this programme is yet to be quantitatively evaluated and, consequently, the literature about methods of dietary assessment in children and other outcomes of interest related to such programmes is reviewed.

2.2 Development of dietary habits and patterns in childhood

2.2.1 Introduction

Childhood is an essential period of development, to acquire and refine dietary habits and preferences that shape adult consumption patterns (Heimendinger & Van Duyn, 1995; Morgan, 2010). It is suggested that promoting childhood exposure to and education about F&V, especially before age 15, improves intake and alters the diet of the eventual adult (DiNubile, 1993; Morgan, 2010). However, dietary patterns are shaped by a complex interplay of factors, including innate preferences, role-modelling and parental interactions (Galloway, 2006).

2.2.2 Innate preferences

Children's early experiences around food may shape their attitudes and future dietary patterns. Children are born with innate preferences for sweet and salty flavours, and aversions to sour and bitter flavours (Mennella, 1999). However, maintenance of these preferences may be linked with exposure to the flavours (Sullivan, 1990). Breast milk provides the first opportunity for flavour experiences in infants, which may influence later acceptance of flavours and foods (Sullivan, 1994). Evidence shows garlic and vanilla flavours in breast milk are associated with infants suckling for longer, compared with infants suckling breast milk from a plain diet (Mennella, 1999). Animal studies also support this, showing that flavours of breast milk predict the later preference and quantity of solid foods consumed (Galef, 1982). This theory hypothesises that formula-fed infants receive only the standard formula flavour and will have a greater rejection of unfamiliar foods and flavours in later development. However, this hypothesis has only limited support (Sullivan, 1994).

Infants have an innate ability to self-regulate feed volumes to energy requirements over 24 hours (Birch, 1985). There is some evidence that this ability may extend beyond infancy (Birch, 1985, 1986, 1993, 1991b, 1987a, 1990; Johnson, 1991; Kern, 1993). However, feed volume is visible for formula-fed infants, which increases the risk of parental influence on consuming set volumes (Birch, 1998a), as can also occur when children refuse to eat foods (Klesges, 1983). This overrides self-regulation and disinhibits the infant or child's hunger and satiety cues (Birch, 1998a), which may predispose them to future over-eating and lead to excessive weight gain.

2.2.3 Food neophobia

The progression from liquid feeds to solid foods is important for children's development (Birch, 1998a). Children are often apprehensive about trying new foods, a phenomenon called neophobia (Birch, 1998a); this is hypothesised as 'learned safety', an evolutionary mechanism that protected humans from potentially lethal foods (Birch, 1998b; Cashdan, 1998; Wright, 1991) . Children may guess whether foods are 'safe' by comparing them with previously tasted foods (Birch, 1998a). Although foods are commonly rejected upon visual presentation, it is bitter tastes that are intrinsically associated with toxic substances (Birch, 1987b; McBurney, 1979; Steiner, 1979).

However, bitter-taste aversions are eventually lost through exposure and acceptance of different foods (Birch, 1987b). This requires an encouraging and nurturing feeding style, with food presented in a neutral environment for up to 15 times (Birch, 1982, 1987b; Sullivan, 1994). Recurrent food exposure consistently enhances food preferences (Birch, 1982), and the 'mere exposure' hypothesis is based on this (Zajonc, 1980). The 'mere exposure' hypothesis proposes that preference is developed simply through the familiarity of being exposed to something, including food (Zajonc, 1980). However, this hypothesis is undermined by the greater preference for tasting foods (Birch, 1987b). It may be that these experiences shape preferences in long-term dietary patterns, as is seen in people with high-salt diets who have higher salt preferences, and vice versa (Bertino, 1986).

Food neophobia is age-related; the younger the child (particularly aged less than one year), the fewer presentations with a novel food are required for it to be accepted (Birch, 1998a), while between ages two and six children may be more neophobic (Addessi, 2005; Cashdan, 1994; Cooke, 2003). After this age, neophobia gradually declines through adolescence to adulthood (McFarlane, 1997; Nicklaus, 2005). It is suggested that the elderly may also display neophobia (Otis, 1984; Tuorila, 2001), perhaps as a result of reduced olfactory sensations (Pelchat, 2000) or that more unfamiliar foods have become available due to a greater diversity of ethnic cultures and cuisines (Dovey, Staples, Gibson, & Halford, 2008).

Food rejection has been characterised: firstly, there is rejection of food seen to pose a threat to one's safety; secondly, there is the rejection of an inedible or inappropriate food; next there is the rejection of disgusting food; and finally, rejection occurs due to dislike or aversion (Rozin, 1980a). Disgust rejections of unfamiliar foods may be related to subjective associations that foods appear bitter tasting and therefore taste disgusting (Fallon, 1984; Martins, 2005; Rozin, 1986; Steiner, 1973). Disgust reactions may be more closely linked to foods of animal origin, with foods of plant

origin, including F&V, more easily influenced by environmental factors (Martins, 1997; Pliner, 1991). Childhood F&V neophobia is common, because vegetables can be bitter tasting and fruit may have sour citrus flavours (Stein, 2003). Neophobia can result in a low intake and variety of foods, with consequent inadequate intake of nutrients required for growth and health (Cooke, 2003; Galloway, 2003; Raynor, 2001). Interestingly, breast-fed infants appear less likely to express fruit, but not vegetable, neophobia (Cooke, 2003).

There are three underlying reactions proposed that determine responses to unfamiliar food presentation (Martins, 1997). Firstly, there is the immediate preference for or displeasure with some aspect of the food's sensory qualities, including the appearance, colour, smell or taste, which is termed 'sensory-affective' (Fallon, 1983). Secondly, there is an expected outcome of food consumption – whether it will cause illness or injury, or be safe and advantageous (Fallon, 1983). Thirdly, there is the understanding of the source and characteristics of the food reaction, which is termed 'ideational' (Fallon, 1983). The final reaction is particularly associated with disgust at unfamiliar foods (Fallon, 1983). Theoretically, negative reactions lead to food rejection and positive reactions lead to acceptance. In practice, however, the first two reactions are more significant in determining food responses (Rozin, 1980a), extending an approach to reduce neophobia. By providing information about nice tastes of unfamiliar food, 'sensory-affective' reaction is increased (Pelchat, 1995). The evidence for modifying the second reaction is less convincing (Eiser, 1984; Light, 1992; Solheim, 1992), with some support for nutrition information increasing the beneficial expected outcome (Martins, 1997), other studies showing no influence (Pelchat, 1995), and still others showing increased neophobia (Woodward, 1945). The effect of nutrition information on reducing food neophobia may be dependent on food type (Martins, 1997), the subjective importance of nutrition (Aaron, 1994), or influences of food availability and accessibility (Martins, 1997).

2.2.4 Personality and genetics

Food neophobia has been linked to various personality characteristics, including anxiety, openness, neuroticism and lack of sensation-seeking attitudes (Galloway, 2003; Loewen, 1999; McCrae, 2002; Pliner, 1997; Steptoe, 1995; Walsh, 1993). Furthermore, genetic predispositions may exist that make children more likely to develop neophobia (Galloway, 2003). International familial studies have suggested that up to two-thirds of food neophobia variation may be genetically attributed (Knaapila, 2007).

2.2.5 Role-modelling

Food neophobia can be overcome by tasting foods and experiencing 'unexpected pleasantness' (Pliner, 1992; Raudenbush, 1999; Tuorila, 1994). Such experiences can include involving a child in the cooking and preparation of unfamiliar foods, which has been shown to reduce food neophobia (Martins, 1997; McFarlane, 1997; Pelchat, 1995). Furthermore, offering unfamiliar foods in social environments with others present, and preferably eating together, reduces food neophobia through role-modelling (Birch, 1980a, 1980b; Nicklaus, 2005; Visalberghi, 2000). Increased preference for disliked vegetables was demonstrated in preschool children after they had observed peers eating the same vegetables (Birch, 1980a). This was also shown for chilli flavour preference by monkeys that observed flavoured crackers consumed by human keepers and in hierarchical Mexican families (Rozin, 1983, 1980b). While role-modelling can have positive influences, it can also be undermined by over-zealous parental support, parenting styles or negative remarks by others about the food (Birch, 1998a, 1998b; Cullen, 2000; Wardle, 1995). Additionally, younger children are more influenced by parents, siblings and caregivers, while older children may be better influenced by peers and role models (Birch, 1998b; Harper, 1975; Shepard, 1996).

Children are particularly vulnerable to social and societal influences, and in this way television advertising and modelling may impact on dietary choices. Advertisements during children's television shows are often for energy-dense and nutrient-poor foods (Cotunga, 1988). In turn, children have increased asking behaviours for these foods, in frequency with the quantity of advertisements observed (Galst, 1976; Goldberg, 1978; Taras, 1989). But although television advertisements may influence children's food preferences, there is little evidence for how this affects their nutritional intake. Furthermore, television advertising in NZ is bound by guidelines that bans advertising during pre-school aged children's viewing time and limits the advertising during school-aged children's programmes (Advertising Standards Authority, 2006).

2.2.5.1 Parental role-modelling

Parental role-modelling can be a double-edged sword, potentially improving food acceptance and diet quality, but also encouraging the same poor dietary habits. Research shows that toddlers were more willing to try new foods after their mother had eaten these foods in front of them, but not if a stranger had done so (Harper, 1975). Consequently, mothers who calorie-restrict are more likely to

have daughters who calorie-restrict, and children of parents who struggle to control their own diet are more likely to have the same problem (Fisher, 1996; Pike, 1991). This was also extended to a link between mothers' and daughters' intake of vegetables (Fisher, 2002; Galloway, 2005; Gibson, 1998). In addition, parents who consumed fewer F&V were shown to be more likely to pressure their children to consume F&V (Fisher, 2002). Other research has shown high saturated-fat intake by parents is mirrored by their children (Oliveria, 1992). This emphasises that familiar foods are more readily accepted by children. It is logical, then, that the more available and accessible F&V are, the greater the preference children will have for them (Hearn, 1998).

Parental and family role-modelling may extend beyond dietary behaviours, as evidence has shown a beneficial association of regular family meals with reduced tobacco, alcohol and marijuana use, greater academic performance, and lower risk of depression and suicide (Eisenberg, Olson, Neumark-Sztainer, Story, & Bearinger, 2004).

2.2.6 Gender interactions

The influence of gender on food neophobia is uncertain, with evidence both for and against a gender interaction and for greater neophobia in females than males (Birch, 1980a; Frank, 1994; Harper, 1975; Koivisto-Hursti, 1996; Tuorila, 2001). Some studies attribute gender differences to the earlier social development and responses to peer pressure of females (Black, 1992; Hendy, 2000; Neppl, 1997).

2.2.7 Geographic location

Cultural diversity is also thought to influence dietary patterns, with a greater variety of cultures and cuisines in urban areas. One study showed more neophobic children in rural areas, attributed to the relative lack of exposure to different ethnic foods (Flight, 2003; Tuorila, 2001). However, further research has shown this to be less significant if rural areas are within proximity of an urban hub (Dovey, 2006).

2.2.8 Limitations

Most research quantifying food neophobia influences is based on the assumption that a person's willingness to try an unfamiliar food is indicative of their level of food neophobia (Pliner, 1992;

Raudenbush, 1999). However, while this relationship has not been well supported (Flight, 2003; Tuorila, 2001), the lack of strong correlations between food neophobia and willingness to try unfamiliar foods may be due to small samples, for which significance levels can be difficult to achieve.

Furthermore, much of the research into dietary pattern development is based on a subset of the population, mainly Caucasian middle-class children, and comes from international literature. In light of this, such results may be somewhat limited in their applicability to NZ children.

2.2.9 Summary

For the reasons described in this chapter, in forming their dietary habits children are very vulnerable to the influences of others, as well as their own innate preferences and neophobia. These factors can be significant, because their early consumption patterns can play a role in a child's development of obesity and disease, both in childhood and beyond.

2.3 Importance of childhood nutrition

2.3.1 Introduction

The dietary patterns adopted in childhood and maintained into adulthood may be influenced by a variety of factors, as previously discussed, but can predispose or reduce the risk of developing many disease conditions that burden NZ. Healthy eating for children, including a variety of F&V, is critical for emotional, physical and academic development and maturation (Koch, 2006; Lineberger, 2000; Morgan, 2010; Morris., 2000), as well as for the prevention of childhood asthma, obesity and bronchitis and other diseases in adulthood, including cardiovascular disease (CVD), hypertension, diverticulosis, Type 2 Diabetes Mellitus (T2DM), stroke, osteoporosis, cataracts, Chronic Obstructive Pulmonary Disease (COPD) and cancer (Calvert, 1997; Koch, 2006; Lautenschlager, 2007a, 2007b; Lineberger, 2000; Liquori, 1998; McAleese, 2007; Morgan, 2010; Munoz, 1997; Newell, 2004; O'Brien, 2006; Potter, 2000; Ransley, 2007; Robinson-O'Brien, 2009; Somerset, 2009; Van Duyn, 2000). It has been estimated that a low F&V intake between 1997 and 2001 contributed to at least 1559, or 6%, of all NZ deaths (Ministry of Health, 2003b), a sharp increase from the 2.4% cited in earlier studies (Ransley, 2007). Internationally, non-communicable diseases(NCD) – mainly CVD, stroke, cancers, T2DM and COPD – are the leading cause of death, accounting for 36.1 million deaths annually, which is equivalent to two-thirds of worldwide deaths (Beaglehole, 2011; Zarocostas, 2011). Of these, 2.7 million deaths worldwide, equating to 1.8% of the total global disease burden, have been attributed to poor F&V intake (Ransley, 2007), and this figure is expected to rise.

For this reason, cost-efficient interventions that reduce NCD risk, with early screening and efficient management, are essential (Beaglehole, 2011; Zarocostas, 2011). The United Nations (UN) highlighted the most pertinent approaches for managing the NCD epidemic as minimising tobacco use and second-hand smoke exposure, increasing physical activity (PA), moderating alcohol intake, and improving the nutritional quality of diets by reducing fat, sugar and salt intakes (Beaglehole, 2011; Zarocostas, 2011). These interventions are not only necessary to protect the health of future generations, but are essential to reduce the burden of NCD on health care systems (Beaglehole, 2011); there is convincing evidence for increased F&V consumption reducing the risk of CVD and probable evidence for a reduction in cancers, diabetes and obesity (Ransley, 2007). Such interventions may not be expensive – the UN estimated that every $1 invested potentially saves $3 by reducing the burden of NCD (Beaglehole, 2011). Another estimate sees an increase in F&V intake of one serving per day as avoiding 334 NZ deaths annually, and saving 3,448 years of life lost (YLL)

(Ministry of Health, 2003b). Therefore, strategies that focus on the early adoption of healthful behaviours, such as F&V consumption in childhood, will have the greatest beneficial effect on reducing NCD.

2.3.2 Obesity

Intake of F&V forms an integral component of a healthy diet that prevents obesity, especially when developed during childhood, as it leads to a long-term reduced risk of developing obesity (Lautenschlager, 2007b). This is pertinent, given the high and increasing obesity prevalence in NZ. Obesity is defined by the World Health Organisation (WHO) using BMI cut-off points (World Health Organisation, 2007).The WHO defines adult BMI ranges as: normal 18.5-24.9kg/m^2, overweight 25.0-29.9kg/m^2 and obese greater than 30.0kg/m^2 (World Health Organisation, 2007). For children aged under 18 years, age- and gender-specific BMI cut-offs to classify normal weight, overweight and obesity (Ministry of Health, 2012d) were developed from international skin-fold thickness centile curves (Cole, Bellizzi, Flegal, & Dietz, 2000; Cole, Flegal, Nicholls, & Jackson, 2007).

The 2002 National Children's Nutrition Survey (NCNS) found 21.3% of five to 14 year olds to be overweight and a further 9.8% were obese (Ministry of Health, 2003c). While the results of the past New Zealand Health Survey (NZHS) suggested obesity was declining, with 20.9% of NZ children aged two to 14 years overweight and 8.3% obese, this change was not significant and nor has it continued (Ministry of Health, 2008); the 2011/12 NZHS showed 21% of two to 14 year olds were overweight and a further 11% were obese (Ministry of Health, 2012d). This trend was further supported by higher figures in the 2008/09 National Survey of Children and Young People's Physical Activity and Dietary Behaviours in New Zealand (NSCYPPADBNZ), with 22.5% of five to 24 year olds overweight and 13.0% obese (Maddison, 2010).

The results of the 2011/12 NZHS show consistency between genders and age groups, but there were ethnic and deprivation differences (Ministry of Health, 2012d). Maori children were twice as likely to be obese (17%) than non-Maori children (Ministry of Health, 2012d). This represented a significant increase in the proportion of obese Maori boys since the 2006/07 NZHS, but not of Maori girls (Ministry of Health, 2012d). Pacific children were also significantly more likely to be obese (23%) than non-Pacific children, although this had not changed since the previous NZHS (Ministry of Health, 2012d). The children of the lowest socio-economic status (SES) were 2.3 times more likely to be obese (19%), compared with only 3% of the highest SES children (Ministry of Health, 2012d).

Dietary and lifestyle habits learned in childhood, until approximately age 15, may be sustained into adulthood (Cullen, 2001; DiNubile, 1993; Foerster, 1998; Heimendinger & Van Duyn, 1995; Kelder, 1994; Sandeno et al., 2000; Singer et al., 1995), underlining the importance of establishing F&V consumption early in life (Parmer, 2009). Consequently, overweight or obese children are at higher risk of becoming overweight or obese adults (Ministry of Health, 2012d). Therefore, tackling childhood obesity may be a strategy for addressing adult obesity rates in NZ, which are continuing to increase (Ministry of Health, 2012c).

Concerningly, NZ has the third-highest adult obesity rate of Organisation for Economic Co-operation and Development (OECD) countries, following the United States and Mexico, and this rate is significantly greater than the OECD average (Ministry of Health, 2012c). Furthermore, the results of periodic NZHS indicate the rate of adult obesity in NZ is increasing (Ministry of Health, 2012c). The 2011/12 NZHS indicated that 35% of NZ adults were overweight and a further 28% obese, which was similar for both genders (Ministry of Health, 2012c) and represented a significant increasing trend, with only 19% obesity rates in 1997, rising to 26% in the 2006/07 NZHS, to the current highest levels (Ministry of Health, 2012c).

Estimates for the cost of overweight and obesity to the NZ health care system in 2006 was NZ$624 million, equivalent to 4.4% of the total health care expenditure (Lal, Moodie, Ashton, Siahpush, & Swinburn, 2012) and higher than the previous estimates of 2.5% in 1991 (Lal et al., 2012). This included the cost of inpatients in hospitals, allied health professional costs, subsidies for general practitioner (GP) costs, care facility costs, medications and laboratory tests (Lal et al., 2012). Furthermore, overweight and obesity in NZ in 2006 cost NZ$98 million or NZ$225 million in loss of productivity (Lal et al., 2012), using the friction cost approach and human capital approach, respectively (Lal et al., 2012); this included loss of revenue from premature death, costs for training and recruiting staff, and temporary absenteeism (Lal et al., 2012). The greatest costs were attributed to diabetes, followed by hypertension and colorectal cancer (Lal et al., 2012).

The risk of developing obesity is estimated to be high. The community-based Framingham study showed the four-year risk of becoming overweight was 14-19% and 26-30% and of developing obesity 5-7% and 7-9% for women and men, respectively (Vasan, Pencina, Cobain, Freiberg, & D'Agostino, 2005). The 10- to 30-year risk of becoming overweight was 50%, developing obesity was 25% and developing stage II obesity (defined as a BMI of 35kg/m^2 or greater) as 10% for both men

and women (Vasan et al., 2005). This long-term risk differed by age; younger participants had lower risks (Vasan et al., 2005). These risks were measured using BMI change, which may not reflect a change in body composition or body-fat distribution, known to occur with aging (Vasan et al., 2005). This study was also only performed on a group of middle-aged Caucasian people, and the applicability of the results to a wider population may be limited (Vasan et al., 2005). Nevertheless, the results of this study are concerning and emphasise the need for public health strategies that reduce the incidence of obesity.

2.3.3 Cardiovascular disease

The protective effect of F&V on cardiovascular health has strong support from observational studies and several intervention studies (Ransley, 2007). The action of cardiovascular protection by F&V is not known, but it is thought that several mechanisms may work synergistically, possibly attributable to antioxidants, vitamin C, vitamin E, beta-carotene, selenium and zinc reducing oxidative atherosclerotic processes (Ministry of Health, 2003b). Moreover, folate content may also be involved by lowering homocysteine levels (Ministry of Health, 2003b). Likewise, potassium in F&V may reduce blood pressure (BP), promoting cardiovascular protection (Ministry of Health, 2003b). It is estimated that 15-30% of ischemic heart disease (IHD) deaths and 10-20% of ischaemic stroke deaths in NZ between 1997 and 2001 are attributable to low F&V intake (Ministry of Health, 2003b). An increase of one F&V serve per day is estimated to avoid 4-20% of IHD deaths, equivalent to saving 235 lives and 2389 YLL annually (Ministry of Health, 2003b); and to avoid 3-11% of ischemic stroke deaths, saving 37 deaths and 306 YLL annually (Ministry of Health, 2003b). Thus, the earlier in life that recommended F&V intakes are achieved, the greater lifetime protection there is against CVD.

