NUTRITION AND PHYSICAL ACTIVITY FOR PRE-SCHOOLERS: EARLY CHILDHOOD EDUCATION TEACHERS' KNOWLEDGE AND PERSPECTIVES

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

Masters of Science

In

Nutrition and Dietetics

Massey University, Albany

New Zealand

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2017

ABSTRACT

Background Caregivers' knowledge of the links between nutrition, diet and physical activity is increasingly being recognised as important for children's health and body size. Evidence is limited for early childhood education (ECE) teachers' knowledge about nutrition and physical activity for pre-schoolers, especially in New Zealand. Identifying knowledge gaps amongst teachers may direct professional development, health promotion and obesity prevention strategies in childcare settings.

Aims The primary aim was to measure early childhood education (ECE) teachers' nutrition knowledge for pre-schoolers (2-5-year-olds); and their perspectives towards nutrition and physical activity. In order to achieve this, a secondary aim was to design an ECE teacher nutrition knowledge questionnaire that satisfies psychometric criteria of validity and reliability.

Methods Questionnaire items were generated based on New Zealand Ministry of Health nutrition guidelines for pre-schoolers, a literature search and expert advice. Nutrition (n=40) and non-nutrition (n=51) university students completed the questionnaire once; 35 of the nutrition students completed the questionnaire twice.

Psychometric tests for construct and test-retest reliability were conducted. The cross-sectional online validated questionnaire of New Zealand ECE teachers' nutrition knowledge for pre-schoolers was then used to measure ECE teachers' nutrition knowledge for pre-schoolers. Knowledge was scored and measured against the Ministry of Health *Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2-18 years): A background paper* (2015c). Teachers' perspectives towards nutrition and physical activity for pre-schoolers were assessed using Likert scales within the questionnaire. Analysis included descriptive statistics, correlation and linear regression.

Results The questionnaire achieved an acceptable level of content and construct validity and test-retest reliability. ECE teachers (n=386) from New Zealand childcare centres

completed the validated questionnaire. Teachers' knowledge of nutrition was lacking; overall score was 22.56 ± 2.83 (mean ± SD), or 61% correct. Age, qualification level, employment role and years of experience did not predict overall nutrition knowledge scores. Teachers' increased years of experience significantly predicted an increase in knowing that New Zealand nutrition and physical activity guidelines existed (B=0.02 [95% CI, 0.00-0.03], r^2=0.13, P=0.033). Teachers' increased agreement in feeling they were confident talking about nutrition to parents significantly predicted an increase in overall nutrition knowledge scores, (B=0.34 [95% CI, 0.06-0.63], r^2=0.15, P=0.019). The belief that ECE teachers play a vital role in promoting pre-schoolers' healthy eating and physical activity was widespread. Teachers generally held positive perspectives towards feeding practices and perceived themselves to understand key physical activity concepts. Common barriers for ECE teachers' nutrition and physical activity knowledge included a lack of staff training, confidence and resources.

Conclusion The questionnaire achieved an acceptable level of construct validity and test-retest reliability and is suitable to measure ECE teachers' nutrition knowledge for pre-schoolers (2-5-year-olds) in New Zealand. ECE teachers may lack nutrition knowledge for pre-schoolers in New Zealand, particularly with regards to basic nutrition recommendations (servings, food/beverage choices and portion sizes).

Keywords: childhood obesity, childcare, kindergarten, day care, pre-school, nutrition environment, psychometric validation, nutrition literacy

ACKNOWLEDGEMENTS

I must express my greatest appreciation to everyone who made this research possible. Firstly, I would like to thank all childcare staff who volunteered their time to participate in this research and for completing the study questionnaire in a timely and thorough manner. A special thanks to BestStart and the Heart Foundation for their support and for distributing the questionnaire to their networks.

My deepest gratitude to my two supervisors Cathryn Conlon and Ajmol Ali, who guided me with their extensive expertise: your knowledge and experience in research, statistical analysis, liaising with key stakeholders and the media and interpretation/presentation of study results was invaluable. Thank you for investing your time and being a great inspiration to me. Pamela von Hurst, thank you for your assistance with validating the questionnaire. Thank you Kathryn Beck for also helping with the questionnaire validation, as well as sharing your wide expertise in statistical analyses. Daniel Gordon, your assistance with Qualtrics was invaluable. Thank you Owen Mugridge for supporting the research process. Thank you to Massey University and the Ethics committee, I am privileged and pleased to be able to present this thesis with your support.

I was overwhelmed by the support and interest from childcare centres, the public and media during the recruitment phase. Thank you Jenna Ward and Genevieve Westcott for liaising with the press and managing the study's press release. Special thanks to *RadioLive* and *News Talk ZB* for inviting me to talk about this study on your radio shows and *The North Shore Times* for publishing articles on this study.

To my family: Mum, Dad, Gran, Gareth, Vicki and Willow. It is difficult to put into words the sincere gratitude I have for you. You have supported me emotionally and financially throughout my studies and helped me face some enormous life challenges that presented themselves along the way. Your interest, feedback and advice throughout this research was invaluable. You have believed in me and given me unconditional love throughout my whole life and most of all you have been my best friends and confidants. Thank you to all my friends who have stood by me no matter what. I have an extremely blessed and fulfilled life because of you all.

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LIST OF ABBREVIATIONS AND SYMBOLS

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Abbreviation or symbol	Definition
%	Percentage
<	Less than
=	Equal to
>	Greater than
±	Plus-minus
≤	Equal to or Less than
≥	Equal to or Greater than
ANOVA	Analysis of variance
AUS	Australia
BMI	Body mass index
CACFP	Child and Adult Care Food Program
CDC	Centers for Disease Control and Prevention
CI	Confidence Interval (i.e. Upper and Lower Bounds)
cont.	Continued
d	Cohen's effect size index
df	Degrees of freedom
Dr	Doctor
e.g.	Example
ECE	Early childhood education
et al.	and others
F	F-ratio
HHA	Healthy Heart Award
IBM	International Business Machines Corporation
kg	Kilogram
MEDLINE	Medical Literature Analysis and Retrieval System Online

MeSH	Medical Subject Headings
METs	Metabolic equivalents
mg	Milligram
MoH	Ministry of Health
MS	Mean squares
MSc	Master of Science
MVPA	Moderate-vigorous intensity physical activity
N	Population size
n	Sample size
NAP SACC	Nutrition and Physical Activity Self-Assessment for Child Care
NK	Nutrition knowledge
NSW	New South Wales
NZ	New Zealand
OECD	Organisation for Economic Co-operation and Development
PAHA	Physical Activity Health Alliance
PAK	Physical activity knowledge
PubMed	Public/Publisher MEDLINE
P-value	The probability of rejecting the null hypothesis when it is true
r	Pearson's product-moment correlation coefficient
r^2	Coefficient of determination (r-squared)
RCT	Randomised control trial
RDA	Recommended daily allowance
RDI	Recommended daily intake
r_s	Spearman's correlation coefficient
SD	Standard deviation
SPANS	Schools Physical Activity and Nutrition Survey
SPSS	Statistical Package for the Social Sciences
U	Mann-Whitney U (Wilcoxon) statistic
UK	United Kingdom
US or USA	United States of America

USDA	United States Department of Agriculture
VPA	Vigorous intensity physical activity
WHO	World Health Organization
y	Years
z	Standard score
zBMI	Body mass index-for-age z-score (or standard deviation score)
β	Greek Beta (the probability of a Type II error)

CHAPTER 1: INTRODUCTION

Childhood obesity is a preventable epidemic, yet 41 million under-five-year-old children in the world were overweight or obese in 2014 (World Health Organization, 2016a). In New Zealand, the prevalence of obesity amongst 2-4-year-olds was recently as high as 7% (Ministry of Health, 2016). Meanwhile, New Zealand childcare attendance rates are amongst the highest in the world (Organisation for Economic Co-operation and Development, 2014), with almost 96.7% of children starting school having attended early childhood education (ECE) in the year ending December 2016 (Education Counts, 2017). With more children being enrolled for longer hours in childcare (Education Counts, 2017; Ministry of Education, 2013; OECD, 2014), these settings are increasingly being targeted for improving child health and preventing obesity (Larson, Ward, Neelon, & Story, 2011; Sisson, Krampe, Anundson, & Castle, 2016; Story, Kaphingst, & French, 2006; Swinburn, Egger, & Raza, 1999; Young, 1997).

Alarmingly, even with mixed evidence (Pearce et al., 2010; Zahir, Heyman, & Wojcicki, 2013), children who attend childcare may be more likely to be overweight or obese, compared to children who do not attend childcare (Geoffroy et al., 2013; Gubbels, Gerards, & Kremers, 2015; McGrady, Mitchell, Theodore, Sersion, & Holtzapple, 2010). A United States (US) cross-sectional study reported that a less obesogenic and healthier nutrition and physical activity childcare environment was associated with lower body mass index (BMI) percentile amongst 3-5-year-olds (Sisson et al., 2015). Yet, several obesogenic (obesity-promoting) features have been identified in childcare, including high electronic screen availability and use, small outdoor/indoor space, limited structured play, lack of portable or diverse equipment (Dowda et al., 2009; Gerritsen, 2016; Hodges, Smith, Tidwell, & Berry, 2013; Vanderloo, Tucker, Johnson, Burke, & Irwin, 2015), insufficient teacher training in physical activity or nutrition (Derscheid, Umoren, Kim, Henry, & Zittel, 2010; Hodges et al., 2013), low service quality (Britto et al., 2017; Dowda et al., 2009), food of poor nutritional quality (Larson et al., 2011), limited nutrition education for children (Jones &

Zidenberg-Cherr, 2015) and limited written nutrition or physical activity policies (Bell et al., 2015; Gerritsen et al., 2016; Larson et al., 2011). Obesogenic behaviours are also prevalent in childcare. Two large reviews investigating pre-schoolers' physical activity across several countries (e.g. US, Belgium, Scotland, Sweden and Australia) reported low levels of objectively measured physical activity and high sedentary behaviours amongst pre-schoolers while in childcare (Hodges, Smith, Tidwell, & Berry, 2013; Reilly, 2010 (Vanderloo, 2014)). Poor dietary habits are also common (Gerritsen, Wall, & Morton, 2016; Larson et al., 2011; Story et al., 2006), with pre-schoolers frequently consuming high saturated fat foods and eating few vegetables in childcare (Larson et al., 2011).

Low physical activity, high sedentary behaviours and poor diets are associated with increased body fat mass (Hodges et al., 2013). Insufficient physical activity may lead to poor motor skill attainment (Barnett, Morgan, van Beurden, & Beard, 2008; Brown et al., 2009; Williams et al., 2008; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006), diminished cognitive development (Timmons et al., 2012), reduced bone density (Goulding et al., 2000; Janz et al., 2007; Timmons et al., 2012), disrupted sleep patterns (Daniels, 2006; Thompson & Christakis, 2005) and impaired motor competence that may affect lifelong physical activity (Ali, Pigou, Clarke, & McLachlan, 2017). Obese children often experience breathing difficulties, poor sleep, low self-esteem, podiatric complications, hypertension, hyperlipidaemia, insulin resistance (Daniels, 2006; Reilly, 2005) and bone fractures (Goulding et al., 2000). Long-term negative outcomes may include a higher risk of premature death, type 2 diabetes, cardiovascular disease and physical disability in adult years (Daniels, 2006; Reilly, 2005). In view of these complications and the role that ECE might play in reducing health risk, it is important to ensure that all aspects of ECE environments, including carers' nutrition and physical activity knowledge, are supportive for children's health and body size (Britto et al., 2017; Sisson, Krampe, et al., 2016).

Evidence of ECE teachers' nutrition and physical activity knowledge and perspectives for pre-schoolers seems relatively limited, especially in New Zealand. Studies in the US (Derscheid et al., 2010; Moore et al., 2005; Sharma et al., 2013; Soliah, Newell, Vaden, & Dayton, 1983) and Australia (Booth, Booth, Wilkenfeld, Pagnini, & King, 2007; O'Dea, 2016) report widespread positive attitudes towards nutrition or physical activity amongst childcare

staff. Yet, ECE teachers receive minimal, if any, formal nutrition and physical activity training (Gerritsen, 2016; Kane et al., 2005; McLachlan et al., 2017; Moore et al., 2005) and may lack nutrition or physical activity knowledge (Alkon et al., 2014; Freedman & Alvarez, 2010; Jones & Zidenberg-Cherr, 2015; Lanigan, 2012; Nahikian-Nelms, 1997; O'Dea, 2016; Sharma et al., 2013). Researchers have suggested that ECE teachers may lack the knowledge, skills or self-efficacy to translate positive nutrition/physical activity attitudes into practice (Derscheid et al., 2010; Moore et al., 2005). For example, in-depth qualitative interviews amongst 16 educators from four childcare centres in Tasmania, Australian showed that although most of the ECE educators agreed that they had an important role to interact with children during outdoor physical activity, some were unsure about what was expected of them during this time (Coleman & Dyment, 2013). In New Zealand, ECE teachers have expressed that they lack the skills and confidence to have difficult conversations with whānau (families) about healthy food and physical activity (Malatest International, 2014). Meanwhile, a lack of ECE teachers' knowledge, skills and confidence to provide an extensive range of physical activity opportunities have been considered to be barriers for pre-schoolers' physical activity in New Zealand childcare settings (Kolt et al., 2005; Oliver, Schofield, Kolt, & McLachlan, 2007).

Overall, studies investigating ECE teachers' nutrition and/or physical activity knowledge and perspectives have largely been conducted in the US, appear relatively out-of-date and/or use poorly validated knowledge questionnaires to measure study outcomes (Alkon et al., 2014; Derscheid et al., 2010; Freedman & Alvarez, 2010; Gillis & Sabry, 1980; Jones & Zidenberg-Cherr, 2015; Lanigan, 2012; Moore et al., 2005; Nahikian-Nelms, 1997; O'Dea, 2016; Petersen & Kies, 1972; Sharma et al., 2013; Soliah et al., 1983). More studies using validated methodologies are needed to accurately identify nutrition and physical activity knowledge gaps amongst ECE teachers, especially in New Zealand. This information should be useful to inform and justify future interventions that involve professional development for teachers.

1.1 Summary and Justification for Research

Childhood obesity remains a vast problem in New Zealand (Ministry of Health, 2017a). Without intervention, over 70 million infants and young children worldwide may be

overweight and obese in 2025 (World Health Organization, 2014). Obesity is difficult to treat (Wang & Lobstein, 2006) and current trends forecast enormous healthcare costs and burden to an already stretched health care system (Blakely et al., 2015). Early prevention is, therefore, a global priority (Ministry of Health, 2017a; World Health Organization, 2014). Furthermore, failing to take action may amount to "medical neglect" (Varness, Allen, Carrel, & Fost, 2009) or "child abuse" (Dentzer, 2010), which justifies resourcing this research. A recent Lancet Series (2017) about early childhood development has deemed home and care settings as the "single most powerful context for nurturing care," which is partially defined as "a stable environment that is sensitive to children's health and nutritional needs." In New Zealand, the revised *Te Whāriki – Early childhood curriculum* (2017) states that "a child is a treasure, to be nurtured, to grow, to flourish," and that protecting and nurturing a child's health and wellbeing includes paying attention to nutrition and physical activity. With rising childcare attendance (Education Counts, 2017; OECD, 2014) and global priorities to support caregivers' understanding of the links between child health, diet and physical activity (Ministry of Health, 2017a; World Health Organization, 2014), this research is timely. This study should also begin to improve the shortage of literature about ECE teachers' nutrition and physical activity knowledge, particularly in New Zealand. Identifying specific knowledge gaps amongst ECE teachers may lead to teachers being offered professional development that provides them with the knowledge and confidence to support children's healthy eating habits and physical activity.

1.2 Purpose of the Study

The overall purpose of this study is to provide more evidence for ECE teachers' nutrition and physical activity knowledge for pre-schoolers, particularly in New Zealand. This is in response to global priorities to maximise child development, prevent childhood obesity and ensure caregivers have the knowledge and support needed for promoting healthy lifestyles for young children (Britto et al., 2017; World Health Organization, 2014). This study offers practical information for the design of future professional development, health promotion and obesity prevention interventions in childcare.

1.3 Aims and Objectives

Aims

To measure early childhood education (ECE) teachers' nutrition knowledge for pre-schoolers (2-5-year-olds); and their perspectives towards nutrition and physical activity.

Objectives

1. To measure ECE teachers' nutrition knowledge against the Ministry of Health *Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2-18 years)*.

2. To design and validate an ECE nutrition knowledge questionnaire that satisfies psychometric criteria (content, construct validity and test-retest reliability).

1.4 Thesis Structure

Chapter 1 introduces this study by outlining aims and objectives and providing research justification. **Chapter 2** is a review of related literature, covering the background to the study and key concepts, such as childhood obesity, nutrition and physical activity for pre-schoolers and ECE nutrition and physical activity environments. **Chapter 3** is a narrative review of ECE teachers' nutrition knowledge and is presented as a manuscript for publication. **Chapter 4** shows the results of the questionnaire validation study and is presented as a manuscript for publication. **Chapter 5** shows the results of the study investigating ECE teachers' nutrition knowledge and related perspectives for pre-schoolers and has also been prepared as a manuscript. Chapters 3, 4 and 5 are presented as generic manuscripts for publication, however, are formatted to meet the requirements of the thesis. Lastly, **Chapter 6** includes a brief overview and achievement of the aims and objectives of this study, explores the impact and contributions of this research, discusses study strengths and limitations and provides final recommendations from this study. **Supplementary appendices** include additional background methods and study protocol, analyses on ECE teachers' nutrition and physical activity perspectives and a copy of the questionnaire.

1.5 Contributions of Researchers

Table 1.1. Contributions of researchers

Researcher	Contribution
Jeanette Rapson MSc Nutrition and Dietetic Student	Primary author of this thesis and responsible for all aspects of the study including: research proposal, literature reviews, assisting with ethics application, study design/questionnaire validation, liaising with key stakeholders/media press, data collection, statistical analysis and preparing the final manuscript.
Dr Cathryn Conlon Academic Supervisor	Supervision of the entire research process through to final submission. Assisted with the research question, study design and questionnaire development/validation. Assisted with the editing, finalising and submission of all thesis chapters and manuscripts.
Dr Ajmol Ali Academic Supervisor	Supervision throughout research process. Assisted with ethics application, liaising with key stakeholders, validation of questionnaire, statistical analysis and submission of narrative review. Assisted with the editing, finalising and submission of all thesis chapters and manuscripts.
Dr Kathryn Beck	Assisted with development and content validation of questionnaire. Assisted with statistical analysis for ECE teachers' responses.
Dr Pamela von Hurst Professional supervisor	Assisted with development and content validation of questionnaire.
Owen Mugridge	Assisted with research proposal and questionnaire development

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature for the topic of ECE teachers' nutrition and physical activity knowledge for pre-schoolers. MEDLINE/PubMed, Scopus and Google Scholar were searched using search terms in different combinations (Figure 2.1). Search terms were determined from this study's purpose, aims and objectives. To manage large search returns, filters were applied and reference lists from relevant articles were screened. Only full-text English journal articles published up to July 2017 were reviewed.

Date searched: March 2016 – August 2017

Search terms
Child care centre OR child care center OR childcare OR child care OR child-care OR daycare OR day care OR day-care OR kindergarten OR preschool OR pre-school OR nursery OR nurseries OR elementary OR caregiver
AND nutrition, diet, feeding
AND physical activity OR exercise
AND teacher
AND knowledge OR literacy
AND obesity OR childhood obesity
AND child development
AND New Zealand
AND questionnaire
AND knowledge validation
AND review

Filters: past 5 years, past 10 years

Electronic Databases: MEDLINE/PubMed, Scopus, Google Scholar

Figure 2.1. Search strategy

2.2 Childhood Obesity

2.2.1 Obesity rates in pre-schoolers

Worldwide overweight and obesity rates in pre-schoolers increased from approximately 4% in 1990 to 7% in 2010 (Wang & Lim, 2012). The latest prevalence rates of overweight under-5's is now 5.0%-9.9% in countries including US, Australia, Mexico, Brazil, Saudi Arabia and China , with ≥20% in Libya (World Health Organization, 2016b). In New Zealand, approximately 7% of 2-4-year-olds were obese in 2015/16 (Ministry of Health, 2016). The *Healthy Auckland Together* report (2017) found that the number of overweight or obese children in Auckland pre-schoolers was 15% and 6%, respectively. These rates are comparable to some of the highest in the world (OECD, 2017).

2.2.2 Childhood obesity aetiology

Obesity is defined as abnormal or excessive fat accumulation that mediates health risk (World Health Organization, 2016c) and is framed by a complex interaction of biological, environmental and behavioural influences (Kelly & Swinburn, 2015; Swinburn et al., 1999). Young children copy behaviours of other humans to form food and lifestyle preferences (Birch & Fisher, 1998). Therefore, pre-schoolers easily adopt surrounding obesogenic lifestyles and are highly susceptible to overweight and obesity (Reilly, 2008). Obesity is often understood as a consequence of positive energy balance, in which intake of energy from food and beverages exceeds the energy expended from physical activity and metabolism (Han, Lawlor, & Kimm, 2010). Skipping breakfast, drinking sugary drinks, insufficient sleep, low physical activity (Duncan, Schofield, Duncan, & Rush, 2008) and watching television for two or more hours per day are key risk factors associated with obesity in New Zealand children (Scragg, Quigley, & Taylor, 2006). Other factors include eating away from home, large portion sizes, coercive parenting styles (Ministry of Health, 2015b) and exposure to obesogenic environments (e.g. persistent marketing and availability of cheap, energy-dense/nutrient-poor foods) (Jenkin, Signal, & Thomson, 2011).

As society normalises obesity (Kelly & Swinburn, 2015), parents and caregivers may struggle to recognise excessive fat mass in children, with nine out of ten New Zealand

parents believing that their 2-4-year-old obese child was of normal weight (Ministry of Health, 2015c). This acceptance of, or inability to identify harmful body fatness in children may contribute to obesity aetiology.

2.2.3 Health consequences of childhood obesity

Obese children are at higher risk of being obese as adults (Llewellyn, Simmonds, Owen, & Woolacott, 2016) and may experience adverse health consequences such as breathing difficulties, podiatric impediments, hypertension, hyperlipidaemia, insulin resistance (Daniels, 2006; Reilly, 2005), psychosocial problems (Pulgarón, 2013) and musculoskeletal complaints (Paulis, Silva, Koes, & Middelkoop, 2014). These complications may increase the risk of other chronic diseases (e.g. type 2 diabetes, cardiovascular disease), some cancers (Llewellyn et al., 2016) and all-cause mortality in adulthood (Park, Falconer, Viner, & Kinra, 2012). Over-nutrition and high-fat mass early in life may be linked to rapid growth and early 'adiposity rebound' (the time when body mass index (BMI) increases from a nadir at age 3-6-years), which may increase the risk of obesity later in life (Reilly, 2008).

2.3 Nutrition for Pre-schoolers (2-5-year-olds)

2.3.1 Definitions

Nutrition is defined as "the intake of food, considered in relation to the body's dietary needs", while "good nutrition" refers to "an adequate, well-balanced diet combined with regular physical activity" (World Health Organization, no date-a).

Nutrition literacy is defined as "the degree to which individuals obtain, process and understand basic health (nutrition) information and services to make informed health (nutrition) decisions" (Carbone & Zoellner, 2012; Silk et al., 2008). This emphasises a link between specific sets of nutrition knowledge and skills with certain dietary choices and actions (Carbone & Zoellner, 2012).

Knowledge is difficult to define but can refer to the "understanding of a subject or domain" (Swain, 2013). **Nutrition knowledge** is the understanding of nutrition concepts and usually focuses more on declarative information (e.g. facts about nutrients) without considering the link between knowledge and action (Spronk, Kullen, Burdon, & O'Connor, 2014).

Pre-schoolers was recently defined by the Ministry of Health as children aged 3- to 4-years (inclusive) (Ministry of Health, 2017b). However, the Ministry of Health have previously defined pre-schoolers as "children aged from two years up until their fifth birthday" (Ministry of Health, 2015b). The latter definition is accepted in the United Kingdom (UK) (Public Health Public Health England, 2017b), Australia (Baxter, 2015) and US (United States Department of Agriculture, 2015). Still, this varies depending on geographical location or study, for example, the CDC (2017) defined pre-schoolers as 3- to 5-years of age, while the term 'under-5's' is often used to refer to pre-schoolers (De Onis, Blössner, & Borghi, 2012; Gerritsen, 2013). To avoid excluding important research, any of these definitions will be acceptable for this thesis.

2.3.2 Energy and key nutrients for growth and development

Energy requirements are high for pre-schoolers as all body organs and structures are growing and developing (Croxford, 2015). In healthy children the optimal energy intake is the amount needed for growth and to match energy expenditure (Mann & Truswell, 2012).

Carbohydrates are easily used by cells for energy and metabolism, so are ideal for supporting rapid growth and brain development during childhood (Croxford, 2015). Protein and amino acids (nine of which must be obtained from food) are essential for tissue growth, maintenance and repair, especially during rapid growth and development in children (Croxford, 2015; Mahan, Escott-Stump, L. Raymond, & Krause, 2012). Dietary fats are an important source of energy, carry fat soluble vitamins A, D, E and K and are precursors for hormones needed for child growth and development (Mahan et al., 2012; Ministry of Health, 2015b). Limiting saturated fat intake in children is important as excessive consumption of saturated fat is linked to atherosclerosis and cardiovascular disease processes, which can begin as early as the first year of life (Hong, 2010).

Dietary fibre refers to molecules in plant materials that are resistant to digestion and absorption in the small bowel, such as polysaccharides (e.g. cellulose, pectin), oligosaccharides (e.g. inulin) and lignin (Croxford, 2015). In children, dietary fibre is beneficial for digestive health (e.g. laxation, microbiota) (Dahl & Stewart, 2015; Korczak, Kamil, Fleige, Donovan, & Slavin, 2017), improving lipid profiles (e.g. reduced serum cholesterol), (Ruottinen et al., 2010) and preventing excessive energy intake and weight gain due to satiation effects (Dong, Bilger, van Dam, & Finkelstein, 2015). However, the latter is debatable with a prospective randomised control trial (RCT) showing no association between dietary fibre intake and weight status in children (Ruottinen et al., 2010). Moreover, young children have small stomachs, thus too much dietary fibre may increase their risk of reaching satiety before achieving adequate energy and nutrient intake (Ministry of Health, 2015b).

B-vitamins, iron, calcium and vitamin D are key micronutrients required in high amounts for children in critical stages of growth and development, such as in pre-school years (Croxford, 2015). B-vitamins, folate (Black, 2008) and iron (Coad & Pedley, 2014)

support children's rapid brain development, energy metabolism and maturing immunity. Calcium is vital for assisting children's rapidly developing bones and teeth (Mahan et al., 2012). Adequate calcium intake early in life maximises peak bone mass and reduces the risk of age-related bone loss and osteoporosis later in life (Weaver et al., 2016). Vitamin D has an essential role in maintaining calcium and phosphate homeostasis and supporting bone and muscle health in children, with low levels of Vitamin D being associated with rickets in children and bone disease later in life (Ministry of Health and Cancer Society of New Zealand, 2012). Overall, ensuring that young children meet all their nutritional requirements is vital for both short and long-term health outcomes.

2.3.3 Nutritional Intakes of New Zealand pre-schoolers

National nutrition surveys have not assessed dietary intakes for pre-schoolers, therefore, there is little data for New Zealand pre-schoolers' energy and nutrient intake. However, 65% and 27% of 5-14-year-olds had inadequate calcium and B-vitamin intake, respectively (Ministry of Health, 2015b). These inadequate intakes may have started in early years, however, this needs to be investigated. Regional studies (e.g. Dunedin, Auckland, Christchurch and Invercargill) indicate a prevalence of iron-deficiency anaemia in infants and toddlers ranging from at least 4-14% and that pre-schoolers could be at risk of iron-deficiency anaemia (Grant, Wall, Brunt, Crengle, & Scragg, 2007; Heath, Reeves Tuttle, Simons, Cleghorn, & Parnell, 2002; Soh, Ferguson, McKenzie, Homs, & Gibson, 2004). More dietary intake data for New Zealand pre-schoolers is needed to assess nutritional risk and direct further intervention.

2.3.4 Nutrition recommendations and feeding practices for pre-schoolers

According to the Ministry of Health *Food and Nutrition Guidelines for Healthy Children and Young People (aged 2-18 years): A background paper* (2015b), healthy children should consume the recommended daily serves of a variety of foods from the four major food groups – breads and cereals, fruits and vegetables, milk and milk products, lean meat and meat alternatives. This it to ensure children meet their energy and nutrient requirements for optimal growth, development and body weight.