2.3.4 Cancer

Fruits and vegetables have been linked with reduced rates of lung, oesophageal, stomach and colorectal cancers (Ministry of Health, 2003b). As with CVD, dietary patterns that include F&V obtained in childhood and maintained into adulthood will have the greatest carcinogenic protective effects. However, as with CVD, there is stronger support from observational than intervention studies, and for this reason the mechanism of causality is not completely understood (Ransley, 2007). Anti-carcinogenic effects are attributed to the antioxidant, carcinogen-inhibiting and carcinogen-detoxifying properties of F&V (Ministry of Health, 2003b). More specifically, carotenoids,

flavonoids, phytoestrogens, capsaicin, anthocanins, phenols, selenium, vitamin C and vitamin A have antioxidant actions; phytosterols and phytoestrogens are carcinogen-inhibiting; and sulphides and isothiocyanates are carcinogen-detoxifying (Ministry of Health, 2003b). Furthermore, the role of F&V in weight maintenance may also protect against obesity-linked cancers (Ministry of Health, 2003b). Interestingly, dietary supplementation by carotenoids increased lung cancer risk rather than minimising the anti-carcinogenic properties of carotenoids in F&V (Blumberg, 1994; Omenn, 1996). Therefore, consuming F&V as part of a balanced diet appears to protect against cancer through a synergistic interplay of multi-elements (Ministry of Health, 2003b).

It is estimated that low F&V intake was responsible for 7-12% of NZ lung cancer deaths, 10-20% of oesophageal cancer deaths, 10-20% stomach cancer deaths and 2% of colorectal cancer deaths between 1997 to 2001 (Ministry of Health, 2003b); this represented 3% of all cancer deaths (Ministry of Health, 2003b). An increase of one serve of F&V per day is estimated to reduce lung cancer deaths by 2-10%, equivalent to saving 36 lives and 469 YLL annually (Ministry of Health, 2003b); to reduce 3-17% of oesophageal cancer deaths, avoiding nine deaths and 107 YLL per annum (Ministry of Health, 2003b); to reduce stomach cancer deaths by 3-17%, saving 10 deaths and 126 YLL per year (Ministry of Health, 2003b); and to reduce colorectal cancer deaths by 1-2%, equivalent to saving four lives and 51 YLL (Ministry of Health, 2003b). Again, this highlights the importance of strategies to improve F&V consumption, the earlier in life it is improved resulting in the greatest reduction in cancer deaths.

2.3.5 Dyslipidemia, hypertension and diabetes

Poor F&V intake may predispose to overweight and obesity, and overweight or obese children are more at risk of developing dyslipidemia, hypertension and diabetes at an earlier age (Ministry of Health, 2012d). This is concerning, given the rising prevalence of hypertension, hyperlipidemia and T2DM (Ministry of Health, 2012c).

Children in the 2002 NCNS had a mean serum total cholesterol of 4.38mmol/L, mean high-density lipoprotein (HDL) cholesterol of 1.43mmol/L, and mean HDL cholesterol to total cholesterol ratio of 3.21 (Ministry of Health, 2003c). Of these, only the total cholesterol is above recommended levels (Dietitians NZ Inc, 2010). Additionally, Maori and New Zealand European and Other (NZEO) children had higher mean serum total cholesterol than other ethnic groups (Ministry of Health, 2003c). The 2011/12 NZHS indicated that more adults are taking hypertension and hyperlipidemia medications

than ever before (Ministry of Health, 2012c), which may reflect a true increase in disease prevalence or could be due to a higher diagnosis rate or improved treatment methods(Ministry of Health, 2012c). These conditions were greatest in adults who were aged 55 years and over, people of Maori and Pacific ethnicity, and those who had the lowest SES (Ministry of Health, 2012c).

Similarly, NZ adult diabetes rates have been increasing for 15 years and have now reached 5.5% (Ministry of Health, 2012c). Men are 1.2 times more likely to be diagnosed, and prevalence is also greater for Pacific and Maori adults, Asian men and those with the lowest SES (Ministry of Health, 2012c).

2.3.6 Emotional health

The stigmatism associated with childhood overweight and obesity is associated with social and emotional conditions, especially low self-esteem (Ministry of Health, 2012d). Society's perception of thinness as attractive appears to affect youth (Hill, 1992), with young pre-pubertal children shown to manipulate their dietary behaviours due to body dissatisfaction (Gustafson-Larson, 1992). This may inadvertently increase their risk of developing obesity, as dieting practices involving disinhibited hunger and satiety cues (which is also linked to parental pressure to consume set quantities of formula or breast milk) can lead to binge eating and undermine attempted weight loss (Huon, 1994). Dieting attempts due to body dissatisfaction may negatively affect children's emotional health and increase anxiety, depression and feelings of worthlessness, or fear of weight gain (Killen, 1994; Rosen, 1987).

2.3.7 Summary

The importance of developing dietary patterns that include adequate F&V is paramount to reducing the risk of obesity and NCD both in childhood and beyond, into adulthood. However, information gained from national surveys has indicated that few NZ children are meeting recommended F&V intakes.

2.4 Current recommendations and dietary patterns of New Zealand children

2.4.1 Introduction

For optimum health, a diet should include a variety of foods from the four food groups: F&V; breads and cereals; milk and milk products; and lean meat, poultry, seafood, eggs, legumes, nuts and seeds (Ministry of Health, 2012a). Each group plays a role in providing vital nutrients and energy which, when consumed in the recommended amounts, promote growth in children and young people and act as key health determinants (Ministry of Health, 2003b, 2012a), as well as reducing the risk of obesity and associated diseases. The WHO describes an adequate F&V intake as at least 400-500g per day, roughly equivalent to the five serves of F&V adopted widely worldwide; however, data from numerous studies suggests that this recommendation is not followed by many population groups internationally (Ransley, 2007).The Ministry of Health (MoH) provides guidelines for the consumption of these food groups and refers to standard serving sizes, developed by the Department of Health, representing average sizes consumed by participants of the 1989 Life in New Zealand survey, and in forms that can be easily sourced (Ministry of Health, 2012b).

2.4.2 Fruit and vegetables

Fruits and vegetables are a significant source of dietary fibre, vitamin A, vitamin C, folate, potassium and magnesium (Ministry of Health, 2012b) and are associated with health-beneficial behaviours such as regular PA, not smoking, and low saturated fat and cholesterol intakes (Ministry of Health, 2003b). Fruit and vegetables are generally low-energy and nutrient-dense, with starchy vegetables being carbohydrate-rich and more energy-dense (Ministry of Health, 2012b). They are also satiating, which may aid in weight management (Ministry of Health, 2012b). Greater intakes of F&V appear to be protective against CVD, T2DM and some cancers (Ministry of Health, 2012b). It is proposed that this benefit is due to a synergistic effect of the compounds provided by plant foods, including F&V, some of which include dietary fibre and phytochemicals, with some yet to be discovered (Ministry of Health, 2012b). Therefore, guidelines for F&V intake include at least two daily servings of both F&V for pre-schoolers and at least three vegetable servings and at least two fruit servings for children and young people per day (Ministry of Health, 2012b). Fruit and vegetables should also reflect a range of colours, as this is correlated with nutrient variety (Ministry of Health, 2012b).

Current dietary patterns of children in NZ are not consistent with these recommendations (Ministry of Health, 2012b). The 2002 NCNS showed that only 43% of NZ children aged five to 14 years met the daily fruit intake guidelines (Ministry of Health, 2003c). In addition, NZEO children were the least likely to have met the fruit guideline, followed by Maori children (Ministry of Health, 2003c). The most frequently consumed fruits from the 2002 NCNS is presented in Table 1(Ministry of Health, 2003c).

Table 1: Fruits most frequently consumed by New Zealand children (Ministry of Health, 2003c)

Fruit	Proportion of children who consumed this fruit weekly
Apples or pears	83%
Oranges	67%
Bananas	63%

There were similar consumption patterns between males and females, except for 'Oranges or mandarins', which fewer males consumed (Ministry of Health, 2003c). There were also ethnic differences in the most frequently consumed fruits (Ministry of Health, 2003c). More Pacific females consumed 'Bananas' than did NZEO or Maori females (Ministry of Health, 2003c). Pacific and Maori males also had greater 'Banana' consumption than did NZEO males (Ministry of Health, 2003c). More NZEO females consumed 'Kiwifruit' than did Maori females, and more Pacific and NZEO males consumed 'Kiwifruit' than Maori males (Ministry of Health, 2003c). However, more Maori children consumed 'Canned or cooked fruit' than NZEO children (Ministry of Health, 2003c), as did more children from rural areas compared with children from urban areas (Ministry of Health, 2003c). In addition, older children aged 11-14 years less frequently ate 'Bananas', 'Apples or pears' and 'Dried fruit' than younger children aged five to six years (Ministry of Health, 2003c).

The 2002 NCNS also reported that only 57% of NZ children aged five to 14 years met recommendations for vegetable intake (Ministry of Health, 2003c). However, 'Fried potatoes' was included in this survey (Ministry of Health, 2003c), which may be significant given that it was the third most frequently consumed vegetable (Ministry of Health, 2003c), as presented in Table 2.

Table 2: Vegetables most frequently consumed by New Zealand children (Ministry of Health, 2003c)

Vegetable	Proportion of children who consumed this vegetable weekly
Other potato	87%
Carrots	79%
Fried potato	65%
Broccoli	60%
Peas	59%
Mixed vegetables	58%
Lettuce, green salad	56%
Cauliflower or cabbage	55%
Tomatoes (raw or cooked)	53%
Corn	48%

There was little difference in vegetable intake between different genders and age groups, but there were ethnic differences (Ministry of Health, 2003c). NZEO children consumed more 'Carrots' and 'Broccoli' and less 'Kumara' and 'Mixed vegetables' than other ethnic groups (Ministry of Health, 2003c). More Maori children ate 'Corn' and 'Silverbeet, spinach, puha, or watercress' than Pacific and NZEO children (Ministry of Health, 2003c). More Pacific children consumed 'Taro', 'Cooked green banana', 'Cassava' and 'Tomatoes', and fewer consumed 'Other potatoes' and 'Peas' than Maori and NZEO children (Ministry of Health, 2003c). Similarly, more urban-living children consumed 'Taro', 'Cassava' and 'Cooked green bananas' than children who lived rurally (Ministry of Health, 2003c), while more children who lived rurally consumed 'Other potatoes' (Ministry of Health, 2003c).

In contrast to these results, the results of the 2008/09 NSCYPPADBNZ showed a greater proportion of NZ youth aged five to 24 years were meeting fruit recommendations, while fewer were meeting vegetable recommendations and only 31.7% were meeting both (Maddison, 2010), as detailed in Table 3. In addition, F&V intakes were inversely age-related in both the 2002 NCNS and the 2008/09 NSCYPPADBNZ (Maddison, 2010; Ministry of Health, 2003c).

Table 3: Proportion of New Zealand children and youth meeting fruit and vegetable recommendations (Maddison, 2010; Ministry of Health, 2003c)

	Proportion meeting fruit recommendation	Proportion meeting vegetable recommendation	Proportion meeting fruit and vegetable recommendation
2002 National Children's Nutrition Survey	43%	57%	Not reported
2008/09 National Survey of Children and Young People's Physical Activity and Dietary Behaviours in New Zealand	68.6%	39.7%	31.7%

Dietary intake in childhood, including F&V, may be sustained into adulthood, which may be a significant predictor of disease risk. While evidence of childhood dietary patterns tracking into adulthood is not strong (Boulton, 1987; Post, 2001; Robson, 2000; Singer et al., 1995; Stein, 1991; Twisk, 1997; Welton, 1997), the challenges of longitudinal dietary assessment may have confounded these results (Livingstone, 2003a). However, the most recent NZHS suggests that adults are more likely to meet the recommendations for F&V intake than are NZ children. Sixty-eight percent of adult New Zealanders met vegetable recommendations, but with greater consumption by women (Ministry of Health, 2012c). The overall proportion of adults meeting the vegetable recommendation had increased since the previous health survey but, significantly, only for men (Ministry of Health, 2012c). Similarly, a greater proportion of women (64%) met recommended fruit intake than did men (53%). However, the overall proportion of adults meeting fruit recommendations (59%) was still greater than for children (Ministry of Health, 2012c). This may conceal the significant increase in the proportion of men meeting the recommended fruit intake and concurrent decrease for women since the previous health survey (Ministry of Health, 2012c). As with children, fewer adults from more deprived areas met F&V recommended intakes than adults from less deprived areas (Ministry of Health, 2012c). Long-term data shows F&V availability increased between 1960 and 1996, which may be a proxy indicator of increased consumption (Ministry of Health, 2003b), supported by increases in average F&V intake from 3.9 to 4.4 serves per day between 1995 and 1999, attributed to the introduction of the 5+ a day campaign (Ministry of Health, 2003b). However, the overall F&V intake of both children and adults in NZ is insufficient, and this justifies the need for targeted health promotion strategies to improve intakes, particularly for children for whom dietary patterns are amenable to change and who stand to benefit most from the long-term disease protection properties of F&V.

2.4.3 Dietary patterns

Dietary patterns are indicators of overall and future health. While F&V are the focus of the current research, they need to be considered in the context of overall dietary and lifestyle patterns that may also impact on disease risk or protection. Evidence of the dietary patterns of NZ children is sourced from the 2002 NCNS and the 2011/12 NZHS.

Eating breakfast at home is associated with lower energy-dense snack consumption and less risk of overweight or obesity (Ministry of Health, 2012d). Therefore, breakfast consumption serves as a proxy indicator of healthy dietary patterns that may contribute towards reduced obesity disease risk (Ministry of Health, 2012d). Most NZ children (87%) in the most recent NZHS consumed breakfast at home (Ministry of Health, 2012d). This result was similar between genders and had not changed since the previous NZHS (Ministry of Health, 2012d), which was higher than the 2002 NCNS results (Ministry of Health, 2003c). However, there were clear discrepancies in breakfast consumption patterns, with older children, children living in greater deprivation, girls, Maori and Pacific children all less likely to consume breakfast (Ministry of Health, 2012d). In addition, more rural-living girls consumed breakfast at home than urban-dwelling girls, but fewer rural-living males consumed breakfast at home than urban-living males (Ministry of Health, 2003c).

Most NZ children in the 2002 NCNS consumed lunch (94.3%) and a morning snack (86.9%) at school, although this was less prevalent for older children, children living in greater deprivation, Maori and Pacific children, and urban-living girls (Ministry of Health, 2003c). Most (84.4%) NZ children brought most of their school lunches from home, with about half purchasing some food from the canteen or tuckshop and one quarter purchasing some food from a shop or takeaway outlet (Ministry of Health, 2012d). Generally, older children, children living in greater deprivation, urban-dwelling children, and NZEO children were more likely to purchase some food from the canteen or tuckshop (Ministry of Health, 2003c).

While it is thought that consumption of a lunch brought from home is preferable to lunch bought from a canteen, tuckshop, takeaway outlet or shop, a recent study of NZ children's eating patterns showed all school lunches frequently had foods high in fat, sodium and sugar, and this has been supported in further research (Dresler-Hawke et al., 2009; Ransley et al., 2010). There were also too few F&V in school lunches, including those brought from home (Dresler-Hawke et al., 2009). Furthermore, F&V, when included, were the foods least likely to be consumed (Dresler-Hawke et al.,

2009). For this reason, the consumption of F&V in the school setting is highlighted as a potential area for significant and meaningful health promotion for children.

2.4.4 Food security

Food security involves available, nutritionally sufficient and safe foods that can be obtained in a personally and socially acceptable manner (Ministry of Health, 2003c). A state of food insecurity may impinge on the types and amounts of foods consumed by New Zealanders and therefore needs to be considered in the context of dietary intake. Living in a state of food insecurity impacts on F&V intake; both the 2002 NCNS and 2008/09 NSCYPPADBNZ showed significant negative associations between vegetable consumption and deprivation, but not for fruit (Maddison, 2010; Ministry of Health, 2003c). International research also shows the effects of inequality, with children of low SES having lower F&V intake (Klemmer, 2005; Koch, 2006; Lautenschlager, 2007a). Urban-living low-SES children are a further disadvantaged population, as there is a trend for more children from rural areas to meet both F&V recommendations than urban-living children (Maddison, 2010).

Predictably, households in areas of greater deprivation consistently indicated greater food insecurity (Ministry of Health, 2003c). Likewise, households with seven or more members, families with at least five children, and Maori and Pacific households showed greater food insecurity (Ministry of Health, 2003c). The statement illustrating greatest food insecurity in the 2002 NCNS was the ability to provide a variety of foods due to monetary constraints, with 25.6% responding 'Sometimes' and a further 9% responding 'Often' (Ministry of Health, 2003c), which is likely to affect the diversity of F&V consumed by these families. In this way, children living in low-SES conditions are at greatest risk of food insecurity and stand to benefit from strategies that improve F&V consumption within their economic constraints.

Decile is often used as an indicator of the SES of children who attend school (New Zealand Ministry of Education, 2009). Schools with the lowest deciles, e.g. decile 1, have the highest proportion of children from low SES backgrounds, whereas schools with the highest deciles, e.g. decile 10, have the lowest proportion of children from low SES backgrounds (New Zealand Ministry of Education, 2009).

2.4.5 Summary

The results of national surveys have consistently shown the inadequacy of NZ children's diets in relation to F&V recommendations, which may predispose them to obesity and NCD. This is particularly important for the vulnerable low socio-economic and ethnic population groups identified in these surveys. Further research into dietary patterns, especially the foods consumed at school, has highlighted the potential for school-based nutrition-promotion strategies to improve F&V consumption by NZ children.

2.5 Strategies to improve fruit and vegetable intake

2.5.1 Introduction

The need for F&V promotion has been identified internationally, with most of the many initiatives established resulting in an increase in consumption (Ransley, 2007). The success of such initiatives has been linked with theory-based and behaviour-focused approaches (Rasmussen, 2006), longer and more intense interventions (Krebs-Smith, 1995), clear messages (Krebs-Smith, 1995) and the inclusion of influential people (Krebs-Smith, 1995). Some of the highlighted barriers to F&V promotion are the individual perceptions of F&V being expensive, perceived adequate intake, family and personal dietary dynamics, limited environmental availability and affordability, and a lack of preparation skills or time (Ransley, 2007).

Given the room for improvement in children's dietary intake, the susceptibility of children's dietary patterns and the potential for long-term dietary improvement and disease prevention in targeting children, schools have been identified as ideal settings for nutrition promotion; however, this comes with advantages and barriers. Evaluation of the British National School Fruit Scheme, piloted in 2000, found that using a whole-school approach, class-group settings for consumption of fruit, integrating the programme into the curriculum, having an underlying structure and teacher role-modelling behaviours were associated with the programme's success (Ministry of Health, 2003b). An international review of primary school-based F&V promotion initiatives found these to generally increase consumption (Ransley, 2007). There were greater effects with programmes that included clear and specific F&V messages, active skill-based learning, provision of F&V, and the involvement of peers, teachers and parents (Ransley, 2007). New Zealand research has highlighted some barriers to implementing school nutrition programmes, including an already full school curriculum, lack of resources, and the effect of home-brought foods undermining nutrition-promotion messages (Walton et al., 2010). Furthermore, fast-food outlets often surround schools, in addition to the available and affordable foods sold at school tuckshops (Walton et al., 2010).

Identified as having potential for improving nutrition (Robinson-O'Brien, 2009), many garden-based nutrition-education programmes have been introduced internationally (Parmer, 2009; Ransley et al., 2010; Somerset, 2009). Schools emerged as an ideal site (Lautenschlager, 2007a; Lineberger, 2000; McAleese, 2007; Morris., 2000), given that children spend a lot of time there (Janke, 2012; Lineberger, 2000), they are well-equipped to deliver structured information (Janke, 2012), many

children already learn about nutrition from schools (McPherson, 1995), and a large portion of a child's daily foods are consumed there (Morgan, 2010; Walton et al., 2010). School gardens were traditionally introduced to improve the visual outlook of schools, and became a food production strategy to aid America during World War II (Subramaniam, 2002). The re-emergence of such initiatives resulted from growing concerns that children are disconnected from their environment and have lost gardening knowledge and skills due to societal changes that focus on fast foods, two-income families and rapid technological advances (Dickinson, 2013; Oxenham, 2010). Such programmes may educate about different components, including the planting, harvesting, preparing and sharing of meals, but all essentially promote healthy eating, with a seed-to-plate model (Blair, 1991; Morris., 2000; Parmer, 2009). As well as effects on children, school gardens can become so prolific that produce can be distributed among the community, potentially improving nutritional intake and easing food insecurity. School gardening programmes also offer a strategy to teach sustainable and eco-friendly techniques (Dillon, 2005; Palmer, 1993). These experiences may mould the attitudes of future adults, as children with greater gardening exposure are more likely to be environmentally aware (Chawla, 1998; Lohr, 2006) and to participate in community gardening initiatives as adults (Blair, 1991).

Developing a successful programme requires a theoretical framework that focuses on specific behaviours, actions and motivations, to be addressed in the programme's goals (Morris., 2000). The social cognitive theory often underpins school gardening (Dickinson, 2013), proposing that by influencing children's beliefs, values and knowledge, programmes generate behaviour change (Dickinson, 2013). The socio-ecological framework also applies, as the connections between the school, family and wider community environments collectively and synergistically influence children's dietary patterns (Dickinson, 2013; Gibbs, 2013a). This model is underpinned by combining central public health concepts of policy, environment, community, services and individuals with proximal and distal consequences for students, parents, schools and communities, as demonstrated in Figure 1 (Gibbs, 2013b; McLaren, 2005; Ozer, 2007). This outlines that such programmes have both short- and long-term influences, on not only knowledge and attitudes but academic achievement, nutritional intake, peer relationships and school pride (Ozer, 2007). It predicts that by changing the school environment, a change in diet will result, and this is achieved more effectively than by targeting an individual (Walton et al., 2010).

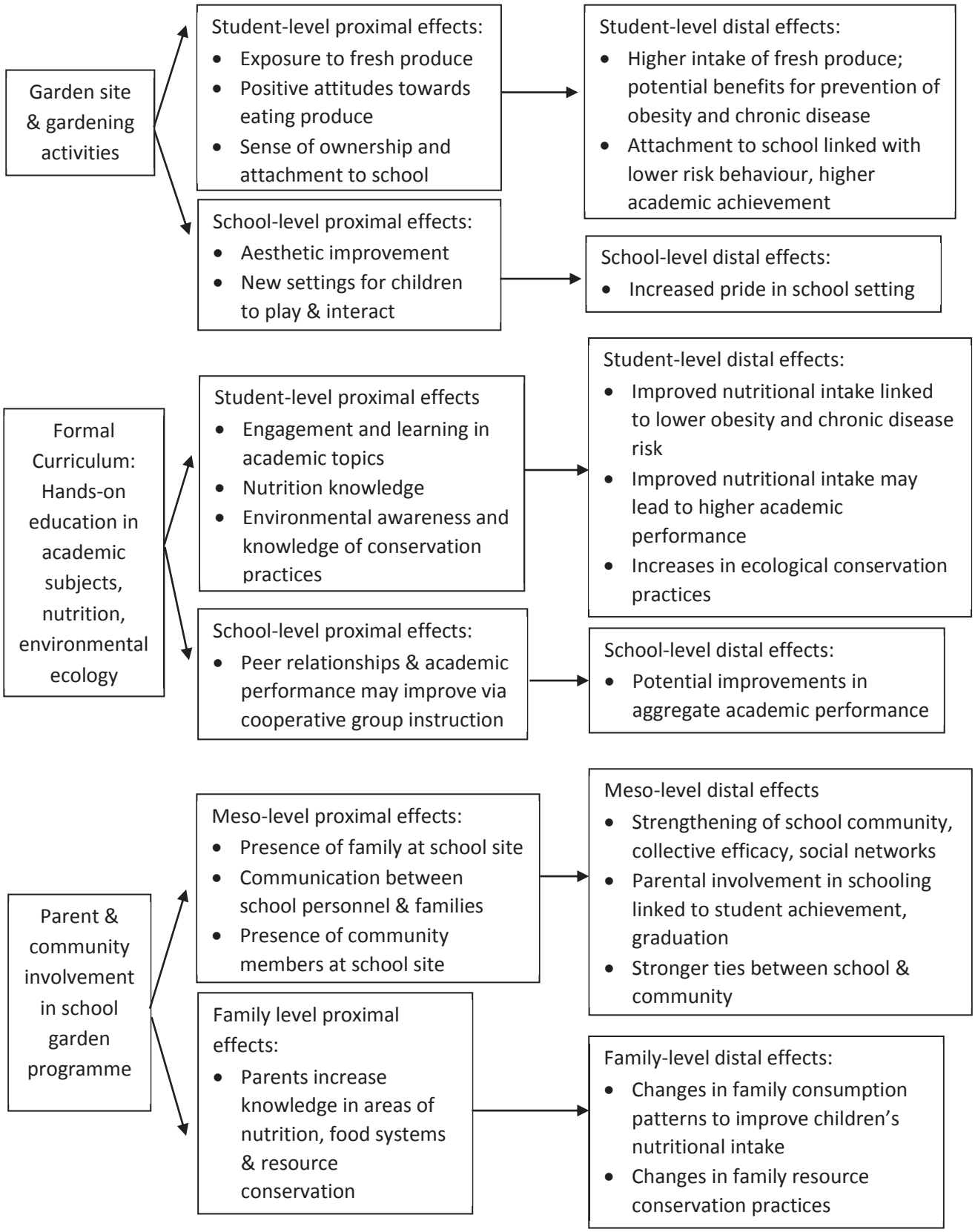

Figure 1: Conceptual model of potential effects of school gardens
The components of a school-based gardening programme (left) lead to proximal (centre) and distal (right) effects on students, schools, family, and community.
Diagram from Ozer (2007)

There is stronger evidence for the success of nutrition-education programmes that include a gardening component than for nutrition-education programmes without a gardening component (Graham, 2005; Lautenschlager, 2007a, 2007b; Parmer, 2009). The introduction of school gardening and cooking programmes has only recently re-emerged, and as a result there are few studies evaluating their success (Dickinson, 2013). It is also difficult to compare these evaluations, due to differences in the amount of student involvement; the presence or absence of nutrition education; the role of other settings including communities, afterschool or holiday centres; different participant ages; and the presence or absence of a cooking component (Dickinson, 2013; Gibbs, 2013b). The overall evidence shows benefits in the forms of reduced neophobia (Cason, 1999; Lautenschlager, 2007a; Morris, 2001); increased knowledge and preference (Liquori, 1998; Morris, 2002a; Newell, 2004), attitude (Heim, 2009; Lineberger, 2000; Liquori, 1998; Morris, 2002a), self-efficacy (Liquori, 1998), environmental awareness, self-esteem and academic performance (Gibbs, 2013b; Klemmer, 2005); building positive relationships (Waliczek, Bradley, & Zajicek, 2001); and potentially improving F&V consumption (Lineberger, 2000; Pothukuchi, 2004). Many of these outcomes have been applied as proxy indicators of dietary patterns (Somerset, 2009). Furthermore, a period of at least 15 hours of gardening experience is suggested to increase knowledge, while 50 hours participating in such a programme is required for dietary behaviour change (Morris., 2000); however, these hours need not be solely from hands-on experiences and can include curriculum-integrated education (Dickinson, 2013).

2.5.2 The effects of cooking and gardening on fruit and vegetable intake

Cooking and, particularly, gardening programmes potentially encourage children to adopt healthier dietary patterns that may continue into adulthood (Lautenschlager, 2007a; Morris, 2002a; Parmer, 2009) . Fruit and vegetable exposure provided by these programmes may be linked with consumption (Morgan, 2010), but there is mixed support for this, with studies showing increased F&V intake (Atkins, 2010; McAleese, 2007; Parmer, 2009; Somerset, 2009), improved vegetable but not fruit consumption (Hermann, 2006; Ransley et al., 2010), or no effect (Morgan, 2010). Much of this research is limited by study designs that preclude randomised-control trial methods and are instead based on comparisons (Janke, 2012; Morgan, 2010).

Several studies have lent support to the inclusion of gardening in school nutrition-education programmes increasing children's F&V consumption, but there are fewer results for cooking components. As described in Table 4, all but one study of in-school programmes found positive

effects on F&V consumption. However, the study that failed to support this has been criticised for its brief intervention period, which may have been insufficient to modify dietary behaviours (Morgan, 2010). The results may also be limited by contamination of treatment groups within the same schools (Janke, 2012; Morgan, 2010). The studies showing support are not without fault, as one has been criticised for the potential bias created by the use of self-reported multiple 24-hour recalls (McAleese, 2007). Several other studies, in after-school settings, have similarly supported childhood gardening programmes for increased PA and vegetable, but not fruit, intake, as outlined in Table 4. Further support for gardening programmes improving F&V consumption is shown in community settings, as well as in adult and older adult populations, which is detailed in Table 4.

Table 4: Summary of studies evaluating cooking and gardening programmes' effects on fruit and vegetable consumption

Authors	Setting	Programme Description	Study Details	Participant Details	Outcome
Atkin and Atkin, 2010	In-school	The Edible Schoolyard – a curriculum-integrated programme involving cooking and gardening education and promoting healthy cafeteria food.	Three-year evaluation prospective study comparing outcomes in children with different levels of programme exposure.	327 year four and five students.	Increased parental perceptions of children's healthy eating and an average increase in F&V servings per day consumed by younger children.
McAleese and Rankin, 2007	In-school	Nutrition in the Garden – developed by Linerberger and Zajicek (Lineberger, 2000), with nutrition, horticulture education and curriculum-integrated garden-based activities.	Quasi-experimental study of a 12-week nutrition education programme with and without a gardening component, and a control group.	99 students aged 10 to 13 years old.	Nutrition-education, including gardening, significantly increased F&V consumption, as well as vitamin A, vitamin C and fibre intakes, compared with nutrition-education without gardening and the control group.
Morgan, Warren,	In-school	Nutrition-education	Quasi-experimental	127 students	No effect on F&V intake, with

Lubans, Saunders, Quick, and Collins, 2010		programme curriculum, based on that developed by Lineberger and Zajicek (Lineberger, 2000), and Morris and colleagues (Morris, 2002a, 2002b).	study of a 10-week nutrition education programme with and without a gardening component and a control group.	aged 11 and 12 years.	no gender effects (Janke, 2012).
Parmer, Salisbury-Glennon, Shannon and Struempler, 2009	In-school	Pyramid Café and Health and Nutrition from the Garden – classroom nutrition and gardening education and hands-on gardening activities.	Quasi-experimental study of 28-week nutrition education programme with and without a gardening component and a control group.	115 students aged six and seven years old.	Nutrition education, including gardening, significantly increased vegetable consumption compared with nutrition education without gardening and control groups.
Somerset and Markwell, 2009	In-school	School-based food garden and curriculum-integrated weekly gardening activities.	Quasi-experimental study of 12-month school-based food garden compared with control group.	252 students aged nine to 13 years old.	Increase in perceived F&V intake.
Ransley, Taylor, Radwan, Kitchen, Greenwood, & Cade, 2010	After-school	After-school gardening club.	Cross-sectional study comparing children from schools with and without an after-school gardening club.	2,530 students aged six and seven years old.	Greater vegetable, but not fruit, intake, and parental involvement also appeared to be associated with greater vegetable intake.
Hermann, Parker, Bown, Siewe, Benney and Walker, 2006	After-school	After-school nutrition education and gardening programme, including food preparation	Prospective study comparing outcomes in children pre- and post-programme	43 students aged eight to 14 years old.	Significantly improved vegetable consumption and PA.

		activities.	participation.		
Blair, Giesecke and Sherman, 1991	Community	Philadelphia Urban Gardening Project – a programme facilitating community members to develop their own gardens.	Quasi-experimental study comparing groups who had and had not participated in the programme.	211 adult community members.	Greater vegetable consumption in participating group than the group who had not participated in the programme.
Lautenschlager and Smith, 2007	Community	Youth Farm Market Project – including gardening, cooking, exposure to supermarkets, restaurants, environmental centres and cultural occasions, with science, health and literature education.	A 10-week prospective study using the Theory of Planned Behaviour to assess the influence of the Youth Farm Market Project on youth behaviour.	97 children aged eight to 15 years old.	Improved F&V intake, but only for boys. However, girls had greater initial intakes, making the difference less likely to reach significance. Gardening participation also increased F&V variety.
Hackman and Wagner, 1990	Community	Nutrition Education Through Gardening Programme – bimonthly nutrition and gardening meetings and provision of a raised garden box.	Prospective study of a five-month programme evaluating dietary behaviour change and psychological well-being.	55 senior community members.	Greater vegetable consumption.

F&V = fruit and vegetable
PA = is physical activity

2.5.3 The effects of cooking and gardening on knowledge and preference

Research in Australia, America and Britain has consistently shown the success of school, after-school and community gardens in improving children's F&V knowledge and preference (Graham, 2005; Newell, 2004; O'Brien, 2006; Parmer, 2009; Ransley et al., 2010; Somerset, 2009) compared with nutrition education on its own (Parmer, 2009). These gardening programmes are hypothesised to predict intake (Morris, 2002b) and for this reason have been a focus of many intervention strategies

(Morgan, 2010), based on the assumption that a change in knowledge will precede preference, which precedes changes in overall patterns (Morris., 2000). There is stronger evidence for preference to predict intake (Birch, 1979; Blanchette & Brug, 2005; Domel, 1996; Harvey-Berino, 1997) than knowledge (Somerset, 2009), as knowledge only provides the information and not necessarily the total motivation to make dietary changes (O'Brien, 2006). These associations are further complicated by availability, taste, cost, and peer or family acceptance (Dittus, 1995; Hearn, 1998).

Evidence for the influence of school cooking and gardening programmes impacting on knowledge and preference has been mixed (Lineberger, 2000; Morgan, 2010; O'Brien, 2006; Poston, 2005), but generally shows support (Atkins, 2010; Koch, 2006; Liquori, 1998; Morris, 2002b; Morris, 2001; Newell, 2004; Reinaerts et al., 2007). Some authors have found such programmes to be most effective for subgroups of children with initially low F&V-related knowledge (Morgan, 2010). Furthermore, there is evidence that such programmes result in an improved preference for vegetables that have not been grown in the programme, suggesting an effect beyond mere exposure (Morris, 2002b). There is stronger support for such programmes impacting on preference for vegetables than fruit, but this may be attributed to the generally higher baseline fruit preference in children (Heim, 2009). In addition, one study found encouraging results for knowledge and some preference scores to be sustained at six months' follow-up (Morris, 2002b), suggesting such programmes may be effective in moulding the long-term knowledge of and preference for F&V of children, and may shape their future dietary patterns.

2.5.4 The effects of cooking and gardening on attitude

Attitude has been found to be a more significant predictor of intention (a theorised predictor of behaviour), than subjective norm or perceived behavioural control, using a Theory of Planned Behaviour model in relation to F&V consumption by youth (Lautenschlager, 2007b). However, studies have shown conflicting results for the effects of nutrition-education with gardening programmes on F&V attitudes, with some finding an improvement (Atkins, 2010; Morgan, 2010; Newell, 2004), and others finding no effect on attitude (Koch, 2006; Lineberger, 2000; Liquori, 1998). However, several explanations for a lack of effect have been postulated. Firstly, one study found an effect on attitude, assessed by taste ratings, only in a group with initially low scores, while another study (Morgan, 2010), which failed to find any effect, had initially high reported scores, which may have undermined any improvement (Koch, 2006). For this reason, it's possible that such

programmes are particularly effective to an amenable subset of students with low initial attitudes. However, such positive findings for attitude towards F&V were not found to impact on intake in one study (Reinaerts et al., 2007). Therefore, support for such programmes to influence attitudes is mixed and it is unclear how such effects may impact on children's future dietary patterns.

2.5.5 The effects of cooking and gardening on self-efficacy, preparation skills, asking behaviour and food awareness

Other predictors of F&V intake used in evaluating nutrition-education programmes include self-efficacy or preparation skills (Liquori, 1998), asking behaviour (Heim, 2009) and food awareness (Somerset, 2009). Several studies have shown in-school gardening programmes to increase children's self-efficacy, or confidence, in preparing F&V (Liquori, 1998; Newell, 2004; Somerset, 2009), one of which has been criticised for a lack of prospective comparison and potential bias from voluntary school participation (Newell, 2004).

Three evaluation studies in out-of-school and after-school settings demonstrated improved self-efficacy, but with mixed knowledge and preference results. Self-efficacy improved in the summer-school intervention group of one study, but decreased in the autumn after-school intervention, in addition to having no improved knowledge or preference scores in either group (Poston, 2005). However, these results are limited by the small sample size, short intervention period, inconsistent participant attendance and recruitment bias (Poston, 2005). Similarly, an after-school nutrition-education with gardening programme evaluation showed significant improvements in self-efficacy scores, but no increase in knowledge or vegetable preferences (O'Brien, 2006). However, this study had only 21 students and the intervention was of short duration, which may have been too few and too brief, respectively, to show a difference (O'Brien, 2006). Anther out-of-school study demonstrated that preference for vegetable, but not fruit or F&V snacks improved, as did F&V preparation skills and F&V asking-behaviour (Heim, 2009). This lack of improved fruit preference may be attributed to the high baseline fruit preference (Heim, 2009).

2.5.6 The effects of cooking and gardening on willingness to try

The familiarity with F&V grown or cooked in school nutrition-education programmes (Ozer, 2007) may aid children in conquering neophobia. It is proposed that exposure to vegetables precedes preference, which precedes increased willingness to try (Birch, 1987b), which acts as a predictor of

consumption (Heim, 2009). However, while the results of such programme evaluations have shown conflicting results with regard to willingness to try unfamiliar F&V (Morris, 2002b; Reverdy, 2008; Somerset, 2009), most have shown positive results (Cason, 1999; Lautenschlager, 2007a; Morgan, 2010; Morris, 2001), with one study suggesting a 69% increase in willingness to try F&V (Cason, 1999). The results of another study were particularly encouraging, showing increased willingness to try vegetables that differed from the vegetables grown in the programme (Morgan, 2010), which suggests that such programmes may have a greater effect than just exposure. However, this positive effect may be undermined by the results of yet another study, which showed such increase in willingness to try was transient, being lost at the 10 month follow-up (Reverdy, 2008). This suggests that continued sensory exposure, such as on-going programme participation, is required to maintain the reduced neophobia.

Further complicating the issue are the results of two studies from the same researchers. The first demonstrated that school gardening programmes improved children's vegetable preference but not their willingness to try unfamiliar vegetables (Morris, 2002b). The second study showed small increases in preference, but a significantly improved willingness to try unfamiliar vegetables (Morris, 2001). The second was a pilot study, with a smaller sample size and a younger population group, but it had a longer intervention period, suggesting that the length of intervention may be of importance in reducing neophobia.

2.5.7 The effects of cooking and gardening on experiential learning

Studies suggest that the practical aspect of nutrition-education programmes that incorporate gardening and cooking facilitate a change in dietary behaviour (Lautenschlager, 2007b; Lineberger, 2000; Thomas, 2003). Such education is grounded by experiential learning, proposed to shape cognitive skills both for gardening and cooking (Rahm, 2002; Waliczek, 2003). This combination of F&V exposure and hands-on experiences is key to school gardening and cooking programmes (Heim, 2009; Koch, 2006; Lautenschlager, 2007a; Ransley et al., 2010; Somerset, 2009), as they are engaging (Alexander, 1995), provide skills for improved F&V consumption (Liquori, 1998; Somerset, 2009) and provide tangible rewards for children's work (Alexander, 1995). Moreover, gardening can enhance children's understanding of seasons, nature, food origins and different sensations (Morgan, 2010). Experiential learning is thought to be particularly effective in boys (Carrier, 2009; King, 2006; Taylor, 2002), which may be significant since boys have shown lower F&V preferences (Bere, 2007).

However, evidence to date has not shown strong support for gender differences in school-gardening programmes (Gortmaker, 1999; Janke, 2012; Slusser, 2007).

2.5.8 The effects of cooking and gardening on role-modelling

F&V promotion through school cooking and gardening programmes has the additional benefit of increasing social norms for F&V consumption among children's peers (Ozer, 2007) and allows the modelling of healthy eating behaviour (Ransley et al., 2010).

2.5.9 The effects of cooking and gardening on academic performance, co-operative behaviour and relationships

Some research suggests that including gardening in school curriculums improves student's academic performance, particularly for science and maths (Graham, 2005; Klemmer, 2005; Pigg, 2006). It also encourages environmental and sustainability knowledge (Lautenschlager, 2007a; Morris., 2000; Skelly, 1998) and enhanced classroom behaviours (Graham, 2005), and augments peer relationships (Lautenschlager, 2007a). Conversely, another study found that such programmes did not impact on interpersonal relationships or school attitudes; however, it was criticised for being performed at the end of the school year, which may have undermined the results (Waliczek et al., 2001). Other evidence suggests that school gardening programmes may reduce emotional stress, risk-taking behaviour, aggression or violence, substance abuse and early sexual activity (Hawkins, 2001; Resnick, 1997).

2.5.10 Summary

The highlighted need for promotion of F&V in children has been targeted through in-school programmes, such as cooking- and gardening-based nutrition education strategies, for which there is support in improving children's knowledge, preference, attitude, neophobia, self-efficacy and F&V consumption. This has prompted the introduction of such programmes into the NZ school setting, but an evaluation of whether this will encourage NZ children to adopt healthier dietary patterns is yet to be performed.

2.6 Background information about Garden to Table

2.6.1 Introduction

The trend for the introduction of school-based cooking and gardening programmes has reached NZ. The GtT programme is a NZ-based in-school cooking and gardening programme, integrated with the curriculum and providing a 'seed-to-table experience' that is based on the Australian Stephanie Alexander Kitchen Garden (SAKG) programme (Block, 2012). Children learn to build and maintain gardens; to grow and harvest F&V and herbs; and to prepare and share meals (Block, 2009; Garden to Table, n.d.-a). The programme offers practical food education, targeted at eight to 12 year olds, with at least 45 minutes of gardening and 90 minutes of cooking education each week throughout the school year. However, this amount of time can be adapted to the needs and restrictions of individual schools and communities (Block, 2012; Gibbs, 2013a). The programme extends to classroom learning through programme journals that include activities participated in, new words and related activities such as maths or science (Gibbs, 2013a). There is a focus on organic techniques, which is supported in the designing and preparation of gardens; planting of seeds or seedlings; weeding; watering; applying homemade compost, worm juice and pest control; and in harvesting (Block, 2012). In the kitchen, children are taught by staff and volunteers to cook foods made from the fresh produce, and they share a multi-course meal with the class (Block, 2012). Examples of foods likely to be prepared in a GtT kitchen include herb-topped bread, homemade pasta with broccoli sauce, curries, salads, vegetable soup, glazed fruits, or orange and cardamom cake (Block, 2012; Gibbs, 2013a).