2.3.3.1 Recommended servings per day

As per Ministry of Health guidelines (2015b), healthy children eating at least 4 servings of breads and cereals (e.g. 1 serving as 1 medium slice of bread), including wholegrain varieties where possible is recommended to ensure adequate energy, fibre and B-vitamin intake. Eating at least 2 servings of a variety of vegetables (e.g. 1 serving as 1 medium potato) and 2 servings of a variety of fruit (e.g. 1 serving as 1 medium banana) per day is recommended to ensure adequate energy, fibre, mineral and vitamin intake. Eating at least 2-3 servings of milk and milk products (e.g. 1 serving as 1 cup of reduced- or low-fat milk) ensures children meet their protein, energy and calcium requirements. Finally, eating at least 1 serving of lean meat or meat alternatives is recommended to ensure adequate protein, B12 and iron intake.

2.3.3.2 Serving versus portions

Although the number of servings varies across age groups, the actual serving size does not change. As per Ministry of Health guidelines (2015b), a serving size is not the same as a portion size. A portion is defined as the amount of food offered at a single eating occasion. A serving is a standard measured amount and does not vary according to the size of an individual's hand. One standard serving of milk and milk products (e.g. 250 ml glass of milk) may be too large for a child to consume in one sitting, therefore, it can be divided into two 125 ml manageable portions. It is possible that educators unintentionally use these terms interchangeably, which is misleading (McCormick & Press, 2014; New Zealand Nutrition Foundation, 2013; Nutricia, 2015). To add to the confusion, a standard serve of some food groups can sometimes equal a portion size, for example, 1 egg is 1 serving of meat alternatives and could be eaten in one sitting as 1 portion by a child (Ministry of Health, 2015b; More & Emmett, 2015) . To the author's knowledge, no studies have investigated caregivers' knowledge about serving and portion sizes in New Zealand. If knowledge gaps exist, carers may not be able to support children in meeting their daily energy and nutrient requirements.

2.3.3.3 Eating variety

Early childhood is a sensitive time for shaping lifelong healthy habits and food preferences (Birch, Savage, & Ventura, 2007). As nutrient composition and associated health benefits differ amongst fruits and vegetables, it is widely recommended that children eat a variety of foods to maximise nutrient intake (Ministry of Health, 2015b; Slavin & Lloyd, 2012). However, children have an innate preference for sweet, salty and familiar foods, and experience 'food neophobia' (a natural avoidance of unfamiliar food) due to evolutionary mechanisms to protect children from poisonous foods and maximise energy intake for survival (E Leigh Gibson & Cooke, 2017). Therefore, multiple exposures to a variety of food types, textures, colours and flavours is recommended to help children improve food acceptance, prevent suboptimal food intake, obesity (Dovey, Staples, Gibson, & Halford, 2008; E Leigh Gibson & Cooke, 2017; Taylor, Wernimont, Northstone, & Emmett, 2015) and avoid feeding difficulties throughout life (Schwartz, Scholtens, Lalanne, Weenen, & Nicklaus, 2011).

2.3.3.4 Eating frequency

As per Ministry of Health guidelines (2012b), it is encouraged that children eat regularly over the day, that is, have breakfast, lunch and dinner, and include in-between snacks (2-3 snacks) for young children if they are hungry. Regular meal patterns make it easier for children to meet their high energy and nutrient requirements despite their small stomachs (Ministry of Health, 2015b) and build positive food preferences (Birch et al., 2007). Skipping meals (e.g. breakfast) may be associated with overweight and obesity in pre-schoolers (Dubois, Girard, Kent, Farmer, & Tatone-Tokuda, 2009). Three reviews comprising meta-analyses of cross-sectional data reported a statistically significant association between skipping breakfast and excess weight gain in children (Brown, Brown, & Allison, 2013; Horikawa et al., 2011; Szajewska & Ruszczyński, 2010). Although these studies were peer-reviewed, between-study heterogeneity was apparent and cross-sectional data could not confirm causality, therefore, RCT's are needed to confirm findings.

2.3.3.5 Food and beverage choices

The Ministry of Health (2012b) recommend children consume food and beverages low in fat (especially saturated fat), drink plenty of water and avoid sugary beverages. This is because energy-dense foods and beverages increase the likelihood of excessive energy and fat intake, thus increasing obesity and chronic disease risk in children (Pérez-Escamilla et al., 2012). A recent systematic review and meta-analysis of dietary sugars and body weight reported 15 out of 23 cohort studies found increased sugar consumption (e.g. sugar sweetened beverages) was positively associated with adiposity in children, compared to only four studies showing no association (Te Morenga, Mallard, & Mann, 2013). A systematic review and meta-analysis reported a significant relationship between obesity and dental caries in children (Hayden et al., 2013). A recent meta-analysis and meta-regression found that high consumption of carbonated drinks and acidic snacks/sweets/fruit juices increased the likelihood for tooth erosion, while erosion occurrence was reduced by high intakes of milk and yoghurts in children (Salas et al., 2015).

The Ministry of Health (2012b) recommends children limit frequent consumption of sticky snacks (e.g. fruit leathers, dried fruit) and/or foods that stay in the mouth too long (e.g. lollipops, sipping fruit juices constantly). This is to avoid demineralisation of children's teeth, caused by exposing their characteristically vulnerable teeth to excess sugar and acid (Kierce, Boyd, Rainchuso, Palmer, & Rothman, 2016). Alcohol (Newbury-Birch, 2009) and energy drinks/shots are not recommended for pre-schoolers as they offer them no sensible health benefits (Ministry of Health, 2015b; New Zealand Food Safety Authority, 2010; Seifert, Schaechter, Hershorin, & Lipshultz, 2011). It is advised that children limit their intake of caffeinated foods and drinks (Ministry of Health, 2015b) due to potential adverse effects of caffeine in children, such as depression and disrupted sleep patterns (I. Clark & Landolt, 2017). As pre-schoolers' brains are still developing, they may be particularly sensitive to the negative effects of caffeine on the nervous system (Ahluwalia, Herrick, Moshfegh, & Rybak, 2014).

2.3.3.6 Other feeding practices

As per Ministry of Health guidelines (2012b), it is recommended that children eat meals with family as often as possible. It is unclear if eating together affects children's body size (Dietary Guidelines Assesing Dietary Guidelines Assessing Committee, 2016a; Hammons & Fiese, 2011; Valdes, Rodríguez-Artalejo, Aguilar, Jaen-Casquero, & Royo-Bordonada, 2013); unclear findings may be due to heterogeneity between studies (e.g. different definitions or outcome measures used) or studies not adequately adjusting for confounders. Meanwhile, eating together may improve diet quality and nutrition-related behaviours in children (Fiese, Hammons, & Grigsby-Toussaint, 2012; Fulkerson, Larson, Horning, & Neumark-Sztainer, 2014; Utter et al., 2013). Some of this evidence may be considered "B grade" (e.g. excellent evidence base, satisfactory impact and good consistency, generalisability and applicability) (Gerritsen & Wall, 2017), however, study designs were either cross-sectional or review papers, so are limited by being unable to prove causality. Observational research in the Netherlands investigating staff food practices and children's dietary intake observed greater dietary fibre and energy intake in pre-schoolers who ate together with childcare staff (Gubbels, Kremers, Stafleu, Dagnelie, De Vries, & Thijs, 2010). Other evidence found pre-schoolers consumed more sweet snacks when eating with childcare staff (Gubbels et al., 2015; Gubbels, Kremers, Stafleu, Dagnelie, De Vries, & Thijs, 2010). Researchers suggested the conflicting data related to the way teachers were role modelling food (Gubbels et al., 2015). For example, Hendy and Raudenbush's (2000) found that enthusiastic role modelling (e.g. "Mmm! I love mangos!") improved children's food acceptance. The problem with these types of observational or quasi-experimental studies is that it is difficult to determine or create an acceptable behaviour change that is sustained long enough to observe and measure outcomes. Nevertheless, the Ministry of Health recommend ECE teachers to "be an enthusiastic, positive role model for healthy eating during mealtimes" (Gerristen & Wall, 2017).

Encouraging children to be involved in the shopping, growing and cooking of family meals is another Ministry of Health (2012b) recommendation. These practices may improve food acceptance, nutritional intake and healthy habits in children (Dudley, Cotton, & Peralta, 2015; Van der Horst, Ferrage, & Rytz, 2014). Pre-schoolers who are involved in edible

gardens and cooking programmes may learn more about fruit and vegetables, be more willing to try new foods and consume more fruit and vegetables (Dawson, Richards, Collins, Reeder, & Gray, 2014; Garden to Table, 2017; Gerritsen et al, 2016; Hersch, Perdue, Ambroz, & Boucher, 2014; Ohly et al., 2016). Gubbels et al. (2015) observed that pre-schoolers ate less sweet snacks when they were involved in preparing meals while in childcare. Some of this evidence (Dudley et al., 2015; Hersch et al., 2014; Ohly et al., 2016) has been considered "C grade" (e.g. satisfactory evidence base and consistency, but excellent impact, generalisability and applicability) (Gerritsen & Wall, 2017), however, there is still limited quantitative evidence on this subject and most studies rely on self-reported outcome data that is likely affected by social desirability bias.

Other guidelines include making meal times/preparation fun, encouraging children to try new foods and avoiding rewards, forcing or pushing a child to eat (Ministry of Health, 2012). Supporting evidence for these recommendations are centred around improving food preferences, dietary intake or improved weight status in children (Gerritsen & Wall, 2017).

2.4 Nutrition in Early Childhood Education (ECE)

2.4.1 Food and nutrition environments in ECE centres

ECE centres include any group-based education and care setting for under 5-year-olds (e.g. day cares, nurseries, pre-schools and kindergartens) (Ministry of Education, 2016). All licensed ECE services are required to follow the *Education (Early Childhood Services) Regulations 2008* (2017b) which specify that food is to be "served at appropriate times to meet the nutritional needs of each child while they are attending. Where food is provided by the service, it is of sufficient variety, quantity and quality to meet these needs. Where food is provided by parents, the service encourages and promotes healthy eating guidelines." A recent New Zealand study investigating nutrition and physical activity policy and practice in 257 ECE centres reported that regulations are weak and lack comprehensiveness in comparison to other countries (Gerritsen et al., 2016). Most of these services did not have written nutrition policies that referred to the Ministry of Health nutrition guidelines (2012b), which may make it difficult for teachers to know about and promote nutrition guidelines.

It may be common practice to serve high fat, sugar and/or salt foods on special occasions and fundraisers in childcare. Gerritsen et al. (2016) found that on special occasions, one in seven of the 257 ECE centres investigated in New Zealand typically served confectionary items, with a few offering fizzy, sports or cordial drinks; only half of the centres offered fruit and vegetables, one in four centres served three or more types of food that were high in sugar, salt and/or saturated fat and fundraisers mostly featured high-energy-low-nutrient foods (e.g. pizza, pies, cake). Some of these centres reported celebrating special occasions weekly, which suggests children are likely eating "occasional" foods more regularly than advised by the Ministry of Health (2015b). Similar practices were reported in US childcare centres (Lynch & Batal, 2012; Trost, Ward, & Senso, 2010), with some centres offering a weekly 'treat day' (e.g. Fridays) that involved several high fat/sugar treat foods (e.g. cookies) (Lynch & Batal, 2012). Other common negative feeding practices in the US have included hiding unfamiliar foods or using food rewards to entice children to try new foods (Gubbels et al., 2015; Lynch & Batal, 2012), however, some positive behaviours have also been reported (e.g. eating together). In New Zealand, a positive finding was that almost all ECE centres (89.5% of 257 centres) had edible gardens and 60% of centres reported that teachers cooked and talked with children at least weekly (Gerritsen et al.,2016). Overall, more studies are needed to clarify ECE teachers' feeding practice knowledge and behaviours, especially in New Zealand.

2.4.2 Te Whāriki – Early childhood curriculum

The recently updated *Te Whāriki – Early childhood curriculum* (2017) considers New Zealand's early learning standards to be amongst the highest in the world. It is a celebrated framework that has provided New Zealand's distinct approach to early learning; for example, it uses the concept of a green whāriki or woven mat that references several concepts including new life, learning, growth, potential, expert planning and cultural diversity and connectedness. Child carers are encouraged to keep informed about nutrition and physical activity information, model healthy eating and physical activity to children, teach these as part of early learning curriculum and reflect "in what ways are individual nutritional needs or preferences catered for?" (Ministry of Education, 2017c).

2.4.3 The Healthy Heart Award programme

The Heart Foundation offers the *Healthy Heart Award (HHA)* programme for ECE centres, which aims to combat childhood obesity by providing guidance and structure for ECE centres to create supportive environments for healthy eating and physical activity for under-5's (NZ Heart New Zealand Heart Foundation, 2015). The programme has three levels that follow a bronze, silver and gold system (*Rito Award*, *Whānau Award* and *Pā-harakeke Award*, respectively). Achievement criteria becomes more stringent as the levels progress and once they have completed all four strands on one level, they become a *HHA ECE service*. The benefits of participating in the programme include nutrition and physical activity education (e.g. workshops, one on one support from a Nutrition Advisor), access to useful resources and promotion for the ECE centre involved. Nutrition Advisors provide support in policies, food provision, learning and teaching, collaboration and professional development. Workshops cover nutrition fundamentals for under-fives, such as the importance of nutrition in early years, healthy food groups (application to lunchboxes and menus), portion sizes and food choices to avoid. These can be tailored according to centre needs (e.g. healthy celebrations).

2.4.4 ECE teachers' nutrition knowledge for pre-schoolers

Contrary to common assumptions, ECE teachers may lack nutrition knowledge for pre-schoolers (Derscheid et al., 2010; Freedman & Alvarez, 2010; Jones & Zidenberg-Cherr, 2015; O'Dea, 2016; Sharma et al., 2013). A narrative review about ECE teachers' nutrition knowledge is provided in Chapter 3 of this thesis. Studies (mostly in the US) reported a lack of or low levels of nutrition knowledge amongst ECE teachers (Alkon et al., 2014; Derscheid et al., 2010; Freedman & Alvarez, 2010; Gillis & Sabry, 1980; Jones & Zidenberg-Cherr, 2015; Lanigan, 2012; Moore et al., 2005; Nahikian-Nelms, 1997; O'Dea, 2016; Petersen & Kies, 1972; Soliah et al., 1983). This data could not be extrapolated to New Zealand ECE teachers due to variances in population characteristics (e.g. ethnicity), being relatively out-of-date (ranging from 1970-2015) and variances in study design.

Nutrition knowledge deficits amongst ECE teachers may be expected if teachers do not typically receive formal nutrition training (Coleman & Dyment, 2013; Moore et al., 2005) and if generic competencies (e.g. thinking) rather than domain-specific knowledge (e.g. nutrition) are prioritised (Hedges & Cullen, 2005; Kane et al., 2005; McLachlan, Fleer, & Edwards, 2013; Ministry of Education, 1996, 2007). At most, a few hours of nutrition training is included during a 3- or -4-year teacher training qualification in New Zealand and the UK (Gerritsen, 2016). Teachers may learn about nutrition through ECE initiatives such as the HHA, yet only 25% of ECE centres (approximately 1100 out of 4500 centres) throughout New Zealand were involved in this programme in 2014 (Malatest International, 2014). Therefore, a large majority of ECE teachers may not be receiving adequate nutrition training and support.

2.4.5 Barriers for ECE teachers' nutrition and physical activity knowledge

2.4.5.1 Educational background

US studies reported that ECE teachers with higher teacher qualifications may have greater nutrition knowledge (Gillis & Sabry, 1980; Nahikian-Nelms, 1997; Soliah et al., 1983) and may be more able to promote healthy eating in pre-schoolers (Derscheid et al., 2010). One review found that a 4-year college degree, especially with some specialised content, was associated with better teacher behaviour, skills and knowledge in centre-based ECE settings (Whitebook, 2003). Perhaps if ECE teachers received specialised nutrition or physical activity training, ECE teachers' knowledge would improve in these areas. In disagreement, Jones et al. (2015) found no association between teachers' education level and nutrition knowledge amongst 102 US kindergarten to 12th grade teachers. However, high school teachers had significantly higher nutrition knowledge scores than elementary or middle school teachers, which researchers suggested may have related to differences in education (Jones & Zidenberg-Cherr, 2015).

Meanwhile, although not all studies agree (Gillis & Sabry, 1980; Nahikian-Nelms, 1997), a mixed mode descriptive study involving 168 childcare staff in the UK found that those with previous nutrition training had better nutrition knowledge (Moore et al., 2005).

This is supported by studies reporting ECE teachers' nutrition knowledge significantly improved following nutrition training (O'Dea, 2016; Unusan, 2007). For example, Australian elementary teachers' nutrition knowledge scores doubling after exposure to a nutrition workshop (O'Dea, 2016). Furthermore, ECE teachers from four ECE centres in Tasmania, perceived that physical activity training would improve their confidence teaching physical activity to children (Dyment & Coleman, 2013). Overall, this evidence suggests that if ECE qualifications or previous nutrition and physical activity training are enablers for ECE teachers' nutrition and physical activity knowledge, then a lack of these may be knowledge barriers.

2.4.5.2 Perceived responsibilities

Internal motivation and responsibility to learn is a principle of andragogy (the theory of adult learning) popularised by Knowles (1975, 1980) . According to a recent qualitative study, teachers are motivated to pursue professional development if they are dissatisfied with their teaching and student's learning (Appova & Arbaugh, 2018). With society normalising obesity (Kelly & Swinburn, 2015) and if ECE teachers perceive that it is mostly the parents' responsibility to provide a child's healthy diet (Moore et al., 2005), teachers may not be experiencing the dissatisfaction needed to motivate professional development in nutrition and physical activity. Thus, a lack of perceived responsibility may be a barrier for ECE teachers' nutrition and physical activity knowledge.

2.4.5.3 Confounding nutrition messages

Contradictory nutrition advice in the media (Nestle, 2013) may be a barrier for ECE teachers' nutrition knowledge. A cross-sectional study involving 176 ECE teachers in the US reported nutrition knowledge deficits in ECE teachers, with more than half the teachers having trouble knowing what nutrition information to believe (Sharma et al., 2013).

2.4.5.4 Other potential barriers

Common barriers for teaching nutrition in kindergarten to 12-grade schools in California included a lack of instructional time and nutrition knowledge being untested in

State tests (Jones & Zidenberg-Cherr, 2015). Teachers' perceived self-efficacy may also be a factor that influences teachers' motivation to develop new skills and implement health interventions (Payr et al., 2014). Perhaps these are barriers for ECE teachers' nutrition and physical activity knowledge, however, more studies are needed to specifically identify barriers for ECE teachers' nutrition and physical activity knowledge. Additionally, most studies discussed in this section rely on self-reported data, so may be subject to social desirability bias; conducting RCT's or studies using validated measuring tools may improve the quality of evidence on this topic.

2.4.6 The impact of ECE teachers' nutrition knowledge

2.4.6.1 Improved nutrition knowledge or behaviours in children

O'Dea (2016) found that increased nutrition and physical activity knowledge in primary teachers did not predict children's nutrition and physical activity knowledge, behaviours, attitudes or self-efficacy. However, this study demonstrated limited generalisability and similar studies appear sparse. Therefore, more research may find that ECE teachers' nutrition knowledge can predict children's nutrition knowledge or behaviours, especially in light of evidence suggesting that parents' nutrition knowledge predicts children's nutrition knowledge (Barzegari, Ebrahimi, Azizi, & Ranjbar, 2011). Furthermore, a systematic review reported that nutrition knowledge may play a small but pivotal role in the adoption of healthier food habits and found that providing nutrition education to school children can bring about positive change in children's dietary behaviour, which may last over 2-years (Worsley, 2002).

2.4.6.2 Improved health behaviours in teachers

Longitudinal research in the US found a reduction in teachers' misconceptions (e.g. using food as a reward for good behaviour) was significantly associated with improved feeding practices (e.g. involving children in food preparation) in bivariate ($r=0.52$, $P<0.01$) and regression analysis ($\beta=0.90$, $P<0.01$), yet these effects were not uniform across all practices (Lanigan, 2012). Alkon et al. (2014) found that although non-significant, there were positive changes in teachers' feeding practices (e.g. improvements in types of foods offered)

within the intervention ECE centres compared to control ECE centres. In Turkey, a study examining the effects of nutrition knowledge on self-reported behaviours of ECE teacher candidates found that as candidates' nutrition knowledge increased, their eating behaviours improved. For example, they started eating breakfast and lunch every day, reduced their sodium and sugar intake and/or increased their water consumption (Unusan, 2007). If improvements in ECE teachers' nutrition knowledge leads to positive dietary changes, not only should teachers experience personal health benefits, but they may be better able to role model healthy lifestyles to children (Derscheid et al., 2010; Gubbels et al., 2015; Hendy & Raudenbush, 2000; Nicklas et al., 2001).

2.4.6.3 Improved BMI in children

A seven-month RCT that offered nutrition and physical activity workshops for childcare providers and parents in US childcare centres reported a significant increase in providers' and parents' knowledge of nutrition and physical activity, as well as improved BMI in pre-schoolers (Alkon et al., 2014). If was not discussed as to whether ECE teachers' knowledge directly played a role in improving pre-schoolers' body size, so further investigation is needed. A systematic review of parental influence and obesity prevention in pre-schoolers showed that parents' knowledge may improve pre-schoolers' weight (Skouteris et al., 2011), thus future studies may find similar effects amongst ECE teachers' and pre-schoolers.

2.4.6.4 Improved nutrition environments in childcare

Molloy, Kearney, Hayes, Slattery and Corish (2015) recently investigated nutrition environments in 62 Irish pre-schoolers using a randomised study. They reported healthier nutrition environments with increased nutrition education of managers and teachers (Molloy et al, 2015). Furthermore, a large intervention showed childcare staff were able to create more supportive meal time feeding environments following nutrition training (Sigman-Grant et al., 2011). This evidence suggests that better nutrition knowledge amongst ECE teachers may improve childcare nutrition environment. However, both of these studies

used observational data that may be limited by subjective analysis, thus RCT's or studies using validated outcome measuring tools may be needed to establish causality.

2.4.6.5 Improved rates of teaching nutrition in class

Elementary, middle and high school teachers in the US who received professional development in health instruction were 2.3 times more likely to teach nutrition in class (Hammerschmidt, Tackett, Golzynski, & Golzynski, 2011; Lambert & Carr, 2006). Jones et al. (2015) reported that ECE teachers believed that improving their nutrition knowledge would increase their likelihood to teach nutrition in class, yet about half of the teachers who did not teach nutrition disagreed. This was supported with no significant difference in teachers' knowledge between those who taught nutrition and those who did not. Mixed evidence may be a result of studies failing to accurately assess knowledge and literacy deficits or behaviours (Parmenter & Wardle, 1999; Spronk et al., 2014) (see section 2.6). Nevertheless, improved ECE teachers' nutrition knowledge may improve rates of teaching nutrition in class, which is important because providing nutrition education to children is a global obesity prevention strategy (World Health Organization, 2016b).

Good nutrition is recommended alongside adequate physical activity as both are considered equally important for children's health, development and obesity prevention (Ministry of Health, 2015b). Therefore, the next section will outline physical activity for pre-schoolers, including evidence for ECE teachers' physical activity knowledge and perceptions.

2.5 Physical Activity for Pre-schoolers (2-5-year-olds)

2.5.1 Definitions

Fundamental movement skills are the foundational movements needed to engage in physical activities, which can be categorised into **locomotive skills** (directional movement, such as walking, running, hopping), **stability skills** (static or dynamic body balance, such as landing, rotating) and **manipulative skills** (handling and controlling objects, such as kicking, catching, throwing) (Sports New Zealand, 2012).

Moderate-vigorous intensity physical activity (MVPA) is distinguished by a slight, but noticeable, increase in breath and heart rate following movement such as brisk walking, cycling (WHO, no date-b).

Vigorous intensity physical activity (VPA) is signalled by a sensation of feeling out of breath following movement such as running and hiking uphill (WHO, no date-b).**Motor competence** goes by many different terms (e.g. motor proficiency, motor performance, fundamental movement or motor skill and motor coordination) and essentially describes purposeful bodily actions and the capacity of an individual to coordinate and control their body in space (Robinson et al., 2015; Stodden, Langendorfer, & Roberton, 2009).

Physical activity refers to all bodily movements that require energy expenditure including work, recreation, exercise, sporting activities and play (Sports New Zealand, 2012). Physical activity can be categorised as structured (e.g. sporting games with rules) or unstructured (e.g. child directed free play time) (Coleman & Dyment, 2013).

Physical activity literacy is "the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for maintaining purposeful physical pursuits/activities throughout the life course," which is in the context of maximising an individual's human health and abilities (Whitehead, 2013).

Play has been interpreted in various ways in the literature (Ebbeck & Waniganayake, 2010; Wood & Attfield, 2005). However, for this research, play is considered as physical

activity for pre-schoolers (e.g. bike riding, digging in the sand, tag games) (Coleman & Dyment, 2013).

Sedentary behaviour is so far defined as "any waking behaviour characterised by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting or reclining posture" (Barnes et al., 2012). It is a discrete concept that has different determinants to physical activity and does not merely indicate a lack of physical activity (Reilly, 2008).

2.5.2 Physical activity for growth and development

Children need physical activity for developing strong musculoskeletal tissues, a healthy cardiovascular system, social and mental well-being and for maintaining energy balance and metabolism for growth and development (Janssen & LeBlanc, 2010; Lindsay, Greaney, Wallington, Mesa, & Salas, 2017; World Health Organization, 2016d). Although evidence for a dose-response relationship between physical activity, sedentary behaviour and obesity remains unclear, it is suggested that physical activity is obesity-protective during pre-school years, while sedentary behaviour (e.g. television viewing) is obesogenic (Reilly, 2008).

Physical activity cultivates the development of fundamental motor skills needed for motor competence (Robinson et al., 2015). However, children do not organically learn fundamental movement skills through maturation alone (Goodway & Branta, 2003). Instead, these skills must be continually fostered and taught (Robinson et al., 2015), which highlights the importance of equipping caregivers for this task. Pre-schoolers with better motor competence are shown to be more active, compared to children with less-developed motor skills (Williams et al., 2008). Early development of motor competence may increase the likelihood that physical activity is sustained throughout the life (Ali et al., 2017). Children with better motor competence are 10-20% more likely to engage in vigorous physical activity (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009), have better physical fitness and greater perceived sports competence in adolescence (Barnett, Morgan, van Beurden, & Beard, 2008). Together, these outcomes may increase the likelihood that physical activity is sustained throughout life (Ali et al., 2017). Better motor skills may also lead to enhanced

cognitive function and academic achievement in children up to the age of 13-years (Haapala, 2013) and improved weight status across childhood and adolescence (Robinson et al., 2015). Children that lack mature motor skills may be at greater risk of injury (e.g. falls due to lack of balance or coordination), therefore, enhancing children's motor competence early in life is suggested as an effective strategy to reduce risk of fall related injury (Adirim & Cheng, 2003; Pigou, 2013).

Increased sedentary behaviour of pre-schoolers in childcare is strongly linked to several negative health outcomes, such as poor executive functioning (Nathanson, Aladé, Sharp, Rasmussen, & Christy, 2014), decreased emotional well-being, poorer family functioning (e.g. getting on with parents) (Hinkley et al., 2014) and obesity (Reilly, 2008; Vanderloo, 2014). The *Framingham Children's Study*, which followed 106 children from pre-school years to early adolescence (about 11-years), found television viewing to be independently associated with BMI throughout childhood, and when combined with high-fat diets or further sedentary behaviours, effects were worsened (Proctor et al., 2003).

2.5.3 Physical activity recommendations for pre-schoolers

The Ministry of Health (2017) recently published the *Sit Less, Move More, Sleep Well Active Play Guidelines for Under-fives.* To "sit less", these guidelines advise that under-5's should be provided with regular activity breaks to limit children's sitting time, have screen time limited to less than one hour per day (at best) for children aged two years or older and limit time in equipment that restricts free movement. To "move more," under-5's should be provided with fun physical activities for at least three hours per day, spread throughout the day with plenty of opportunities for active play (Ministry of Health, 2017b).

Similarly, Australia (Australian Government Department of Health and Ageing, 2010) and the UK (Physical Activity and Health Alliance, 2010) recommend that pre-schoolers engage in at least 3 hours of physical activity daily and that sedentary activity should be no more than one hour per day. US guidelines are more specific in terms of intensities and types of play. For example, it is recommended by the National Association for Sport Physical Education that "pre-schoolers should accumulate at least 60 minutes of structured and at

least 60 minutes, and up to several hours, of unstructured physical activity every day, and should not be sedentary for more than 60 minutes (unless sleep)" (as cited in Cliff, Reilly, & Okely, 2009). The American Heart Association (2013) recommend that all children aged 2 years and older should engage in at least 60 minutes of moderate-intensity physical activity daily that are developmentally appropriate and varied. Canadian guidelines outline that "pre-schoolers (aged 3–4-years) should accumulate at least 180 minutes of physical activity at any intensity spread throughout the day, including a variety of activities in different environments, activities that develop movement skills, and progression toward at least 60 minutes of energetic play by 5-years of age" (Tremblay et al., 2012). With increasing physical activity research in pre-schoolers (Allen and Clarke, 2016; Hodges et al., 2013; Reilly, 2008) and New Zealand now having more specific guidelines for under-5s, it seems that positive steps are being made towards more universal and evidence-based physical activity guidelines for pre-schoolers.