2.6.2 The Stephanie Alexander Kitchen Garden Development

The SAKG programme was established by the Australian celebrity chef Stephanie Alexander in a Melbourne primary school in 2001 (The Stephanie Alexander Kitchen Garden Foundation, n.d.-a). The SAKG Foundation was founded as a not-for-profit non-government organisation that works towards piloting SAKG into more schools, through fundraising and support, and by engaging policy makers to endorse the programme as a valid food-education model (The Stephanie Alexander Kitchen Garden Foundation, n.d.-a). The key principle of both the SAKG and the subsequent GtT programme is that by setting good examples and engaging children's curiosity, energy and tastebuds, positive and memorable food experiences are created that form the basis of positive

lifelong eating habits (Garden to Table, n.d.-a; The Stephanie Alexander Kitchen Garden Foundation, n.d.-a).

The SAKG Foundation was successful in convincing policy makers of the programme's worth, as 11 years later it has been introduced to 456 schools nationwide (The Stephanie Alexander Kitchen Garden Foundation, n.d.-a). It has drawn support from national and state governments, non-government organisations and businesses, volunteers and philanthropic individuals (The Stephanie Alexander Kitchen Garden Foundation, n.d.-a).

The Australian federal government contributed $12 million between 2008 and 2012 to launch the programme nationally, which has since been supported by a further $5.4 million (The Stephanie Alexander Kitchen Garden Foundation, n.d.-b). Meanwhile, the Queensland state government contributed $2 million between 2011 and 2012 to set up the programme in additional schools within that state (The Stephanie Alexander Kitchen Garden Foundation, n.d.-b). The Victoria state government funded 46 schools to initiate the programme, with $2.5 million contributed between 2005 and 2010 (The Stephanie Alexander Kitchen Garden Foundation, n.d.-b).

Between 2007 and 2009, an evaluation of the SAKG programme was performed to assess its impact on key objectives (Garden to Table, n.d.-d; Gibbs, 2013b). The primary objective was to increase children's willingness to try unfamiliar foods (Gibbs, 2013b) and reduce their neophobia, with the secondary objectives to increase skills, knowledge of and self-efficacy for cooking and gardening; increase enjoyment in eating a variety of foods; increase articulation of these food experiences; increase children's co-operation, self-esteem and affirmative relationships; and increase understanding of sustainability and the environment (Gibbs, 2013a).

The evaluation showed the programme improved children's attitudes, knowledge and confidence in cooking and gardening (Block, 2009; Garden to Table, n.d.-d).This evaluation was conducted as a mixed method, with both qualitative and quantitative measures, including focus groups, surveys, interviews and observations (Block, 2012; Gibbs, 2013b). It gained evidence from a range of sources, including the students, as well as parents, teachers, volunteers, principals and specialist staff (Block, 2012). The primary outcome showed an increase in willingness to try new foods from both the qualitative and quantitative measures, but showed no support for an impact on food descriptions (Gibbs, 2013a). Additionally, the qualitative results lent support that the programme was effective in improving the F&V intake of participants, but this was not shown quantitatively (Gibbs, 2013a).

Qualitative findings for the impact on the social and learning environment found increased confidence, social skills, teamwork and engagement of students through the experiential and integrated education (Block, 2012). They also showed extension of the programme beyond the school setting, with connections to the wider community (Block, 2012). However, quantitative results failed to support these findings (Block, 2012).

2.6.3 Garden to Table development

The success of the SAKG programme prompted the introduction of the GtT programme, spearheaded by the NZ chef and editorial director of *Dish* magazine Catherine Bell into selected primary schools (Dickinson, 2013; Garden to Table, n.d.-a). Piloted in 2009, it now operates in 15 schools, predominantly in Auckland, with others in Thames, Queenstown and Christchurch (Garden to Table, n.d.-b). There is currently no government funding for the GtT programme, and it is financially supported by the GtT Trust for two years to implement the programme, with the additional support of the Trust's partners, including Kiehl's, Pead PR, Fisher & Paykel, Opus, Oakdale Organics, The Village Press, Living Earth, Fodda, Brookfields, Business World Travel and McGregor's (Dickinson, 2013; Garden to Table, n.d.-c). After the first two years, the schools must financially sustain the programme themselves (Dickinson, 2013).

The SHORE and Whariki Research Centre performed a qualitative process and outcome evaluation of the GtT programme on three pilot schools: Meadowbank Primary School, Penninsula Primary School, and East Tamaki Primary School (Dickinson, 2013). This measured the efficiency of introducing the programme and its achievement of the planned outcomes (Dickinson, 2013) through a case-study methodology involving interviews, observations, focus groups, documentation appraisals and a literature review (Dickinson, 2013). These intended outcomes are presented through a logic model in Figure 2. In implementing the programme, the evaluation found that the pilot schools were following the established model, but it highlighted barriers in financial support and the Trust's misunderstanding of school systems (Dickinson, 2013). The evaluation found the programme successfully increased willingness to try unfamiliar foods, as well as knowledge and skills of students (Dickinson, 2013). There was also evidence of an extension into the home environment, with the children and their families initiating their own vegetable gardens and repeating recipes they had used at school (Dickinson, 2013). Another finding was the development of friendships between students and increased community engagement, through media and website communications and newsletters, and by involving volunteers (Dickinson, 2013). However, there has been no quantitative

research evaluating the GtT programme in NZ, which is critical in measuring its success, especially given the discrepancy in the mixed method results of the SAKG evaluation.

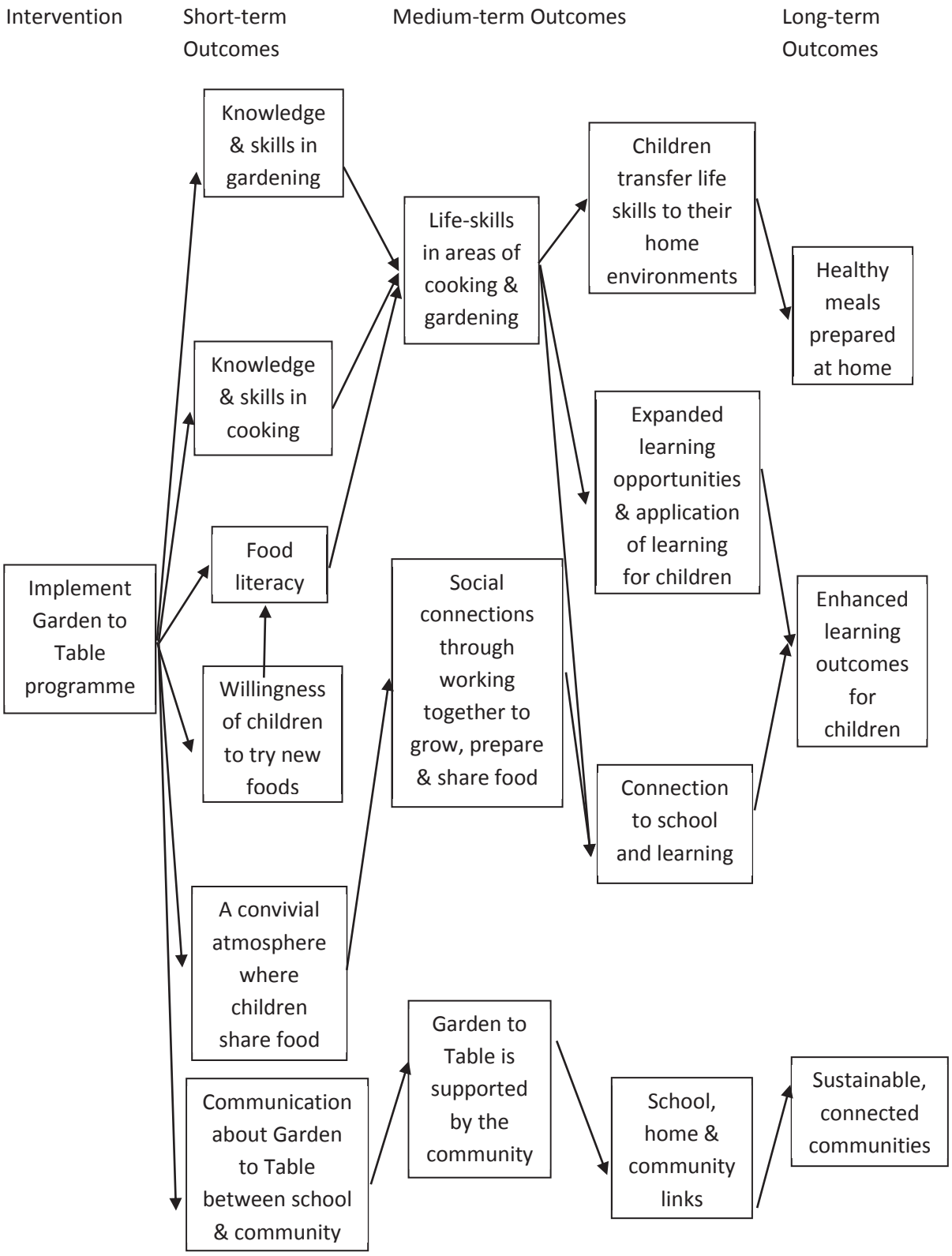

Figure 2: Garden to Table Logic Model
The short, medium-term and long-term intended outcomes of the Garden to table programme. Diagram from Dickinson & Gregory, 2013 (Dickinson, 2013).

2.6.4 Summary

The GtT programme is a NZ version of the Australian SAKG model. While a qualitative evaluation has been completed, there has been no quantitative evaluation of the GtT programme and its intended outcomes. Preparing healthy meals at home is one of the intended outcomes of this programme, but it is difficult to measure because of the nature of dietary assessment methods in children.

2.7 Review of dietary assessment methods in children

2.7.1 Introduction

The measurement of change is important to the implementation of programmes that intend to improve F&V consumption; however, quantifying diet is a difficult task (Calvert, 1997). A variety of methods have been used for such purposes, some relying heavily on interviewer skills and others on participant compliance (Calvert, 1997). At the cusp of many of these methods is the requirement for participant recall, the accuracy of which is influenced by a variety of individual-level factors such as age, gender, education, culture, health literacy, knowledge and attitudes, and this is a source of much error (Calvert, 1997). Another issue that relates specifically to measurement of F&V intake is the social desirability bias, where participants are inclined to over-estimate consumption because such foods are perceived as being healthy; this is a consistently reported problem in assessments of F&V (Calvert, 1997). Also of consideration in such measurements is the difficulties of measuring the F&V that are included in mixed-food dishes or recipes that are frequently not included in such methods, but which are reported to represent as much as 25-54% and 1-14% of vegetable and fruit intake, respectively (Calvert, 1997). Furthermore, the language included in such methods is important, because misunderstanding of serving and serving sizes without explanations can result in misreporting (Calvert, 1997). Measuring dietary intake in children and adolescents is an important component of many studies that evaluate interventions intended to improve F&V consumption, but it is fraught with challenges. While accuracy and reliability of measurements may be essential to a study, there's no widely accepted gold standard method (Willett, 1998). Moreover, methods adopted for measuring dietary intake need to be applicable to the participants' level of understanding, and be practical (Gibson, 2005a).

2.7.2 Challenges of dietary measurement in children

While random and systematic errors are inherent to dietary assessment, child populations may be a particularly susceptible group (Margetts, 2010). It is hypothesised that time is an abstract concept for children, until they reach about seven to eight years old, before which parental reports of children's dietary intake are often favoured. This presents a challenge, in that children invariably spend some time away from home, making parental reports of children's consumption during this time difficult (Baranowski, 1991). After they reach approximately eight years, children can more reliably recall food consumed within 24 hours, but they still struggle with portion-size estimations,

food knowledge and recalling the frequency of irregularly consumed foods (Achterber, 1991; Emmons, 1973; Haraldsdóttir, 1995; Lytle, 1993; Sobo, 2000; Van Horn, 1990).

Children's dietary recalls have greater within subject: between subject variation than adult recalls, which means a greater number of days are required to be recalled for the same validity (Farris, 1985a, 1985b; Miller, 1991; Nelson, 1989). However, this within subject: between subject variation appears to be less for younger children, males and foods that are regularly consumed (Birch, 1991b). The scope of this high variability bias requires further investigation (Livingstone, 2004). Estimating portion size, even with visual aids, is a difficult cognitive action, which is problematic for children and less clearly age-dependent, as adults too struggle with this (Baranowski, 1994; Chambers, 2000; Huenemann, 1942; Matheson, 2002; Meredith, 1951). Portion-size training has increased the validity of portion-size reporting in adults, potentially aiding children as well (Weber, 1999).

Recalling consumed food is a difficult process, involving attention, perception, organisation, retention, retrieval and response formulation, with a high level of error (Baranowski, 1994). Food-recall strategies used by children may include visualisation, habitual patterns, behaviour-chains and preferences (Baxter, 1997; Warren et al., 2003). It is proposed that much of food recall is based on generic rather than actual long-term memory (Bradburn, 1987; Nelson, 1993), and that as much as 30% of food memory can be lost within 24 hours (Fries, 1995). In children, this leads to both under- and over-reporting of foods consumed (Baranowski, 1986; Crawford, 1994; Domel, 1997, 1994; Emmons, 1973; Meredith, 1951; Samuelson, 1970; Simons-Morton, 1990). It appears that under-reporting increases with age, especially after 12 years (Livingstone, 2004) and possibly even more so with overweight or obese adolescents (Bandini, 1997, 1990; Champagne, 1998; Fisher, 2000; Johnson, 1996; Livingstone, 2003b; McGloin, 2002; Reilly, 2001). It's also not clear whether under-reporting is applied generally, or is selective, as in adults (Kersting, 1998; Livingstone, 2003a).

Ideally, biochemical measures would be used to validate measures of dietary intake; however, while plasma carotenoids have been used, they are expensive to test and do not directly correlate with F&V consumption (Calvert, 1997; Rockett, 1997). Weighed or estimated food diaries, while apparently valid measures of energy intake in lean children up to age nine (Bandini, 1997; Davies, 1994; Livingstone, 1992; McGloin, 2002), show under-reporting bias beyond this age, by approximately 20%. (Bandini, 1997; Bratteby, 1998; Livingstone, 1992). Diet histories, validated against weighed food records, failed to support individual-level differences in energy intake (Livingstone, 1992). Similarly, the few studies validating 24-hour recalls have shown poor individual

accuracy (Fisher, 2000; Ku, 1998; Reilly, 2001). Likewise, validations of food frequency questionnaire (FFQ) methods also supported an inability to measure individual differences (Kaskoun, 1994; Perks, 2000). However, it seems that, due to insufficient evidence, no one method shows stronger validity, at least in relation to energy intake. The validity of these dietary assessment methods may be improved by repeated measurements and use of multiple methods (Livingstone, 1992, 2004).

Tools used to assess dietary intake in evaluations of school cooking and gardening programmes include 24-hour recalls, child and parental surveys, interviews and observations (Gibbs, 2013b). These evaluations have also differed in their methodology, with some studies including control groups, and others using baseline information, multiple evaluation tools and/or repeated evaluation tools (Calvert, 1997; Gibbs, 2013b).

2.7.3 Food recalls

Food recalls typically involve a trained interviewer asking participants for details of their previous day's or 24 hours' worth of dietary intake, including preparation techniques and added ingredients, portion sizes and repeated servings, using a standardised process (Gibson, 2005b; Thompson, 1994). Portion-size estimation may be aided using visual pictures or models, and household measurements (Gibson, 2005a; Gibson, 2005b). This method is well suited to studies that require group-level data, but the major limitation is that they may not reflect usual intake unless repeated (Calvert, 1997).

Twenty-four hour recalls have shown validity for food or nutrient groups, in comparison to long-term measures of dietary intake, at least when repeated more than twice (Eck, 1991; Frank, 1977; Mullenbach, 1992; Persson, 1984; Young, 1952). Many of the studies evaluating school gardening and nutrition programmes have used 24-hour recalls (Lautenschlager, 2007b; Lineberger, 2000; McAleese, 2007) and employed the three-pass technique (Morgan, 2010), which involves an interview. The interview firstly takes an uninterrupted report of foods eaten on the previous day, followed by a review of intake with prompts from the interviewer; after this, details are explored, including brands, serving sizes and quantities, combinations, ingredients and preparation techniques; and finally, the interviewer reviews recall, prompting and clarifying chronologically (Morgan, 2010). These studies have often applied repeated measures to improve the validity (Morgan, 2010). Some have also employed visual aids to assist in estimating portion sizes (Lautenschlager, 2007b). Others have used written 24-hour recall journals, administered by classroom teachers trained in their use, with instructions, explanations, prompts for meals and

portion-size examples included (Jendrysik, 1991; Lineberger, 2000; McAleese, 2007). One study used a 24-hour recall-based method, the Child and Diet Evaluation Tool (CADET), to record mean food and nutrient consumption (Ransley et al., 2010). This was validated against a 24-hour semi-weighed food diary, with close associations (Cade, 2006).

Overall, 24-hour recalls have been shown to be appropriate measures of assessing food intake in children, but have several limitations. Firstly, the differences in consumption patterns between days may undermine the applicability of any one day's measurement to general patterns, for which repeated measurements can compensate (Gibson, 2005b). Forgetting something has been eaten is a frequent problem in 24-hour recalls, which leads to under-estimation (Serdula, 2001); however, this can be overcome with intentional interviewer prompting and multiple measurements.

2.7.4 Food frequency questionnaires

A FFQ is usually presented as a list of foods and drinks, with responses available to indicate the frequency with which they are consumed (Gibson, 1990). Some additionally include estimates of portion size; the former are termed qualitative or non-quantitative, while the latter are quantitative (Gibson, 1990). Portion size may be estimated by closed questions, including 'small', 'medium' or 'large'; or open-ended questions related to measurements, visual aids or palm volume (Gibson, 2005b; Young, 1995). Alternatively, a standard portion size could be used, and participants asked how frequently that quantity is consumed; this is termed semi-quantitative FFQ (Gibson, 2005b). This method reduces the number of questions, but may be confusing to participants (Willett, 1998). Assessing portion size in a FFQ, while providing more detail, also appears to increase errors and remains a complex issue (Margetts, 2010).The exclusion of portion-size estimates reduces a FFQ's sensitivity but still allows for categorising participants into frequency groups (Cade, 2002; Gibson, 2005b; Nelson, 1996).

The frequency of consumption for FFQ was shown to range from one week to one year in the nine studies of a recent review (Serdula, 2001). These can be coded as multiple-choice, including per day, week or month; or with open-ended questions, which are more difficult to analyse and more likely to not be completed, but may gather more information (Cade, 2002; Subar, 1997; Willett, 1998). Frequency options often range from 'Never' to "Six or more times per day", with five to 10 options in between (Willett, 1998), although a maximum frequency of "Two or more times per day" has been demonstrated to be enough by some studies (Subar, 1997; Willett, 1998).

While FFQ may not be specific enough to accurately measure intake of specific nutrients, these have shown to be mostly reliable in quantifying dietary patterns and consumption of different foods, particularly F&V (Cade, 2002; Gibson, 2005b; Serdula, 2001) and especially in ranking intake at a group level (Calvert, 1997), although some have suggested a tendency for over-estimation (Stein, 1992). Furthermore, FFQ have the added benefits of being self-administered, making them inexpensive, timely, able to be completed in a variety of settings, of minimal burden to participants and able to canvass usual intake with one administration. This makes them the method of choice for many epidemiological studies (Gibson, 2005b; Stein, 1992). However, some of these advantages may be offset by the intensity of input required to develop and validate a FFQ, to find a balance between being long enough to accurately represent all important components and not so long that they cause participant fatigue (Gibson, 2005b; Margetts, 2010). While between five and 350 foods have been used in different studies, it is hypothesised that a maximum of 100 should be applied (Cade, 2002; Willett, 1998). In addition, similar foods should be grouped together (Willett, 1998) and the most important foods should be near the start, due to the initial errors that occur when completing a FFQ but taking advantage of the earlier attention and interest (Molag, 2007). It should also be as simple to read as possible, avoiding questions that include many foods in preference for multiple questions for each food (Cade, 2004, 2002). Moreover, a FFQ must be updated before use to include all relevant foods and products that may have become available since it was last used (Willett, 1998). In such cases, the use of a previously developed FFQ has been shown to be as valid as for the study population it was designed for (Cade, 2004).

Overall, validation studies of FFQ for assessing F&V intake in children and adolescents have found reasonable reliability and validity (Blom, 1989; Domel, 1994; Eck, 1991; Frank, 1992; Hebden, 2012; Jenner, 1989; Magarey, 2009; Rockett, 1997; Watson, 2009; Wilson, 2008). Most of these studies have used food recalls for comparison (Eck, 1991; Frank, 1992; Hebden, 2012; Rockett, 1997), which have their own limitations, as discussed; others have used food records (Blom, 1989; Watson, 2009; Wilson, 2008). Assumedly, some of the differences in results from these studies can be attributable to variable study methods, use of portion-size examples, FFQ design, and age of participants (Rockett, 1997). However, there has been a consistent finding for FFQ to over-estimate intake, particularly for F&V (Blom, 1989; Domel, 1994; Hebden, 2012), but consistent with parental over-estimation (Wilson, 2008). This over-estimation may be attributed to children's difficulties in estimating portion sizes and therefore assuming that each fruit or vegetable consumed, partial or whole, represents one serve (Wilson, 2008). While FFQ have been found to be unacceptable for

measuring individual intake, they have been suitable for categorising intake into groups (Watson, 2009). Studies using FFQ in school settings have shown poor results, possibly due to an excessive FFQ item length (Jenner, 1989) and less than ideal data-collection timing, one month prior to the end of term (Domel, 1994), both factors contributing to participant fatigue. FFQ have been criticised by some for an inability to detect short-term changes in dietary intake (Morgan, 2010).