2.5.4 Physical activity in ECE centres

Two large recent reviews of children's physical activity report that pre-schoolers are engaging in low levels of objectively measured physical activity while in childcare and generally do not meet recommendations for 60 minutes of MVPA daily (Hodges et al., 2013; Reilly, 2008). Other studies show that between 4%-10% under-5's were not engaging in 180 minutes of daily physical activity (Goldfield, Harvey, Grattan, & Adamo, 2012; Hnatiuk et al., 2012). Longitudinal research involving 242 children in New Zealand found that physical activity levels of 5-year-olds had reduced by about half of that observed when they were 3-years-old, which researchers speculated might relate to childcare attendance (Taylor, Williams, Farmer, & Taylor, 2013). Additionally, although most (n=203, 86.8%) of 237 New Zealand ECE services provided teacher-led play for some part of the day, more than half of the play centres reported that they provided only child-led 'free play' (Gerritsen et al., 2016), which misaligns with Ministry of Health (2017b) guidelines to balance unstructured play with adult-led activities.

A recent review (including studies from the US, Australia, UK and Canada) found that the time pre-schoolers spent sedentary ranged from 34%-94%, with a median of 77%

(approximately 10 hours per day) (Hnatiuk, Salmon, Hinkley, Okely, & Trost, 2014). A systematic review of pre-schoolers' screen-viewing (including studies in the US and Australia) reported somewhat high sedentary behaviour involving screens (e.g. television, tablets and computers) amongst pre-schoolers in centre- and home-based childcare (approximately 0.1-1.3 and 1.8-2.5 hours/day, respectively) (Vanderloo, 2014). Gerritsen et al. (2016b) found that most 3-4-year-olds use screens occasionally and one-third of children (from the sample of 237 New Zealand ECE centres) use screens at least weekly. If New Zealand pre-schoolers are watching 2 hours or more of television daily outside ECE (Ministry of Health, 2015a), researchers suggest that any screen-time whilst in childcare would far exceed recommended screen-use limits (Sarah Gerritsen et al., 2016).

Barriers for pre-schoolers' physical activity in childcare include limited physical activity policies (Bell et al., 2015; Sarah Gerritsen et al., 2016), high electronic screen use, lack of variety or portability of play equipment, small indoor and outdoor play spaces, insufficient teacher training in physical activity (Dowda et al., 2009; Sarah Gerritsen et al., 2016; Hodges et al., 2013; Vanderloo et al., 2015) and rigid safety regulations (e.g. playground equipment height restrictions) (Coleman & Dyment, 2013). In New Zealand, other barriers have included limited storage, insufficient funds, lack of staff training in unstructured play and safety concerns of parents (Sarah Gerritsen et al., 2016). In contrast, characteristics of more supportive ECE environments include "structured and unstructured physical activity opportunities, accessibility to a variety of portable play equipment and high levels of intentionality from staff" (Peden, Jones, Costa, Ellis, & Okely, 2017). Building these types of environments and addressing physical activity barriers may improve pre-schoolers physical activity levels (Peden et al., 2017; Vanderloo et al., 2014).

2.5.5 ECE teachers' physical activity knowledge and perspectives for pre-schoolers

Several misconceptions towards physical activity feature amongst ECE teachers, including an assumption that children are naturally active (Goldfield, Harvey, Grattan, & Adamo, 2012; J. Hnatiuk et al., 2012; McLachlan, 2015) and are fragile so must be wrapped in "cotton wool" (be extensively protected from physical injury) (Coleman & Dyment, 2013; Hyndman & Telford, 2015). These misconceptions may be cultivated by overly-restrictive ECE playground

regulations (e.g. equipment height restrictions and small minimum outdoor play spaces), which emphasise safety and may restrict children's movement during outdoor play (Coleman & Dyment, 2013; Dwyer, Higgs, Hardy, & Baur, 2008; Sarah Gerritsen et al., 2016). Additionally, despite teachers' beliefs that structured play is important for children (Coleman & Dyment, 2013; McLachlan et al., 2017), a preference for providing unstructured play may persist amongst ECE teachers (Cashmore & Jones, 2008; Sarah Gerritsen et al., 2016). This may be an effect of certain approaches to early childhood learning, including Reggio Emilia pedagogy, which emphasises the environment as the third teacher rather than specifying that ECE teachers should intentionally teach physical activity to children (Fraser & Gestwicki, 2002; McLachlan et al., 2017). However, teachers also appear to be unsure of how to provide structured play to children (Coleman & Dyment, 2013; McLachlan et al., 2017), which suggests that they may lack the knowledge, skills and confidence to translate their positive intentions to support children's physical activity into practice (Derscheid et al., 2010).

A recent New Zealand study assessed how ECE teachers' knowledge and skills changed following a 10-week physical activity intervention programme (*Jumping Beans*) that involved teacher professional development (McLachlan et al., 2017). Positive changes in teachers' physical activity knowledge and skills were found post-intervention, for example, teachers were more aware of the importance of physical activity for children. However, some negative findings persisted post-intervention, for example, teachers still did not have the confidence to teach physical activity and were unable to articulate how *Te Whāriki* related to physical activity. Teachers also continued to externalise responsibility by surmising that they could not offer a challenging physical activity programme without an increase in resources or external support (McLachlan et al., 2017). Meanwhile, Gerritsen et al. (2016b) recently reported that more than half of 257 ECE centres sampled in New Zealand were unable to identify a physical activity 'champion' (someone in their centre who actively shares knowledge and skills about physical activity while promoting physical activity to children) (Gerritsen et al., 2016). This evidence suggests that teachers may lack the physical activity knowledge, skills and confidence to support children's physical activity, which is consistent with previous research (Coleman & Dyment, 2013; Kolt et al., 2005; Oliver, Schofield, Kolt, &

McLachlan, 2007). However, larger studies that address the limitations of this evidence (e.g. self-reported bias and poor generalizability) are needed to confirm findings. As the importance of ECE teachers' nutrition and physical activity knowledge is established, it is vital to gather up-to-date evidence of teachers' knowledge. The best method to achieve this involves the use of valid and reliable knowledge questionnaires (Parmenter & Wardle, 1999; Rust & Golombok, 2014; Zinn, Schofield, & Wall, 2005). The next section will discuss nutrition and physical activity knowledge questionnaires, including questionnaire validation methods.

2.6 Nutrition and Physical Activity Knowledge Questionnaires

'Validation' refers to an assessment of how well a measuring instrument is able to measure what it is supposed to measure (Kaaks, Ferrari, Ciampi, Plummer, & Riboli, 2002). Well-validated, up-to-date knowledge questionnaires are needed to clarify current levels of ECE teachers' nutrition and physical activity knowledge for pre-schoolers. Psychometrics is the science of maximising quality assessment and provides criteria for validating a knowledge questionnaire (Parmenter & Wardle, 1999; Rust & Golombok, 2014).

2.6.1 Content validity

Content validity refers to how well the questionnaire content matches with the questionnaire purpose (Coaley, 2014; Rust & Golombok, 2014). The questionnaire items must cover all the key attributes of the subject (e.g. nutrition knowledge) and be easily read and understood by the target audience (Coaley, 2014; Parmenter & Wardle, 1999; Rust & Golombok, 2014). Items should be of a reasonable difficulty to reduce bias and scores for individual items or subcategories should correlate to the total scores (internal reliability) (Parmenter & Wardle, 1999). Face validity differs to content validity as it considers the acceptability of the test to the users, thus the test characteristics (e.g. style, format, testing conditions) should meet their expectations so that they seriously complete the test and provide meaningful data (Rust & Golombok, 2014). Content and face validity are not sufficient alone, so other forms of validity are needed (Coaley, 2014).

2.6.2 Construct validity

Construct validity is the most important form of validation in psychometrics (Rust & Golombok, 2014). It refers to the extent the measure's variance relates with the variance of the underlying construct or idea of an attribute (Coaley, 2014). This means the questionnaire must show that when administered to a group of experts (e.g. nutritionists) of the attribute in question, their scores must be significantly higher than a group of non-experts (e.g. non-nutritionists) completing the same questionnaire (Parmenter & Wardle, 1999).

2.6.3 Reliability

The questionnaire should withstand test-retest reliability, which means scores do not significantly change when completed by the same sample on two separate occasions over a specified time frame (Rust & Golombok, 2014). A two-week time frame is recommended as this is long enough that exact answers are not remembered but short enough to avoid real change in knowledge over time (Parmenter & Wardle, 1999). A Pearson product-moment correlation coefficient is generally calculated on this data, with a correlation of 1 showing perfect reliability and 0 indicating no reliability (Rust & Golombok, 2014).

2.6.4 Current questionnaires

Most studies investigating nutrition and/or physical activity knowledge in childcare have used questionnaires to measure outcomes, yet few achieve psychometric validation or provide formal validation methods (as summarised in Table 2.1). A recent systematic review of the relationship between nutrition knowledge and dietary intake in adults (mean age ≥18-years) reported that only 8 of the 29 studies used all five types of validation discussed (face validity, pre- or pilot testing, content validity, test-retest validity and internal consistency) for nutrition knowledge instruments; 7 studies did not indicate formal validation methods (Spronk et al., 2014).

As with most nutrition knowledge questionnaires (Parmenter & Wardle, 1999; Spronk et al., 2014), the questionnaires in Table 2.1 considerably vary in content and rely on less reliable self-reported data. Eight of the 12 questionnaires measured ECE teachers' knowledge about specific nutrition concepts for pre-schoolers (e.g. recommended dietary intakes (RDI's) for pre-schoolers), while four measured general nutrition knowledge (e.g. naming the 5 food groups). Questionnaires also vary in their measurement of specific nutrients (e.g. iron, calcium, vitamin A, vitamin C). Soliah et al. (1983) provided a 115-item self-administered questionnaire that measured an extensive scope of nutrition knowledge (from defining a calorie and identifying major food of vitamins/minerals to food preparation methods and advertising claims) but this content was not specifically related to pre-schoolers' nutrition. Meanwhile, O'Dea. (2016) used a questionnaire that was less

comprehensive and included items that related to the study's intervention workshops, rather than general nutrition guidelines, for example, "Can you draw the level of the human body and the brain that is made up of water?" These inconsistencies between studies make it difficult to generalise, pool or compare findings (Bangdiwala et al., 2016). Additionally, collecting knowledge of nutrition facts or RDI values could be irrelevant if these are phasing out from public nutrition resources (Ministry of Health, 2012) and food marketing or health promotion strategies (Campos, Doxey, & Hammond, 2011; Mhurchu & Gorton, 2007). Overall, it seems that the most comprehensive questionnaires chose to focus on nutrition or physical activity knowledge concepts (Nahikian-Nelms, 1997; Parmenter & Wardle, 1999; Soliah et al., 1983; Zinn et al., 2005), compared to relatively less comprehensive questionnaires that covered both nutrition and physical activity knowledge (Alkon et al., 2014). Alternatively, questionnaires have included physical activity perspective questions alongside nutrition knowledge questions (Derscheid et al., 2010; O'Dea, 2016), which seems to be a positive solution for reducing participant burden without disregarding the important symbiotic relationship of nutrition and physical activity.

Table 2.1. Psychometric validation of existing ECE teachers' nutrition and/or physical activity knowledge questionnaires

Authors (year)	*Country*	*Target population*	*Scope*	*Psychometric measures*
Jones et al. (2015)	USA	Kindergarten to 12th grade teachers	NK for pre-schoolers	Internal consistency, content and construct validity and test-retest reliability
Alkon et al. (2014)	USA	Childcare providers & parents	NK and PAK for pre-schoolers	None (content validity assessed by investigators)
O'Dea et al. (2014)	Australia	Elementary teachers	General NK	None described
Sharma et al. (2013)	USA	Head Start (childcare) teachers	General NK	Not validated itself (adapted from the validated NSW SPANS, validated for 5-16-year-olds)†
Lanigan et al. (2012)	USA	Childcare providers	NK for pre-schoolers	None described
Derscheid et al. (2010)	USA	Childcare staff and teachers	NK for pre-schoolers	None (adapted from a pilot study, which had no validation methods available‡)
Freedman et al. (2010)	USA	Childcare teachers	NK for pre-schoolers	Face and construct validity
Moore et al. (2005)	UK	Childcare providers	NK for pre-schoolers	None described
Nahikian-Nelms (1997)	USA	Childcare teachers	NK for pre-schoolers	Content validity and internal reliability (no construct validity)
Petersen et al. (1972)	USA	Childcare teachers	General NK	None (evaluated and pre-tested in population group)
Gillis et al. (1980)	USA	Day care teachers	NK for pre-schoolers	Construct and content validity and reliability
Soliah et al. (1983)	USA	Elementary teachers	General NK	Content and construct validity

†Survey can be retrieved from NSW Department of Health (2016) .
‡Pilot study from Moore et al. (2005).
Note. Studies are organised by publication date. All questionnaires included items on nutrition or physical activity perspectives/attitudes to enrich evidence.
Abbreviations: USA=United States of America; NK=nutrition knowledge; PAK=physical activity knowledge; NSW=New South Wales; SPAN=Schools Physical Activity and Nutrition Survey; UK=United Kingdom.

Zinn et al. (2005) developed a psychometrically valid and reliable sports nutrition knowledge questionnaire. Content validity was affirmed by an expert panel of six practising sports dietitians and a reviewer group of academics and hockey coaches in New Zealand, who provided verbal and written feedback on the comprehension and clarity of questionnaire items. Construct validity was achieved by comparing the mean knowledge total score and sub-category scores between five population groups: university business staff (n = 230), dietitians (n = 96), nutrition students (n= 25), business students (n = 30), fitness students (n = 60). Test-retest reliability was achieved by distributing the same questionnaire a second time (two weeks apart) to the business staff and registered dietitians who had returned their first questionnaire. To provide a more robust measure of reliability, the second measure of test-retest reliability was conducted by comparing participant's scores for each question and sub-category to their scores for the same questions of the second questionnaire.

Rust and Golombok (2014) provide guidelines for designing a reliable and valid questionnaire. These guidelines recommend providing sufficient space for demographic information, including clear and unambiguous instructions on how to choose a response (e.g. "please tick") and stressing confidentiality to improve compliance. Tips to improve layout include numbering items, keeping sentences short (<12 words per line) and grouping similar items together. Successfully validated nutrition knowledge questionnaires demonstrate these qualities (Parmenter & Wardle, 1999; Zinn et al., 2005) and clearly explain what each sub-category is about (e.g. "the first few items are about what advice you think experts are giving us" (Parmenter & Wardle, 1999)), provide a purpose for the survey (including participant rights), use easy tick formats, provide a "not sure" option, begin with easier items and place more difficult or sensitive information towards the end. These methods and features may be useful to consider for the design and validation of an ECE nutrition and physical activity knowledge questionnaire.

2.7 Summary

This literature review examined key contextual issues and evidence for ECE teachers' nutrition and physical activity knowledge for pre-schoolers. Carers' knowledge is recognised as one of many important factors to consider when supporting pre-schoolers' growth and development. Yet, there is limited data available on this subject, especially in New Zealand. Furthermore, few studies have used psychometrically valid and reliable knowledge questionnaires to objectively measure ECE teachers' nutrition and physical activity knowledge for pre-schoolers. Future studies should use validated measuring tools to accurately identify nutrition and physical activity knowledge gaps amongst ECE teachers. To sufficiently cover both nutrition and physical activity knowledge in one questionnaire may be too cumbersome for participants, thus future studies may wish to focus on one area. Additionally, collecting additional information on nutrition or physical activity perspectives should enrich discussion.

Overall, this thesis research should provide more evidence for ECE teachers' nutrition and physical activity knowledge for pre-schoolers in New Zealand. This information should be useful for interventions aiming to improve ECE teachers' nutrition and physical activity knowledge. However, investigating or improving ECE teachers' nutrition and physical activity knowledge alone will not reduce obesity or ensure optimal growth and development in children. On-going research and a multi-professional approach for supporting pre-schoolers' health eating and physical activity for optimal growth and development and body size will be needed.

CHAPTER 3: Early childhood education teachers' nutrition knowledge for 2-5-year-old children in childcare: a narrative review

3.1 Abstract

Aim To review evidence for ECE teachers' nutrition knowledge for pre-schoolers.

Methods Article searches were conducted from March 2016 to May 2017 across three databases and were considered eligible if published in English up to May 2017 and related to ECE teachers' nutrition knowledge.

Results Of the articles that met inclusion criteria (n=16), six directly measured ECE teachers' nutrition knowledge for pre-schoolers and three studies directly measured ECE teachers' general nutrition knowledge. All articles provided data for ECE staff nutrition-related attitudes, beliefs and/or behaviours. Studies were non-experimental, descriptive, cohort and/or cross-sectional, with one randomised control trial (RCT); all but one study used questionnaires to measure outcomes.

Conclusions Summarising ECE teachers' nutrition knowledge and identifying knowledge gaps contributes to existing literature and provides a resource for health promotion initiatives in ECE centres. Most studies suggested ECE teachers lack nutrition knowledge, however, more up-to-date research is needed.

Keywords: childhood obesity, child care, kindergarten, day care, nutrition environment, nutrition training, nutrition literacy, feeding practices, nutrition attitudes

3.2 Introduction

Recent trends predict that over 70 million infants and young children worldwide will likely be overweight and obese in 2025 (World Health World Health Organization, 2014). A systematic review and meta-analysis showed that obese children were about five times more likely to be obese in adulthood than children with a healthier weight (Simmonds, Llewellyn, Owen, & Woolacott, 2016). This anticipates enormous burden on already stretched healthcare structures (Blakely et al., 2015; Roberto et al., 2015). With more children being enrolled in early childcare education (ECE) centres (Education Counts, 2017; Ministry of Education, 2013; OECD, 2014), this environment is highly important for children's health, particularly with regards to body weight (CDC, Larson et al., 2011; Story et al., 2006; Swinburn et al., 1999; 1997). Despite mixed evidence (Pearce et al., 2010; Zahir et al., 2013), longitudinal and observational research report that children who attend childcare are more likely to be overweight (Geoffroy et al., 2013; Gubbels, Kremers, Stafleu, Dagnelie, De Vries, Van Buuren, et al., 2010; McGrady et al., 2010). Several obesogenic characteristics have been identified in childcare, such as limited nutrition and physical activity policies (Gerritsen, 2016; Sisson, Li, et al., 2016) and lack of outdoor and/or indoor play space for physical activity (Bell et al., 2015; Copeland, Khoury, & Kalkwarf, 2016; Henderson, Grode, O'Connell, & Schwartz, 2015; Hesketh, Lakshman, & Sluijs, 2017; Hodges et al., 2013). Although more research is needed (Geoffroy et al., 2013; Sisson, Li, et al., 2016), these characteristics are likely contributing to current obesogenic behaviours in children, such as increased screen-use, low physical activity and poor diets (Reilly, 2008; Sisson, Krampe, Anundson, & Castle, 2016), which are associated with higher disease risk factors, such as hypertension, insulin resistance (Daniels, 2006; Reilly, 2005) and increased body fat mass (Hodges et al., 2013).

One aspect of the childcare environment that remains particularly unreported is the status and role of ECE teachers' knowledge about nutrition for pre-schoolers (2-5-year-olds) in childcare. This is disconcerting with research suggesting ECE teachers' knowledge may affect the health and behaviour of children (Lanigan, 2012; Worsley, 2002). Moreover, lack of enquiry would be an inappropriate response to current global strategies that now recognise the importance of caregivers' health knowledge (Britto et al., 2017) and their understanding of the links between health, diet and physical activity for children's health (World Health Organization, 2016b). In New

Zealand, the revised *Te Whāriki – Early childhood curriculum* (2017) also advocates that child carers be frequently informed about nutrition and physical activity for children and teach these as part of early learning curriculum.

Over the past 30 years, relatively few studies have investigated ECE teachers' nutrition knowledge for pre-schoolers (Table 3.1). To the authors' knowledge, there are no literature reviews specifically reporting ECE teachers' nutrition knowledge for pre-schoolers. Therefore, the purpose of this narrative review was to address this gap in the literature and provide a summary and appraisal of published articles for what ECE teachers know about nutrition for pre-schoolers. We aim to provide evidence that advocates the importance of research in childcare and provide a resource for future health promotion initiatives. It was hypothesised that ECE teachers' lack nutrition knowledge for pre-schoolers and that this would be supported by limited evidence.

3.2.1 Objectives

The objectives of this manuscript were to first identify studies from published articles that provide evidence for ECE teachers' nutrition knowledge, and then describe and summarise what is known about ECE teachers' nutrition knowledge for pre-schoolers in childcare. The secondary objectives were to appraise studies and evaluate the need for future research investigating ECE teachers' nutrition knowledge for pre-schoolers.

3.3 Methods

This study followed available steps for writing a non-systematic narrative literature review (Green, Johnson, & Adams, 2006) and guidance for writing scientific manuscripts (Ferrari, 2015; Liumbruno, Velati, Pasqualetti, & Franchini, 2013). To align with recent New Zealand research, we defined ECE centres to include any group-based education and childcare setting for under 5-year-olds (e.g. day cares, nurseries, pre-schools and kindergartens) (Gerritsen, 2016). No ethical approval was required as this review examined existing literature.

3.3.1 Search procedure

The authors searched the credible databases MEDLINE/PubMed, Scopus and Google Scholar (Liumbruno et al., 2013) using specific search terms in various combinations. These terms were derived from study research objectives and medical subject headings (MeSh) or tag words from relevant papers (Figure 3.1). Our preliminary search of the literature endeavoured to establish the need for a review of ECE teachers' nutrition knowledge for pre-schoolers and to refine the topic and objectives. Despite efforts to refine searches, some results were excessively large and mostly irrelevant, and to screen all items was deemed extraneous for this narrative review. Therefore, a particularly relevant article was selected from these search results and then a link to similar articles was followed until a point of data saturation was experienced (e.g. studies appeared repeatedly across searches or studies). Additional references were identified by manually screening reference lists of relevant articles. To find the most recent literature, filters for specific time frames (e.g. past 5 years) were applied. Using key filters, search terms and links to related articles provided some search logic to improve search objectivity and to optimise article retrieval (Green et al., 2006). Searches were conducted March 2016 through May 2017, with articles published up to May 2017 included in this review.

3.3.2 Inclusion and exclusion criteria

An article was considered if it met the criteria listed in Figure.3.1. All types of study designs were permitted if they offered qualitative and/or quantitative data for ECE teachers' nutrition knowledge. To minimise the loss of useful data, we did not limit the inclusion of articles to ECE teachers' nutrition knowledge specifically for pre-schoolers but also considered papers reporting ECE teachers' general nutrition knowledge and/or nutrition-related attitudes, beliefs and behaviours, since these may provide insight into nutrition knowledge (Nahikian-Nelms, 1997; O'Dea, 2016; Spronk et al., 2014). Broadening our search in these ways was particularly important given the scarcity of available literature and preliminary nature of this research. A critical assessment of the articles was conducted following suggestions by Ferrari (2015). With regards to eligibility, no further information from authors was pursued.

Date searched: March 2016 – May 2017

Inclusion criteria

Written in English only
Published up to May 2017
ECE teachers in ECE childcare centres
Outcomes of ECE teachers' nutrition knowledge

Exclusion criteria

Not in English
Published after May 2017
Full-text unavailable
Articles without outcome measures for ECE teachers' nutrition knowledge

Search terms

child care centre OR childcare Or child care OR child-care OR daycare OR day care OR day-care OR kindergarten OR preschool OR pre-school OR nursery OR nurseries OR elementary OR caregiver
AND nutrition, diet, feeding
AND teacher
AND knowledge
AND review

Search terms that returned more focused results

PubMed: child, preschool OR child day care centers OR child day care centres AND nutrition knowledge
Scopus: nutrition knowledge AND teacher
Google Scholar: child care AND teacher AND nutrition knowledge

Filters: past 5 years, past 10 years

Electronic Databases: MEDLINE/PubMed, Scopus, Google Scholar

Figure 3.1. Search terms, and inclusion and exclusion criteria

3.4 Results

3.4.1 Summarising the articles

Table 3.1 summarises 16 articles identified in this literature review that provides information about ECE teachers' nutrition knowledge. Of these, six studies directly measured ECE teachers' nutrition knowledge for pre-schoolers and three studies directly measured ECE teachers' general nutrition knowledge. The remaining studies focused on ECE teachers' nutrition-related attitudes, beliefs and/or behaviours, which could be reflective of teachers' nutrition knowledge. Fourteen studies used questionnaires to measure outcomes, with one of these using additional focus groups; the remaining study used semi-structured interviewing. Most (n=10) of the studies were conducted in the United States (US), one in New Zealand, two in Australia, one in Canada and one in the United Kingdom (UK). No meta-analysis and systematic reviews were found; studies included were non-experimental, descriptive, cohort and/or cross-sectional, with one randomised control trial (RCT). Earlier studies (1970's and 1980's) focused more on ECE teachers' nutrition knowledge for pre-schoolers, with one study providing detailed information about ECE teachers' beliefs and behaviours. More recent studies, although reported on ECE nutrition knowledge, attitudes, beliefs and/or behaviours, focused on other objectives, such as investigating policies, barriers for nutrition in childcare and/or the effectiveness of nutrition programmes.

3.4.2 Outcome findings

3.4.2.1 ECE teachers' nutrition knowledge

A lack of nutrition knowledge in ECE teachers was apparent across all articles in this review, with five studies specifically reporting low objectively measured nutrition knowledge scores amongst ECE teachers (Freedman & Alvarez, 2010; Gillis & Sabry, 1980; Nahikian-Nelms, 1997; Petersen & Kies, 1972; Soliah et al., 1983). Jones et al. (2015) reported an average nutrition knowledge score of 61.4% amongst ECE teachers. This was considered "less than ideal" as questions related to current dietary recommendations, nutrients and diet-disease links that teachers would be expected to have understood well. Sharma et al. (2013) reported that out of 176 ECE teachers, only four teachers (3%) answered at least four out of five nutrition-related questions correctly, 27 teachers (18%) answered at least three correctly and no teacher was able

to answer all five correctly. Three of these questions asked about basic food groups in relation to adult nutrition guidelines (e.g. “How many servings of fruits and vegetables should you eat per day?”), while two asked about recommended daily intake (RDI) values (e.g. “What percent of your daily calories should come from fat?”). In New Zealand, a recent study of 257 ECE centres reported that staff demonstrated nutrition knowledge deficits when nutrition policies misaligned with current food and nutrition guidelines, for example, it was found that some policy statements permitted regular provision of high sugar, salt and/or saturated foods and beverages (e.g. instant noodles, milo, cordial, full-fat milk) (Sarah Gerritsen, Wall, & Morton, 2016). Although this may be more reflective of knowledge deficits amongst policy makers (who are not necessarily ECE teachers), it is possible that these policies are misinforming teachers and increasing the likelihood of nutrition knowledge deficits amongst teachers. Furthermore, several studies indicated that most ECE teachers did not know about and/or perceived a lack of nutrition resources (Derscheid et al., 2010; Jones & Zidenberg-Cherr, 2015; Nahikian-Nelms, 1997).

Four studies reported ECE teachers’ nutrition knowledge deficits before and after exposure to a nutrition intervention, with all showing significant improvements in teachers’ nutrition knowledge at follow-up (Alkon et al., 2014; Freedman & Alvarez, 2010; Lanigan, 2012; O’Dea, 2016). In Australia, O’Dea (2016) reported elementary school teachers’ overall nutrition knowledge mean score doubled after exposure to the *Healthy Active Kids* programme, and each nutrition knowledge variable showed an improvement from baseline to follow-up ($P<0.0001$). Questionnaire items related to basic nutrition concepts, such as, “Can you name the 5 food groups?” and “Can you name 1 key nutrient provided by each Food Group?” More challenging questions were included, such as “Can you draw the level of the human body and the brain that is made up of water (on the diagrams below?)” (O’Dea, 2016). Although it was shown that low baseline knowledge in students predicted their knowledge gain, knowledge gains in teachers did not predict any independent variables in children. Nevertheless, the intervention lead to several improvements in children’s dietary behaviours, for example, 89.1% of children reported “drinking more water each day” post-intervention. It was concluded that although basic nutrition knowledge was important for both teachers and students, other factors such as self-efficacy, empowerment and skill development were vital for behaviour change in children. Meanwhile, a seven-month RCT in the US reported an ($P<0.0001$) improvement in childcare staff’s overall nutrition knowledge scores post-intervention (after nutrition workshops) (Alkon et al., 2014).

Although there were no corresponding significant changes in eating behaviours or children's healthy lunches, a trend toward serving healthier lunches was observed in the intervention versus control centres, for example, an 8% increase in healthy foods offered in intervention centres compared to a 1% increase in control centres. Decreases in children's age- and sex-specific standardised body mass index (zBMI) and significant improvements in centre policies were also observed in the intervention centres.

Two studies reported objectively measured knowledge deficits amongst ECE teachers towards feeding practices at baseline. Lanigan et al. (2012) found particular feeding knowledge deficits towards the importance of child involvement in meal preparation, eating the same food as children, sitting with children at mealtimes, honouring children's satiety cues and/or respecting children's food preferences. Misconceptions about using food as a reward, children's ability to self-regulate food intake and a notion that society had gone overboard limiting sweets were also reported. Freedman et al. (2010) found that before exposure to the intervention (a nutrition class), 48% of childcare providers correctly answered "false" that dessert should be used as a reward, 46% knew that children should self-regulate food intake and 48% knew that it is not okay to cook only meals children liked was appropriate to manage picky eaters. After attending a nutrition class, these teachers showed a significant improvement in knowledge about using dessert as a reward, if children should self-regulate food intake, if children should be forced to finish eating everything on their plate, have regular meals and snacks and be allowed to eat only preferred foods to ensure food intake. No follow-up was conducted to assess knowledge retention or behaviour change, however, it was found that knowledge did not always translate into behaviour during the study, for example, >90% of respondents understood that multiple exposures to a new food increases child food acceptance, yet 59% of all providers were forcing children to finish everything on their plate before dessert.

3.4.2.2 ECE teachers' nutrition-related attitudes and beliefs

Nine of the 16 articles reported favourable nutrition-related attitudes and/or beliefs in ECE teachers (Derscheid et al., 2010; Freedman & Alvarez, 2010; Jones & Zidenberg-Cherr, 2015; Moore et al., 2005; Nahikian-Nelms, 1997; O'Dea, 2016; Petersen & Kies, 1972; Sharma et al., 2013; Soliah et al., 1983). O'Dea (2016) showed that at baseline, 66.7% of teachers believed health and nutrition were important and 26.7% believed this to be very important. The latter increased to

60% after their involvement in the *Healthy Active Kids* programme (Nestle Healthy Active Nestle Healthy Active Kids, no date) which included a teacher professional development day. Three US studies showed ECE teachers believed in the important link between nutrition and child health (Derscheid et al., 2010; Moore et al., 2005; Sharma et al., 2013). Specifically, teachers generally believed both physical activity and nutrition is essential for overall health (Derscheid et al., 2010) and 93% of teachers agreed that learning the relationship between nutrition and health was important (Sharma et al., 2013). Moore et al. (2005) reported 64% ECE teachers strongly agreed and 20% agreed slightly that diets early in life have long-term health effects. A sense of responsibility to promote health to children and widespread awareness for the need to promote fruits and vegetables to children was also found amongst these teachers, yet, 5% strongly agreed, 21% slightly agreed and 25% disagreed slightly that it is the parents' responsibility to meet children's dietary needs. Two studies found that ECE teachers believed they had a role to model nutritional concepts throughout the day and that mealtime or involving children in meal preparation encouraged children to learn about nutrition and try new foods (Derscheid et al., 2010; Nahikian-Nelms, 1997). Lynch and Batal (2012) found ECE teachers believed that it is important to not use pressure techniques to get children to eat food and that the look of food was vitally important to improve food acceptance (e.g. if food looked fresh or recognisable), especially for children with particular sensitivities to food characteristics (e.g. textures, colours).

ECE teachers also demonstrated negative nutrition-related attitudes and beliefs, for example, 14.2% of the caregivers agreed that promising a dessert or another treat encourages children to try new foods (Nahikian-Nelms, 1997). Sigman-Grant et al. (2011) found at least two-thirds of childcare staff believed role modelling, teaching, coaxing and restriction are effective strategies for getting children to try new foods. Lynch and Batal (2012) found many providers believed that to get children to eat healthily, caregivers needed to disguise less preferred foods, dilute sugary drinks or add ketchup, cheese and dips and offer dessert as a reward. Their study reported that when children were hungry soon after lunch, providers used phrases such as "If you ate better at lunch then you would have enough to keep you" or that snack time is "not for a few more hours this is why you should eat all your food at lunchtime, so you won't be starving". Furthermore, three studies that collected self-reported data on ECE teachers' nutrition-related attitudes and perspectives suggested that ECE teachers' lacked confidence about their nutrition knowledge and skills (Malatest Malatest International, 2014; O'Dea, 2016; Sharma et al., 2013).

For example, O'Dea (2016) reported that most (66%) of the teachers felt a "little confident" teaching nutrition in the classroom prior receiving the intervention nutrition workshops; only 13.3% felt very confident. Meanwhile, Sharma et al., (2013) found that half of the teachers (54%) in their study agreed that it was hard to know which nutrition information to believe.

3.4.2.3 ECE teachers' nutrition-related behaviours and feeding practices

Ten of the 16 articles reported ECE teachers' nutrition-related behaviours and/or feeding practices (Alkon et al., 2014; Freedman & Alvarez, 2010; Sarah Gerritsen et al., 2016; S Gerritsen et al., 2016; Lanigan, 2012; Lynch & Batal, 2012; Nahikian-Nelms, 1997; Petersen & Kies, 1972; Sigman-Grant et al., 2011; Soliah et al., 1983; Trost, Messner, Fitzgerald, & Roths, 2009). Gerritsen et al. (2016b) found most centres promoted some healthy eating behaviours, for example, 25% of centres in their study were involved in the *Healthy Heart Award* programme (which strives to promote and create a healthy eating environment (NZ Heart Foundation, 2015)) yet more than 50% had not yet achieved the award. Three studies found unhealthy foods were commonly served in childcare centres on special occasions and/or sold for fundraisers (Gerritsen et al., 2016; Lynch & Batal, 2012; Trost et al., 2009), with some childcare centres providing a special treat day (e.g. Fridays) that entail several treat foods (e.g. cookies) (Lynch & Batal, 2012). Trost et al. (2009) found, despite some positive practices, only 23% reported serving meals family style (e.g. eating together at the table) and less than 50% celebrated special occasions with healthy or non-treat foods. Freedman et al. (2010) showed that 59% of all providers insisted children finished all the food on their plate before dessert and that some practices were more prevalent in certain ethnic groups, for example, greater than 85% Hispanic providers reported forcing children to eat food they thought is good for them, compared to 59% Asians and 44% whites. It was also found that those with some college education were more likely to practice some positive feeding practices, such as eating with children. More recently, Gerritsen et al. (2016a) found 49.6% of the staff always talked to children in childcare about what they were eating or asked if children were full before offering a second helping of food.

In contrast, three studies reported positive behaviours and feeding practices (Derscheid et al., 2010; Freedman & Alvarez, 2010; Sigman-Grant et al., 2011). For example, despite a tendency for *Child and Adult Care Food Program* (CACFP)-funded centres to report more supportive feeding practices than non-funded centres, 90% of childcare staff from both types of centres in the US

noticed and commented on (90%) and praised (95%) children who were eating well (Sigman-Grant et al., 2011). Most (87%) reported never using food as a bribe or for consolation. Freedman et al. (2010) reported other positive behaviours, such as 63 out of 70 ECE teachers reported turning off the television during meal times. Other US ECE teachers reported sitting with children during meal times four times per day (Derscheid et al., 2010).

3.4.2.4 ECE teachers' background and nutrition knowledge/attitudes/practices

Six studies indicated that ECE teachers' educational background predicted nutrition knowledge, attitudes and/or practices (Derscheid et al., 2010; Freedman & Alvarez, 2010; Lanigan, 2012; Moore et al., 2005; Nahikian-Nelms, 1997; Soliah et al., 1983). For example, there was a statistically significant relationship (r=0.27, P=0.003) between their level of education and nutrition knowledge (Nahikian-Nelms, 1997). It was reported that compared to those with higher qualifications (e.g. bachelor's degree), ECE professionals in the US with lower education levels (e.g. high school diploma) were more likely to strongly agree that it is difficult to persuade children to try healthy foods (Derscheid et al., 2010). Similarly, years of experience was shown to be positively correlated with nutrition-related perceptions (Derscheid et al., 2010) and behaviours (Nahikian-Nelms, 1997). Furthermore, two early studies found a positive relationship between nutrition knowledge and attitudes and/or practices (Nahikian-Nelms, 1997; Soliah et al., 1983). Meanwhile two studies showed that previous nutrition training did not predict nutrition knowledge (Gillis & Sabry, 1980; Nahikian-Nelms, 1997).

Table 3.1. Study characteristics

Authors[a] (year)	*Country*	*Design*	*Sample*	*Purpose*	*Validated NK questionnaire*	*Relevant outcome measures*	*Relevant findings*
Gerritsen et al. (2016a, 2016b)	NZ	Cross-sectional	n=257 managers/head teachers of licensed ECE centres	To describe nutrition environments in formal childcare for 3-4-year-olds	No	NK/practices for pre-schoolers	• Knowledge deficits evident in nutrition policies • Largely high sugar, salt and/or saturated fat foods at celebrations (some weekly) and sold for fundraising; >50% of centres had not gained HHA (n=29; 58% of centres enrolled)
Jones et al. (2015)	US	Observational	n=102 pre-kindergarten to 12th grade teachers	To determine resources used, barriers, & NK/nutrition taught links	Yes	NK/beliefs for pre-schoolers	• Teachers unaware of nutrition resources NK scores ranged from 5 to 53 of a maximum possible of 58 (n=85); mean score 35.6 (SD 10.3)
Alkon et al. (2014)	US	RCT (7 months)	n=17 licensed ECE centres; 90 staff went to workshops	To evaluate impact of NAP SACC intervention	No	NK/practices for pre-schoolers	• Providers' healthy eating knowledge pre-test mean 2.05 (SD 0.67) of a range of 0-4; post-test mean 3.63 (SD 0.56); this was a significant increase (P<0.0001)
O'Dea (2014)	AUS	Cohort	n=23 primary school teachers; 301 Years 5 and 6 school children	To examine change in nutrition and PA knowledge, efficacy, behaviours and attitudes after a nutrition programme	Validation not outlined	General NK/attitudes	• Teachers' nutrition NK significantly improved (P<0.0001); from 24.27 (SD 4.89) to 51.0 (SD 5.61) • Teachers attitudes towards the importance of nutrition and self-efficacy to teach nutrition increased significantly (P<0.01) • Baseline: 13.3% teachers felt very confident to teach nutrition; 66% a little confident; 66.7% teachers believed health and nutrition were important and 26.7% said very important

Authors[a] (year)	*Country*	*Design*	*Sample*	*Purpose*	*Validated NK questionnaire*	*Relevant outcome measures*	*Relevant findings*
Sharma et al. (2013)	US	Cross-sectional	n=176 Head Start teachers	To describe the nutrition-related knowledge, attitudes and behaviours among Head Start teachers	No	General NK/beliefs	• None answered all five nutrition items correctly; food groups to be consumed most, foods groups to be consumed least, daily servings fruits and vegetables, daily fat recommendations, macronutrient with most calories (10%, 68%, 39%, 8 %, 48%, respectively) • Teachers agreed with: being overweight increases health risks (75%); it is difficult to know what nutrition information (54%); 79% teachers were obese; weight-loss practices in >70% teachers
Lanigan et al. (2012)	US	Longitudinal	n=72 child care providers from 45 ECE settings	To examine nutrition-related child care provider practices, knowledge and beliefs	Validation not outlined	NK/practices for pre-schoolers	• Misconceptions (mean score 9.4 (SD 2.8) baseline, mean score 9.3 (SD 2.3) n=72; no significant change • Feeding knowledge baseline mean score 13.9 (SD 2.8), follow-up mean score 12.3 (SD 1.9) (significant change P<0.01) n=72; scores ranged from 5-20. • Improvements in nutrition education correlated significant with changes in providers' efficacy (r=0.68; P<0.01), misconception (r=0.51;P<0.01), feeding knowledge (r=0.35; P<0.05) and priority placed on children's healthy eating (r=0.26; P<0.05)
Lynch et al. (2012)	Canada	Cross-sectional	n=13 formal, licensed ECE providers	To understand the strategies childcare providers perceive to encourage	n/a (used semi-structured interviewing)	Beliefs/practices for pre-schoolers	• Positive and negative nutrition-related beliefs/behaviours

Authors[a] (year)	*Country*	*Design*	*Sample*	*Purpose*	*Validated NK questionnaire*	*Relevant outcome measures*	*Relevant findings*
				healthy eating in childcare settings			
Sigman-Grant et al. (2011)	US	Observational	n=203 ECE directors and 567 staff	To compare self-reported feeding practices at ECE centres CACFP-funded versus non-funded centres)	Yes	Feeding practices for pre-schoolers	• CACFP-funded centres reported more supportive feeding practices than non-funded centres for 10 of 26 practices; widespread positive feeding practices evident. • Strategies included role modelling, teaching, coaxing and restriction
Derscheid et al. (2010)	US	Mixed-mode descriptive (quantitative & qualitative)	n=360 ECE staff (includes 32 ECE teachers)	To identify early childhood professionals' perceptions and knowledge about healthy habits		NK/beliefs for pre-schoolers	• Responses for 5 of 18 survey items significantly differed by education levels (e.g. higher NK correlated with more positive beliefs); years of experience significantly differed on 3 items (e.g. less experienced agreed government nutrition guidelines useful) • Positive teacher nutrition beliefs/behaviours • Teachers perceived lack of resources; identified nutritionist as their source of ideas for teaching nutrition
Freedman et al. (2010)	US	Observational	n=72 ECE providers (licensed/non-licensed); 50 completed NK tests	To examine child feeding attitudes, practices and knowledge of multi-ethnic ECE providers (pre-post a 90 minute nutrition class)	Yes	NK/attitudes/practices for pre-schoolers	• Increase in child feeding knowledge from 73% correct (pre-test) to 82% (post-test); increased knowledge on 5 of 13 items; knowledge not always matching behaviour • Many positive attitudes and practices (e.g. "I turn the TV off during mealtimes"); some negative (e.g. only 24% Hispanic providers reported eating meals together

Authors[a] (year)	*Country*	*Design*	*Sample*	*Purpose*	*Validated NK questionnaire*	*Relevant outcome measures*	*Relevant findings*
							with children, compared to all whites and most Asians (86%) – (x^2 [4,65]=3.04; P<0.05) • Those with more education were more likely to eat with children (x^2 [3,65]=8.06; P<0.05)
Trost et al. (2009)	US	Cross-sectional	n=297 registered family childcare homes	To describe policies and practices related to nutrition and PA	Yes	Feeding practices for pre-schoolers	• Positive practices: most providers served enough fruit and vegetables daily; few served fried meats/unhealthy foods regularly; most reported eating meals with children; almost none reported routinely using treat foods as a reward for behaviour or withholding food as punishment • Negative practices (e.g. infrequent (<14%) servings of low-fat milk; frequent use of unhealthy foods for celebrations) • <50% received regular nutrition training
Moore et al. (2005)	UK	Mixed-mode descriptive (quantitative /qualitative)	n=168 ECE registered providers	To investigate the food offered to under-5's in childcare & nutrition-related ECE provider attitudes/roles	Validation not outlined	NK/beliefs for pre-schoolers	• Positive nutrition-related beliefs • Providers strongly agreed (5%), slightly agreed (21%) and disagreed slightly (25%) that parents were responsible to meet dietary needs • About 25% did not find government guidance on nutrition useful or did not have a view; NK gained from peers/family • Staff with some training were more able to identify importance of dietary components (e.g. carbohydrates)

Authors[a] (year)	*Country*	*Design*	*Sample*	*Purpose*	*Validated NK questionnaire*	*Relevant outcome measures*	*Relevant findings*
Nahikian-Nelms et al. (1997)	US	Non-experimental	n=113 caregivers in 24 licensed childcare programs	To measure the NK and attitudes of caregivers in childcare programs and to observe the behaviours of caregivers as they interact with children at mealtime	Yes	NK/attitudes/behaviours for pre-schoolers	• High mean scores for attitudes (69 out of 81 points); low scores for NK (10.9 out of 20 points); mean score for behaviour was 6.59 out of 10 possible points • NK item scores: <50% teachers answered 10 of NK questions correctly; RDA, nutrients (iron, vitamin A), food groups (13%, <50%, <50% correct answers, respectively); 40% knew the recommended fruit and vegetable servings; 19% correctly related intake of sugar to tooth decay; 49% did not know how much of a child's nutrition needs should be met in childcare • >70% had attitudes that met feeding recommendations (e.g. sitting with children during meals to model good eating habits); negative attitudes present (e.g. 14.2% agreed with using food as rewards) • Positive correlation (r=0.18, P=.04) between caregivers' NK and behaviour at mealtime; years of teaching experience positively correlated with caregiver mealtime behaviour (r=0.10, P=.03) • Level of education predicted NK; highest NK scores were more likely to score highest for attitudes (full model not significant).

Authors[a] (year)	*Country*	*Design*	*Sample*	*Purpose*	*Validated NK questionnaire*	*Relevant outcome measures*	*Relevant findings*
							• No correlation between previous nutrition training and caregivers' nutrition attitudes or behaviour • Used out-dated resources/text-books
Petersen et al. (1972)	US	Cross-sectional	n=910 early elementary teachers	To measure NK and attitudes of early elementary teachers	No	General NK/attitudes/practices	• NK scores were low, greater tendency to score higher on general knowledge items and lower on those related to food composition • Poor relationships between knowledge scores, attitudes and teaching nutrition
Gillis et al. (1980)	US	Cross-sectional	n=120 day care teachers	To gain a perspective on the status of the day care teacher as an active proponent of good nutrition	Yes	NK for pre-schoolers	• NK was low; Mean (SD) overall NK score 10.9 (3.1) out of a possible score of 20. • Opinions on the importance of nutrition were positive • Backgrounds in ECE or previous nutrition training did not predict NK; those with ECE degrees/diplomas used food more frequently in learning activities
Soliah et al. (1983)	US	Cross-sectional, descriptive	n=819 elementary teachers	To assess NK, attitudes and practices of elementary teachers	Yes	General NK/attitudes/practices	• Higher qualifications or were teaching nutrition had higher scores on NK, attitudes and practices • NK scores positively correlated with attitudes and practices; they had favourable attitudes (e.g. almost all believed nutrition should be taught in elementary school); few teacher taught nutrition concepts

[a]Some publications reported on the same study and are therefore clustered in one cell.
Note. Studies are organised by publication date.

Abbreviations: NK=nutrition knowledge; HHA=Healthy Heart Award; PA=physical activity; NAP SACC=Nutrition and Physical Activity Self-Assessment for Child Care; RCT=randomised control trial; ECE=early childhood education; CACFP=Child and Adult Care Food Program; US=United States of America; UK=United Kingdom; NZ=New Zealand; AUS=Australia; RDA=recommended dietary allowance.

3.5 Discussion

The purpose of this narrative review was to identify and summarise what is known about ECE teachers' nutrition knowledge for pre-schoolers (2-5-year-olds). This review has identified (a) nutrition knowledge deficits in ECE teachers, and (b) a lack of up-to-date data for ECE teachers' current nutrition knowledge for pre-schoolers.

Results of this review suggest a lack of nutrition knowledge in ECE teachers that has persisted over time. Of the articles that provided quantitative data, researchers either interpreted mean scores for ECE teachers' nutrition knowledge to be low (Freedman & Alvarez, 2010; Gillis & Sabry, 1980; Jones & Zidenberg-Cherr, 2015; Nahikian-Nelms, 1997; Petersen & Kies, 1972; Soliah et al., 1983) or reported significantly improved nutrition knowledge scores after nutrition training was provided for teachers (Alkon et al., 2014; Freedman & Alvarez, 2010; Lanigan, 2012; O'Dea, 2016). The latter implies that ECE teachers had initially low or limited nutrition knowledge and that this would likely continue without appropriate nutrition education. However, there is a lack of up-to-date data and considerable variation across studies (e.g. not all studies tested the same nutrition concepts), thus ECE teachers may generally lack nutrition knowledge for pre-schoolers, yet exact levels are unclear.

ECE teachers may lack basic nutrition knowledge relating to main food groups and key nutrients. It was shown that only 10% of US ECE teachers knew which food group should be consumed the most (Sharma et al., 2013), while Australian teachers scored lower on the key nutrients and the five food groups before exposure to a nutrition programme, compared to after exposure (O'Dea, 2016). This was consistent with early research that showed few ECE teachers were knowledgeable about food groups and nutrients (Nahikian-Nelms, 1997; Petersen & Kies, 1972), which suggests knowledge deficits towards basic nutrition concepts have persisted over time. It is not currently possible to identify specific food groups or nutrients that ECE teachers, in general, consistently lack knowledge about. This may be expected if teachers are exposed to variable nutrition training programmes and policies (Gerritsen, 2016) that may increase the likelihood of ECE teachers gaining different

knowledge and skill sets. Moreover, if knowledge deficits towards specific topics vary between providers then programmes should be tailored accordingly – a strategy increasingly being advocated (Broekhuizen, Kroeze, van Poppel, Oenema, & Brug, 2012; Campbell et al., 1994; De Bourdeaudhuij et al., 2011; Langford, Bonell, Jones, & Campbell, 2015; Oenema, Brug, & Lechner, 2001).

Compared to knowledge scores for basic food groups and nutrients, ECE teachers tend to score lower on items about recommended dietary intake (RDI) values. It was shown that only 8% of teachers knew about the recommended percentage of daily calories from fat, compared to 68% who knew that fats and oils should be consumed the least (Sharma et al., 2013). This trend was similar in early research, with fewer teachers knowing about RDI values and how to apply them (19%), compared to knowing about the recommended fruit and vegetable servings (40%) (Nahikian-Nelms, 1997). This suggests ECE teachers have found some nutrition concepts (e.g. RDI values) more challenging than other areas (e.g. food groups) for some time. This is not surprising if teachers rely on gaining knowledge from public nutrition resources (e.g. My Plate, Eating for Healthy Children from 2-12 years, etc.), which tend to emphasise the recommended servings from food groups, rather than specific RDI values (Ministry of Health, 2012; Public Health Public Health England, 2017a; United States Department of Agriculture, 2017). Moreover, research shows that nutrition information panels and RDI values are less well understood by the general public, as this demands greater numeracy and literacy skills to interpret (Campos et al., 2011; Mhurchu & Gorton, 2007). If nutrition resources do not currently emphasise RDI values and ECE teachers continue to misunderstand them, it may be less important to continue to clarify knowledge gaps in this area. A move towards nutrition professional development programmes that focus on basic food groups and nutrients that demand less numeracy or literacy skills may prove more productive and meaningful.

ECE teachers may lack knowledge about appropriate everyday foods for pre-schoolers, as evidence by foods high in saturated fat, sugar and/or salt being commonly served on special occasions and for fundraisers and some centre policies authorising these foods to be served on a regular basis (Gerritsen et al., 2016). However, this may be more of a reflection of the knowledge of ECE policy makers, which do not necessarily involve ECE

teachers. It may be more likely that teachers are being misinformed and developing misconceptions about nutrition for pre-schoolers as a consequence. Nevertheless, New Zealand ECE centres that are celebrating special occasions with "occasional" foods weekly may be demonstrating a lack of awareness that the Ministry of Health recommends serving "occasional" foods less than once per week. It is important to identify if ECE teachers and staff lack knowledge about the importance of limiting these types of foods, since regular consumption increases children's risk of obesity, developing chronic diseases (Biro & Wien, 2010; Guyenet & Schwartz, 2012; Pérez-Escamilla et al., 2012; Piernas & Popkin, 2011; Swinburn, Sacks, & Ravussin, 2009), sugar-induced hyperactivity and dental caries (Hayden et al., 2013). In addition, always providing these types of foods at fun, celebratory or positive social events may encourage children to associate these foods with positive emotions, causing them to eat and choose foods based on emotional rewards rather than on satiety cues or nutrient needs (Fisher & Birch, 1999; Johansson et al., 2009). The Heart Foundation (2017) recently released a *Healthy Celebrations* (2017) resource that provides recipes and practical ideas that help and encourage ECE teachers and parents to get creative with keeping healthy eating and physical activity an integral part of celebrations, for example, substituting traditional birthday cakes with a special birthday hat or using assembling fresh fruit into the shape of a cake. This means that the benefits of celebration (e.g. building relationships) (Johansson & Berthelsen, 2014; NZ Heart Foundation, 2017) are preserved without compromising children's healthy eating.

Despite the mixed evidence, a lack of knowledge towards child-feeding practices may be widespread in ECE teachers, especially towards involving children in meal preparation, food role modelling, cultivating satiety cues and managing picky eating (Freedman & Alvarez, 2010; Lanigan, 2012). This may be supported by negative beliefs amongst teachers, since Eagly and Chaiken's (1993) attitude constructs that specify attitudes and beliefs partly reflect knowledge, or vice versa. For example, ECE teachers believing that coaxing, bribing and/or restricting are suitable strategies to get children to eat new foods (Lynch & Batal, 2012; Sigman-Grant et al., 2011), may demonstrate a lack of feeding practice knowledge. In conflict, some evidence found positive ECE teachers' beliefs such as not pressuring children to eat, role modelling food, involving children in meal preparation (Lynch & Batal, 2012) and

sitting with children at meal times (Derscheid et al., 2010) are important, which suggests that some ECE teachers are knowledgeable about recommended feeding practices. More research may clarify mixed results, yet it may be enough to know that knowledge gaps exist towards feeding practices and need to be addressed in future interventions. This is vital in light of considerable evidence supporting recommended feeding practices, for example, healthy food role modelling and eating together has been shown to improve dietary intake in children (Gerritsen & Wall, 2017), whereas, using food (especially sweets and dessert) as a reward for good behaviour or to pressure/bribe children is counterproductive to establishing healthy food preferences and relationships (Cooke, Chambers, Añez, & Wardle, 2011; Edward Leigh Gibson et al., 2012). Moreover, if these children establish negative eating habits during their highly impressionable pre-school years, they are likely to carry these behaviours into adulthood and so be at higher risk of ongoing health problems (Larson et al., 2011).

In general, it seems ECE teachers believe that nutrition is important for health (Derscheid et al., 2010; Moore et al., 2005; O'Dea, 2016; Sharma et al., 2013) and that they have a responsibility to promote health to children (Booth et al., 2007; Moore et al., 2005). Yet, with several negative behaviours (e.g. serving unhealthy foods regularly), a lack of awareness of nutrition resources (Jones & Zidenberg-Cherr, 2015; Nahikian-Nelms, 1997) and New Zealand ECE teachers expressing a lack of confidence having conversations with families/whānau about healthy eating (Malatest Malatest International, 2014), it seems that ECE teachers may lack the knowledge, skills and abilities to translate good intentions into action. This is likely in light of Azjen's (1991) *Theory of Planned Behaviour*, which shows attitudes and self-efficacy and skills are key determinants of behaviour. Although not all studies have found correlations between nutrition knowledge and health behaviours (a possible effect of not using validated measuring tools) (Parmenter & Wardle, 1999; Spronk et al., 2014), Azjen's theory supports findings in this review showing positive correlations between ECE teachers' nutrition knowledge and attitudes and practices (Nahikian-Nelms, 1997; Soliah et al., 1983). Future interventions should not only provide teachers with nutrition knowledge for pre-schoolers, but also the skills and self-efficacy to put this knowledge into practice; any needs assessment or evaluations must involve validated

methodologies and nutrition knowledge measuring tools to ensure that true evidence is supporting and justifying interventions.

ECE teachers likely lack nutrition knowledge as few teachers receive formal nutrition training (Moore et al., 2005; Nahikian-Nelms, 1997; Trost et al., 2009). In New Zealand and the UK teachers receive only a few hours (at most) of nutrition training during their 3- or 4-year teacher training qualifications, therefore, teachers may only gain nutrition knowledge if their childcare centre participates in a health promotion initiative (Gerritsen, 2016). Furthermore, ECE services tend to focus more on generic competencies (e.g. thinking) rather than domain-specific knowledge (e.g. nutrition) (Hedges & Cullen, 2005; Kane et al., 2005; McLachlan et al., 2013; Ministry of Education, 1996, 2007), which may reduce the likelihood of nutrition being taught. In addition, it seems that previous ECE teacher training is positively associated with nutrition knowledge (Freedman & Alvarez, 2010; Moore et al., 2005), attitudes and practices (Nahikian-Nelms, 1997), however, this is not always consistent (Gillis & Sabry, 1980; Nahikian-Nelms, 1997). More studies may clarify this relationship, nevertheless, reviewing current ECE teacher training to maximise nutrition knowledge may be beneficial.