Large-scale studies have also included FFQ methodologies. The New South Wales (NSW) Schools Physical Activity and Nutrition Survey was conducted with 8,058 children to evaluate the success of plans addressing childhood obesity in the state (Hardy, 2011). It included several questionnaires, one of them about dietary habits, asking the frequency of consumption for F&V as well as various energy-dense foods and beverages (Hardy, 2011). Children in years six, eight and 10 used self-administered questionnaires, while parents of kindergarten-aged and grades two and four children completed questionnaires on their children's behalf (Hardy, 2011). Likewise, the MoH used a FFQ in its 2002 NCNS, in addition to 24-hour recalls (Dick, 2004). This study was conducted with 3,275 children aged five to 14, from 172 schools (Ministry of Health, 2003c). Information was collected during interviews in the home, with parents or caregivers present (Ministry of Health, 2003c). The 24-hour recalls were interview-based, with the FFQ completed by the child and their parent or caregiver before being checked by the interviewer (Ministry of Health, 2003c).

2.7.5 Other methods of dietary assessment in children

Several other studies evaluating school gardening programmes have measured diet quality through simple statements or questions. Hermann et al (2006) compared participants' responses to the statement "I eat vegetables every day" before and after completing an after-school gardening programme (Hermann, 2006). Koch et al (2006) asked children "What did you eat for a snack today?" as part of their evaluation of a summer gardening programme (Koch, 2006). The evaluation for the Tooty Fruity Vegie project surveyed both children and their parents about whether they perceived F&V intake to have increased as a result of participating in the programme (Newell, 2004).

In addition to using quantitative questionnaires with parents about their children's dietary intake, Gibbs et al (2013) used qualitative measures to evaluate the impact of the SAKG programme on children's F&V consumption, among other objectives (Gibbs, 2013b). This was mostly gained from focus groups, in addition to interviews and observations made (Gibbs, 2013b).

Other studies evaluating nutrition education and gardening programmes have employed observation-based methods (Parmer, 2009). One visually estimated the plate waste of vegetables and wholegrain foods from a school cafeteria, based on the results of its pilot study (Liquori, 1998). Another calculated choice and consumption scores based on visual observations of children's lunchroom behaviour (Parmer, 2009). However, neither of these studies reported their validity.

Prospective food recalls offer another strategy to assess the dietary intake of children. This requires documenting all foods and drinks consumed, with details of types or brands, preparation techniques, and ingredients over a set timeframe, usually several days. Portion size is either visually estimated, measured or weighed (Thompson, 1994). If completed appropriately, this offers a highly accurate method, but it is limited by the intense requirements for completion, placing a large burden on participants, who must be literate and numerate. There is also the possibility of forgetting to record foods or participants changing their consumption patterns to make completing the record easier (Gibson, 2005b).

2.7.6 Summary

No measure of dietary assessment in children is without limitations, and for this reason researchers must closely consider their research objectives, their study population and setting, the available time and resources, and the applicability of these for their choice of measures (Calvert, 1997). In addition, dietary intake may not be the only outcome of interest in evaluating school cooking and gardening programmes, for which a variety of methods exist.

2.8 Methods of assessing children's knowledge, preferences, attitudes, self-efficacy and willingness to try

2.8.1 Introduction

Studies evaluating school gardening and cooking programmes have used a variety of measures to assess a range of different outcomes. Some have used similar or modified methods used by other authors, while others have developed their own based on the specifics of their programme. Similarly, some reported the validity of the methods, while others have not. The differences in assessment measures make the comparison of results all the more complicated.

2.8.2 Knowledge

A variety of assessment tools have been developed and used by different authors to evaluate the impact of school cooking and gardening programmes on children's knowledge. Most have used multiple-choice or true and false questions that relate specifically to the curriculum of each programme (Baranowski, 2000; Koch, 2006; Morgan, 2010; Morris, 2002b; O'Brien, 2006; Poston, 2005). Several others have used visual identification of F&V (Morris, 2001; Somerset, 2009), and short- or long-answer open-ended questions (Liquori, 1998; Parmer, 2009). Few of these studies have reported the validity of the measures, but those which have, have found good reliability and consistency (Koch, 2006; Morris, 2002b; Somerset, 2009).

2.8.3 Preference

Many of the studies evaluating school cooking and gardening programmes have assessed children's preference for F&V as an outcome measure. Most have used Likert-type scales for how well-liked each F&V was following visual presentation or tasting (Heim, 2009; Koch, 2006; Liquori, 1998; Morris, 2002b), while several others have also used hedonic scales, with different facial expressions to express the preference options on a Likert-type scale (Birch, 1991a; Domel, 1993; Lineberger, 2000; Morgan, 2010; Morris, 2001; O'Brien, 2006; Parmer, 2009). Few authors have reported the validity of the measures, but of those that have been reported, good reliability and consistency has been found (Koch, 2006; Liquori, 1998).

2.8.4 Attitude

Attitude in this context is considered the perception of favour or disfavour toward food (Lautenschlager, 2007a; Liquori, 1998; Miller, 2001; Somerset, 2009). Attitudes were assessed by Somerset et al (2008) using a 38-item questionnaire with three-point Likert scale responses (Somerset, 2009), as developed and validated by Miller and colleagues in evaluating the Tooty Fruity Vegie Project (Miller, 2001). Liquori et al (1998) assessed attitude through nine or 17 questions in short and long questionnaires, respectively (Liquori, 1998). These questions related to health and cooking, environmental protection and cooperation. Likewise, this showed good reliability (Liquori, 1998).

In contrast, attitude was assessed by focus-group discussions in Lautenschlager and Smith's (2007) evaluation (Lautenschlager, 2007a). The focus-group questions related to what participants hoped to learn from the Youth Farm and Market Program, what healthy eating meant, why and how they ate F&V, if they would sell produce, what they thought of F&V, which were their favourite F&V, what they liked about gardening, what were the barriers to gardening, and what their favourite foods were and why (Lautenschlager, 2007a).

2.8.5 Self-efficacy

Self-efficacy for F&V-related activities, including gardening and preparing snacks, has been measured by several authors. Again, Likert-type scales have been used, but in different ways. Some authors have used them to assess how sure participants are that they can complete such activities (Domel, 1996; Heim, 2009; O'Brien, 2006; Poston, 2005), while others have assessed how much help would be needed to assist children in completing these activities (Liquori, 1998). In each way, these have been used to reflect a children's confidence or self-efficacy.

2.8.6 Willingness to try

A variety of tools have been used to assess children's willingness to try, as a measure of neophobia. Several studies evaluating school cooking and gardening programmes have employed the six-item Food Neophobia Scale for Children developed by Pliner & Hobden (1992), which has been shown to have good validity (Galloway, 2003; Martins, 1997; Pliner, 1992; Reverdy, 2008). Other tools used in similar evaluations had included the 10-item Food Situations Questionnaire (Galloway, 2003), a 12-itemed questionnaire using a Likert-type scale to describe willingness to eat a small amount of food

that participants had previously been exposed to (Martins, 1997) and the Willingness to Taste Novel Foods Test (Reverdy, 2008). Yet another approach is the assessment of neophobia through participants' choice to taste or eat one of a pair of foods they had already been exposed to, as developed by Birch and colleagues (1987) in their investigations of neophobia and dietary pattern development (Birch, 1982, 1987b). There is no consistent method for assessing neophobia in children, as multiple methods have been employed by different authors in their research relating to school cooking and gardening programmes.

2.8.7 Summary

In addition to consumption of F&V, outcomes such as knowledge, preference, attitude, self-efficacy and willingness to try have been used by authors in evaluations of school cooking and gardening programmes. These outcomes have been measured using different methods, for which validity has been inconsistently reported. This variation in methodology adds to the difficulties in evaluating programmes such as the GtT programme.

2.9 Summary

Infancy and childhood is a critical period of development which is susceptible to innate preferences, role-modelling and parental influences that may shape the future dietary patterns of a child. There is strong evidence for the role of healthy dietary patterns, which include F&V, in reducing the risks of developing obesity and NCD. These risks are of concern, given the high and increasing prevalence of obesity in NZ children and highlight the need for public health strategies to improve childhood nutrition and reduce disease burden. National surveys have consistently demonstrated the inadequacy of NZ children's and adults' dietary intake of F&V, and have also highlighted several particularly vulnerable population groups. Furthermore, research into the foods consumed by children while at school has highlighted the potential for school-based nutrition promotion strategies. One such strategy, which has recently gained support internationally, is the introduction of school-based cooking and gardening nutrition-education programmes, for which there is evidence of improved outcomes, including knowledge, preference, attitude, neophobia, self-efficacy and F&V consumption. The GtT programme is a NZ-based in-school cooking and gardening programme, based on the Australian SAKG model. Qualitative research has supported the implementation of the programme, but a quantitative evaluation of the intended outcomes is yet to be completed. However, this is made difficult by the challenges of dietary assessment in children, for which there is no gold-standard method. Furthermore, a variety of assessment tools have been employed by authors investigating other outcomes of similar programmes.

Chapter 3: Methods

3.1 Study Design

An epidemiological comparative study was used to compare the effects of the Garden to Table (GtT) programme on the amount and variety of fruit and vegetable (F&V) consumption by year four and five children, their knowledge of and attitudes towards fruits, vegetables, cooking and gardening, and their cooking- and gardening-related self-efficacy and behaviours. This quantitative evaluation provided evidence of the differences observed in children participating in the GtT programme, compared with children not participating in the programme.

3.2 Survey Development

A literature review was conducted to evaluate the efficacy of existing questionnaires for use in the current research. While there were few validated questionnaires, two quantitative questionnaires were shown to be useful and these were the evaluation tools selected for the present study. The first assessed F&V intake and variety using a food-frequency questionnaire (FFQ) (Appendix A). It was adapted from the questionnaire used in the Ministry of Health's 2002 National Children's Nutrition Survey (NCNS) (Ministry of Health, 2003a) and was designed specifically for children. There were two sections, one for fruit intake and the other for vegetable intake. Each fruit or vegetable included in this section of the questionnaire was measured on a 7-point scale, with responses ranging from 'never or less than once per month' to 'two or more times per day'. For a full list of the F&V included in this section of the modified FFQ, refer to Appendix A. Both the fruit intake and vegetable intake sections included two 'other' spaces for participants to list any fruits or vegetables consumed that were not included elsewhere.

Adaptations included the addition of three questions. The first of these was a summary question, examining the total number of serves of F&V normally consumed per day, on a 6-point scale, with responses ranging from 'none' to 'more than five per day'. This question assessed whether the recommendation to consume at least five servings of F&V per day was being met. The second additional question encompassed variety of fruit intake by asking which fruits had been consumed in the previous week. It also included two 'other' spaces for participants to complete if they had recently consumed any fruits that were not included in the questionnaire. The third additional question covered variety of vegetable intake by asking which vegetables had been consumed in the

previous week. It also included eight 'other' spaces for participants to complete if they had recently consumed any vegetables that were not included. Refer to Appendix A for the full list of F&V included in this section of the modified FFQ. The FFQ included a total of 35 questions, the first ten related to frequency of fruits consumed, the second 22 related to frequency of vegetables consumed. This was followed by a new additional question, relating to the number of serves of fruits and vegetables consumed daily. Finally two new additional questions relating to the frequency for fruits and vegetables consumed weekly, respectively was included.

The second questionnaire canvassed knowledge (questions 12-16, 19-30) of and attitudes (questions 5, 9, 31-35) towards fruits, vegetables, cooking and gardening, and cooking- and gardening-related self-efficacy (questions 16-18) and behaviours (questions 7, 8, 10, & 11), and was developed by the University of Melbourne and Deakin University as part of their evaluation of the Stephanie Alexander Kitchen Garden (SAKG) programme (Gibbs, 2013b). The 30 questions included in this questionnaire were sourced as key indicators for evaluating the programme's objectives, and were mostly based on previously validated assessments (Gibbs, 2013b). These included increasing willingness to try new foods; increasing appreciation and enjoyment of foods; increasing capacity to describe food experiences; increasing skills, knowledge and confidence in cooking and gardening; increasing cooperative behaviour; increasing knowledge of sustainability; and the extension of benefits into the home environment (Gibbs, 2013b). This questionnaire also included demographic information (questions 1-4) with the new additional question regarding length of school attendance.

The questions about participant characteristics that were included from the original questionnaire were gender, year level and time at the present school (Gibbs, 2013b), with the addition of a question about ethnicity. This information was designed to be easily read, with tick boxes for the applicable categories and a limited answer required for time at the current school.

The questionnaire included several questions that evaluated participants' knowledge of fruits, vegetables, cooking and gardening. Cooking knowledge was measured using the summed responses for four open-ended questions, including salad ingredients; soup ingredients; food made with pumpkin, potatoes and several other ingredients; and evaluating when a cake is cooked (Gibbs, 2013b). Gardening knowledge was measured using the summed responses to eight multiple-choice questions, with four to eight possible answers per question, one of which was correct (Gibbs, 2013b). Knowledge of what plants need to grow and natural plant protection from snails were measures using two open-ended questions (Gibbs, 2013b). The number of things participants helped

to look after in the garden was measured using a multiple-choice question, with eight possible answers and multiple selections offered, including 'vegetables', 'flowers', 'herbs', 'weeds', 'grass', 'fruit', 'trees' or 'nothing'. The number of tools used was measured using a multiple-choice question, with eight possible answers and multiple selections offered, including 'hose', 'shovel', 'fork', 'hoe', 'watering can', 'spade', 'trowel' or 'I don't know'. An additional knowledge-related question was initially included in the questionnaire, but it was misunderstood or not responded to by all participants and therefore was excluded from the analyses. (It was an open-ended question asking participants to list four pairs of plants that grow better together.)

This questionnaire also included questions relating to the participants' attitudes towards fruits, vegetables, cooking and gardening. Liking of cooking and gardening were measured on a 4-point Likert-type scale, with responses ranging from 'not at all' to 'a lot' (Gibbs, 2013b). Attitudes towards food preferences and descriptions were measured using open-ended questions, with responses including names and descriptions of the taste and texture of favourite foods (Gibbs, 2013b). Each question was related to a different food category, which included savoury foods, sweet foods, and F&V (Gibbs, 2013b). Participants' attitudes towards trying new foods were measured using summed scores from a three-part question, including whether they had tried the food before, whether they had cooked the food and whether they had grown the food in the garden. Each part was rated on a 4-point Likert-type scale, with responses ranging from 'never' to 'always'. Participants' attitudes towards cooperative group behaviours were measured using a 4-point Likert-type scale for responses to a series of five questions (Gibbs, 2013b). These questions included working with people, working well in groups, the importance of what other people say, following instructions in groups, and the importance of all group members participating, with responses ranging from 'never' to 'always'.

Participants' confidence in cooking and gardening was also measured in this questionnaire. Cooking self-efficacy was measured in two questions. The first was an open-ended question, with responses including a list of evening meals that participants could cook on their own (Gibbs, 2013b). The second was a three-part question, including whether help was needed to prepare hand-made pasta, mixed salad and vegetables and cheese (Gibbs, 2013b). Each part was measured using a 4-point Likert-type scale, with responses ranging from 'not at all' to 'all by myself' (Gibbs, 2013b). Gardening self-efficacy was measured using a three-part question, including whether help was needed to grow broccoli, silverbeet seedlings and pumpkin seeds (Gibbs, 2013b). Each part was measured using a 4-point Likert-type scale, with responses ranging from 'not at all' to 'all by myself' (Gibbs, 2013b).

The questionnaire also included questions that measured cooking- and gardening-related behaviours. There were questions relating to gardening and cooking activity in the home, each with a 4-point Likert-type scale ranging from 'never' to 'always'. It also included questions regarding participants eating with their family at night and eating dinner in front of the television, each with a 4-point Likert-type scale ranging from 'never' to 'always'.

Both adapted questionnaires were piloted among 25 year four and five children at a school that had not been approached to participate in the research.

Ethical approval (Application 12/07*5)* for the research was provided by the Massey University Human Ethics Committee, Auckland. Parents gave written consent and children gave written assent to participate in the research.

3.3 Recruitment

Three principals from GtT schools (Meadowbank, East Tamaki and Dawson) and six principals from schools that did not have the programme but were planning to start it in the near future (Flatbush, Ponsonby, Yendarra, Sir Edmund Hilary Collegiate, Rongomai and Bayfield) were approached and invited to take part in the research. The initial goal was to compare decile 1 and decile 10 schools. However, due to difficulties in recruiting schools, the principal of another GtT school, Edendale, a decile 5 school, was invited to participate in the research.

School principals from Meadowbank, Edendale, East Tamaki, Flatbush, Ponsonby and Bayfield primary schools gave consent for their schools to participate in the study. Before proceeding with recruitment, school principals were consulted about how to occupy students who chose not to participate in the research while other students were involved with it.

A voluntary recruitment process was implemented in which the researcher or research assistant addressed the students during class, presenting a brief lesson to each class about the scientific process, introducing them to the study and providing information and answers to any questions. Following this, information sheets and consent forms for themselves and their parents were provided to students. Eligible participants were year four or five students who had attended one of

the recruited schools for at least one school year, and those who gave assent and whose parents consented were able to participate.

It was calculated that in order to show a difference of 20% (providing 80% power and significance of 0.05 from 57% [results from the 2002 NCNS] to 77%) between groups in the proportion of children who consumed at least three servings of vegetables per day, 83 children would be needed per group. At least 332 children were to be recruited to participate in the study, including 166 children who had been exposed to the programme for at least one school year. Of these, 83 were to be from decile 1 schools and 83 from decile 10 schools. Another 166 children from control schools were to be included. Of these, 83 were to be from decile 1 and 83 from decile 10 schools. Approximately 880 students were invited to participate in the research (220 from Meadowbank, 180 from Edendale, 130 from East Tamaki, 115 from Ponsonby, 110 from Bayfield and 125 from Flatbush).

Of the approximately 880 students invited to participate in the research, 307 students (170 participants from GtT schools and 137 participants from control schools) were recruited, with a further 27 excluded (18 participants from GtT schools and 9 participants from control schools) due to either attending their current school for less than one school year or being in year 6. Therefore, the analyses were based on 152 participants from GtT schools and 128 participants from control schools, as detailed in Figure 3. While exclusions were based on length of school attendance, duration of GtT participation was not measured and may have differed between students from different schools and year levels.

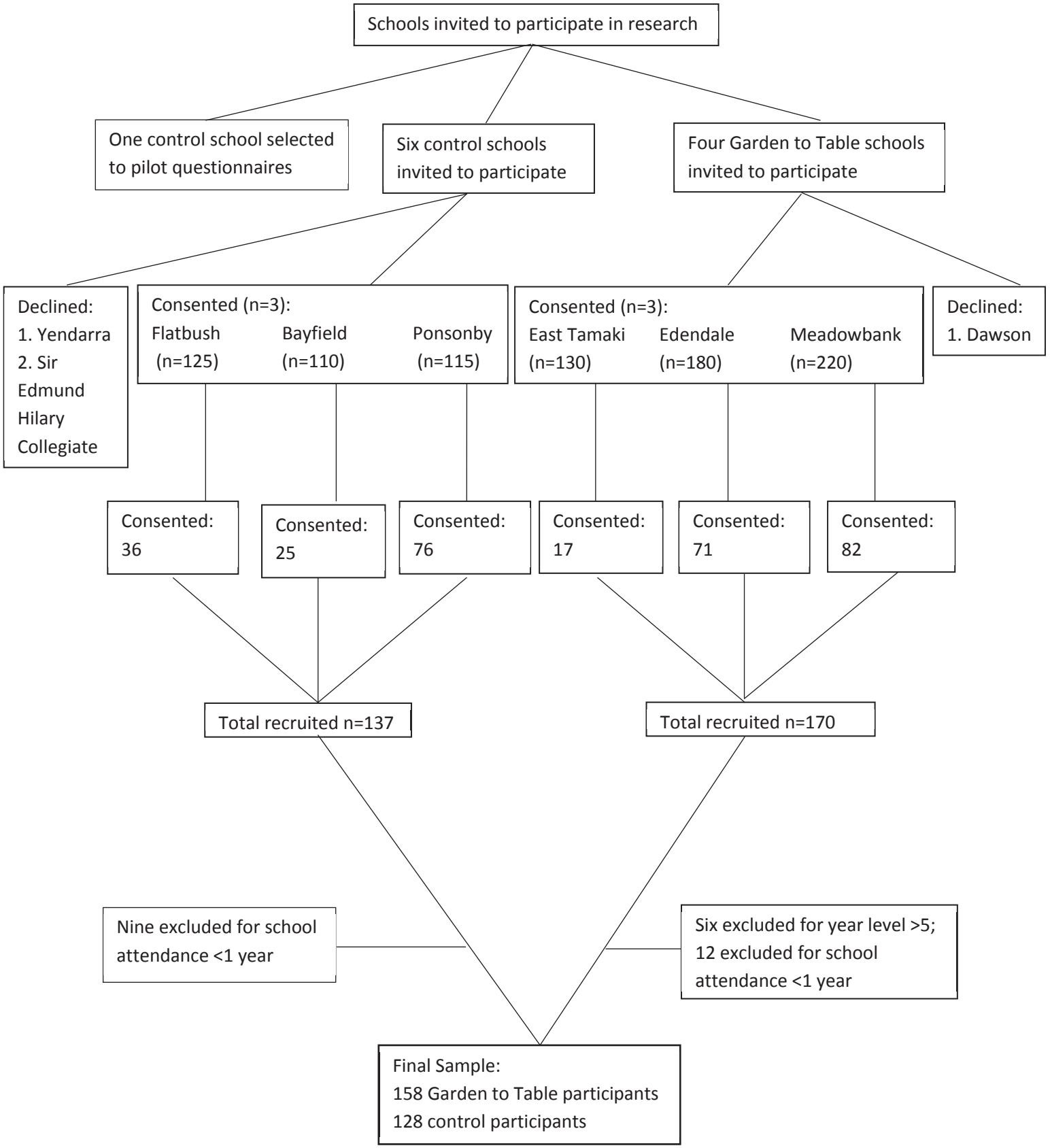

*Figure 3: Summary of schools and participants recruited into the study (*n *is the number of participants)*

3.4 Data Collection

The researcher or research assistant returned to the schools and asked the participating children to complete two anonymous surveys. The surveys were distributed and collected in the participants' classrooms, with the supervision of their teacher and the researcher or research assistant and took approximately 45-60 minutes to complete. The researcher or research assistant read each question aloud to the participants and explained what the intended response entailed, to help guide the participants in completing the questionnaires. Participants were invited to ask for assistance from the researcher, research assistant or teacher at any time during the data collection.