The main strength of this research is that this is, to the authors' knowledge, the first literature review investigating ECE teachers' nutrition knowledge for pre-schoolers. Secondly, despite limited data, this review found a need for future work to identify and address nutrition knowledge gaps in ECE teachers. The main limitation of this review is that there is considerable variability across studies, which limits generalisability and makes it difficult to determine a specific level of nutrition knowledge for pre-schoolers in ECE teachers. Studies varied in terms of outcomes measured (e.g. nutrition knowledge versus attitudes), items included in questionnaires (e.g. food groups, RDIs, feeding practices, etc.) and validity of measuring tools. Some studies lacked detailed descriptions of questionnaire items (Gillis & Sabry, 1980; Jones & Zidenberg-Cherr, 2015; Petersen & Kies, 1972; Soliah et al., 1983), making it difficult to assess the fairness of tests. Yet, it is possible that most questionnaires were of similar difficulty, since there was only one instance (made transparent) when teachers could not have been expected to answer an item correctly without specialised training (e.g. "Can you draw the level of the human body and the brain

that are made up of water (on the diagrams below?") (O'Dea, 2016). Another major limitation of this review is that literature searches lacked the comprehensiveness of a systematic review or meta-analysis, thus articles may have been missed. Formal quality assessment of the evidence was not completed and many of the studies had a potential bias as they relied on self-reported data, used small samples sizes from a narrow geographical catchment and likely attracted participants that were interested in health, which may have skewed results.

3.6 Conclusions

ECE teachers appear to have lacked nutrition knowledge for pre-schoolers at least for the past three decades. It seems that although ECE teachers desire to support healthy eating in pre-schoolers, many may lack the knowledge, skills and abilities to do so. Although more up-to-date research is needed, ECE teachers should benefit from future interventions that aim to assist in translating nutrition recommendations for pre-schoolers (especially about food groups and feeding-practices) into action. This is important since teachers generally receive little nutrition training and may not be benefiting from current or previous intervention (since knowledge gaps seem to be persisting over time). Future research needs to directly measure ECE teachers' nutrition knowledge using validated tools in order to accurately identify knowledge gaps so that teachers can be offered relevant, practical nutrition education that gives them the confidence to support and create appropriate environments for pre-schoolers to make healthy choices. This recommendation is justified with growing acknowledgement that teachers and their nutrition knowledge influence child health.

CHAPTER 4: Development of a psychometrically valid and reliable early childhood education teachers' nutrition knowledge questionnaire

4.1 Abstract

Aim To design an early childhood education (ECE) teacher nutrition knowledge questionnaire that satisfies psychometric criteria of validity and reliability.

Methods Items were generated based on New Zealand Ministry of Health nutrition guidelines for pre-schoolers, a literature search and expert advice. Nutrition (n=40) and non-nutrition (n=51) university students completed the questionnaire once; 35 of the nutrition students completed the questionnaire twice. Construct validity was analysed using descriptive statistics, Mann-Whitney-U test and a median-split table; Pearson's product-moment correlation measured test-retest reliability.

Results Nutrition students achieved higher overall and sub-category scores ($P<0.01$). All nutrition students scored better than the median of the combined group, while 72% of non-nutrition students scored below the median. Test-retest reliability was satisfactory as first and second median scores for overall and sub-category scores were significantly correlated ($r=0.43$-0.78; $P<0.01$).

Conclusion The questionnaire achieved an acceptable level of construct validity and test-retest reliability, and is suitable to measure ECE teachers' nutrition knowledge for pre-schoolers (2-5-year-olds).

Keywords: childhood obesity, childcare, kindergarten, day care, assessment, pre-school, nutrition environment

4.2 Introduction

Providing guidance to caregivers and early childhood education (ECE) teachers on appropriate nutrition, diet, portion size and physical activity for pre-schoolers is recommended as part of global strategies to end childhood obesity (World Health Organization, 2016b). The first step for providing this support is to accurately identify knowledge deficits (World Health Organization, 2012), in which using a valid and reliable ECE teacher nutrition and physical activity knowledge questionnaire is useful. The current range of ECE teacher nutrition and physical activity knowledge questionnaires are relatively out-of-date (ranging from 1972-2015), mostly relate to US teachers and/or often include content that is non-specific to pre-schoolers' nutrition (Alkon et al., 2014; Derscheid et al., 2010; Freedman & Alvarez, 2010; Gillis & Sabry, 1980; Lanigan, 2012; Moore et al., 2005; Nahikian-Nelms, 1997; O'Dea, 2016; Petersen & Kies, 1972; Sharma et al., 2013; Soliah et al., 1983). Only four (Freedman & Alvarez, 2010; Gillis & Sabry, 1980; Jones & Zidenberg-Cherr, 2015; Soliah et al., 1983) out of 12 studies used ECE nutrition/physical activity knowledge questionnaires that showed content and construct validity; one was partially validated (no construct validity) (Nahikian-Nelms, 1997) and the remaining seven (Alkon et al., 2014; Derscheid et al., 2010; Lanigan, 2012; Moore et al., 2005; O'Dea, 2016; Petersen & Kies, 1972; Sharma et al., 2013) either did not describe validation methods or were not validated. These characteristics may have limited the efficacy and progress of research about ECE teachers' nutrition knowledge.

Psychometrics, the science of maximising quality assessment, provides criteria for validating a knowledge questionnaire (Rust & Golombok, 2014). Common forms of validity used for nutrition knowledge questionnaires include content and construct validity and test-retest reliability (Freedman & Alvarez, 2010; Gillis & Sabry, 1980; Nahikian-Nelms, 1997; Parmenter & Wardle, 1999; Soliah et al., 1983; Zinn et al., 2005). Content validity refers to how well the questionnaire content matches with the questionnaire purpose (Coaley, 2014; Rust & Golombok, 2014). Assessment for content validity varies, however, the most common procedures involve reviewing feedback from experts in the instrument's relevant field (Poutziouris, Smyrnios, & Klein, 2008). Construct validity refers to the extent that the measure's variance relates with the variance of its underlying construct or idea of an

attribute (Coaley, 2014). This means that a group of experts of the attribute in question (e.g. nutritionists) score significantly higher on a questionnaire than a group of non-experts (e.g. non-nutritionists) completing the same questionnaire (Parmenter & Wardle, 1999). Test-retest reliability ensures scores do not significantly change when completed by the same sample on two separate occasions (Rust & Golombok, 2014), which is usually assessed by the Pearson product-moment correlation method (Parmenter & Wardle, 1999; Rust & Golombok, 2014; Zinn et al., 2005). While construct validity is the most important form of validation (Rust & Golombok, 2014), using several measures may improve evidence of validity (Coaley, 2014).

In New Zealand, no studies have objectively measured ECE teachers' nutrition knowledge for pre-schoolers, which may partly be due to a lack of suitable measuring tools. To help address this issue it should prove useful to develop a psychometrically valid and reliable questionnaire that can measure New Zealand ECE teachers' nutrition knowledge. Therefore, the aim of this study is to design an ECE teachers' nutrition knowledge questionnaire that satisfies psychometric criteria of validity and reliability.

4.3 Methods

4.3.1 Study design

Following psychometric guidelines for constructing questionnaires (Coaley, 2014; Rust & Golombok, 2014) and methods of previous studies (Parmenter & Wardle, 1999; Zinn et al., 2005), a protocol flow diagram was developed (Figure 4.1).

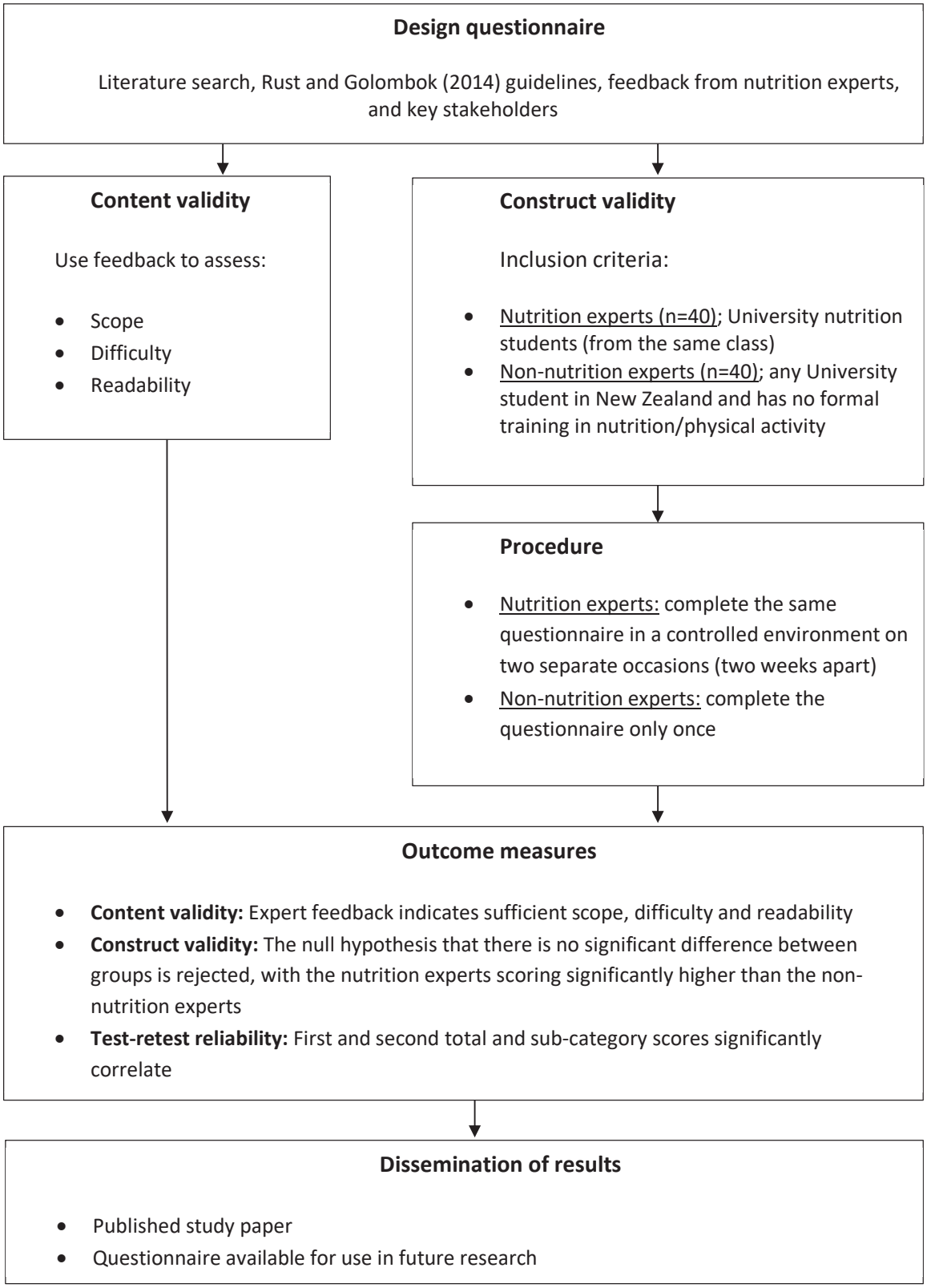

Figure 4.1. Questionnaire validation for ECE teachers' nutrition knowledge study protocol flow diagram

4.3.2 Questionnaire design

The questionnaire was primarily based on nutrition guidelines for pre-schoolers (Ministry of Health, 2012, 2015b). A literature search of existing ECE nutrition knowledge questionnaires generated a pool of 253 ECE-related nutrition knowledge items; a further 186 general nutrition knowledge items that demonstrated psychometric validation (Parmenter & Wardle, 1999; Zinn et al., 2005). From this pool and input from ECE stakeholders and nutrition experts, 37 possible items were generated and then reduced to 25 items divided into three main subcategories: servings, food choices and portions. Two additional items regarding teachers' knowledge of the availability of national nutrition/physical activity guidelines were categorised into a minor group of 'resources'. Following a similar procedure, 12 items asking for ECE teachers' nutrition and physical activity perspectives were included to enrich data; some statements were taken from national guidelines (2012a) or adapted from seven key papers (Leann Lipps Birch & Davison, 2001; Elford & Brown, 2014; Moore et al., 2005; Musher-Eizenman & Holub, 2007; Nahikian-Nelms, 1997; O'Dea, 2016). Skip-logic questions were used where necessary to reduce respondent burden, thus improve response rates. Demographic items (n=8) concerned gender, age, ethnicity, current course of study, previous training in nutrition and highest qualification; some were adapted from New Zealand national surveys or previous studies. After the questionnaire was piloted to a group of 40 nutrition students, it was found that it took approximately 24 minutes to complete, thus, a further 5 nutrition knowledge items that appeared cumbersome (required reading a case study) were omitted to reduce completion time. The final 40-item questionnaire took approximately 15 minutes to complete; 19 of these items objectively measured nutrition and were tested for validity.

To ensure reasonable difficulty, testing concepts that seemed historically difficult to grasp were avoided, such as recommended daily intakes (RDI's) (Campos et al., 2011; Mhurchu & Gorton, 2007; Nahikian-Nelms, 1997; Sharma et al., 2013). Moreover, RDI's appear to be phasing out from nutrition resources (Ministry of Health, 2012; Public Health Public Health England, 2017a; United States Department of Agriculture, 2017), so were less relevant. Examples of serving sizes were taken from nutrition guidelines (Ministry of Health, 2012, 2015b) to standardise answers for the servings' sub-category. Images used in the

questionnaire were royalty-free images or photographs taken by the author. Lunchbox food images were based on More and Emmett's (2015) evidence-based, practical food portion sizes for a pre-schoolers' study. Rust and Golombok's (2014) guidelines for designing a psychometrically valid knowledge questionnaire were followed. In order to maximise data quality and increase response rates, the questionnaire favoured closed-questions (quantitative data), however, open-questions (qualitative) were included (e.g. "please specify") to elaborate answers and identify issues not captured in the questionnaire (O'Cathain & Thomas, 2004). A mixture of forced responses and request responses were used to minimise missing data, however, an option to "choose not to answer" was provided as well. There were approximately 20 revisions of the questionnaire until it was considered satisfactory. Items were coded in numeric form, with nutrition knowledge items being given a "+1" score for a correct answer and "0" for an incorrect, 'choose not to answer' or 'not sure' response; the sum of these answers provided total and sub-category knowledge scores. The nutrition guidelines (Ministry of Health, 2012, 2015b) defined correct answers, however, the *Food for Under 5's* (Kristen Leaity, 2009), a New Zealand ECE resource, was consulted when Ministry of Health guidelines were less clear. Missing data was not possible for nutrition knowledge items as these were forced responses. Ethical approval to conduct this study was provided by the Massey University Human Ethics Committee: Northern (application 15/36). See Appendix C for a copy of the questionnaire.

4.3.3 Participants

With permission, the author invited a class of nutrition students to participate in the study. Those who agreed to participate completed the questionnaire online in a controlled setting, in which the primary author was present. These students completed the questionnaire on two separate occasions that were two weeks apart, which is considered an ideal time frame (Parmenter & Wardle, 1999). Codes were used to match the two data sets. Non-nutrition students were invited to participate via e-mail and complete the questionnaire once. A sample of at least 40 students per group was required to assess validity in this context (Zinn et al., 2005).

4.3.4 Statistical analysis

Statistical analysis was conducted using IBM SPSS Statistics (version 24.0). Descriptive statistics summarised participant characteristics and overall and sub-category nutrition knowledge scores. Data from the first administration were used to assess construct validity. As data was not normal, Mann-Whitney-U test was used to test construct validity and median [25th, 75th percentiles] scores were reported. A median-split table was used as a second measure of construct validity. Pearson product-moment correlation coefficient was used to assess test-retest reliability (nutrition students' data only). Significance level was $P<0.05$ for all tests. Effect size was calculated using Rosenthal's (1991) formula and interpreted using Cohen's (1988, 1992) guidelines on effect size *r* (small: 0.1, medium: 0.3, large: 0.5). Content validity was not statistically measured, but would be considered satisfactory if there were organised design methods involving experts (Parmenter & Wardle, 1999; Poutziouris et al., 2008).

4.4 Results

4.4.1 Participants

The total sample was comprised of 77 females and 13 males; 58.2% were aged 16-24-years and 67% were New Zealand European. The nutrition students (n=40) included 35 females and 5 males; 67.5% were aged 16-24-year and 62.5% were New Zealand European. The non-nutrition students (n=51) included 42 females and 8 males; 50.9% were aged 16-24-years and 70.6% were New Zealand European.

4.4.2 Content validity

Written and verbal feedback from three ECE stakeholders, nutrition students and a round table of experts consisting of three nutrition experts confirmed content validity.

4.4.3 Construct validity

Nutrition students' median scores for overall and sub-category nutrition knowledge were higher than the non-nutrition students ($P<0.05$) (Table 4.1). The median-split table

(Table 4.2) shows that 100% of nutrition students scored better than the median of the combined group, while 72% of non-nutrition students scored below the median.

Table 4.1. Mann-Whitney test comparing nutrition knowledge scores between nutrition and non-nutrition students (n=91)

	Median [25th, 75th percentiles]		U	z	P-value	Effect size (r)†
	Nutrition students (n=40)	Non-nutrition students (n=51)				
Total	26.00 [24.00, 28.00]	17.00 [15.00, 20.00]	105.50	-7.33	<0.0001	0.77
Servings	3.00 [2.00, 4.00]	2.00 [1.00, 3.00]	602.00	-3.45	0.001	0.36
Food choices	18.00 [16.25, 19.00]	13.00 [11.00, 15.00]	163.00	-6.88	<0.0001	0.72
Portions	3.43 [3.00, 4.00]	2.00 [1.00, 3.00]	643.00	-5.34	<0.0001	0.56
Resources	1.00 [1.00, 2.00]	0.00 [0.00, 1.00]	301.50	-6.16	<0.0001	0.65

†Calculated using Rosenthal's, (1991) formula; Cohen's (1988, 1992) effect sizes for r were small (0.1), medium (0.3), large (0.5); (P<0.05).
Abbreviations: U, Mann-Whitney test statistics; z, z-score.
Note. Scoring: correct response: +1; incorrect response: 0; unsure response or choose not to answer: 0. Maximum possible scores: total=37; servings=6; food choices=25; portions=5; resource=1.

Table 4.2. Median-split table (n=91)

	Median or above (n)	Below median (n)
Nutrition students (n=40)	40	0
Non-nutrition students (n=51)	9	42

4.4.4 Test-retest reliability

Results of reliability for overall and sub-category scores are shown in Table 4.3. First and second median scores for overall and sub-category scores were significantly correlated (P<0.01); correlation coefficients ranged from r=0.43-0.78. There was a small but non-significant correlation (r=0.12, P=0.503) for the resources sub-category.

Table 4.3. Test-retest reliability using Pearson's product-moment correlation (n=35; nutrition students only)

Knowledge section†	Pearson's product-moment correlation (r)‡	P-value
Total	0.50	0.002
Servings	0.78	<0.001
Food choices	0.43	0.011
Portions	0.54	0.001

†Only results for medium to large correlations shown.
‡Cohen's (1988, 1992) effect sizes for r were small (0.1), medium (0.3) and large (0.5); (P<0.05).

4.5 Discussion

This study aimed to develop a psychometrically valid and reliable ECE teacher nutrition knowledge questionnaire, which was successfully achieved. As the nutrition students scored significantly higher overall and for each sub-category, the questionnaire demonstrated satisfactory construct validity. This was supported by the median-split table showing that 100% of nutrition students scored above the median of the combined group, while 72% scored below this median. The questionnaire also meets satisfactory content validity; other researchers may consider these organised methods (including a literature review and expert advice) to indicate "undoubtedly high" (Parmenter & Wardle, 1999) content validity, however, we remain conservative in view of no other benchmarks available. The test-retest reliability of this tool proved acceptable levels for reliability, with all correlation coefficients being above zero and of medium to large strength). The small and non-significant correlation for the 'resources' sub-category suggested that these items were less reliable, however, they were retained in the interest of content validity, which is not an uncommon practice if overall reliability is unaffected (Parmenter & Wardle, 1999). Furthermore, scores for this section might be considered less indicative of ECE teachers' nutrition knowledge for pre-schoolers, as it only consisted of two items asking if New

Zealand had specific nutrition and physical activity guidelines, rather than testing the content of these guidelines.

This questionnaire covers current New Zealand nutrition recommendations for pre-schoolers, thus represents a comprehensive and objective assessment of knowledge in this area. Previous to this study, the range of ECE nutrition knowledge questionnaires were relatively out-of-date, poorly validated and/or non-specific for pre-schoolers' nutrition. Given the validity and currency of this tool, it may be adapted for use in other countries, especially in those with similar nutrition guidelines; for example, both Australia (National Health and Medical Research Council, 2016) and New Zealand (Ministry of Health, 2015b) recommend 4 servings of breads and cereals, however, *Australian Dietary Guidelines* (2013) use the terms "grains", thus vocabulary may be changed to suit. Additionally, this questionnaire may serve as a template for other studies investigating parents', caregivers, practitioners' and/or teachers' nutrition knowledge.

4.5.1 Limitations

Our study did not use a recommended minimum acceptable correlation coefficient of 0.7 for internal consistency (Kline, 2000; Parmenter & Wardle, 1999; Zinn et al., 2005), however, correlations were significant and construct validity was satisfactory, which is deemed the most important form of validity (Coaley, 2014).

4.6 Conclusion

This study is the first to develop a psychometrically valid and reliable ECE teachers' nutrition knowledge for pre-schoolers questionnaire that can be used in New Zealand. It is intended that this tool be used by researchers, practitioners or ECE providers aiming to investigate ECE teachers' nutrition knowledge and related perspectives in New Zealand or potentially internationally. Identifying knowledge gaps is the first step for providing ECE teachers with the relevant knowledge to support and implement children's healthy eating practices whilst in childcare. This may be one of many important strategies for obesity prevention in early life.

CHAPTER 5: Nutrition and physical activity for pre-schoolers: knowledge and perspectives amongst early childhood education teachers

5.1 Abstract

Aim To measure early childhood education (ECE) teachers' nutrition knowledge for pre-schoolers (2-5-year-olds); and their perspectives towards nutrition and physical activity.

Methods Cross-sectional online validated questionnaire of New Zealand ECE teachers' nutrition knowledge for pre-schoolers. Knowledge was measured against Ministry of Health nutrition guidelines for pre-schoolers. Perspectives were assessed using Likert scales. Analysis included descriptive statistics, correlation and linear regression.

Results Participants were ECE teachers (n=386) from New Zealand childcare centres. Teachers' knowledge of nutrition was lacking; overall score was 22.56 ± 2.83 (mean ± SD), or 61% correct. Age, qualification level, employment role and years of experience did not predict overall nutrition knowledge scores. Increased years of experience significantly predicted an increase in knowing that New Zealand nutrition and physical activity guidelines existed (B=0.02 [95% CI, 0.00-0.03], r^2=0.13, P=0.033). Teachers' increased agreement in feeling they were confident talking about nutrition to parents significantly predicted an increase in overall nutrition knowledge scores (B=0.34 [95% CI, 0.06-0.63], r^2=0.15, P=0.019). The belief that ECE teachers play a vital role in promoting pre-schoolers' healthy eating and physical activity was widespread. Teachers generally held positive perspectives towards feeding practice and perceived themselves to understand key physical activity concepts. Common barriers for ECE teachers' nutrition and physical activity knowledge included a lack of staff training, confidence and resources.

Conclusion ECE teachers may lack nutrition knowledge for pre-schoolers in New Zealand, particularly with regards to basic nutrition recommendations (servings, food/beverage choices and portion sizes).

Keywords: childhood obesity, child care, kindergarten, day care, nutrition environment, nutrition training, nutrition literacy

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5.2 Introduction

With more children being enrolled in early childcare education (ECE) centres (Education Counts, 2017; Ministry of Education, 2013; OECD, 2014), this setting is becoming increasingly important for children's health and body weight (CDC, Larson et al., 2011; Story et al., 2006; Swinburn et al., 1999; 1997). Despite conflicting research (Pearce et al., 2010; Zahir et al., 2013), many studies suggest that children who attend childcare are more likely to be overweight or obese (Geoffroy et al., 2013; Gubbels, Kremers, Stafleu, Dagnelie, De Vries, Van Buuren, et al., 2010; McGrady et al., 2010). Obesity in childhood has immediate and long-term health consequences (Kelsey, Zaepfel, Bjornstad, & Nadeau, 2014; Lobstein & Jackson-Leach, 2006; Miller, Jong, & Lumeng, 2015; Pizzi & Vroman, 2013) and strongly predicts adult obesity (Litwin, 2014; Nader et al., 2006), yet progress in addressing childhood obesity has been slow (World Health Organization, 2016b).

Global strategies to eliminate childhood obesity recognise the importance of caregivers' knowledge (Britto et al., 2017) and their understanding of the links between health, diet and physical activity in children (World Health Organization, 2016b). Despite mixed evidence, a systematic review found that that nutrition knowledge may have a role in establishing healthier food habits in children (Worsley, 2002). ECE teachers' knowledge about nutrition and physical activity for pre-schoolers (2-5-year-olds) remains relatively unreported, with none specific to New Zealand. Most studies have been conducted amongst ECE teachers in the US, who likely differ to New Zealand ECE teachers in ethnic and educational background; for example, important New Zealand ethnic groups (e.g. Māori, Pacific peoples and Asian) are not distinguished amongst US ECE teachers (Whitebook,

McLean, & Austin, 2016). Acknowledging the effects of these variables are important with studies showing that ethnic (Freedman & Alvarez, 2010) and educational backgrounds affected nutrition knowledge (Nahikian-Nelms, 1997; Soliah et al., 1983). Moreover, there is considerable variability across studies with regards to questionnaire content and psychometric validity and it appears that knowledge about important nutrition concepts (e.g. portion sizes, drink choices) has not been measured. Previous studies are relatively out-of-date (ranging from 1983-2015), with the most comprehensive being conducted in the 1970's-1990's (Gillis & Sabry, 1980; Nahikian-Nelms, 1997; Petersen & Kies, 1972). Therefore, it would be inaccurate to extrapolate previous findings on ECE teachers' nutrition and physical activity knowledge to a New Zealand population.

Nevertheless, available evidence suggests ECE teachers may lack nutrition and physical activity knowledge in several countries (including US, Australia and UK) (Jones & Zidenberg-Cherr, 2015; Moore et al., 2005; Nahikian-Nelms, 1997; O'Dea, 2016; Petersen & Kies, 1972; Sharma et al., 2013; Soliah et al., 1983). It is important to confirm what knowledge gaps exist in order to design and justify interventions providing relevant training that will give teachers the confidence and abilities to support children's healthy eating and physical activity. The aim of this cross-sectional study was to measure what ECE teachers in New Zealand know about nutrition for pre-schoolers, and to investigate their nutrition and physical activity perspectives.

5.3 Methods

5.3.1 Participants

The cross-sectional anonymous online questionnaire was used to collect data from ECE teachers employed by New Zealand ECE centres, which is any group-based education and care setting for under-5s (e.g. day-cares, nurseries, preschools and kindergartens) (Gerritsen, 2016; Ministry of Education, 2016). To meet study objectives, only ECE teachers who held an approved New Zealand ECE teacher's qualification (certificate, diploma, bachelors or higher) and/or had a role as a qualified teacher were selected. To improve specificity, participants who did not hold an ECE qualification or did not specify the field of their qualification were excluded if they also did not select "qualified teacher" as their current role (see Appendix A). Ethical approval to conduct this study was provided by the Massey University Human Ethics Committee: Northern (application 15/36).

5.3.2 Recruitment

Invitations to participate in the study were primarily sent by email to the manager, administrator or head teacher of New Zealand ECE centres. This invitation included a link to the questionnaire via the online software tool Qualtrics, which could be accessed from May 16 – August 7, 2017. A questionnaire link was also available on several media platforms (e.g. social media, web applications and mass media) (see Appendix A and C). Approximately two to four email reminders were sent. No incentives were offered to participants. Informed consent was questionnaire submission.

5.3.3 Questionnaire

The final validated 40-item questionnaire took approximately 15 minutes to complete. Items were based on New Zealand nutrition and physical activity guidelines for pre-schoolers (Ministry of Health, 2015b; Sport New Zealand, 2015) literature studies, key ECE stakeholders and input from nutrition and exercise science experts. Nutrition knowledge items were grouped into sub-categories: servings, food choices, portions and resources;

which directly measured nutrition knowledge. Serving size examples (Ministry of Health, 2012) were provided to standardise answers for the servings' sub-category only. Food portion images (More & Emmett, 2015) and other food/beverage images were included to improve readability. Including a combination of closed- and open-questions aimed to maximise data quality and increase response rates (O'Cathain & Thomas, 2004). A mixture of forced responses and request responses aimed to minimise missing data; options to "choose not to answer" were also included. To ensure acceptable difficulty, relatively basic nutrition principles were tested. Recommended daily intakes (RDI's) were excluded as these are historically difficult concepts to grasp (Campos et al., 2011; Mhurchu & Gorton, 2007; Nahikian-Nelms, 1997; Sharma et al., 2013) and feature less in public nutrition resources (Ministry of Health, 2012). After feedback from the expert panel, items were omitted or adjusted. The nutrition knowledge items satisfied psychometric criteria of validity (content and construct) and test-retest reliability (see Chapter 4). Perspective and demographic items were included to enrich data and were measured using Likert scales, multi-select boxes and/or free-text (see Appendix A and C).

Responses were scored to attain overall and sub-category mean nutrition knowledge scores (Table 5.2). Although previous studies have interpreted an overall nutrition knowledge score of ≤61% as low (Alkon et al., 2014; Gillis & Sabry, 1980; Jones & Zidenberg-Cherr, 2015; Nahikian-Nelms, 1997), formal criteria was not explained and study designs varied, therefore, criteria for high, medium or low scores could not be deduced from the literature. To be conservative and reduce subjectivity, scores below 100% indicated knowledge deficit; the further below 100%, the greater the knowledge deficit. Sub-category scores were compared to each other using the terms "higher" or lower". To align with previous studies (Freedman & Alvarez, 2010; Lynch & Batal, 2012), perspectives were regarded as positive if they supported current nutrition or physical activity guidelines, negative if they were unsupportive, or mutual if they indicated "neither agree nor disagree".

5.3.4 Statistical analysis

Statistical analysis was conducted using IBM SPSS Statistics (version 24.0). Descriptive statistics summarised participant characteristics and mean ± SD overall and sub-category nutrition knowledge scores. As only 1.3% of the sample was male, no gender analysis was

undertaken. One-way analysis of variance (ANOVA) was used to assess if nutrition knowledge scores were affected by teacher variables. Post-hoc tests, using Bonferroni correction, determined where these differences lay. Statistical significance was set at $P<0.05$. Correlation analyses (Pearson's or Spearman's rank) were conducted to examine the association between nutrition knowledge and participant variables. Correlations (r) were interpreted using Cohen's (1988, 1992) guidelines (small: 0.1, medium: 0.3, large: 0.5). Effect sizes (d) were calculated using Cohen's (1988) formula, with benchmark criteria of small (0.2), medium (0.5) and large (0.8) . Linear regression analysis was conducted to predict nutrition knowledge scores from participant variables. Qualitative information did not require statistical analysis (see Appendix A and B for more detail).

5.4 Results

5.4.1 Participants

A total of 386 ECE teachers were eligible and included in the study (Figure 5.1). The sample was comprised of 328 female and 5 male teachers (53 chose not to answer), aged 39.9 ± 11.5 years, with a range of ethnicities and from all regions of New Zealand (Table 5.1). Of the total responses, 88.0% indicated ECE-related qualifications and 94.0% stated they were currently in a teaching role; those that did not specify their current role held ECE-related qualifications. The teachers' years' of experience was 7.3 ± 4.2 years.

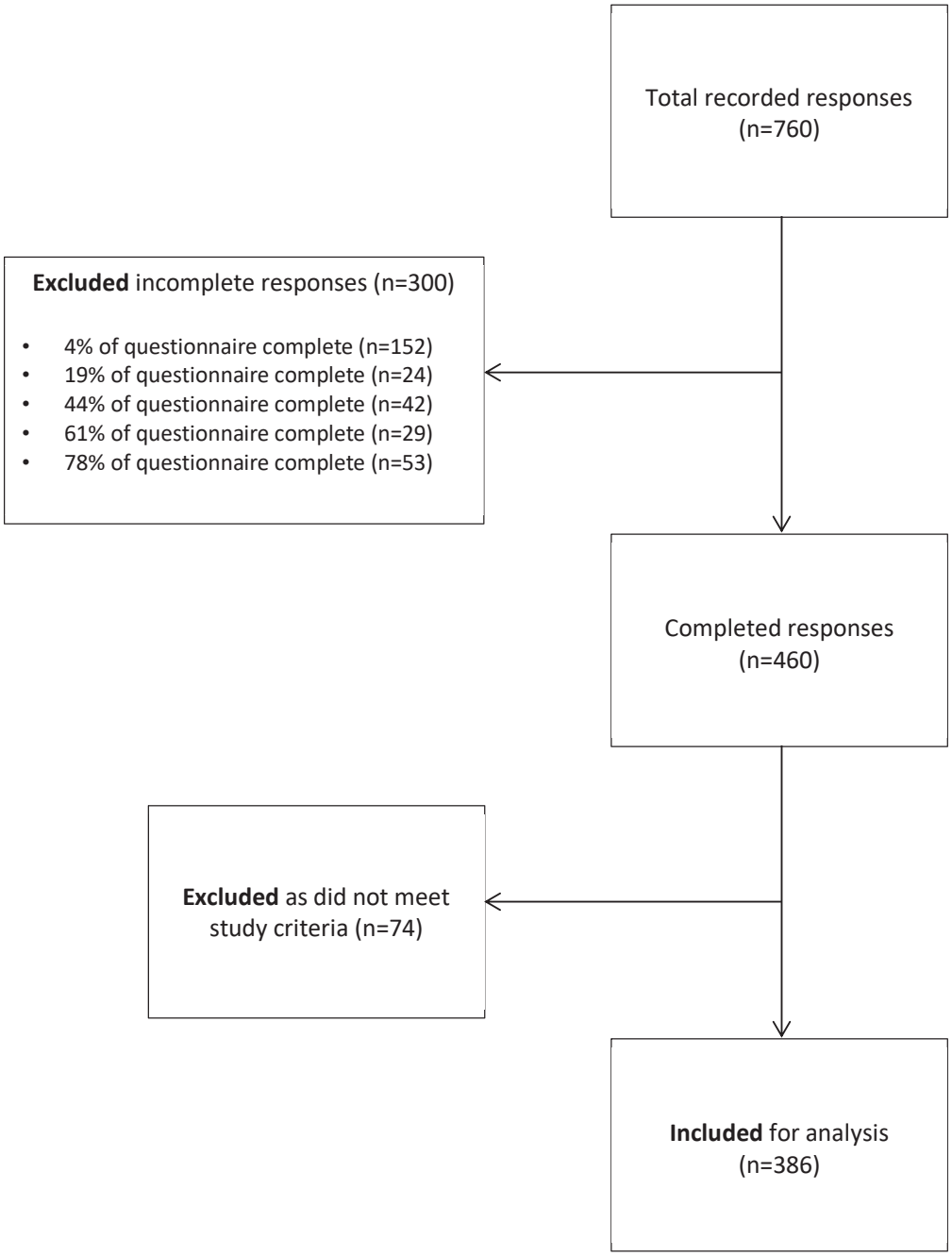

Figure 5.1. Participant flow diagram
Demographic information for incomplete responses was unavailable.

Table 5.1. Participant characteristics (n=386)

	n	%
Gender (n=333)†		
Male	5	1.3
Female	328	85.0
Age, y, (n=377)†		
20-29	94	24.4
30-39	102	26.4
40-49	96	24.9
50-59	61	15.8
60-69	24	6.2
Ethnicity‡		
Māori	39	9.1
Pacific Island	15	3.9
New Zealand European/Pakeha	280	72.5
Other European	52	13.5
Asian/Indian	61	15.8
Qualification level		
Sub-degree (certificate, diploma)	128	33.2
Bachelor	217	56.2
Post-graduate level	31	8.0
Other	10	2.6
Employment role		
Qualified teacher	319	82.6
Manager/teacher	44	11.4
Other (+ teachers' qualification)	23	3.1
Years of experience		
≤3	60	15.5
4-10	163	42.2
11+	163	42.2
ECE region		
Auckland	90	23.3
Bay of Plenty	25	6.5
Canterbury	62	16.1
Hawkes Bay	3	0.8
Manawatu-Wanganui	11	2.8
Marlborough	3	0.8
Nelson	1	0.3
Northland	4	1.0
Otago	22	5.7
Southland	8	2.1
Taranaki	11	2.8
Tasman	1	0.3
Waikato	44	11.4
Wellington	45	11.7
Unknown	56	14.5

† The remaining participants chose not to answer. ‡Does not total 100% because participants could select more than one option. Abbreviations: +, plus; y, years; ECE, early childhood education.

5.4.2 Overall nutrition knowledge

Teachers' overall and sub-category mean nutrition knowledge scores are shown in Table 5.2; responses for each item are shown in Table 5.3. The overall mean score was 22.56 ± 2.83, or 61.1% correct. Differences in participant characteristics (e.g. age, qualification, current role, or years of experience) did not significantly affect overall nutrition knowledge scores (Table 5.4 and supplementary Table B.5).

5.4.3 Servings

The mean servings' score was 2.26 ± 1.16, or 43.3% correct (Table 5.2); one teacher answered all 6 items correctly (see supplementary Table B.1). Examples of incorrect answers included "at least 3" (n=172) and "at least 7" (n=1) servings of vegetables, no breads and cereals (n=4) and "at least 7" (n=1) servings of meat/meat alternatives; 49 responses were "not sure" (supplementary Table B.2). There was a small but significant effect of teachers' years of experience on servings' scores ($F(2, 383)=3.93$, $P<0.05$, $d=0.3$). Teachers' years of experience impacted on servings' scores ($P=0.02$), with the 4-10-years group (2.45 ± 1.2) scoring higher than the 11+ years group (2.12 ± 1.1, $P<0.05$); there was no difference between the ≤3 years' group and other groups. Correlational analysis showed no relationship between years of experience and servings' score ($r=-0.02$, $P=0.633$). No other variables significantly affected serving scores' (Table 5.4).

5.4.4 Food choices

The mean food choices score was 18.03 ± 2.24, or 72% correct (Table 5.2); no teachers scored all items correctly (supplementary Table B.1). Items incorrectly selected were dilute orange juice (n=79; 20.5%), coconut water (n=60; 15.5%), Calci-yum flavoured milk (n=15; 3.9%), flavoured water (n=11; 2.8%), orange juice, (n=7; 1.8%), fruit drink (n=6; 1.6%); none selected Coke Zero, Powerade and V-Zero. Other drinks that teachers identified as suitable included cow's milk alternatives (e.g. almond, soya, goats, oat), breast milk, herbal tea, fruit/vegetable smoothies, kombucha/probiotics, freshly squeezed juice, toddler milk and Milo; one teacher commented that "energy drinks" were suitable (supplementary Table B.3).

Incorrect answers for nuts (any type) included every day (n=170; 44.0%), sometimes (n=145; 37.6%) and occasional (n=32; 8.3%); 15 (3.9%) teachers were unsure and (n=1; 0.3%) chose not to answer. Incorrect answers for hard dried fruits included every day (n=31; 8.0%), sometimes (n=210; 54.4%), occasional (n=111; 28.8); 8 (2.1%) teachers were unsure. Incorrect responses for snack frequency included at least 4 (n=25; 6.5%), at least 5 (n=6; 1.6%), at least 6 (n=8; 2.1%) and more than 6 snacks (n=2; 0.5%) per day; 13 (3.4%) teachers were unsure and 2 (0.5%) chose not to answer. Items selected for a healthy lunchbox (in different combinations) were cheese (n=363; 94.0%), wholemeal bread (n=369; 95.6%), tomato (n=379; 98.2%), mandarin (n=379; 98.2%), lettuce (n=365; 94.6%), fruit and nut muesli bar (n=73; 18.9%), fruit roll up (n=7; 1.8%), fried chicken nuggets (n=5; 1.3%) and potato crisps (n=5; 1.3%) (supplementary Table B.3). Teacher variables did not significantly affect food choice scores (Table 5.4).

5.4.5 Portions

The overall mean portions' score was 1.77 ± 1.41, or 36% correct (Table 5.2); 15 teachers answered all five items correctly (supplementary Table B.1). Teacher variables did not significantly affect portion scores (Table 5.4). One teacher commented that "there can be a significant difference between healthy portion sizes for a 2-year-old and a near 5-year-old" (supplementary Table B.13)

5.4.6 Resources

The overall mean resources score was 0.51 ± 0.40 correct, or 50% correct (Table 5.2). There was a small but significant effect of teachers' years of experience on resources scores ($F(2, 383)=5.68$, $P<0.01$, $d=0.17$). Teachers' years of experience impacted on servings' scores ($P=0.004$), with the 11+ years group (0.58 ± 0.39) scoring higher than those with ≤3 years' (0.41 ± 0.42, $P<0.05$, $d=0.42$) and 4-10-years' (0.47 ± 0.40, $P<0.05$, $d=0.28$) of experience; there was no difference between the 4-10-years and ≤3 years' groups. Correlational analysis showed a significant relationship between years of experience and resource score ($r=0.16$, $P=0.001$). Regression analysis showed that increased years of experience significantly predicted an increase in awareness of New Zealand nutrition and physical activity guidelines

(B=0.02 [95% CI, 0.00-0.03], r^2=0.13, P=0.033). Other teacher variables did not significantly affect resources scores (Table 5.4 and supplementary Table B.5).

5.4.7 Perspectives

ECE teachers' nutrition- and physical activity-related perspectives can be viewed in Table 5.5 (see supplementary Table B.13 to B.14 for more detail). Increased agreement in teachers feeling confident in talking about nutrition significantly predicted an increase in overall nutrition knowledge scores, (B=0.34 [95% CI, 0.06-0.63], r^2=0.15, P=0.019); no other significant relationships were found between nutrition perspectives and nutrition knowledge (supplementary Table B.7 to B.10). Teachers reported "I am able to define the term physical activity" (98.2%) and "fundamental movement skills" (90.4%), "I understand the difference between structured and unstructured play" (98.4%), "I know what activities will develop specific movements skills" (93.8%) and "I have the skills and abilities I need to support children's physical activity and development" (96.1%) (supplementary Table B.6). One teacher commented that "many teachers are unaware of the fundamentals" of physical activity (supplementary Table B.14).

5.4.8 Barriers for teachers' knowledge

Teachers stated "no, there are no factors that make it difficult to know about healthy eating" (42.0%) or "physical activity" (52.0%). Commonly perceived barriers for nutrition knowledge were confusing nutrition messages in the media (32.0%), lack of staff training (19.0%), lack of confidence talking about nutrition (14.0%), lack of support from parents/whānau (13.2%) and lack of resources (12.0%); one teacher specified a barrier of "inappropriate advice promoting diets high in carbohydrate and sugar, e.g. the food triangle". Common barriers for teachers' physical activity knowledge included lack of resources (21.0%), lack of staff training (16.1%), lack of confidence (12.7%) and insufficient time to teach physical activity (11.4%); four teachers indicated safety concerns (supplementary Table B.12)

5.4.9 Additional comments

Collaboration with parents/whānau (family) to support pre-schoolers' healthy eating was a key theme amongst teachers' comments. Comments included: "It's a very 'hairy' issue for ECE teachers (who are we to judge the parents?)" and "it is really about getting parents and whānau on board". Five teachers expressed a desire for more accessible, less expensive, more interactive (e.g. games) or easier to understand nutrition/physical activity resources (see supplementary Table B.13 to B.14).

Table 5.2. Mean ± SD nutrition knowledge scores by participant variables

	Total score (mean ± SD)	Servings score (mean ± SD)	Food choices Score (mean ± SD)	Portions score (mean ± SD)	Resource score (mean ± SD)
All teachers (n=386)	22.56 ± 2.83	2.26 ± 1.16	18.03 ± 2.24	1.77 ± 1.41	0.51 ± 0.40
Variable					
Age, y					
20-29 (n=94)	22.16 ± 2.82	2.28 ± 1.09	17.73 ± 2.44	1.78 ± 1.38	0.45 ± 0.40
30-39 (n=102)	22.71 ± 2.60	2.32 ± 1.18	18.03 ± 2.14	1.80 ± 1.41	0.49 ± 0.40
40-49 (n=96)	22.45 ± 3.01	2.40 ± 1.20	18.14 ± 2.29	1.65 ± 1.41	0.50 ± 0.40
50-59 (n=61)	22.84 ± 3.10	1.92 ± 1.08	18.07 ± 2.27	1.93 ± 1.48	0.59 ± 0.40
60-69 (n=24)	23.33 ± 2.42	2.17 ± 1.17	18.63 ± 1.88	1.83 ± 1.34	0.63 ± 0.40
Choose not to answer (n=9)	22.50 ± 2.33	2.33 ± 1.32	18.11 ± 1.05	1.44 ± 1.59	0.50 ± 0.43
Qualification level					
Sub-degree (n=128)	22.27 ± 2.84	2.19 ± 1.18	17.97 ± 2.19	1.73 ± 1.48	0.53 ± 0.41
Bachelors (n=217)	22.75 ± 2.75	2.32 ± 1.12	18.07 ± 2.21	1.82 ± 1.38	0.49 ± 0.40
Post-graduate level (n=31)	22.76 ± 2.78	2.23 ± 1.33	18.39 ± 2.17	1.55 ± 1.23	0.53 ± 0.39
Other (n=10)	21.60 ± 4.14	1.90 ± 0.20	16.70 ± 3.30	1.90 ± 1.60	0.50 ± 0.47
Employment role					
Qualified teacher (n=319)	22.52 ± 2.80	2.29 ± 1.19	18.08 ± 2.22	1.73 ± 1.37	0.51 ± 0.40
Manager/teacher (n=44)	23.00 ± 3.23	2.07 ± 0.97	17.84 ± 2.53	2.05 ± 1.60	0.55 ± 0.42
Other (n=33)	22.30 ± 2.36	2.17 ± 0.94	17.74 ± 2.00	1.78 ± 1.54	0.43 ± 0.43
Years of experience, y					
≤3 (n=60)	21.91 ± 3.21	2.12 ± 1.22	17.55 ± 2.61	1.62 ± 1.45	0.41 ± 0.42
4-10 (n=163)	22.72 ± 2.75	2.45 ± 1.14†	18.14 ± 2.15	1.79 ± 1.40	0.47 ± 0.40
11+ (n=163)	22.65 ± 2.73	2.12 ± 1.12	18.09 ± 2.17	1.82 ± 1.41	0.58 ± 0.39‡

†Statistically significantly greater mean score than teachers with 11+ years of experience (P<0.05).
‡Statistically significantly greater mean score than teachers with ≤3 years or 4-10 years of experience (P<0.05).
Note. Questionnaire scoring: correct response: +1; incorrect response: 0; unsure response or choose not to answer: 0. Total score ranged from 13.5 to 30 of a maximum possible of 37; servings' scores ranged from 0 to 6 of a maximum possible of 6; food choices scores ranged from 11 to 23 of a maximum possible of 25; portions' scores ranged from 0 to 5 of a maximum possible of 5; resources score ranged from 0 to 1 of a maximum possible of 1. The higher the score the better the performance.
Abbreviations: SD, standard deviation; y, years.

Table 5.3. Responses of ECE teachers in New Zealand on nutrition knowledge items (n=386)

Question content†	Correct response	% correct‡
SERVINGS		
Fruit	at least 2	46
Vegetables	at least 2	23
Breads and cereals	at least 4	8
Wholegrain breads/cereals	most days	31
Lean meat/alternatives	at least 1	51
Milk products/alternatives	at least 2 or 3	67
FOOD CHOICES		
Frequency of beverages		
- Water	Everyday	99
- Cow's milk	Everyday Occasional/never	82
- Flavoured milk		90
- Fizzy drinks	Occasional/never Occasional/never	99
- Cordial or fruit drinks		95
- Tea or coffee	Never	98
- Sports or energy drinks	Never	99
- Suitable everyday drinks¶	Cow's milk + water	55
Other suitable drinks§	*See Appendix B*	88
Frequency of snacks		
- Potato/corn crisps	Occasional	63
- Fruit	Everyday	99
- Chocolate/cream biscuits	Occasional	63
- Plain biscuits	Sometimes/occasional	93
- Yoghurt pottle (all types)	Everyday	38
- Vegetable sticks	Everyday	95

Question content†	Correct response	% correct‡
FOOD CHOICES *(cont.)*		
Frequency of snacks *(cont.)*		
- Nuts (all types)	Never	6
- Hard dried fruits	Never	8
- Soft dried fruits	Sometimes	59
- Ice-cream	Occasional	70
- Cheese	Everyday	57
- Pastries	Occasional	64
- Plain crackers/crisp breads	Sometimes	52
Snacks per day	2 or 3 snacks	80
Other suitable snacks§	*See Appendix B*	80
Foods for a healthy lunchbox¶	Cheese + wholemeal bread + tomato + lettuce + mandarin	71
PORTIONS¶		
Dairy	1 cup cow's milk (250ml)	65
Fruit	One medium banana	56
Vegetables	One medium carrot	63
Breads and cereals	1/2 slice of bread	50
Meat	1 chicken drumstick	24
RESOURCES		
MOH nutrition guidelines exist	Yes	56
NZ PA guidelines exist	Yes	46

†Correct answers were based on *Ministry of Health Food and Nutrition Guidelines for Healthy Children and Young people (2-18-years)* for pre-schoolers, ‡The percentage of total sample (n=386) that correctly answered the item, §Participants selected text and images, ¶Responses were categorised into themes. Abbreviations: cont., continued; MoH, Ministry of Health; NZ, New Zealand; PA, physical activity.

Table 5.4. Analysis of variance (ANOVA) and correlation analysis of ECE teachers' nutrition knowledge scores and age, qualification, employment role and years of experience (n=386)

Variable		ANOVA					Pearson's correlation coefficient, r	Spearman's correlation coefficient, r_s	P-value
		df	MS	F	P-value	Effect size (d)			
Age	Total	4,372	9.36	1.16	0.327		0.08		0.120
	Servings	4,372	2.39	1.81	0.126		-0.09		0.079
	Food choices	4,372	4.47	0.87	0.481		0.07		0.173
	Portions	4,372	0.83	0.42	0.797		0.03		0.588
	Resources	4,372	0.28	1.76	0.136		0.13		0.013
Qualification level	Total	3,382	9.78	1.23	0.299			0.06	0.214
	Servings	3,382	0.91	0.68	0.565			0.02	0.702
	Food choices	3,382	7.51	1.50	0.214			0.01	0.813
	Portions	3,382	0.86	0.43	0.730			0.01	0.780
	Resources	3,382	0.04	0.27	0.849			-0.02	0.633
Employment role	Total	2,383	5.24	0.66	0.520			0.04	0.486
	Servings	2,383	1.02	0.76	0.466			-0.05	0.299
	Food choices	2,383	2.09	0.41	0.661			-0.04	0.450
	Portions	2,383	1.88	0.95	0.388			0.05	0.322
	Resources	2,383	0.09	0.57	0.565			0.01	0.901
Years of experience	Total	2, 383	15.43	1.94	0.145		0.08		0.128
	Servings	2, 383	5.17	3.93	0.020	0.29	-0.02		0.633
	Food choices	2, 383	8.23	1.65	0.194		0.06		0.208
	Portions	2, 383	0.90	0.45	0.638		0.08		0.127
	Resources	2, 383	0.90	5.68	0.004	0.17	0.16		0.001

Note. Effect sizes (d) were only calculated where there was statistical significance (P<0.05).
Abbreviations: df, degrees of freedom; MS, mean square; F, f-ratio; d, Cohen's value.

Table 5.5.ECE teachers' nutrition and physical activity-related perspectives (7-point Likert scale)

Feeding practices†	Strongly disagree, n (%)	Disagree, n (%)	Somewhat disagree, n (%)	Neither agree nor disagree, n (%)	Somewhat agree, n (%)	Agree, n (%)	Strongly agree, n (%)
Mealtimes should be fun (n=385)	1 (0.3)	3 (0.8)	6 (1.6)	20 (5.2)	64 (16.6)	109 (28.2)	182 (47.2)
Pre-schoolers should eat together (n=386)	2 (0.5)	4 (1)	4 (1)	23 (6)	62 (16.1)	131 (33.9)	160 (41.5)
Snacks should be low in sugar (n=386)	3 (0.8)	0 (0)	1 (0.3)	2 (0.5)	25 (6.5)	107 (27.7)	248 (64.2)
Pre-schoolers should have a choice of a variety of foods at mealtimes (n=385)	1 (0.3)	7 (1.8)	11 (2.8)	19 (4.9)	54 (14)	135 (35)	158 (40.9)
Pre-schoolers should always eat all the food on their plate (n=385)	54 (14)	121 (31.3)	80 (20.7)	49 (12.7)	56 (14.5)	17 (4.4)	8 (2.1)
ECE teachers should role model healthy eating to pre-schoolers (n=383)	0 (0)	0 (0)	1 (0.3)	3 (0.8)	13 (3.4)	110 (28.5)	256 (66.3)
ECE teachers should eat with pre-schoolers (n=384)	4 (1)	15 (3.9)	9 (2.3)	47 (12.2)	81 (21)	126 (32.6)	102 (26.4)
ECE teachers should talk to pre-schoolers about what they are eating (n=385)	1 (0.3)	3 (0.8)	2 (0.5)	7 (1.8)	19 (4.9)	122 (31.6)	231 (59.8)
ECE teachers should encourage pre-schoolers to try new foods (n=385)	1 (0.3)	0 (0)	1 (0.3)	5 (1.3)	23 (6)	142 (36.8)	213 (55.2)
It is important that pre-schoolers are involved in an edible garden in ECE settings (n=385)	1 (0.3)	0 (0)	0 (0)	13 (3.4)	52 (13.5)	143 (37)	176 (45.6)
Other†							
I feel confident having conversations with parents about food and nutrition (n=377)	2 (0.5)	5 (1.3)	17 (4.4)	21 (5.4)	83 (21.5)	132 (34.2)	117 (30.3)
ECE teachers play a vital role in promoting nutrition to pre-schoolers (n=385)	0 (0)	1 (0.3)	1 (0.3)	7 (1.8)	25 (6.5)	140 (36.3)	211 (54.7)
A pre-schooler's healthy eating is more of the parent's responsibility (n=386)	14 (3.6)	36 (9.3)	46 (11.9)	75 (19.4)	108 (28)	66 (17.1)	41 (10.6)
ECE teachers play a vital role in promoting pre-schoolers' physical activity and development (n=385)	1 (0.3)	0 (0)	1 (0.3)	3 (0.8)	17 (4.4)	113 (29.3)	250 (64.8)
A pre-schooler's physical activity and development is more of the parent's responsibility (n=384)	27 (7.0)	63.0 (16.3)	54 (14.0)	112 (29.0)	64 (16.6)	36 (9.3)	28 (7.3)

†Remaining responses were "not sure" or "choose not to answer".

5.5 Discussion

This study investigated ECE teachers' nutrition and physical activity knowledge for pre-schoolers (2-5-year-olds) in New Zealand. The findings indicate a lack of nutrition knowledge amongst New Zealand ECE teachers. Teachers generally reported that they understood key physical activity concepts, however, desired more physical activity training.

5.5.1 Overall nutrition knowledge scores

The overall nutrition knowledge score of 61% suggests a lack of nutrition knowledge amongst New Zealand ECE teachers. This is in agreement with previous studies reporting similar deficits, with overall nutrition knowledge scores ranging from 51%-61% correct (Alkon et al., 2014; Gillis & Sabry, 1980; Jones & Zidenberg-Cherr, 2015; Nahikian-Nelms, 1997). Similar to Jones et al. (2015), we view this score as less than ideal, especially since teachers lacked knowledge towards relatively basic nutrition concepts (recommended servings, food choices and portion sizes).

5.5.2 Servings

A mean servings' score of 43.3% correct suggests that ECE teachers lack knowledge about the recommended servings from the four main food groups for pre-schoolers. Knowledge deficits were apparent across all food groups, however, teachers scored the lowest for breads and cereals, so may lack the most knowledge towards this food group. Most (84.9%) teachers underestimated the recommended servings for breads and cereals, while 42% incorrectly answered that pre-schoolers must eat wholegrains every day. Pre-schoolers that consume too little breads and cereals might not meet their energy and B-vitamin requirements for rapid brain development and growth, or dietary fibre for digestive health (Ministry of Health, 2015b). Meanwhile, pre-schoolers consuming too many wholegrain foods may experience early satiety (due to their small stomachs), thus find it difficult to meet their high energy requirements. These risks highlight the importance of ensuring that teachers understand dietary guidelines for breads and cereals. Perhaps

knowledge deficits towards food group servings are due to confusing media messages (e.g. low carbohydrate diets), with 32% of teachers identifying this to be a barrier for their nutrition knowledge. Similarly, Sharma et al. (2013) reported that over half of ECE teachers found it difficult to know what nutrition information to believe; few (10.0%) teachers were able to correctly answer for grains, while more teachers (68.0%) correctly answered for fruits and vegetables. Teachers also scored higher for fruits and vegetables than breads and cereals in our study, yet, 45.6% and 70.6% of teachers, respectively, indicated more servings than is recommended for fruits and vegetables. Perhaps teachers are overestimating pre-schoolers' serving requirements after misinterpreting prominent health promotion messages (e.g. *Five+ a Day*). Meanwhile, teachers may know more about recommended servings for lean meat/meat alternatives and milk/milk alternatives, however, with 49% and 33% of teachers providing incorrect answers for each, respectively, there is room to improve their knowledge. Mixed results for the relationship between years of experience and servings' score may be an effect of high inter-individual variation (SD=1.16) between servings' scores, so future studies may clarify findings. Nevertheless, if ECE teachers lack knowledge about recommended daily servings, it seems difficult to expect them to support pre-schoolers in meeting their daily energy and nutrient requirements.