3.5 Coding

The FFQ was coded based on each section of the questionnaire. Fruit intake was coded as the summed intake of each fruit, on a per-day basis. Thus, each fruit was individually assessed to represent the quantity consumed per day, which was then cumulated to represent a total fruit intake per day.

Similarly, intake of vegetables was coded based on a summed daily intake. Responses to each vegetable serving were coded as detailed above for fruit intake. The codes for each vegetable variable were then summed to give a value representing the total servings of vegetables per day, as for fruit intake.

The F&V summary section was initially coded and then recoded in two ways. These variables were first coded to represent whether the recommendation for F&V intake was met. The second way this question was recoded was to represent a summary of F&V intake per day.

Fruit and vegetable variety sections were coded similarly, as the summed count of the number of fruits or vegetables consumed in the previous week.

The attitudes, knowledge and self-efficacy questionnaire was coded based on the systems used in the evaluation of the Stephanie Alexander Kitchen Garden Program by Deakin University and the University of Melbourne (Gibbs, 2013b). Full details of the coding used in both the modified FFQ and the modified children's knowledge, attitudes and self-efficacy questionnaire are detailed in Appendix C.

3.6 Statistical Analysis

All participants with a school attendance of less than one year or a year level greater than 5 were excluded from the dataset. All statistical analyses were performed using IBM SPSS statistics version 20 (IBM Corporation, New York, USA). The F&V serves per day summary question was recoded to create a new variable, with participants stratified according to whether they met the recommended intake of F&V per day.

All continuous variables were stratified by GtT participation and tested for normality using Shapiro-Wilk and Kolmogorov-Smirnov tests. Their histograms, Q-Q plots and box-plots were also evaluated to determine normality, due to the large sample sizes. If these variables were found to violate normality, they were transformed by logarithmic or square root transformations and again tested for normality. A significance level of $P<0.05$ was used for all statistical tests.

For descriptive analysis, frequency was used to present nominal variables, while mean (95^{th} confidence intervals) was used for normally distributed continuous variables, and median (25^{th} and 75^{th} percentiles) for non-normally distributed continuous variables. Variables that were transformed into normal distributions by logarithmic or square root transformations were back-transformed into mean (95% confidence intervals) from summary statistics. Levene's test was applied to continuous variables, stratified by GtT participation, to assess homogeneity before inferential statistics were applied.

For continuous variables which met the parametric assumptions, Independent T-tests were used to compare the GtT and control groups. For non-parametric continuous variables, the Mann-Whitney test was used to compare the GtT and control groups. For variables found to be significantly associated with GtT participation, odds ratios were calculated for nominal variables, and effect sizes for continuous variables. Effect sizes were calculated as $r=\sqrt{(t^2)/(t^2+df)}$ for Independent T-tests (Field, 2009) and as $r=Z/\sqrt{N}$ for Mann-Whitney tests (Field, 2009). Effect sizes can be interpreted as $r=0.1$ representing a small effect size, $r=0.3$ representing a medium effect size and $r=0.5$ representing a large effect size (Field, 2009). Chi-squared tests were used for nominal variables and were only included if the expected count in each cell was greater than five. If this assumption was not met, a Fischer's Exact test was performed. Odds ratios were calculated for Chi-squared and Fischer's Exact tests that were found to be significant.

A further analysis of parametric continuous variables was performed to investigate any interaction or confounding effects. Interaction effects by GtT participation with year level or gender were assessed using a two-way ANOVA. If a significant confounding effect on GtT participation by year level or gender was found (with no significant interaction effect by the confounding variable), a comparison of the variable between GtT participation groups, while controlling for the confounding variable, was made using an ANCOVA test. If interaction effects were found, comparisons between groups were assessed, and stratified for the interaction effect.

Chapter 4: Results

4.1 Introduction

A total of 307 participants were recruited for the study, with 170 participants attending a Garden to Table (GtT) school (87 year 4 students and 65 year 5 students) and 137 participants at control schools (59 year 4 students and 59 year 5 students), as detailed previously in Chapter 3. Difficulties in recruiting participants limited the number of participants from a range of deciles, and the numbers were insufficient to meet the calculated significance for a decile comparison, which could no longer be examined. With the exclusion of the decile criteria, the recruited numbers from the GtT and control groups exceeded the minimum required to show significance per group.

4.2 Demographic information

The population characteristics are summarised in Table 1. The GtT and control groups were alike with regard to gender, *p*=0.09 (2-tailed), and year level, *p*=0.06 (2-tailed).

Table 5: Population characteristics

Variable	Garden to Table Group (n=152)	Control Group (n=128)	P-value
Decile*			<0.01
1	8.00 (5.30%)	34.0 (26.6%)	
5	65.0 (42.8%)	0.00 (0.00%)	
10	79.0 (52.0%)	94.0 (73.4%)	
Gender*			0.09
Male	63.0 (41.4%)	66.0 (51.6)	
Female	89.0 (58.6)	62.0 (48.4%)	
Year level*			0.06
4	87 (57.2%)	59 (46.1%)	
5	65 (42.8%)	59 (53.9%)	
Ethnicity~			<0.01
New Zealand European	98.0 (64.9%)	86.0 (67.2%)	
Māori	13.0 (8.60%)	15.0 (11.7%)	
Pacifika	14.0 (9.30%)	24.0 (18.8%)	
Asian	18.0 (11.9%)	3.00 (2.30%)	
Other	8.00 (5.30%)	0.00 (0.00%)	

*Values are count (frequency) and tested as Pearson Chi-Square test (2-tailed)

~ Pearson Chi-Square test (2-tailed) excluding 'Other' ethnicity category due to counts in cell less than 5 violating assumptions.

However, there was a difference in deciles between the GtT and control groups (χ^2[2]=80.93, p<0.01 [2-tailed]). The GtT cohort included participants from decile 5, in addition to deciles 1 and 10, whereas the control cohort only included participants from deciles 1 and 10. Because of the inclusion of decile 5 participants in the GtT cohort, this group also had fewer participants from decile 1 and 10, compared with the control cohort.

The distribution of ethnicities also differed significantly between the GtT and control cohorts (ethnicity χ^2 [3]=13.48, p<0.01 [2-tailed]). More Pacifika children from the control schools than the GtT schools volunteered to participate, while more Asian children from the GtT schools than the control schools volunteered to participate. The distribution of participants of Māori and New Zealand European ethnicities were similar between the GtT and control groups.

The number of years attended at the current school was not significantly different between the participants of the GtT and control groups, p=0.35 (2-tailed). Participants of the GtT group had attended their current school for 5 years (4, 5) and participants of the control group had attended their current school for 4 years (4, 5).

4.3 Fruit and vegetable intake and variety of intake

The intake and variety of fruit and vegetable (F&V) for the GtT and control groups are summarised in Table 2. Participants from the control group reported higher F&V intakes than the GtT group. On average, participants from the control group had a greater fruit intake than participants from the GtT group. This was a significant difference, t(278) = -2.40, p=0.02 (2-tailed), but only represented a small effect, r=0.15. However, reported intakes of fruit had a very large range, with participants from the GtT group reporting intakes between 0.00 and 16.0 serves per day, and participants from the control group reporting intakes of 0.57 to 15.4 serves per day. Participants from the control group also had a greater vegetable intake than participants from the GtT group. However, the significant difference, t(277)=-2.30, p=0.02 (2-tailed), also only had a small effect, r=0.14. Similarly, there was a large range in intake of vegetables, with participants from the GtT group reporting consuming between 0.00 and 34.0 serves per day, and participants from the control group reporting consuming between 1.06 and 39.2 serves per day.

Table 6: Fruit and vegetable intake and variety of intake

Variable	Garden to Table Group (n=152)	Control Group (n=128)	P-value
Fruit intake* (servings per day)	3.77 (3.37, 4.20)	4.62 (4.08, 5.19)	0.02
Vegetable intake* (servings per day)	5.18 (4.55, 5.90)	6.41 (5.62, 7.32)	0.02
Fruit & vegetable intake (proportion meeting recommendation") **°**	59.0 (38.8%)	51.0 (39.8%)	0.29
Fruit & vegetable intake (servings per day) **~**	3.50 (1.50, 5.50)	3.50 (1.50, 5.50)	0.84
Fruit variety (fruit per week)*	8.28 (7.44, 9.13)	9.48 (8.46, 10.5)	0.07
Vegetable variety (vegetables per week)**~**	10.3 (9.15, 11.6)	9.93 (8.70, 11.2)	0.65

*Normally distributed variables described as mean (95% confidence intervals) and tested as Independent T-test (2-tailed)

"Recommendation based on consumption of at least five serves of fruit or vegetables per day

°Nominal variable described as count (frequency) and tested as Fischer's Exact test (2-tailed)

~Non-normally distributed variables described as median (25^{th}, 75^{th} percentiles) and tested as Mann-Whitney (2-tailed)

Fruit and vegetable intake, based on the mean of the categorical response for the number of serves of F&V per day summary question, did not differ significantly between the GtT and control groups, p=0.84 (2-tailed) (summarised below). There was no significant difference in the proportion of participants meeting recommended intakes of F&V, based on at least five serves of fruit or vegetables per day, p=0.29 (2-tailed) (Table 2). Similarly, there were no significant differences in consumption of F&V (when categorised into less than or equal to two servings per day, three to four servings per day, or equal to or greater than five servings per day) between the participants from the GtT and control groups, as presented in Figure 4.

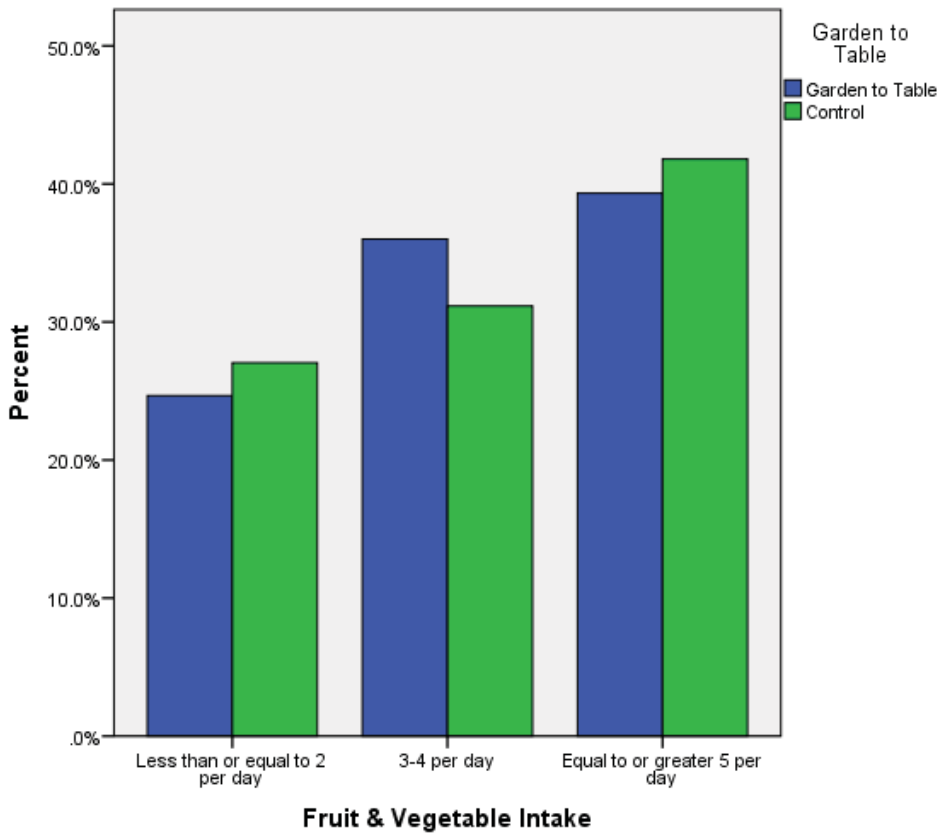

Figure 4: Fruit and vegetable intake

Fruit variety did not appear to differ significantly between GtT participants and control participants, $t(278)=-1.80$, $p=0.07$. However, there was a significant interaction effect between GtT participation and year level, two-way ANOVA, $p<0.01$. Year five participants from the control group reported consuming 3.43 (1.59, 5.27) more types of fruit per week than year five participants from the GtT group. There was no significant difference between GtT and control groups in the year 4 participants, $p=0.22$.

While there did not appear to be a significant difference in the variety of vegetables consumed between GtT participants and control participants, $p=0.65$ (2-tailed), a significant interaction effect between GtT participation and gender existed, two-way ANOVA, $p=0.02$. Boys who had participated in the GtT programme reported consuming 2.93 (0.18, 5.69) more types of vegetables per week than boys in the control group, $p=0.04$. However, there was no significant difference between GtT and control groups for girls, $p=0.19$.

Intakes of individual vegetables were compared between participants from the GtT and control groups, but no significant differences were found.

4.4 Knowledge of fruit, vegetables, cooking and gardening

The knowledge of fruit, vegetables, cooking and gardening in the GtT and control groups is summarised in Table 4. The proportion of participants with gardens at home did not differ significantly between the two groups, p=0.86. Of the GtT group participants, 132 (86.8%) had a garden at home and 20 (13.2%) did not. Of the control group participants, 110 (85.9%) had a garden at home and 18 (14.1%) did not. There were significant differences between the GtT and control groups in the scores for several knowledge-based variables.

Table 7: Knowledge of fruit, vegetables, cooking and gardening

Variable (range of scores)	Garden to Table Group (n=152)	Control Group (n=128)	P-value
Number of things helped in the garden score (0-7)*	2.80 (2.46, 3.13)	2.91 (2.54, 3.27)	0.66
Cooking knowledge score (0-16)*	7.32 (6.87, 7.78)	6.48 (5.94, 7.02)	0.02
Number of tools used score (0-7)*	5.59 (5.39, 5.80)	4.45 (4.16, 4.75)	<0.01
Gardening knowledge score (0-8)*	5.55 (5.32, 5.78)	4.43 (4.12, 4.74)	<0.01
What plants need to grow score (0-4)*	2.95 (2.80, 3.09)	2.18 (2.01, 2.35)	<0.01
Natural plant protection score (0-4)~	2.00 (1.00, 3.00)	1.00 (1.00, 2.00)	<0.01

*Normally distributed variables are means (95% confidence intervals) and tested as independent T-test (2-tailed)

~Non-normally distributed variable is median (25^{th}, 75^{th} percentiles) and tested as Mann-Whitney (2-tailed)

Participants from the GtT group had a higher cooking knowledge score than participants from the control group. However, the significant difference, t(278)=2.38, p=0.02 (2-tailed), had only a small effect size, r = 0.14.

Participants from the GtT group also had a significantly higher gardening knowledge score than participants from the control group, t(278)=2.38, p<0.01 (2-tailed). This difference showed a medium-sized effect, r=0.34.

Participants from the GtT group reported having used more tools in the garden than participants from the control group. This difference was significant, t(278)=6.39, p<0.01 (2-tailed), and represented a medium-sized effect, r=0.38.

There was also a significant difference, t(278)=6.85, p<0.01 (2-tailed), in the knowledge of what plants need to grow, with participants from the GtT group reporting more detailed and accurate

descriptions of what plants need to grow than participants from the control group. This difference had a medium-sized effect, r=0.40. There was also a significant confounding effect by year level, p=0.03. When the year-level confounding factor was controlled for, the difference in knowledge of what plants need to grow between the GtT and control groups remained significant, ANCOVA, p<0.01.

Participants from the GtT group had a greater knowledge of natural plant protection than the participants from the control group did. This was a significant difference, U=1976, p<0.01 (2-tailed), but with only a small effect size, r=-0.26.

There was no significant difference in the score for the number of things helped with in the garden, p=0.66 (2-tailed), between the GtT and control groups.

4.5 Attitudes towards fruit, vegetables, cooking and gardening

The attitudes of the GtT and control groups towards fruit, vegetables, cooking and gardening are summarised in Table 3. Several variables indicating attitudes towards fruit, vegetables, cooking and gardening showed significant differences between the participants from the GtT group and participants from the control group.

Table 8: Attitudes towards fruit, vegetables, cooking and gardening

Variable (range of scores)	Garden to Table Group (n=152)	Control Group (n=128)	P-value
Like gardening°			0.05
Not at all	6.00 (4.00%)	0.00 (0.00%)	
A little bit	28 (18.5%)	30.0 (23.6%)	
A fair bit	33.0 (21.9%)	36.0 (28.3%)	
A lot	84.0 (55.6%)	61.0 (48.0%)	
Like cooking°			0.04
Not at all	1.00 (0.70%)	0.00 (0.0%)	
A little bit	12.0 (7.90%)	11.0 (8.70%)	
A fair bit	18.0 (11.8%)	30.0 (23.6%)	
A lot	120 (78.9%)	86.0 (67.7%)	
Teamwork score (0-20)~	18.0 (16.0, 19.0)	18.0 (16.0, 19.0)	0.27
Savoury food & description score (0-4)~	2.00 (1.00, 3.00)	2.00 (1.00, 2.00)	<0.01
Sweet food & description score (0-4)~	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	0.27
Fruit & vegetable food & description score (0-4)~	3.00 (2.00, 4.00)	2.00 (2.00, 3.00)	<0.01
Summed food & description score (0-12)*	6.02 (5.65, 6.39)	4.62 (4.31, 4.92)	<0.01
Neophobia score (0-4)*	8.64 (8.22, 9.06)	8.42 (7.96, 8.88)	0.49

°Nominal variables are count (frequency) and tested as Fischer's Exact test (2-tailed)

~Non-normally distributed variables are median (25^{th}, 75^{th} percentiles) and tested as Mann-Whitney (2-tailed)

*Normally distributed variables are means (95% confidence intervals) and tested as Independent T-test (2-tailed)

Liking of both cooking and gardening, as well as F&V, savoury food and summed food and description scores were all significantly greater in the GtT group compared with control participants.

A greater proportion of the GtT participants indicated liking gardening 'a lot', compared with the participants from the control group. This represented a significant difference, χ^2=7.88, p=0.05 (2-tailed). The odds of a GtT participant liking gardening 'a lot', versus any other category, was 1.36 times more likely than for a control group participant to have indicated liking gardening 'a lot'.

A greater proportion of the GtT participants also indicated liking cooking 'a lot' compared with the control group participants, χ^2=8.32, p=0.04 (2-tailed). The odds of a GtT participant liking cooking 'a lot', versus any other category, was 1.85 times more likely than for a control group participant to have indicated liking cooking 'a lot'.

Savoury food and description scores differed significantly between GtT participants and control participants. Garden to Table participants reported favouring more healthy savoury foods and gave more detailed descriptions of savoury foods than did participants of the control group, U=4888, p<0.01 (2-tailed), but with only a small effect size, r=-0.27. Garden to Table participants also had higher F&V food and description scores than control participants. This was a significant difference, U=4249, p<0.01 (2-tailed), with a medium-sized effect, r=-0.37. Participants from the GtT group also had a higher summed food and description score than participants from the control group. This represented a significant difference $t(266) = 5.57$, p<0.01 (2-tailed) and had a medium-sized effect, r=0.34.

There was no significant difference in neophobia scores between the GtT and control groups, p=0.49 (2-tailed). However, a significant interaction effect between GtT participation and gender existed, two-way ANOVA, p=0.01. Girls from the GtT group were significantly less neophobic than girls from the control group, with a 0.91 (0.07, 1.76) higher willingness to try score, p=0.04. There was no significant difference between groups for the boys, p=0.16.

There were no significant differences in the sweet food and description score, p=0.27 (2-tailed), nor the teamwork score, p=0.27 (2-tailed), between the GtT and control groups.

4.6 Cooking and gardening self-efficacy

The cooking and gardening self-efficacy scores for the GtT and control groups are summarised in Table 5. There were no significant differences in any of the self-efficacy scores. Even when significant confounding effects were controlled for, the differences in self-efficacy scores did not reach significance.