5.5.3 Food choices

Fewer than 10% of teachers knew that whole nuts and hard dried fruits should never be given to under-5s. These small hard foods are choking hazards (Ministry of Health, 2015b), thus a lack of knowledge may be a health and safety issue that should be immediately addressed. Meanwhile, although over 60% were able to correctly identify occasional foods (e.g. pastries, ice-cream), up to 17% of teachers stated that these should never be eaten. Demonization of high fat/sugar foods in the media (Abel, 2014; Eli & Ulijaszek, 2014) and ECE nutrition policies that misalign with Ministry of Health guidelines (S Gerritsen et al., 2016) may be contributing to these knowledge deficits. Since banning foods can encourage children to fixate on these items and consume them in excess (Jansen, Mulkens, & Jansen, 2007; Patrick & Nicklas, 2005), it is important that teachers have the knowledge and skills to follow guidelines for food choices. Meanwhile, although 80% of teachers knew the recommended number of snacks per day, 10.7% of teachers answered

more than is recommended. Too much snacking may encourage grazing habits, thus increasing dental caries risk (Melanson, 2008; Ministry of Health, 2015b). Teachers may be unaware of this or are unclear on what constitutes too much snacking. Teachers may have better knowledge about suitable drinks for pre-schoolers, since ≥80% of teachers answered almost all drink items correctly. Yet, only 55% identified that cow's milk and water were the only recommended every day drinks; and three teachers did not know that sports/energy drinks should never be consumed. This is the first study, to the authors' knowledge, to objectively measure this aspect of ECE teachers' knowledge. Findings suggest that New Zealand ECE teachers lack knowledge about recommended food choices for pre-schoolers. If teachers are unable to decipher between "everyday", "occasional" and "never" foods or drinks, they may teach, provide and/or role model inappropriate food choices to pre-schoolers, thus unwittingly encourage pre-schoolers to establish harmful dietary patterns.

5.5.4 Portions

With a mean portions' score of only 36% correct, ECE teachers may lack understanding about the difference between a portion and a serving (even after viewing examples of a serving in an earlier section of the questionnaire). It is important that teachers understand that a serving size is not the same as a portion size. According to Ministry of Health guidelines (2012b), a portion is defined as the amount of food offered at a single eating occasion, whereas, a serving is a standard measured amount and does not vary according to the size of an individual's hand. Although knowledge deficits were widespread in this sub-category, teachers seemed to have the most difficulty identifying a portion of meat (24% correct). Some teachers commented that food amounts or portion sizes differ greatly between a 2-year-old and a 5-year-old, however, a recent UK study on evidence-based portion sizes showed that a 100-120 ml portion of milk is suitable and adequate for healthy 1-4-year-olds (More & Emmett, 2015). This is the first study to examine ECE teachers' knowledge about portions/serving sizes, however, a common misconception is that a serving size for a child is the amount which roughly fits the size of a child's hand (McCormick & Press, 2014; New Zealand Nutrition Foundation, 2013; Nutricia, 2015). If teachers misunderstand these concepts, they may not be able to support a child in meeting their recommended servings per day. Furthermore, as portion sizes continue to grow across

food sources (potentially contributing to childhood obesity) (Leann L Birch, Savage, & Fisher, 2015; Piernas & Popkin, 2011; Zlatevska, Dubelaar, & Holden, 2014), teachers may need more support than ever before to determine healthy portion sizes for pre-schoolers.

5.5.5 Resources

Only 56% of teachers knew about the Ministry of Health food and nutrition guidelines for pre-schoolers and fewer (46%) teachers knew that there were New Zealand physical activity guidelines for pre-schoolers. This may be expected as more comprehensive physical activity guidelines (Ministry of Health, 2017b) were only released at the time of data collection, whereas Ministry of Health nutrition guidelines have been available since 2012. Nevertheless, if teachers do not know that these resources exist, they cannot be expected to know about the recommendations. Additionally, >70% of those who knew of these guidelines also said they used them, which seems at odds with the apparent knowledge deficits. This, along with at least 14% not using the guidelines, suggests that teachers need further support in knowing about and then using these resources.

5.5.6 Determinants of ECE teachers' nutrition knowledge

Overall nutrition knowledge scores were not significantly affected by age, qualification level, employment role or years of experience. This is in agreement with previous studies reporting no relationship between US ECE teachers' educational background and/or previous nutrition training (Gillis & Sabry, 1980; Nahikian-Nelms, 1997), yet disagrees with other studies showing that ECE teachers with higher qualifications and/or who were teaching nutrition had significantly better nutrition knowledge scores (Nahikian-Nelms, 1997; Soliah et al., 1983). These equivocal findings may be due to considerable variability between study methodologies (e.g. questionnaires design), or our findings may be unique to New Zealand ECE teachers. Nevertheless, results suggest that nutrition knowledge deficits may be widespread amongst ECE teachers in New Zealand, regardless of their background.

Sub-category scores were mostly unaffected by differences in teacher variables. It seems that teachers with more years of experience may be more aware that there are New

Zealand nutrition and physical activity guidelines. Reasons for this seem unclear, however, a US study found that ECE teachers with more years of experience (6-10-years) reported nutrition/physical activity government guidelines being less helpful (Derscheid et al., 2010). It was suggested that less experienced teachers needed to rely on guidelines more often, so found them more helpful. Perhaps our findings indicate that less experienced teachers have had less opportunity to be exposed to nutrition and physical activity guidelines, resulting in lower scores. Overall, this evidence suggests that less experienced teachers may need more support in knowing about current nutrition and physical activity guidelines, and perhaps teachers with more experience could offer some of this support.

5.5.7 Perspectives and barriers

The belief that ECE teachers play a vital role in supporting children's healthy eating and physical activity was widespread amongst teachers, which is consistent with previous research (Booth et al., 2007; Derscheid et al., 2010; Moore et al., 2005; O'Dea, 2016; Sharma et al., 2013; Soliah et al., 1983). Teachers generally held positive feeding practice perspectives; however, responses were mixed as to whether "pre-schoolers should always eat everything on their plate". This statement references guidelines to avoid forcing, pressuring or bribing children to eat (Ministry of Health, 2015b), and is commonly argued amongst ECE teachers (Freedman & Alvarez, 2010; Lanigan, 2012). It is important that teachers are aware that coercive feeding practices are not recommended as they are associated with poor dietary behaviours and increased body weight in pre-schoolers (Bergmeier, Skouteris, Horwood, Hooley, & Richardson, 2014; H. R. Clark, Goyder, Bissell, Blank, & Peters, 2007; Hurley, Cross, & Hughes, 2011; Russell et al., 2016; Shloim, Edelson, Martin, & Hetherington, 2015). As to whether these mixed views indicate knowledge deficits or simple disagreement amongst ECE teachers must be confirmed by objective measures. Nevertheless, widespread supportive nutrition perspectives amongst ECE teachers seem promising for creating supportive ECE nutrition environments.

ECE teachers generally believed that they were able to define and understand key physical activity concepts, and thought that they had the knowledge, skills and abilities to support these. However, conflicting comments, such as "many teachers are unaware of the

fundamentals [of physical activity]", may suggest that teachers still lack physical activity knowledge. Perhaps this is similar to findings from a recent New Zealand intervention study that identified a need to increase ECE teachers' physical activity knowledge, with few teachers being able to identify relevant theory or research related to physical activity (pre- and post-intervention) (McLachlan et al., 2017). Furthermore, knowledge gaps seem possible with teachers desiring more staff training, resources and confidence in physical activity in childcare and identifying a lack of these to be barriers to their physical activity knowledge. This study is the first to specifically report barriers for ECE teachers' nutrition and physical activity knowledge, however, a desire and need for more training has previously been reported (Booth et al., 2007; Jones & Zidenberg-Cherr, 2015; Malatest International, 2014; McLachlan et al., 2017). For example, McLachlan et al. (2017) found that some (n=8) ECE teachers identified that they needed to learn more about how to intentionally teach physical activity and wanted more physical activity resources. It was also suggested that further support was needed to increase teacher knowledge and confidence about nutrition and physical activity in childcare (McLachlan et al., 2017). Overall, these findings may further justify providing teachers with physical activity professional development. However, objective measures of physical activity knowledge are needed to accurately guide training content.

Most teachers felt confident talking to parents/whānau about nutrition, which seems to be an improvement on the lack of confidence previously reported by a *Healthy Heart Award* evaluation (Malatest International, 2014). However, teachers in our study still perceived a lack of staff confidence talking about nutrition or teaching physical activity as barriers for their nutrition or physical activity knowledge. Teachers were also concerned about how to effectively collaborate with and get parents "on board" with supporting children's healthy eating and physical activity. Perhaps addressing knowledge deficits towards basic nutrition concepts (as identified in this study) and providing relevant training may give teachers the confidence they need to work with families in supporting pre-schoolers' nutrition and physical activity. Improving ECE teachers' confidence to talk with families may be especially important if this predicts increases in nutrition knowledge.

Overall, this evidence may suggest that teachers are missing key elements of 'nutrition literacy' (Carbone & Zoellner, 2012) and 'physical activity literacy'(Whitehead, 2013), which are concepts that link knowledge, confidence and skills with dietary or physical activity decision/actions, and are strong predictors of health (Carbone & Zoellner, 2012; Silk et al., 2008; Whitehead, 2013). Interventions aiming to establish adequate nutrition and physical activity literacy amongst New Zealand ECE may find targeting the specific knowledge gaps identified in this study useful.

5.5.8 Limitations and strengths

The main limitation of this research is the potential for subjective analysis (e.g. researchers or subjects interpreting items differently), yet this bias was likely reduced by using a psychometrically valid questionnaire and a standard measure to score items. Social desirability may have skewed results for perspectives. The online questionnaire format may have excluded less well-resourced centres and participants may have volunteered based on their interest in the research topic, thus skewing results and limiting generalisability. However, the relatively large sample size and diversity of teachers' ethnic and geographical location may have reduced bias. Finding out if participants had previous nutrition training may have enriched discussion and identified causes for knowledge deficits, however, identifying cause and effects was beyond the scope of this study. The main strength of this study is that it is the first to investigate ECE teachers' nutrition and physical activity knowledge for pre-schoolers in New Zealand. The use of a psychometrically valid knowledge questionnaire to measure study outcomes has improved study strength.

5.6 Conclusions

ECE teachers lack nutrition knowledge for pre-schoolers in New Zealand, particularly towards relatively basic nutrition recommendations (servings, food/beverage choices and portion sizes). Future interventions may provide training, resources or policy changes that target these knowledge gaps and help teachers have the skills and confidence to support children's healthy eating and physical activity. This should be received well if teachers

believe they have a role in promoting nutrition and physical activity to pre-schoolers and desire more nutrition and physical activity resources and training.

CHAPTER 6: CONCLUSIONS

6.1 Overview and Achievement of Study Aims and Objectives

This was the first study, to the authors' knowledge, to investigate ECE teachers' nutrition knowledge for pre-schoolers (2-5-year-olds); and their nutrition and physical activity perspectives in New Zealand. The importance of caregivers' knowledge (Britto et al., 2017) and their understanding of the links between health, diet and physical activity for children's health and body size are now recognised (World Health Organization, 2016b), yet there is a dearth of evidence of ECE teachers' nutrition and physical activity knowledge for pre-schoolers, especially in New Zealand. With children spending more time in childcare (Education Counts, 2017; OECD, 2014) and obesity rates in 2-4-year-olds as high as 7% in New Zealand (Ministry of Health, 2016), it is important to assess if teachers have the required knowledge, confidence and abilities to support pre-schoolers' healthy eating and physical activity.

The study's aim was to measure ECE teachers' nutrition knowledge; and nutrition and physical activity perspectives for pre-schoolers in New Zealand. This was achieved by using a cross-sectional anonymous online questionnaire (designed and psychometrically validated by the researchers) of this knowledge. Responses were then measured against the Ministry of Health's *Food and Nutrition Guidelines for Healthy Children and Young People (2-18-years)* and related resources; findings were reported as a manuscript for publication.

6.2 Findings and Concluding Remarks

Findings indicated a lack of knowledge towards relatively basic nutrition concepts amongst New Zealand ECE teachers. Teachers generally reported that they understood key physical activity concepts, however, desired more physical activity training. Although ECE teachers mostly held positive nutrition and physical activity related perspectives, commonly perceived barriers for ECE teachers' nutrition and physical activity knowledge included a lack of staff training, confusing messages in the media, a lack of confidence talking about nutrition or teaching physical activity and a lack of resources. Teacher variables (age,

qualification level, employment role and years of experience) did not significantly affect overall teachers' nutrition knowledge, suggesting that teachers (regardless of background) have similar knowledge deficits. However, teachers with more years of experience were more aware that New Zealand had nutrition and physical activity guidelines for pre-schoolers, which suggests that teachers with less experience need additional support. Also, teachers' increased agreement in feeling they were confident talking about nutrition to parents/whānau positively predicted increases in overall nutrition knowledge scores, therefore, preserving or improving this confidence may be important for developing teachers' nutrition knowledge. Overall, it is clear that ECE teachers' knowledge towards relatively basic nutrition concepts is less than ideal. They may need further support in having the knowledge, confidence and abilities to positively influence pre-schoolers' healthy eating and physical activity in childcare. Follow-on studies that objectively measure physical activity and feeding practice knowledge should enrich these findings.

6.3 Research Contribution

This study appears to have made a valuable contribution to our understanding of what ECE teachers know about nutrition and their perspectives towards nutrition and physical activity in childcare. This should support research in childhood obesity prevention. This thesis may serve as a resource for those who are interested in creating supportive ECE nutrition and physical activity environments for child health. Furthermore, this study provided the first psychometrically valid and reliable ECE nutrition knowledge questionnaire that can be used in New Zealand and potentially overseas. This may better enable further investigation of ECE teachers' nutrition knowledge and related perspectives.

6.4 Strengths and Limitations

There are many challenges when collecting data using self-reported online questionnaires, particularly as being busy is typical for this population group and a commonly cited reason by teachers to not participate in research (Rusby, Crowley, Jones, & Smolkowski, 2017). Key strengths of this study is that it is the first to investigate this topic and to provide a valid and reliable ECE teachers' nutrition knowledge questionnaire for use

in New Zealand (and potentially overseas), thus it has moved research in this area forward. The relatively large sample size and the use of the validated tool likely reduced the study's main limitations of subjective analysis and restricted generalisability.

6.4.1 Choice of aims and objectives

The aims and objectives were strong because they were well defined, simple, measurable, achievable and timely. They were supported by an in-depth literature search that highlighted a need for studies investigating ECE teachers' nutrition and physical activity knowledge, especially in New Zealand. To align with Ministry of Health guidelines, both nutrition and physical activity components were included, however, it was not a requirement that both nutrition and physical activity knowledge be objectively measured due to time constraints. A follow-on study that objectively measures ECE teachers' physical activity knowledge should supplement our findings, especially with the recent release of the Ministry of Health *Sit Less, Move More, Sleep Well: Active play guidelines for under-fives guidelines* (2017).

6.4.2 Measuring tool: Knowledge questionnaire

The key strength of the questionnaire was that it met psychometric criteria for content and construct validity and test-retest reliability, which improved evidence strength and provided a valuable tool for future studies. The questionnaire was specific for the population group, which improved the accuracy of findings and met study objectives. With rising childcare attendance and around a third of New Zealand ECE centres having waiting times of over a month (Ministry of Education, 2015), ECE teachers may be time poor, thus the tool's ease of use and relatively short duration was a particular strength and likely contributed to the success of a sample size that was relatively larger that preceding studies (see Table 3.1).

A limitation of the questionnaire was the potential for subjective interpretation of questionnaire items, for example, "nuts (any type)" was intended by the researchers to refer to "whole nuts" and exclude nut paste/butter, however, this may not have been clear to participants. Yet, as the tool was validated, this bias was likely reduced. Meanwhile, Ministry

of Health nutrition guidelines were not clear in some instances (e.g. frequency of consuming crackers), which increased subjectivity of scoring. The exclusive online format of the questionnaire may have excluded less well-resourced ECE centres, thus limiting generalisability; however, the relatively large sample size likely reduced this bias. Only one physical activity knowledge question was validated, therefore, physical activity knowledge could not be objectively measured, however, this did not affect the achievement of study aims.

6.4.3 Recruitment and data collection

A strength of this study was that several methods and media platforms were used to recruit ECE teachers, which likely improved the study's reach and sample size. However, participants were self-selected (with no incentives offered), so may have chosen to participate based on their interests or knowledge in the topic of nutrition and physical activity for pre-schoolers, thus potentially skewing results and limiting the generalisability of findings.

6.4.4 Sample size

The sample size of 386 ECE teachers in this study exceeded the *a priori* estimated sample size of 330 participants, so was relatively large. This is a strength of the study as larger sample sizes can generate more powerful and reliable results (Field, 2009).

6.4.5 Statistical analysis

Another strength of the study was that we used a range of statistical analysis procedures. Reporting means ± SD for the primary findings (e.g. nutrition knowledge scores) aligned with previous research, thus stronger comparisons between studies could be made and be easily conveyed to readers. Descriptive statistics allowed the study to measure and describe ECE teachers' nutrition knowledge and related perspectives. Correlation and regression analysis identified predictors of knowledge, which might be useful for planning future interventions. Questionnaire validation methods followed recommended protocols for validating a nutrition knowledge questionnaire (Parmenter & Wardle, 1999; Zinn et al.,

2005) and using two statistical methods to assess construct validity (the most important form of validity), verified our results.

6.5 Directions for Future Research

Given that this study has provided some evidence to suggest that ECE teachers lack nutrition knowledge for pre-schoolers in New Zealand, future research utilizing validated measuring tools and randomised controlled trials with multiple follow-up assessments aimed as investigating contributors to knowledge deficits and the best ways to address knowledge deficits is important. In addition, since teachers' knowledge of physical activity is considered important for children's health (World Health Organization, 2016b), a study that objectively measures ECE teachers' physical activity knowledge for pre-schoolers in New Zealand is needed. Further analysis of related perspectives should also begin to provide greater insight on this topic and direct future intervention.

6.6 Final Recommendations

In order to start addressing these nutrition knowledge deficits amongst ECE teachers in New Zealand, ECE nutrition interventions, changes in ECE regulatory nutrition policies (e.g. enforcing water only policies) and/or advocating more teacher education programmes to include more comprehensive nutrition training is needed. From our research, nutrition interventions (e.g. nutrition workshops or resources) could include the following components:

- Recommended daily serves of a variety of foods from the four major food groups - breads and cereals, fruits and vegetables, milk and milk products and lean meat and meat alternatives. Special attention may be required for breads and cereals, wholegrains and confusing messages in the media about carbohydrates.
- Recommended food choices, with a focus on addressing:
    - Cow's milk and water as the only everyday drinks
    - Avoiding whole nuts and hard dried fruits
    - Issues regarding banning foods
    - Frequency of snacks (the dangers of grazing)

- Portion versus serving sizes
- Access to Ministry of Health and Sport New Zealand guidelines/resources and other reliable sources of nutrition/physical activity information
- Feeding practices, with a focus on addressing:
    - Recommendations to not use rewards or force or push a child to eat
    - Strategies to manage picky eaters/improve food acceptance
- Confusing nutrition messages in the media
- How to have confident conversations about nutrition to parents/whānau
- Strategies to collaborate with parents on supporting children's healthy eating and physical activity

Additionally, interventions should address common barriers for ECE teachers' nutrition and/or physical activity knowledge, including:

- Lack of staff training in nutrition/physical activity
- Lack of confidence talking about nutrition
- Lack of support from parents/whānau
- Lack of resources/information on healthy food for children
- Confusing messages in the media

Specific physical activity knowledge gaps should be objectively measured in future research. ECE teachers may need to be informed about the recent *Sit Less, Move More, Sleep Well: Active play guidelines for under-fives guidelines* (Ministry of Health, 2017b). In addition, although this research has identified specific knowledge gaps to guide the planning of future intervention programmes, these programmes may require additional tailoring according to specific ECE centre needs, as is recommended by global obesity prevention strategies (World Health Organization, 2012). Further studies investigating ECE teachers' perspectives on this topic or identifying causes of nutrition and physical activity deficits amongst ECE teachers (including a collection of data around previous nutrition/physical activity training) would further direct intervention. Such studies may build advocacy for improving ECE regulatory nutrition and physical activity policies (e.g. enforcing water only policies or changing minimum playground space requirements). They could also help support

the inclusion of more comprehensive nutrition and physical activity training in teacher education programmes. This should create the supportive environments that teachers need to support children's healthy eating and physical activity in childcare.

REFERENCES

Abel, S. (2014). *Fat chat: an exploration of obesity discourses in Canadian media and their impacts on social work.* (Master of Social Work in the Program of Social Work), Ryerson University, Canada.

Adirim, T. A., & Cheng, T. L. (2003). Overview of injuries in the young athlete. *Sports Medicine, 33*(1), 75-81.

Ahluwalia, N., Herrick, K., Moshfegh, A., & Rybak, M. (2014). Caffeine intake in children in the United States and 10-y trends: 2001–2010. *The American Journal of Clinical Nutrition, 100*(4), 1124-1132.

Ali, A., Pigou, D., Clarke, L., & McLachlan, C. (2017). Literature review on motor skill and physical activity in preschool children in New Zealand. *Advances in Physical Education, 7*(1), 10-26.

Alkon, A., Crowley, A. A., Neelon, S. E. B., Hill, S., Pan, Y., Nguyen, V., . . . Kotch, J. B. (2014). Nutrition and physical activity randomized control trial in child care centers improves knowledge, policies, and children's body mass index. *BMC Public Health, 14*(1), 215.

Allen and Clarke. (2016). *Review of physical activity guidance and resources for under-fives*. Wellington: Allen and Clarke.

American Heart Association. (2013). The AHA's Recommendations for Physical Activity in Children. Retrieved from http://www.heart.org/HEARTORG/HealthyLiving/HealthyKids/ActivitiesforKids/The-AHAs-Recommendations-for-Physical-Activity-in-Children_UCM_304053_Article.jsp#.WXp5hBWGOUk

Anderson, C. J. (2010). Central limit theorem. In I. B. Weiner & W. E. Craighead (Eds.), *Corsini Encyclopedia of Psychology* (4 ed., Vol. 1-2). New Jersey: John Wiley & Sone, Inc.

Appova, A., & Arbaugh, F. (2018). Teachers' motivation to learn: implications for supporting professional growth. *Professional Development in Education, 44*(1), 5-21.

Australian Government Department of Health and Aging. (2010). Physical activity recommendation for children aged 0-5 years. Retrieved from http://www.health.gov.au/internet/main/publishing.nsf/content/phd-physical-activity-0-5-pdf-cnt.htm

Bangdiwala, S. I., Bhargava, A., O'Connor, D. P., Robinson, T. N., Michie, S., Murray, D. M., . . . Pratt, C. A. (2016). Statistical methodologies to pool across multiple intervention studies. *Translational Behavioral Medicine, 6*(2), 228-235.

Barnes, J., Behrens, T. K., Benden, M. E., Biddle, S., Bond, D., Brassard, P., . . . Christian, H. (2012). Letter to the editor: standardized use of the terms "sedentary" and "sedentary behaviours".

Applied Physiology Nutrition and Metabolism-Physiologie Appliquee Nutrition Et Metabolisme, 37(3), 540-542.

Barnett, L. M., Morgan, P. J., van Beurden, E., & Beard, J. R. (2008). Perceived sports competence mediates the relationship between childhood motor skill proficiency and adolescent physical activity and fitness: a longitudinal assessment. *International Journal of Behavioral Nutrition and Physical Activity, 5*(1), 1.

Barnett, L. M., Van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2009). Childhood motor skill proficiency as a predictor of adolescent physical activity. *Journal of Adolescent Health, 44*(3), 252-259.

Barzegari, A., Ebrahimi, M., Azizi, M., & Ranjbar, K. (2011). A study of nutrition knowledge, attitudes and food habits of college students. *World Applied Sciences Journal, 15*(7), 1012-1017.

Baxter, J. A. (2015). *Child care and early childhood education in Australia (Facts Sheet 2015)*. Melbourne: Australian Institute of Family Studies.

Bell, A. C., Finch, M., Wolfenden, L., Fitzgerald, M., Morgan, P. J., Jones, J., . . . Wiggers, J. (2015). Child physical activity levels and associations with modifiable characteristics in centre-based childcare. *Australian and New Zealand Journal of Public Health, 39*(3), 232-236.

Bergmeier, H., Skouteris, H., Horwood, S., Hooley, M., & Richardson, B. (2014). Associations between child temperament, maternal feeding practices and child body mass index during the preschool years: a systematic review of the literature. *Obesity Reviews, 15*(1), 9-18.

Birch, L., Savage, J. S., & Ventura, A. (2007). Influences on the development of children's eating behaviours: from infancy to adolescence. *Canadian Journal of Dietetic Practice and Research: A Publication of Dietitians of Canada, 68*(1), s1.

Birch, L. L., & Davison, K. K. (2001). Family environmental factors influencing the developing behavioral controls of food intake and childhood overweight. *Pediatric Clinics, 48*(4), 893-907.

Birch, L. L., & Fisher, J. O. (1998). Development of eating behaviors among children and adolescents. *Pediatrics, 101*(Supplement 2), 539-549.

Birch, L. L., Savage, J. S., & Fisher, J. O. (2015). Right sizing prevention. Food portion size effects on children's eating and weight. *Appetite, 88*, 11-16.

Biro, F. M., & Wien, M. (2010). Childhood obesity and adult morbidities. *The American Journal of Clinical Nutrition, 91*(5), 1499S-1505S.

Black, M. M. (2008). Effects of vitamin B12 and folate deficiency on brain development in children. *Food and Nutrition Bulletin, 29*(2_suppl1), S126-S131.

Blakely, T., Atkinson, J., Kvizhinadze, G., Nghiem, N., McLeod, H., Davies, A., & Wilson, N. (2015). Updated New Zealand health system cost estimates from health events by sex, age and proximity to death: further improvements in the age of 'big data'. *New Zealand Medical Journal, 128*(1422), 13-23.

Booth, S., Booth, M., Wilkenfeld, R., Pagnini, D., & King, L. (2007). Early childhood sector staff perceptions of child overweight and obesity: the Weight of Opinion Study. *Health Promotion Journal of Australia: Official Journal of Australian Association of Health Promotion Professionals, 18*(2), 149.

Britto, P. R., Lye, S. J., Proulx, K., Yousafzai, A. K., Matthews, S. G., Vaivada, T., . . . Fernald, L. C. H. (2017). Nurturing care: promoting early childhood development. *The Lancet, 389*(10064), 91-102.

Broekhuizen, K., Kroeze, W., van Poppel, M. N., Oenema, A., & Brug, J. (2012). A systematic review of randomized controlled trials on the effectiveness of computer-tailored physical activity and dietary behavior promotion programs: an update. *Annals of Behavioral Medicine, 44*(2), 259-286.

Brown, A. W., Brown, M. M. B., & Allison, D. B. (2013). Belief beyond the evidence: using the proposed effect of breakfast on obesity to show 2 practices that distort scientific evidence. *The American Journal of Clinical Nutrition, 98*(5), 1298-1308.

Campbell, M. K., DeVellis, B. M., Strecher, V. J., Ammerman, A. S., DeVellis, R. F., & Sandler, R. S. (1994). Improving dietary behavior: the effectiveness of tailored messages in primary care settings. *American Journal of Public Health, 84*(5), 783-787.

Campos, S., Doxey, J., & Hammond, D. (2011). Nutrition labels on pre-packaged foods: a systematic review. *Public Health Nutrition, 14*(8), 1496-1506.

Carbone, E. T., & Zoellner, J. M. (2012). Nutrition and health literacy: a systematic review to inform nutrition research and practice. *Journal of the Academy of Nutrition and Dietetics, 112*(2), 254-265.

Cashmore, A. W., & Jones, S. C. (2008). Growing up active: a study into physical activity in long day care centers. *Journal of Research in Childhood Education, 23*(2), 179-191.

Centers for Disease Control and Prevention. (2017). Child development: preschoolers (3-5 years of age). Retrieved from https://www.cdc.gov/ncbddd/childdevelopment/positiveparenting/preschoolers.html

Clark, H. R., Goyder, E., Bissell, P., Blank, L., & Peters, J. (2007). How do parents' child-feeding behaviours influence child weight? Implications for childhood obesity policy. *Journal of Public Health, 29*(2), 132-141.

Clark, I., & Landolt, H. P. (2017). Coffee, caffeine, and sleep: a systematic review of epidemiological studies and randomized controlled trials. *Sleep Medicine Reviews, 31*, 70-78.

Cliff, D. P., Reilly, J. J., & Okely, A. D. (2009). Methodological considerations in using accelerometers to assess habitual physical activity in children aged 0–5 years. *Journal of Science and Medicine in Sport, 12*(5), 557-567.

Coad, J., & Pedley, K. (2014). Iron deficiency and iron deficiency anemia in women. *Scandinavian Journal of Clinical and Laboratory Investigation, 74*(sup244), 82-89.

Coaley, K. (2014). *An introduction to psychological assessment and psychometrics*. London: Sage.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (second edition)*. New York: Lawrence Erlbaum Associates.

Coleman, B., & Dyment, J. E. (2013). Factors that limit and enable preschool-aged children's physical activity on child care centre playgrounds. *Journal of Early Childhood Research, 11*(3), 203-221.