Table 9: Cooking and gardening self-efficacy

Variable (range of scores)	Garden to Table Group (n=152)	Control Group (n=128)	P-value
Evening meal self-efficacy score (0-4)~	2.00 (1.00, 2.00)	2.00 (1.00, 2.00)	0.06
Cooking self-efficacy score (0-4)*	9.68 (9.35, 10.0)	9.34 (8.99, 9.69)	0.64
Gardening self-efficacy score (0-4)*	9.56 (9.20, 9.91)	9.20 (8.83, 9.57)	0.17

~Non-normally distributed variables are median (25^{th}, 75^{th} percentiles) and tested as Mann-Whitney (2-tailed)

*Normally distributed variables are means (95% confidence intervals) and tested as independent T-test (2-tailed)

Initial analyses showed no significant difference in the cooking self-efficacy scores of participants from the GtT group or participants from the control group, p=0.64 (2-tailed), although a significant confounding effect was found by gender, p<0.01. However, controlling for this confounding effect did not lead to a significant difference in cooking self-efficacy scores between the GtT and control groups, ANOVA, p=0.31.

There was also no significant difference in the gardening self-efficacy scores between participants of the GtT group and participants from the control group, p=0.17 (2-tailed), although there was a significant confounding effect by gender, p<0.01. However, the difference in gardening self-efficacy scores between the GtT and control groups did not reach significance even while gender was controlled for, p=0.29.

There was no significant differences in the evening meal self-efficacy score, p=0.06 (2-tailed), between the GtT and control groups.

4.7 Cooking- and gardening-related behaviour

The cooking- and gardening-related behaviours of the GtT and control groups are summarised in Table 6. There were no significant differences between the groups for any of the cooking- and gardening-related behaviours analysed.

Table 10: Cooking- and gardening-related behaviour *

Variable	Garden to Table Group (n=152)	Control Group (n=128)	P-value
Help with garden at home			0.94
Never	12.0 (9.00%)	11.0 (9.20%)	
Sometimes	65.0 (48.5%)	56.0 (47.1%)	
Often	36.0 (26.9%)	34.0 (28.6%)	
Always	21.0 (15.7%)	18.0 (15.1%)	
Help with cooking at home			0.74
Never	5.0 (3.3%)	4.0 (3.2%)	
Sometimes	62.0 (41.1%)	55.0 (43.7%)	
Often	48.0 (31.8%)	38.0 (30.2%)	
Always	36.0 (23.8%)	29 .0(23.0%)	
Eat dinner with family			0.61
Never	3.0 (2.00%)	0.00 (0.00%)	
Sometimes	16.0 (10.5%)	13.0 (10.3%)	
Often	34.0 (22.4%)	28.0 (22.2%)	
Always	99.0 (65.1%)	85.0 (67.5%)	
Eat dinner in front of TV			0.06
Never	34.0 (22.5%)	33.0 (26.0%)	
Sometimes	80.0 (53.0%)	77.0 (60.6%)	
Often	17.0 (11.3%)	10.0 (7.90%)	
Always	20.0 (13.2%)	7.00 (5.50%)	

*Values are count (frequency) and tested as Mann-Whitney (2-tailed)

Chapter 5: Discussion

5.1 Introduction

The main purpose of this epidemiological study was to evaluate the effects of Garden to Table (GtT) participation, for at least one school year, on children's fruit and vegetable (F&V) consumption and variety of intake, their knowledge of and attitudes towards fruits, vegetables, cooking and gardening, and their cooking- and gardening-related self-efficacy and behaviour. The study was completed using modified versions of the Ministry of Health (MoH) 2002 National Children's Nutrition Survey (NCNS) food frequency questionnaire (FFQ) and the children's questionnaire of the Stephanie Alexander Kitchen Garden (SAKG) evaluation by Gibbs, et al. (2013) (Gibbs, 2013b). Adequate consumption of F&V, as used in this study, was defined by the MoH guidelines for children aged two to 12 years (Ministry of Health, 2012b). These guidelines recommend children consume at least two and at least three servings daily of F&V, respectively (Ministry of Health, 2012a). Data was collected at the end of the school year in order to capture students at the height of their GtT exposure.

The main findings of this study were an association between the GtT programme and greater knowledge of and attitudes towards fruits, vegetables, cooking and gardening. However, the results failed to support an association between the GtT programme and F&V consumption, variety of F&V intake, and cooking- and gardening-related self-efficacy and behaviours. The discussion includes a comparison of F&V consumption by children in years four and five who have and have not participated in the GtT programme, and offers some explanations for these findings. Children's variety of F&V intake and their knowledge of and attitudes towards fruits, vegetables, cooking and gardening are also discussed, as are children's cooking- and gardening-related self-efficacy and behaviours and some methodological constraints.

5.2 Characteristics of children

A total of 158 and 128 participants were recruited from schools with and without the GtT programme, respectively. The intention was to compare responses by decile, but there was insufficient recruitment from different deciles, which meant a comparison by decile could not be completed. While two decile 1 GtT schools and three decile 1 control schools were invited to participate in the research, only one decile 1 GtT school and one decile 1 control school accepted.

The most frequently cited reason for declining to participate in the research was due to having an already-full curriculum, given the timing at the end of the school year. Of the two decile 1 schools participating in the research, fewer children were recruited compared with other schools. The incentives used in recruitment may have been ineffective, as it was observed that classes for which the teachers were more engaged and interested in the research had a greater number of returned consent forms. As a result, the study was under-powered for a decile comparison and any differences based on decile were unable to be explored. These results are also limited in their ability to be generalised beyond year four and five children of schools in Auckland.

5.3 Fruit and vegetable intake and variety of intake

Research has shown FFQs to have questionable validity, especially with use in children. There is a tendency for over-estimation, especially with greater FFQ length (Krebs-Smith, 1995). This was apparent with the current study, with implausible summed frequencies of F&V. The F&V serves per day ranged from zero to 16 and zero to 39.2, respectively. Some authors have endeavoured to control for this by including a cross-check question at the end, which may even be used to adjust the intake of individual items and improve validity (Calvert, 1997). While the FFQ used in the present study had previously been used to measure children's F&V intake, the study protocol of the 2002 NCNS involved considerable parent and interviewer assistance that was not included in this study. For this reason, a cross-check question (*the number of serves of fruit and vegetables per day*) was included in this study to provide some validation, but not to adjust the summed F&V intakes. Furthermore, the cross-check question was also used to compare the proportion of participants meeting recommended daily intakes of F&V.

The findings of this study indicated that F&V intake differed between the GtT and control groups significantly when summed F&V intakes were compared, but did not in both comparisons of the cross-check question. The significantly greater consumption of F&V in the control group based on the summed F&V FFQ intakes showed only small effect sizes (r=0.15 and r=0.14, respectively), which indicates a weak association. The intake ranges seemed doubtful (zero to 16 serves of fruit per day and zero to 39.2 serves of vegetables per day) and were much higher than the results of the 2002 NCNS, for which this FFQ was initially developed and used (Ministry of Health, 2003c).

The median summed intake of fruits in the FFQ found the GtT and control groups consumed about four and five serves of F&V per day, respectively. This suggests the vast majority were meeting the

fruit recommendation (Ministry of Health, 2012b); this is inconsistent with the 2002 NCNS, which showed only 43% of New Zealand (NZ) children met this recommendation (Ministry of Health, 2003c). This was also the case for summed vegetable intake, for which the current study indicated the GtT and control groups consumed an average of five and six serves per day, respectively, which is greater than the results of the 2002 NCNS, with only 57% of participants meeting the recommendation (Ministry of Health, 2003c). Given a lack of more recent national data on children's F&V consumption, caution must be taken in interpreting the results of the 2002 NCNS. More recent surveys of adults' F&V consumption patterns have shown a trend for increased intake (Ministry of Health, 2003b, 2012c). If this is similar for children, it may imply that the discrepancy between the results of this study and the true F&V intake of NZ children is less than the difference in results between this study and the 2002 NCNS.

The study design for self-completed FFQ may have lent itself to greater over-estimation, compared with the interviewer and caregiver-assisted FFQ study design (Serdula, 2001) employed by the 2002 NCNS (Ministry of Health, 2003c). However, due to logistical constraints, it was not possible to complete this research with interviewer-based and caregiver-assisted designs. Another possible explanation for these differences could be that the children surveyed in the 2002 NCNS were of a wider age range (five to 12 years) than the children of the current study (Ministry of Health, 2003c), and literature suggests F&V consumption may change with age (Ransley, 2007; Rasmussen, 2006).

Further scepticism about these results comes from their inconsistency with the cross-check question about F&V intake. This question indicated that 38.8% and 29.8% of the GtT and control groups, respectively, met recommendations for F&V intake. However, there were no significant differences in either analysis of the cross-check question between the GtT and control groups (Maddison, 2010). The discrepancy between the two methods of assessing F&V intake is likely to be the result of over-reporting of both F&V in the FFQ, as both were consistently high. For this reason, the current study found no significant difference in F&V consumption between the GtT and control groups, but several theories are proposed that may offer some explanation for this.

Exposure to F&V is generally associated with increased consumption (Resnicow, 1997) and, unsurprisingly, most of the studies of school gardening programmes have been shown to have an influence on F&V consumption (Atkins, 2010; McAleese, 2007; Somerset, 2009). However, only a few studies have evaluated this outcome. It is also worth noting that the majority of these studies, with the exception of the SAKG evaluation, have focused on gardening programmes that did not have a

cooking component. They have also differed significantly in their study designs with regard to prospective analyses, comparisons with control groups, concordant nutrition-education programmes, the age of participants, and methods of assessing dietary intake.

Despite this, the evaluations of these programmes have shown a trend for a greater effect on vegetable intake than fruit (Hermann, 2006; Parmer, 2009; Ransley et al., 2010). This trend is understandable, given the greater emphasis on vegetables observed in the GtT programme. While this conclusion is not formalised, the logistics of growing and harvesting fruit are more difficult in any gardening programme, as fruit plants generally take longer to establish. This may offer some explanation for the results of the current study, as differences in the proportion of F&V consumed were unable to be assessed because of the unreliability of the F&V frequency data. If the GtT group had consumed a greater proportion of vegetables to fruits and if the control group had consumed a greater proportion of fruits to vegetables, the results would have appeared similar but represented a difference. Although this idea cannot be examined further, if it were the case it could suggest that the GtT programme may be effective in targeting children's vegetable consumption, as has been supported by other studies (Hermann, 2006; Parmer, 2009; Ransley et al., 2010).

If such a difference existed in the proportion of F&V consumed, it may also have been influenced by children's high preference for the innate sweet tastes in fruit (Mennella, 1999). It is suggested that children are more likely to consume fruit because of its sweet taste, which could have led to a greater proportion of fruit to vegetable consumption in the control group. Added to this is the potential of the Fruit in Schools programme – which provides a piece of fruit to all children in decile 1 and 2 schools each day – to have potentially accounted for greater fruit consumption in some of the children (Brug, 1995). Both decile 1 schools, one control and one GtT, were part of the Fruit in Schools programme.

The failure of the present study to show results for higher F&V consumption is supported by several studies. A recent quasi-experimental study by Morgan and colleagues in New South Wales (NSW) was comparable with this study's findings, showing that inclusion of a gardening component in a 10-week nutrition-education programme did not affect F&V intake among 127 11- and 12-year-old children (Morgan, 2010). However, the authors acknowledge that the brief intervention period may have been insufficient to modify dietary behaviours (Morgan, 2010). The research was also limited by the nature of the comparative study design, the brief intervention period, and by the potential contamination between the treatment and control groups being within the same school (Janke,

2012; Morgan, 2010). Another school-based gardening programme also reported no effect on F&V consumption, although preference was increased (Lineberger, 2000). Similarly, the evaluation of the SAKG programme failed to find any effect on F&V intake in its quantitative analysis, although its qualitative research lent strong support for such an effect (Gibbs, 2013a). The authors of the SAKG evaluation suggest it is possible that these results represent a large increase in F&V consumption, but only in a subgroup of participants who have initially lower consumption (Gibbs, 2013a). This suggests that the programme may be more effective in reducing F&V inequalities than increasing overall F&V intake (Gibbs, 2013a). It may be that the findings of this study are a failure of the quantitative measures used, rather than lack of effect of the programme itself. It is not yet clear whether the GtT programme, or in fact the SAKG programme, has a measurable impact on children's F&V consumption.

Another possible explanation for a lack of difference in F&V consumption between the GtT and control groups could be the seasonal effects on F&V accessibility and price. The current study was performed in early summer when more fruit, and particularly vegetables, become available and are more affordably priced. This may have resulted in greater F&V consumption by participants during this period, which may not have been representative of their average annual intake. However, due to logistical issues the study was unable to be performed earlier in the year. Furthermore, some of the differences between the current study and the SAKG evaluation may be related to the different seasonal constraints on F&V growth in NZ and Australia.

It is also possible that the lack of difference in F&V consumption may be due to selection bias, if participants or their parents who are more highly motivated about F&V consumption were more likely to participate. This may have undermined the results if a subgroup of children with low F&V intake were less likely to have participated in the research. Such a potential bias may be significant, given the suggestions by the authors of the SAKG evaluation that this group may stand to benefit most from such programmes (Gibbs, 2013a). Children are also known to have difficulty with serving size estimation and food recalls, which may have been another potential bias because these abilities may or may not have been similar between the GtT and control groups and may have influenced the results of the present study. For example, if a child considered one grape to be a serving of grapes, then this could have led to an over-estimation of fruit consumption.

A further explanation could be that the minimum of one year's participation in the GtT programme may have been insufficient to influence F&V consumption, as a distal outcome extending beyond the

kitchen and garden classes. Since significant differences were found in knowledge and attitude, it is possible that the lack of difference in F&V intake may, in fact, indicate that children are on the continuum of instigating behaviour change but have not yet reached the final result (Dickinson, 2013; Somerset, 2009). This would suggest that, with greater time, healthier dietary patterns may be adopted. While an adequate number of participants were recruited, it is possible that the power calculation used was based on a difference in F&V consumption that was too high. If this were the case, then the current study would have been under-powered to detect changes smaller than a 20% difference in F&V consumption (Lineberger, 2000).

Children's dietary patterns are somewhat dependent on their parents or caregivers in the provision of F&V and their attitudes towards F&V (Blanchette & Brug, 2005). The GtT programme does not primarily target consumption patterns in the home, although it potentially influences other determinants of dietary intake, such as knowledge and attitudes that could affect future F&V consumption. Therefore, a lack of parental involvement in the GtT programme may contribute to the lack of difference in F&V intake found in this study. It may also be that differences in the availability of F&V in the home contributed to the results, but this was not investigated.

There is limited evidence for the effect of school-based cooking and gardening programmes on variety of F&V intake. Although the present study found no overall difference in *F&V variety of intake*, there was significantly greater variety of vegetables consumed by GtT boys, which is comparable with the only other study of F&V variety in such programmes (Lautenschlager, 2007a). However, the present study also found significantly greater variety of fruit consumed by control girls compared with GtT girls. One possible explanation is that the GtT programme focuses on vegetable consumption and children in the GtT group may consequently have displaced some fruit for a wider variety of vegetables.

5.4 Knowledge of fruit, vegetables, cooking and gardening

The GtT children demonstrated significantly greater *cooking knowledge*, *gardening knowledge*, *number of tools used*, *what plants need to grow* and *natural plant protection* scores compared with the control group. This suggests the effectiveness of the GtT programme in increasing children's knowledge about cooking, gardening, fruits and vegetables. This is further supported by the comparable results of the SAKG evaluation (Block, 2009). Most other studies investigating knowledge in school-based gardening programmes found similar results (Atkins, 2010; Cason, 1999;

Koch, 2006; Liquori, 1998; Morris, 2002b; Newell, 2004), with the exception of two studies. The lack of difference in knowledge was attributed to high initial scores (O'Brien, 2006; Poston, 2005). In addition, while Morgan and colleagues' quasi-experimental study found no overall increase in knowledge, a significant increase was found in participants who had initially low knowledge scores (Morgan, 2010). This suggests that school cooking and gardening programmes are effective in influencing children's knowledge, possibly more so for those with lower initial knowledge on these topics. What remains to be determined is the effect of this increased knowledge on children's dietary behaviours and the maintenance of such effects after children have completed participation in these programmes.

5.5 Attitudes towards fruit, vegetables, cooking and gardening

Overall, the results of the present study indicate a more positive attitude towards fruit, vegetables, cooking and gardening in the GtT group. The significantly greater scores for *liking of cooking* in the GtT group are consistent with the findings of the SAKG evaluation (Gibbs, 2013a). However, in contrast to the SAKG evaluation, the present study also found a significant difference in *liking of gardening* (Gibbs, 2013a). These results are consistent with other studies of school gardening and cooking programmes, most of which have found improvements in attitude scores (Atkins, 2010; Lautenschlager, 2007a; Morgan, 2010; Newell, 2004), with few failing to support this (Koch, 2006; Lineberger, 2000). The present study adds to the existing support for school cooking and gardening programmes influencing children's attitudes. However, how this influence impacts on their dietary behaviour is less clear.

The study found no difference in *teamwork* between the GtT and control group, which could be related to the sample size used. It is possible that the sample size may have been inadequate to detect changes, as large confidence intervals may indicate that the sample size was insufficient to detect significant results. There were also similarities in the findings for no difference in *teamwork* scores in the present study and the quantitative analysis of the SAKG evaluation (Gibbs, 2013a). However, the qualitative analysis of the SAKG evaluation found evidence for such an effect (Block, 2012), suggesting that the lack of findings in the present study may be attributed to the quantitative methods used. The differences observed between the quantitative and qualitative evaluation of the SAKG programme were also found between the qualitative evaluation of the GtT programme by the SHORE and Whariki Research Centre and this study. Both studies found an effect on children's knowledge; however, the qualitative evaluation found improved willingness to try new foods,

improved skills and an effect on behaviours in the home environment, none of which were supported in the current quantitative study. This highlights not only the relative benefits of both study methods, but also the challenges in measuring the effectiveness of this programme. It also suggests that the GtT programme may be effective in measuring those areas, but at a level that is not yet able to be quantitatively detected, or that these changes may be better measured over time than by comparison with a control group.

Children's preference for foods and their ability to describe these foods is a marker of their attitude, and may be an indicator of future dietary behaviour change (Dickinson, 2013; Somerset, 2009). More healthy food preferences and more detailed food descriptions were reported for *savoury food* by the GtT group than the control group. Likewise, the preference and description for *fruit and vegetables* was significantly greater in the GtT group, as were the scores for *summed savoury, sweet and fruit and vegetables* preferences and description. However, no difference was found in *preference and description of sweet foods* between the GtT and control groups. One possible explanation for this is that the GtT programme focuses more heavily on vegetables than fruit and for this reason there is less emphasis on sweet than savoury foods. In support of this, the SAKG evaluation found significant increases in food descriptions for both the SAKG and control groups, which was not attributed to the SAKG programme (Gibbs, 2013a). Other studies showing the effect of school cooking and gardening programmes on children's preference scores have been inconsistent. For some studies that have shown increases (Atkins, 2010; Liquori, 1998; Morris, 2002a, 2002b), some have only found improvements in vegetable and not fruit preferences (Heim, 2009; Lineberger, 2000; Morris, 2001) and others have shown no effect (Koch, 2006; O'Brien, 2006; Poston, 2005). This study fits well within these conflicting results, suggesting a possible effect of the programmes on preference and description. A pertinent question arises about whether a change in preference will predict a change in dietary behaviour, but that was beyond the scope of this study.

Children often reject new foods presented to them, a reaction termed neophobia (Birch, 1998a). Neophobia has been measured by many authors, using children's willingness to try new foods. This study measured children's neophobia by their willingness to try new foods if they had *never tried it*, *had grown it*, or *had cooked it before*. No overall differences were detected in willingness to try new foods scores between the GtT and control groups. However, the previous SAKG evaluation using the same children's questionnaire found an overall increased willingness to try new foods by the participants in the SAKG programme (Gibbs, 2013a). Making this result less clear was the findings from the SAKG parental questionnaire, which, as with the present study, showed no improved

willingness to try new foods (Gibbs, 2013a). One possible explanation for the findings of the present study is that the GtT programme offers exposure to a wide variety of foods, rather than repeated exposure to the same foods, which the literature has suggested is important in overcoming food neophobia (Birch, 1982, 1987b; Sullivan, 1994). In addition, the present study did not explore the influence of parental or sibling role-modelling of unfamiliar foods (Birch, 1998b; Harper, 1975; Shepard, 1996), which may contribute to children's willingness to try new foods. Other studies of school gardening and cooking programmes have not shown a general trend with regard to willingness to try new foods. Some studies have shown improvements (Cason, 1999; Lautenschlager, 2007a; Morris, 2001), while others have shown no effect (Morris, 2002b) or, in one case, a reduced willingness to try (Somerset, 2009). Further complicating this literature are the results of Reverdy and colleagues' work, which found an immediate increased willingness to try vegetables that was not sustained in follow-up (Reverdy, 2008). Whether these programmes are an effective strategy to tackle neophobia and whether any changes achieved will be maintained is not clear from this study and its contemporaries.

While previous studies have investigated the role of gender interactions in relation to the experiential basis of gardening and cooking programmes, this study only found a gender interaction in willingness to try new foods. Other studies have hypothesised that the experiential nature of these programmes would make them particularly effective in boys (Carrier, 2009; King, 2006; Taylor, 2002). This has gained support from the qualitative evaluation of the SAKG programme (Block, 2012) and another school-based gardening programme, which reported an effect on F&V consumption only in male participants (Lautenschlager, 2007a). While experiential learning may not link to willingness to try new foods, a gender interaction has also been shown by Morgan and colleagues (Janke, 2012; Morgan, 2010). However, while Morgan and colleagues found a school gardening programme increased willingness to try new foods in boys only (Janke, 2012; Morgan, 2010), this study found greater willingness to try new foods by girls in the GtT group than girls in the control group. Therefore, any difference in the effectiveness of these programmes on children of different genders remains to be determined.

5.6 Cooking and gardening self-efficacy

Self-efficacy is the confidence, ability or skills to perform certain tasks (Brug, 1995), and nutrition-related self-efficacy is associated with healthier dietary habits (Resnicow, 1997). Children's self-efficacy towards *preparing an evening meal*, *cooking* and *gardening* in the present study was not

statistically different between the GtT and control groups. These results were inconsistent with the result of the SAKG evaluation, which used the same questionnaires and programme but found significant improvement in cooking and gardening self-efficacy scores. The vast majority of literature on self-efficacy in school gardening programmes has also shown improvements that contrast with the present study (Heim, 2009; Liquori, 1998; Newell, 2004; O'Brien, 2006; Poston, 2005). There was one exception, which showed reduced self-efficacy but only in the autumn and after-school programme group, attributed to seasonal differences in gardening techniques and vegetable growth (Poston, 2005). As both the GtT and SAKG programmes and evaluation questionnaires were similar, the differences in these self-efficacy results may result from differences in study designs. It is also possible that children in the GtT programme had had an improvement in their cooking and gardening self-efficacy from before they started the GtT programme until the time the data was collected. Because of the comparative nature of this study design, a longitudinal improvement such as this could not have been measured. However, it should be considered in further determining the effect of the GtT programme on children's self-efficacy.

5.7 Cooking- and gardening-related behaviour

The present study found no evidence for an extension of the benefits of the GtT programme in the home environment, with no differences between the GtT and control groups in the proportion of participations who *helped with the garden at home*, *helped with the cooking at home*, *ate dinner with their family* and *ate dinner in front of the television*. Nor were there differences between the GtT and control groups in the proportion of children who had gardens at home. These results have conflicted with those of the qualitative process and outcome evaluation of the GtT programme. It remains unclear whether the GtT programme does effectively influence children's lives outside of school, and the implications of this for their long-term dietary behaviour.

5.8 Methodological constraints

Due to the study design, the results of this research cannot indicate whether participating in the GtT programme has caused the differences observed. However, they do indicate some associations, particularly in relation to GtT and greater knowledge and attitudes. It is possible that the lack of difference in some results could be attributed to a bias in the ability to complete questionnaires, as the control group had a greater proportion of year 5 to year 4 participants.

Some of the results of this study could also be attributed to recruitment bias and research methodologies that favour the literate and articulate. It could be that children and families were inadvertently discriminated against if they were less able to read information sheets and return written consent, or to complete written questionnaires, due to academic ability or language barriers. Furthermore, the research did not account for absenteeism during the school year. However, this is not likely to have had a significant impact on the results, as the number of participants recruited to the study should have been sufficient to negate any small effect this may have had. Other possible explanations for the findings include potential bias from social desirability in completing questionnaires, especially since these were completed in classroom settings. Additionally, as data was collected at the end of the school year, children may have had more generally negative attitudes and been more susceptible to fatigue in completing the questionnaires, which may have influenced the results.

The SAKG evaluation also suggested that the programme was most effective in reducing inequalities in the most disadvantaged students (Block, 2009). As this study was not prospective, it could not assess whether there were increases for participants with low initial results, and there was an inadequate proportion of low-decile participants to accurately present this effect. It is also possible that a ceiling effect occurred. Several of the outcomes analysed, including F&V intake, teamwork and self-efficacy, had relatively high scores.

Another possible explanation for the findings of the present study is the potential for bias in the recruitment of control schools that already had a greater focus on F&V promotion, cooking or gardening in their curriculum. Such pre-existing activities of the control schools included gardening clubs, some cooking curriculum and an environmental protection club. While some of these were offered on a voluntary basis and others as curriculum, they all were likely to involve less time and less structured delivery than the GtT programme. Even so, they may still have threatened the validity of the present study if participants of the control group had pre-existing increased gardening knowledge, self-efficacy or attitudes.

5.9 Summary

The findings of this study have supported an association between the GtT programme and children's greater knowledge of and more positive attitudes towards F&V. While this research found no association between the GtT programme and children's F&V consumption, variety of F&V intake,

self-efficacy and behaviour, many of these results are similar to comparable studies. Furthermore, many methodological constraints may have impacted on the findings and must be considered in the context of these results and for future research.

6.0 Conclusion, strengths, limitations and recommendations

6.1 Summary of the study

Evidence suggests that the inclusion of fruit and vegetables (F&V) within a healthy diet is important for optimising growth and development in childhood (Koch, 2006; Lineberger, 2000; Morris., 2000), as well as contributing to the prevention of obesity and disease (Koch, 2006; Lautenschlager, 2007a, 2007b; Lineberger, 2000; Liquori, 1998; McAleese, 2007; Morgan, 2010; Newell, 2004; O'Brien, 2006; Robinson-O'Brien, 2009; Somerset, 2009). However, childhood is a time of immense change, during which dietary patterns are influenced by a variety of factors, including innate food and flavour preferences (Mennella, 1999; Sullivan, 1994), food neophobia (Birch, 1998a, 1982, 1987b; Sullivan, 1994), role-modelling (Birch, 1980a, 1980b; Nicklaus, 2005; Visalberghi, 2000) and parental interaction (Fisher, 2002; Galloway, 2005; Gibson, 1998; Harper, 1975; Oliveria, 1992). It also represents a critical time for promotion of healthy dietary habits, such as consumption of F&V; these dietary habits, learned before the age of approximately 15, may well be continued into adulthood (Cullen, 2001; DiNubile, 1993; Foerster, 1998; Heimendinger & Van Duyn, 1995; Kelder, 1994; Sandeno et al., 2000; Singer et al., 1995).

Evidence from national surveys has consistently indicated that the diets of New Zealand (NZ) children are lacking in F&V (Maddison, 2010; Ministry of Health, 2003c), which may contribute towards the currently high rates of childhood obesity and non-communicable disease (NCD) in adulthood (Ministry of Health, 2003c, 2012c, 2012d). These findings have drawn attention to the need for effective nutrition-promotion programmes that target F&V consumption in childhood, as a strategy to address public health concerns. National and international research has also indicated a deficit of F&V in children's school lunches, with the inclusion of many foods high in fat, sugar and salt (Dresler-Hawke et al., 2009; Ransley et al., 2010). This deficit, combined with the amount of time children already spend in school and the ability of schools to deliver structured education (Lautenschlager, 2007a; Lineberger, 2000; McAleese, 2007; Morris, 2001; Morris., 2000), has highlighted schools as a setting that is well suited to delivering nutrition-promotion programmes (Robinson-O'Brien, 2009).

Support has grown internationally for the development of school cooking and gardening programmes, as a strategy for nutrition promotion to children. Evaluations of these programmes have shown them to effectively target children's food neophobia (Cason, 1999; Lautenschlager,

2007a; Morgan, 2010; Morris, 2001), knowledge and preferences (Atkins, 2010; Koch, 2006; Liquori, 1998; Morris, 2002b; Morris, 2001; Newell, 2004; Reinaerts et al., 2007), attitudes (Atkins, 2010; Morgan, 2010; Newell, 2004; Reinaerts et al., 2007), self-efficacy (Heim, 2009; Liquori, 1998; Newell, 2004; O'Brien, 2006; Poston, 2005; Somerset, 2009), environmental awareness (Lautenschlager, 2007a; Morris., 2000), academic performance (Graham, 2005; Klemmer, 2005; Pigg, 2006), classroom behaviour (Graham, 2005), peer relationships (Lautenschlager, 2007a) and, potentially, F&V consumption (Atkins, 2010; Hermann, 2006; McAleese, 2007; Parmer, 2009; Ransley et al., 2010; Somerset, 2009). The success of these programmes prompted the introduction of the Garden to Table (GtT) programme into NZ. Based on the Australian Stephanie Alexander Kitchen Garden (SAKG) model, the GtT programme teaches children to build and maintain gardens, to grow and harvest fruit, vegetables and herbs, and to prepare and share meals (Block, 2009). The ultimate goal of the GtT programme is to encourage the adoption of positive lifelong eating habits (Garden to Table, n.d.-a), which closely aligns with the need for improved F&V consumption by NZ children.

A mixed method evaluation of the SAKG programme, the parent model for GtT, gave support to the programme improving children's neophobia, knowledge, attitudes and confidence in cooking; as well as qualitative support for increased F&V consumption (Block, 2012; Gibbs, 2013a, 2013b). A qualitative study lent support to the implementation of the GtT programme in NZ schools, as well as evidence for increased knowledge, confidence and willingness to try new foods (Dickinson, 2013). However, a quantitative evaluation of the outcomes of the GtT programme has not yet been completed. The aim of the current research was to quantitatively evaluate the effects of GtT participation, for at least one school year, on children's F&V consumption and variety of intake, and their F&V-related knowledge, attitudes and self-efficacy.

This epidemiological comparative study compared the differences observed in F&V consumption and variety of F&V intake, as well as knowledge of and attitudes towards fruits, vegetables, cooking and gardening and cooking- and gardening-related self-efficacy and behaviours. This comparison involved 158 year four and five children who had participated in the GtT programme for at least one school year and 128 children who had not, matched for year level. Children completed two questionnaires, a modified version of the Ministry of Health (MoH) food frequency questionnaire (FFQ) used in the 2002 National Children's Nutrition Survey (NCNS) (Ministry of Health, 2003a, 2003c), which assessed children's F&V intake and variety of F&V intake; and a modified version of the children's questionnaire used in the evaluation of the SAKG programme (Block, 2009; Gibbs, 2013b), which assessed children's knowledge, attitudes, self-efficacy and home behaviours. The

questionnaires were completed in a group setting under the supervision of the researcher or research assistant, and the participants' teacher.

The conclusions of this study are addressed in relation to the study objectives presented in Chapter 1. The study's strengths and limitations are then reported, and these shape the recommendations for future studies that follow.

The primary objective, as reported in Chapter 1, was: to investigate whether participation in the GtT programme for one school year has resulted in a greater proportion of year four and five children meeting the recommendations for F&V consumption – that is, at least two servings of fruit and at least three servings of vegetables per day. Based on the results presented in this study, the alternate hypothesis (H_1) is rejected.

The consumption of F&V by children who had participated in the GtT programme did not differ significantly from children who had not participated in the programme, based on the summary cross-check question. Results for greater F&V consumption in children who had not participated in the programme compared with children who had participated in the GtT programme, based on the summed F&V frequencies, is distrusted due to the implausible range of intake, discrepancy between these results and the results of the summary cross-check questions, and their inconsistency with the results of comparative national data. This is likely a result of over-estimation secondary to methodological error that occurred due to the logistical constraints on the study design, and thus these results have been discredited in this conclusion.

Based on the results of the summed cross-check question of this study, together with the limited international research on the impact of school-based cooking and gardening programmes, it is unclear whether such programmes effectively target F&V consumption patterns in children. The results of similar studies, including the evaluation of the GtT parent model, the SAKG programme, have found mixed results with regard to F&V intake. The comparison of these results is further complicated by differences in the programmes themselves, as well as the study designs, inclusion of control groups, concurrent nutrition education, age of participants and methods of dietary assessment employed. The possible contributions to the findings of no difference in F&V consumption between children who had and had not participated in the GtT programme have been presented in Chapter 5 and include the effects of seasonality on F&V price and availability, selection bias, inability of the programme to target the home environment, confounding by the Fruit in

Schools programme, a possible greater effect on a subset of the population with lower initial intakes, or a concurrent increase in vegetable and decrease in fruit consumption that were unable to be assessed.

While the theory behind school cooking and gardening programmes targeting children's F&V consumption is well structured, the evidence demonstrating this is unclear. These programmes certainly do not appear to negatively impact on children's dietary behaviours. Therefore, the potential benefit of the GtT programme does justify both the continued introduction into NZ schools and the continued measurement of its impact on F&V intake.

The secondary objectives, as stated in Chapter 1, were: to assess the variety of F&V intake in children in this study, along with their knowledge of and attitudes towards fruits, vegetables, cooking and gardening and their cooking- and gardening-related self-efficacy and behaviours. The results of the present study demonstrated no overall difference in the variety of F&V consumed by children who had and had not participated in the GtT programme, although gender differences were present, with greater variety of vegetables consumed among boys who had participated in the GtT programme, consistent with a similar study that included gender effects; and greater variety of fruit consumed among girls who had not participated in the GtT programme. It has been proposed that the focus of the GtT programme on vegetables may have had a displacement effect on fruit intake, which could have contributed to the reduced fruit variety of girls who had participated in the programme. However, based on the lack of overall difference in variety of F&V consumed by the GtT and control groups, that alternate hypothesis (H_2) is rejected.

This study also found significantly greater scores for knowledge among children who had participated in the GtT programme, and the alternate hypothesis (H_3) is accepted. This was comparable with the evaluation of the SAKG programme, as well as most other studies that included knowledge as an outcome for assessing school-gardening programmes. However, the results from scores for attitude were less consistent, with significant differences in *liking of cooking and gardening* and some *food preferences and descriptions*, but not for *teamwork* and *willingness to try new foods*. These findings were consistent with the mixed findings of comparable studies. There are several additional factors that may have impacted on these results. Firstly, the methodology used to assess teamwork may have been a limitation, given that the qualitative evaluation of the SAKG evaluation found support for greater *teamwork*. Because there is a greater focus on vegetables than fruit, this may have impacted on the finding for no difference in the *preference and description of*

sweet foods. Finally, the literature suggests that repeated exposure to new foods is required to overcome neophobia, but the GtT programme approach includes a wider exposure to different new foods. This may limit its effect on neophobia and may somewhat explain the finding for no difference in *willingness to try new foods*. Based on the findings of this study, it appears the programme has some influence on the attitudes of children, and for this reason the alternate hypothesis (H_4) is accepted.

Based on the results of this study, there was no difference in cooking- and gardening-related self-efficacy between children who had and had not participated in the GtT programme, and the alternate hypothesis (H_5) is rejected. This was inconsistent with the evaluation of the SAKG programme and the results of most other studies that have included self-efficacy in their evaluations. Due to the similarities of assessment methods between this study and the SAKG evaluation, it is unlikely that these results are due to the questionnaire used. While it is possible that a long-term effect was present, it was unable to be assessed by the study design of the present research.

In conclusion, this study has demonstrated an association between the GtT programme and greater knowledge of and attitudes towards fruits, vegetables, cooking and gardening in year four and five children. What remains unknown is whether these effects are likely to predict or in any way impact on the dietary behaviours of children. The results of this study have failed to support an association between the GtT programme and F&V intake, variety of intake and cooking- and gardening-related self-efficacy. However, other factors, including constraints in the study design, may have limited the ability to detect a difference in such associations rather than a true inability of the programme to influence these outcomes. This is important because it suggests the GtT programme has addressed some of the intended short-term outcomes, which may act as pre-determinants of dietary change. Thus, the GtT programme may eventually lead to the adoption of greater F&V consumption patterns by children who participate in the programme, representing a possible strategy to improve F&V intake by NZ children, which may in turn lend protection against obesity and disease risk.

6.2 Strengths of the present study

This was an epidemiological comparative study comparing two groups of year four and five children, those who had participated in the GtT programme for at least one school year, and those who had not. The study design allowed for the group of children who had participated in the GtT programme

to be matched with a group of children who were similar with respect to year level and therefore age, which allowed for the inclusion of this group as a control group for comparison. In addition, the only exclusion criteria was for children not currently in year four or five or who had not attended their current school for at least one full school year. This meant there was a wide inclusion criterion, which allowed a large population of children to be invited to participate in the research. Thus, the variety of schools and the many participants who were involved in this study created a large sample size for adequate statistical analysis. Furthermore, the inclusion of three of the total of nine schools nationwide involved in the GtT programme represents a significant proportion of children who were exposed to the programme in NZ.

F&V intake and variety were measured using an adapted version of the MOH's 2002 NCNS FFQ. Knowledge of and attitudes towards fruits, vegetables, cooking and gardening and cooking- and gardening-related self-efficacy and behaviours were measured using an adapted version of the children's questionnaire generated specifically for the evaluation of the SAKG programme. The benefit of using these questionnaires is that they have been specifically developed for assessment in children, making them particularly relevant and useful in this study. Moreover, the use of these questionnaires allows for close comparison of the results of this study with the findings of the 2002 NCNS and SAKG programme evaluation, respectively.

Compliance with completing these questionnaires was ensured by the one-off data collection design and group explanation of the questionnaires, and less so through the use of incentives, which suggests the children were interested and willing to participate and thus more likely to be fully compliant in completing the questionnaires. Finally, the use of a questionnaire that included pictures of foods, portion sizes and examples of how to complete the questionnaire made the content relatable and easier to complete for the participants, which may also have contributed to the compliance.

6.3 Limitations of the present study

The primary outcome measured in this study was F&V intake, which is known to differ with the level of deprivation. However, due to the difficulties in recruiting adequate participants from low-decile schools, this study was unable to explore the effect, if any, that decile may have had on the primary and other outcomes of interest. Additionally, difficulties in recruiting schools to participate in this study meant there would have been insufficient participants from the decile 1 and decile 10 GtT

schools. As the other decile 1 and decile 10 GtT schools invited to participate had declined, a decile 5 GtT school was invited to participate; however, as the control schools had already been recruited and data collected, the two groups were not completely similar with regard to decile because the GtT group included a decile 5 school and the control group did not. Moreover, the schools included were all based in Auckland, which may limit the influence of any regional effects. The most cited reason for declining to participate in the research was because, being at the end of term 4, the curriculum was already full with planned end-of-year activities; however, due to the intention to capture students after a year of GtT exposure and logistical constraints, the study was unable to be initiated earlier in the year. This may also have impacted on the quality of participants' responses, as other authors have suggested that children are more easily distracted in completing research closer to the end of the school year, and this may have contributed to the implausible summed F&V frequencies.

Another constraint related to conducting the data collection under the restrictions of the school setting was the inability to individually administer the questionnaires or involve the parents or guardians in the data collection. This meant that the method of data collection differed from those employed with the FFQ used in the 2002 NCNS and may also have contributed to the over-estimated intake reported. While the questionnaire was comparable with that used in the SAKG programme evaluation, this study was limited by being quantitative only, as opposed to the mixed method adopted in the SAKG evaluation. This may have narrowed the scope of the results, as the SAKG programme evaluation did find significant differences between the quantitative and qualitative measures for some outcomes. Another restraint in comparison of this study with the SAKG programme is that this study did not include data collection from parents, teachers and school principals, and nor did it explore the wider effects of the programme on children's wellness, school and community spirit, academic performance, asking behaviour, availability of F&V in the home and other effects on the home environment, as other studies have sought to investigate. In addition, as this study was only a comparative study, without data collection from children of the GtT group prior to participating in the programme, it could not assess longitudinal change. Nor could it assess the maintenance of these effects after GtT programme participation ceased, as no follow-up was included in the study design.

Furthermore, there was potential for this research to have been limited by recruitment bias, whereby participants who were more likely to include F&V in their diets might have been more likely to be interested in the research and more likely to participate. This could have skewed the results to

not represent a true difference, particularly for the subgroup of children with low F&V intakes for whom such programmes may be particularly effective.

6.4 Recommendations for future studies

The findings of this study support the necessity for further evaluation of the GtT programme, including use of a control trial study design to continue the understanding of the benefits of the GtT programme for NZ children. Such future studies should assess the longitudinal effects, as the intended outcomes of interest may require significant time before coming into effect, and study design should consider the inclusion of data collection before and after programme participation. In order to measure the maintenance of any effects after children have finished participating in the GtT programme, data collection at a follow-up period should also be considered for future studies. The relative merits and weaknesses of a concurrent qualitative method of assessment also need to be considered. An exploration of the most efficient and effective methods of collecting data within the constraints of the school setting would also be advantageous. Given the gross over-estimation observed, individual or smaller group data collection may be beneficial in ensuring more accurate information is obtained. In addition, it may also be useful to collect data earlier in the school year to prevent participant fatigue; this would need to be evaluated against children having less than a full year's exposure to the GtT programme.

Further investigations of the GtT programme should also engage the parents, teachers and school principals in their evaluation, as occurred in the SAKG and SHORE and Whariki Research Centre qualitative evaluations, and aim to examine the impact of the programme on the home environment, as is an intended outcome of the GtT programme. It would also be advantageous to include a greater sample of participants from lower deciles and to complete an analysis of the effects of the GtT programme at different levels of deprivation. In order to improve recruitment, it may be beneficial to increase teachers' engagement in the research, as it was observed in this study that they are the drivers behind students returning consent forms and participating in the research. This is particularly important in ensuring that participants who are most likely to benefit from the GtT programme, such as those with initially low F&V intake and other outcomes of interest, are not discouraged from participating. Finally, given the global concern about childhood nutrition and prevalence of obesity, future research evaluating the GtT programme in the context of its counterparts in Australia and the United Kingdom and the ongoing impact of these on dietary patterns is warranted.

In conclusion, this study has shown the GtT programme to be associated with greater knowledge of and attitudes towards fruits, vegetables, cooking and gardening. However, further longitudinal investigations within the constraints of a school setting are needed to ascertain whether the GtT programme effectively targets the dietary behaviours of NZ children.

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