Cooke, L. J., Chambers, L. C., Añez, E. V., & Wardle, J. (2011). Facilitating or undermining? The effect of reward on food acceptance. A narrative review. *Appetite, 57*(2), 493-497.

Copeland, K. A., Khoury, J. C., & Kalkwarf, H. J. (2016). Child care center characteristics associated with preschoolers' physical activity. *American Journal of Preventive Medicine, 50*(4), 470-479.

Croxford, S. (2015). *Food and nutrition throughout life: a comprehensive overview of food and nutrition in all stages of life*. Sydney: Allen & Unwin.

Dahl, W. J., & Stewart, M. L. (2015). Position of the academy of nutrition and dietetics: health implications of dietary fiber. *Journal of the Academy of Nutrition and Dietetics, 115*(11), 1861-1870.

Daniels, S. R. (2006). The consequences of childhood overweight and obesity. *The Future of Children, 16*(1), 47-67.

Dawson, A., Richards, R., Collins, C., Reeder, A. I., & Gray, A. (2014). Edible gardens in early childhood education settings in Aotearoa, New Zealand. *Health Promotion Journal of Australia, 24*(3), 214-218.

De Bourdeaudhuij, I., Van Cauwenberghe, E., Spittaels, H., Oppert, J. M., Rostami, C., Brug, J., . . . Maes, L. (2011). School-based interventions promoting both physical activity and healthy eating in Europe: a systematic review within the HOPE project. *Obesity Reviews, 12*(3), 205-216.

De Onis, M., Blössner, M., & Borghi, E. (2012). Prevalence and trends of stunting among pre-school children, 1990–2020. *Public Health Nutrition, 15*(1), 142-148.

Derscheid, L. E., Umoren, J., Kim, S.-Y., Henry, B. W., & Zittel, L. L. (2010). Early childhood teachers' and staff members' perceptions of nutrition and physical activity practices for preschoolers. *Journal of Research in Childhood Education, 24*(3), 248-265.

Dietary Guidelines Assessing Committee. (2016a). *Evidence summary: What is the relationship between frequency/regularity of family meals and measures of body weight in U.S. population groups?* Washington DC: United States Department of Agriculture.

Dong, D., Bilger, M., van Dam, R. M., & Finkelstein, E. A. (2015). Consumption of specific foods and beverages and excess weight gain among children and adolescents. *Health Affairs, 34*(11), 1940-1948.

Dovey, T. M., Staples, P. A., Gibson, E. L., & Halford, J. C. G. (2008). Food neophobia and 'picky/fussy'eating in children: a review. *Appetite, 50*(2), 181-193.

Dowda, M., Brown, W. H., McIver, K. L., Pfeiffer, K. A., O'Neill, J. R., Addy, C. L., & Pate, R. R. (2009). Policies and characteristics of the preschool environment and physical activity of young children. *Pediatrics, 123*(2), e261-e266.

Dubois, L., Girard, M., Kent, M. P., Farmer, A., & Tatone-Tokuda, F. (2009). Breakfast skipping is associated with differences in meal patterns, macronutrient intakes and overweight among pre-school children. *Public Health Nutrition, 12*(1), 19-28.

Dudley, D. A., Cotton, W. G., & Peralta, L. R. (2015). Teaching approaches and strategies that promote healthy eating in primary school children: a systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity, 12*(1), 28.

Duncan, J. S., Schofield, G., Duncan, E. K., & Rush, E. C. (2008). Risk factors for excess body fatness in New Zealand children. *Asia Pacific Journal of Clinical Nutrition, 17*(1), 138-147.

Dwyer, G. M., Higgs, J., Hardy, L. L., & Baur, L. A. (2008). What do parents and preschool staff tell us about young children's physical activity: a qualitative study. *International Journal of Behavioral Nutrition and Physical Activity, 5*(1), 66.

Dyment, J. E., & Coleman, B. (2013). Factors that limit and enable preschool-aged children's physical activity on child care centre playgrounds. *Journal of Early Childhood Research, 11*(3), 203-221.

Ebbeck, M., & Waniganayake, M. (2010). *Play in early childhood education: learning in diverse contexts*. South Melbourne: Oxford University Press Australia & New Zealand.

Education Counts. (2017). Prior participation in early childhood education. Retrieved from https://www.educationcounts.govt.nz/statistics/indicators/main/student-engagement-participation/1923

Elford, L., & Brown, A. (2014). Exploring child-feeding style in childcare settings: how might nursery practitioners affect child eating style and weight? *Eating Behaviors, 15*(2), 314-317.

Eli, K., & Ulijaszek, S. (2014). *Obesity, eating disorders and the media*. Surrey: Ashgate Publishing, Ltd.

Ferrari, R. (2015). Writing narrative style literature reviews. *Medical Writing, 24*(4), 230-235.

Field, A. (2009). *Discovering statistics using SPSS (third edition)*. London: Sage publications.

Fiese, B. H., Hammons, A., & Grigsby-Toussaint, D. (2012). Family mealtimes: a contextual approach to understanding childhood obesity. *Economics & Human Biology, 10*(4), 365-374.

Fraser, S., & Gestwicki, C. (2002). *Authentic childhood: exploring Reggio Emilia in the classroom*: Cengage Learning.

Freedman, M. R., & Alvarez, K. P. (2010). Early childhood feeding: assessing knowledge, attitude, and practices of multi-ethnic child-care providers. *Journal of the American Dietetic Association, 110*(3), 447-451.

Fulkerson, J. A., Larson, N., Horning, M., & Neumark-Sztainer, D. (2014). A review of associations between family or shared meal frequency and dietary and weight status outcomes across the lifespan. *Journal of Nutrition Education and Behavior, 46*(1), 2-19.

Garden to Table. (2017). Proving it works. Retrieved from http://www.gardentotable.org.nz/proving-it-works

Geoffroy, M.-C., Power, C., Touchette, E., Dubois, L., Boivin, M., Séguin, J. R., . . . Côté, S. M. (2013). Childcare and overweight or obesity over 10 years of follow-up. *The Journal of Pediatrics, 162*(4), 753-758. e751.

Gerritsen, S. (2013). The influence of childcare on preschool dietary patterns and body size. *Obesity Research & Clinical Practice, 7*, e117-e118.

Gerritsen, S. (2016). Nutrition education for early childhood managers, teachers and nursery cooks: a prerequisite for effective obesity prevention. *Public Health, 140*, 56-58.

Gerritsen, S., Morton, S., & Wall, C. R. (2016). Physical activity and screen use policy and practices in childcare: results from a survey of early childhood education services in New Zealand. *Australian and New Zealand Journal of Public Health, 40*(4), 219-325.

Gerritsen, S., & Wall, C. (2017). *How We Eat – Reviews of the evidence on food and eating behaviours related to diet and body size*. Wellington: Ministry of Health.

Gerritsen, S., Wall, C., & Morton, S. (2016). Child-care nutrition environments: results from a survey of policy and practice in New Zealand early childhood education services. *Public Health Nutrition, 19*(9), 1531-1542.

Gibson, E. L., & Cooke, L. (2017). Understanding Food Fussiness and Its Implications for Food Choice, Health, Weight and Interventions in Young Children: the Impact of Professor Jane Wardle. *Current Obesity Reports, 6*(1), 46-56.

Gibson, E. L., Kreichauf, S., Wildgruber, A., Vögele, C., Summerbell, C., Nixon, C., . . . Manios, Y. (2012). A narrative review of psychological and educational strategies applied to young children's eating behaviours aimed at reducing obesity risk. *Obesity Reviews, 13*(s1), 85-95.

Gillis, D. E. G., & Sabry, J. H. (1980). Daycare teachers: nutrition knowledge, opinions, and use of food. *Journal of Nutrition Education, 12*(4), 200-204.

Goldfield, G. S., Harvey, A., Grattan, K., & Adamo, K. B. (2012). Physical activity promotion in the preschool years: a critical period to intervene. *International Journal of Environmental Research and Public Health, 9*(4), 1326-1342.

Goodway, J. D., & Branta, C. F. (2003). Influence of a motor skill intervention on fundamental motor skill development of disadvantaged preschool children. *Research Quarterly for Exercise and Sport, 74*(1), 36-46.

Grant, C. C., Wall, C. R., Brunt, D., Crengle, S., & Scragg, R. (2007). Population prevalence and risk factors for iron deficiency in Auckland, New Zealand. *Journal of Paediatrics and Child Health, 43*(7-8), 532-538.

Green, B. N., Johnson, C. D., & Adams, A. (2006). Writing narrative literature reviews for peer-reviewed journals: secrets of the trade. *Journal of Chiropractic Medicine, 5*(3), 101-117.

Gubbels, J. S., Gerards, S. M. P. L., & Kremers, S. P. J. (2015). Use of food practices by childcare staff and the association with dietary intake of children at childcare. *Nutrients, 7*(4), 2161-2175.

Gubbels, J. S., Kremers, S. P. J., Stafleu, A., Dagnelie, P. C., De Vries, N. K., & Thijs, C. (2010). Child-care environment and dietary intake of 2-and 3-year-old children. *Journal of Human Nutrition and Dietetics, 23*(1), 97-101.

Gubbels, J. S., Kremers, S. P. J., Stafleu, A., Dagnelie, P. C., De Vries, N. K., Van Buuren, S., & Thijs, C. (2010). Child-care use and the association with body mass index and overweight in children from 7 months to 2 years of age. *International Journal of Obesity, 34*(10), 1480-1486.

Guyenet, S. J., & Schwartz, M. W. (2012). Regulation of food intake, energy balance, and body fat mass: implications for the pathogenesis and treatment of obesity. *The Journal of Clinical Endocrinology & Metabolism, 97*(3), 745-755.

Haapala, E. A. (2013). Cardiorespiratory fitness and motor skills in relation to cognition and academic performance in children–a review. *Journal of Human Kinetics, 36*(1), 55-68.

Hammerschmidt, P., Tackett, W., Golzynski, M., & Golzynski, D. (2011). Barriers to and facilitators of healthful eating and physical activity in low-income schools. *Journal of Nutrition Education and Behavior, 43*(1), 63-68.

Hammons, A. J., & Fiese, B. H. (2011). Is frequency of shared family meals related to the nutritional health of children and adolescents? *Pediatrics, 127*(6), e1565-e1574.

Han, J. C., Lawlor, D. A., & Kimm, S. Y. S. (2010). Childhood obesity. *The Lancet, 375*(9727), 1737-1748.

Hayden, C., Bowler, J. O., Chambers, S., Freeman, R., Humphris, G., Richards, D., & Cecil, J. E. (2013). Obesity and dental caries in children: a systematic review and meta-analysis. *Community Dentistry and Oral Epidemiology, 41*(4), 289-308.

Healthy Auckland Together. (2017). Healthy Auckland Together: monitoring report summary 2017. Retrieved from http://www.healthyaucklandtogether.org.nz/assets/Summary-Reports/170401-HAT-Monitoring-Report-Summary-HR.pdf

Heath, A. L. M., Reeves Tuttle, C., Simons, M. S. L., Cleghorn, C. L., & Parnell, W. R. (2002). Longitudinal study of diet and iron deficiency anaemia in infants during the first two years of life. *Asia Pacific Journal of Clinical Nutrition, 11*(4), 251-257.

Hedges, H., & Cullen, J. (2005). *Meaningful teaching and learning: children's and teachers' content knowledge*. Auckland: Auckland College of Education.

Henderson, K. E., Grode, G. M., O'Connell, M. L., & Schwartz, M. B. (2015). Environmental factors associated with physical activity in childcare centers. *International Journal of Behavioral Nutrition and Physical Activity, 12*(1), 43.

Hendy, H. M., & Raudenbush, B. (2000). Effectiveness of teacher modeling to encourage food acceptance in preschool children. *Appetite, 34*(1), 61-76.

Hersch, D., Perdue, L., Ambroz, T., & Boucher, J. L. (2014). Peer reviewed: the impact of cooking classes on food-related preferences, attitudes, and behaviors of school-aged children: a systematic review of the evidence, 2003–2014. *Preventing Chronic Disease, 11*.

Hesketh, K., Lakshman, R., & Sluijs, E. (2017). Barriers and facilitators to young children's physical activity and sedentary behaviour: a systematic review and synthesis of qualitative literature. *Obesity Reviews, 18*(9), 987-1017.

Hinkley, T., Verbestel, V., Ahrens, W., Lissner, L., Molnár, D., Moreno, L. A., . . . Russo, P. (2014). Early childhood electronic media use as a predictor of poorer well-being: a prospective cohort study. *JAMA Pediatrics, 168*(5), 485-492.

Hnatiuk, J., Ridgers, N. D., Salmon, J., Campbell, K., McCallum, Z., & Hesketh, K. (2012). Physical activity levels and patterns of 19-month-old children. *Medicine and Science in Sports and Exercise, 44*(9), 1715-1720.

Hnatiuk, J. A., Salmon, J., Hinkley, T., Okely, A. D., & Trost, S. (2014). A review of preschool children's physical activity and sedentary time using objective measures. *American Journal of Preventive Medicine, 47*(4), 487-497.

Hodges, E. A., Smith, C., Tidwell, S., & Berry, D. (2013). Promoting physical activity in preschoolers to prevent obesity: a review of the literature. *Journal of Pediatric Nursing, 28*(1), 3-19.

Hong, Y. M. (2010). Atherosclerotic cardiovascular disease beginning in childhood. *Korean Circulation Journal, 40*(1), 1-9.

Horikawa, C., Kodama, S., Yachi, Y., Heianza, Y., Hirasawa, R., Ibe, Y., . . . Sone, H. (2011). Skipping breakfast and prevalence of overweight and obesity in Asian and Pacific regions: a meta-analysis. *Preventive Medicine, 53*(4), 260-267.

Hurley, K. M., Cross, M. B., & Hughes, S. O. (2011). A systematic review of responsive feeding and child obesity in high-income countries. *The Journal of Nutrition, 141*(3), 495-501.

Hyndman, B. P., & Telford, A. (2015). Should educators be "wrapping school playgrounds in cotton wool" to encourage physical activity? Exploring primary and secondary students' voices from the school playground. *Australian Journal of Teacher Education, 40*(6), n6.

Jansen, E., Mulkens, S., & Jansen, A. (2007). Do not eat the red food!: prohibition of snacks leads to their relatively higher consumption in children. *Appetite, 49*(3), 572-577.

Janssen, I., & LeBlanc, A. G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity, 7*(1), 40.

Jenkin, G. L., Signal, L., & Thomson, G. (2011). Framing obesity: the framing contest between industry and public health at the New Zealand inquiry into obesity. *Obesity Reviews, 12*(12), 1022-1030.

Johansson, E., & Berthelsen, D. (2014). The birthday cake: social relations and professional practices around mealtimes with toddlers in child care. In *Lived Spaces of Infant-Toddler Education and Care* (pp. 75-88). Dordrecht: Springer.

Jones, A. M., & Zidenberg-Cherr, S. (2015). Exploring nutrition education resources and barriers, and nutrition knowledge in teachers in California. *Journal of Nutrition Education and Behavior, 47*(2), 162-169.

Kaaks, R., Ferrari, P., Ciampi, A., Plummer, M., & Riboli, E. (2002). Uses and limitations of statistical accounting for random error correlations, in the validation of dietary questionnaire assessments. *Public Health Nutrition, 5*(6a), 969-976.

Kane, R. G., Burke, P., Cullen, J., Davey, R., Jordan, B., McCurchy-Pilkington, C., . . . Simpson, M. (2005). *Initial teacher education policy and practice*. New Zealand: Ministry of Education.

Kelly, S., & Swinburn, B. (2015). Childhood obesity in New Zealand. *The New Zealand Medical Journal, 128*(1417), 6-7.

Kelsey, M. M., Zaepfel, A., Bjornstad, P., & Nadeau, K. J. (2014). Age-related consequences of childhood obesity. *Gerontology, 60*(3), 222-228.

Kierce, E. A., Boyd, L. D., Rainchuso, L., Palmer, C. A., & Rothman, A. (2016). Association between early childhood caries, feeding practices and an established dental home. *American Dental Hygienists Association, 90*(1), 18-27.

Kline, P. (2000). *Handbook of psychological testing*. London: Routledge.

Knowles, M. (1980). The modern practice of adult learning: from pedagogy to androgogy. In. New York: Cambridge Books.

Knowles, M. S. (1975). *Self-directed learning*. New York: Association Press.

Kolt, G., Schofield, G., McLachlan, C., Oliver, M., Lucas, P., Maddison, R., & Walters, S. (2005). Active movement scoping exercise and programme evaluation: Report to Sport and Recreation New Zealand. *Centre for Physical Activity and Nutrition Research, Auckland University of Technology for Sport and Recreation New Zealand*.

Korczak, R., Kamil, A., Fleige, L., Donovan, S. M., & Slavin, J. L. (2017). Dietary fiber and digestive health in children. *Nutrition Reviews, 75*(4), 241-259.

Kristen Leaity, A. R., Lily Neumegen. (2009). *Food for Under 5s: a practical guide to food and nutrition for ECE services*. Auckland: Auckland Regional Public Health Service.

Lambert, L. G., & Carr, D. H. (2006). Perceptions of elementary school nutrition education practices by school foodservice directors, teachers, and principals. *The Journal of Child Nutrition & Management, 30*(1).

Langford, R., Bonell, C., Jones, H., & Campbell, R. (2015). Obesity prevention and the health promoting schools framework: essential components and barriers to success. *International Journal of Behavioral Nutrition and Physical Activity, 12*(1), 15.

Lanigan, J. D. (2012). The relationship between practices and child care providers' beliefs related to child feeding and obesity prevention. *Journal of Nutrition Education and Behavior, 44*(6), 521-529.

Larson, N., Ward, D. S., Neelon, S. B., & Story, M. (2011). What role can child-care settings play in obesity prevention? A review of the evidence and call for research efforts. *Journal of the American Dietetic Association, 111*(9), 1343-1362.

Lindsay, A. C., Greaney, M. L., Wallington, S. F., Mesa, T., & Salas, C. F. (2017). A review of early influences on physical activity and sedentary behaviors of preschool-age children in high-income countries. *Journal for Specialists in Pediatric Nursing, 22*(3), e12182.

Litwin, S. E. (2014). Childhood obesity and adulthood cardiovascular disease. *64*(15), 1588-1590.

Liumbruno, G. M., Velati, C., Pasqualetti, P., & Franchini, M. (2013). How to write a scientific manuscript for publication. *Blood Transfus, 11*(2), 217-226.

Llewellyn, A., Simmonds, M., Owen, C. G., & Woolacott, N. (2016). Childhood obesity as a predictor of morbidity in adulthood: a systematic review and meta-analysis. *Obesity Reviews, 17*(1), 56-67.

Lobstein, T., & Jackson-Leach, R. (2006). Estimated burden of paediatric obesity and co-morbidities in Europe. Part 2. Numbers of children with indicators of obesity-related disease. *Pediatric Obesity, 1*(1), 33-41.

Lynch, M., & Batal, M. (2012). Child care providers' strategies for supporting healthy eating: a qualitative approach. *Journal of Research in Childhood Education, 26*(1), 107-121.

Mahan, L. K., Escott-Stump, S., L. Raymond, J., & Krause, M. V. (2012). *Krause's food and the nutrition care process (thirteenth edition)*. United States of America: Elsevier Health Sciences.

Malatest International. (2014). *Evaluation of Healthy Heart Award for early childhood education: Tohu manawa ora - kohungahunga*. Retrieved from Wellington: http://www.learnbyheart.org.nz/files/HHA_Final_Report_20150212.pdf

Mann, J., & Truswell, S. (2012). *Essentials of human nutrition*. Oxford: Oxford University Press.

McCormick, C., & Press, C. (2014). *I'm hungry! I'm bored! Eat and play your way to better health, a leaner physique, and a happier life!* New York: Celestial Press.

McGrady, M. E., Mitchell, M. J., Theodore, S. N., Sersion, B., & Holtzapple, E. (2010). Preschool participation and BMI at kindergarten entry: the case for early behavioral intervention. *Journal of Obesity, 2010*, 1-6.

McLachlan, C. (2015). Children's wellbeing: regulations, polices and directions for research. *Early Education, 57*, 19-23.

McLachlan, C., Fleer, M., & Edwards, S. (2013). *Early childhood curriculum: planning, assessment, and implementation*. Cambridge: Cambridge University Press.

McLachlan, C., Smith, J., McLaughlin, T., Ali, A., Conlon, C., Mugridge, O., & Foster, S. (2017). Development of teachers' knowledge and skills in implementing a physical education curriculum: a New Zealand early childhood intervention study. *International Journal of Early Childhood, 49*(2), 211-228.

Melanson, K. J. (2008). Nutrition review: lifestyle approaches to promoting healthy eating for children. *American Journal of Lifestyle Medicine, 2*(1), 26-29.

Mhurchu, C. N., & Gorton, D. (2007). Nutrition labels and claims in New Zealand and Australia: a review of use and understanding. *Australian and New Zealand Journal of Public Health, 31*(2), 105-112.

Miller, A. L., Jong, H., & Lumeng, J. C. (2015). Obesity-associated biomarkers and executive function in children. *Pediatric Research, 77*(1-2), 143.

Ministry of Education. (1996). *Te Whāriki: He whāriki mātauranga mō ngā mokopuna o Aotearoa: early childhood curriculum*. Wellington: Learning Media.

Ministry of Education. (2007). *The New Zealand Curriculum* Wellington: Ministry of Education.

Ministry of Education. (2013). *Annual ECE census report 2013*. Retrieved from Wellington: http://www.educationcounts.govt.nz/statistics/archived/ece2/number-of-ece-services-publications/annual-ece-summary-reports2

Ministry of Education. (2015). Annual ECE data summary report 2015. Retrieved from https://www.educationcounts.govt.nz/statistics/early-childhood-education/annual-ece-summary-reports

Ministry of Education. (2016). Different kinds of early childhood education. Retrieved from https://parents.education.govt.nz/early-learning/early-childhood-education/different-kinds-of-early-childhood-education/

Ministry of Education. (2017a). *Early childhood education teacher qualifications 2017*. Wellington: Ministry of Education.

Ministry of Education. (2017b). *Education (early childhood services) regulations 2008*. Wellington: Ministry of Education.

Ministry of Education. (2017c). *Te Whāriki - Early childhood curriculum*. Wellington: New Zealand.

Ministry of Health. (2012). Eating for healthy children - from 2-12 years. In. Wellington: Ministry of Health.

Ministry of Health. (2015a). *Annual update of key results 2014/15: New Zealand Health Survey*. Wellington: Ministry of Health.

Ministry of Health. (2015b). *Food and nutrition guidelines for healthy children and young people (aged 2–18 years): a background paper – revised february 2015.* Wellington: Ministry of Health.

Ministry of Health. (2015c). *Understanding excess body weight: New Zealand Health Survey*. Wellington: Ministry of Health.

Ministry of Health. (2016). *Annual update of key results 2015/16: New Zealand Health Survey* (M. o. Health Ed.). Wellington: Ministry of Health.

Ministry of Health. (2017a). Childhood obesity plan. Retrieved from http://www.health.govt.nz/our-work/diseases-and-conditions/obesity/childhood-obesity-plan

Ministry of Health. (2017b). *Sit less, move more, sleep well: active play guidelines for under-fives*. Wellington: Ministry of Health.

Ministry of Health & Cancer Society. (2012). *Consensus statement on vitamin D and sun exposure in New Zealand*. Wellington: Ministry of Health.

Moore, H., Nelson, P., Marshall, J., Cooper, M., Zambas, H., Brewster, K., & Atkin, K. (2005). Laying foundations for health: food provision for under-5s in day care. *Appetite, 44*(2), 207-213.

More, J. A., & Emmett, P. M. (2015). Evidenced-based, practical food portion sizes for preschool children and how they fit into a well balanced, nutritionally adequate diet. *Journal of Human Nutrition and Dietetics, 28*(2), 135-154.

Musher-Eizenman, D., & Holub, S. (2007). Comprehensive feeding practices questionnaire: validation of a new measure of parental feeding practices. *Journal of Pediatric Psychology, 32*(8), 960-972.

Nader, P. R., O'Brien, M., Houts, R., Bradley, R., Belsky, J., Crosnoe, R., . . . Susman, E. J. (2006). Identifying risk for obesity in early childhood. *Pediatrics, 118*(3), e594-e601.

Nahikian-Nelms, M. (1997). Influential factors of caregiver behavior at mealtime: a study of 24 child-care programs. *Journal of the American Dietetic Association, 97*(5), 505-509.

Nathanson, A. I., Aladé, F., Sharp, M. L., Rasmussen, E. E., & Christy, K. (2014). The relation between television exposure and executive function among preschoolers. *Developmental Psychology, 50*(5), 1497.

National Health and Medical Research Council. (2016). *Australian Dietary Guidelines*. Canberra: National Health and Medical Research Council.

Nestle Healthy Active Kids. (no date). Nestle healthy active kids. Retrieved from https://www.healthyactivekids.com.au/

Nestle, M. (2013). *Food politics: how the food industry influences nutrition and health* (Vol. 3). Berkeley: University of California Press.

New Zealand Food Safety Authority. (2010). Caffeine intake and effects studied. Retrieved from http://www.foodsafety.govt.nz/elibrary/industry/Caffeine_Intake-Confirms_Advice.htm

New Zealand Heart Foundation. (2015). Healthy Heart Award. Retrieved from http://www.learnbyheart.org.nz/index.php/health-heart-award-guest

New Zealand Heart Foundation. (2017). Healthy celebrations ideas and recipes for early learning services. Retrieved from http://s3-ap-southeast-2.amazonaws.com/hfweb-fuelled-for-life/uploads/resources/Healthy_Celebrations_26.07.17.pdf

New Zealand Nutrition Foundation. (2013). Children. Retrieved from https://www.nutritionfoundation.org.nz/nutrition-facts/healthy-eating-for-all-ages/children

Newbury-Birch, D. (2009). *Impact of alcohol consumption on young people: a systematic review of published reviews*. Newcastle: Newcastle University, Institute of Health and Society.

Nicklas, T. A., Baranowski, T., Baranowski, J. C., Cullen, K., Rittenberry, L., & Olvera, N. (2001). Family and child-care provider influences on preschool children's fruit, juice, and vegetable consumption. *Nutrition Reviews, 59*(7), 224-235.

NSW Department of Health. (2016). *NSW schools physical activity and nutrition survey (spans) 2015: full report.* Sydney: NSW Department of Health.

Nutricia. (2015). An essential component of an ideal baby nutrition are age-appropriate serving size: learn how you can easily determine the appropriate amounts. Retrieved from http://www.aptaadvantage.com.sg/toddler/nutrition/ideal-baby-nutrition/a-childs-hand-as-a-measure-of-the-correct-serving-size

O'Cathain, A., & Thomas, K. J. (2004). "Any other comments?" Open questions on questionnaires–a bane or a bonus to research? *BMC Medical Research Methodology, 4*(1), 25.

O'Dea, J. A. (2016). Evaluation of nutrition and physical activity knowledge, attitudes, self efficacy and behaviors in teachers and children after implementation of the "healthy active kids" online program in australian elementary schools. *Health, 8*(4), 293.

Oenema, A., Brug, J., & Lechner, L. (2001). Web-based tailored nutrition education: results of a randomized controlled trial. *Health Education Research, 16*(6), 647-660.

Ohly, H., Gentry, S., Wigglesworth, R., Bethel, A., Lovell, R., & Garside, R. (2016). A systematic review of the health and well-being impacts of school gardening: synthesis of quantitative and qualitative evidence. *BMC Public Health, 16*(1), 286.

Oliver, M., Schofield, G. M., Kolt, G. S., & McLachlan, C. (2007). Physical activity in early childhood: current state of knowledge. *New Zealand Research in Early Childhood Education, 10*, 47.

Organisation for Economic Co-operation and Development. (2014). *Education at a glance 2014: OECD indicators*. Paris: OECD Publishing.

Organisation for Economic Co-operation and Development. (2017). *Obesity update 2017*: OECD.

Park, M. H., Falconer, C., Viner, R. M., & Kinra, S. (2012). The impact of childhood obesity on morbidity and mortality in adulthood: a systematic review. *Obesity Reviews, 13*(11), 985-1000.

Parmenter, K., & Wardle, J. (1999). Development of a general nutrition knowledge questionnaire for adults. *European Journal of Clinical Nutrition, 53*(4), 298-308.

Patrick, H., & Nicklas, T. A. (2005). A review of family and social determinants of children's eating patterns and diet quality. *Journal of the American College of Nutrition, 24*(2), 83-92.

Paulis, W. D., Silva, S., Koes, B. W., & Middelkoop, M. (2014). Overweight and obesity are associated with musculoskeletal complaints as early as childhood: a systematic review. *Obesity Reviews, 15*(1), 52-67.

Payr, A., Birnbaum, J., Wildgruber, A., Kreichauf, S., Androutsos, O., Lateva, M., . . . Manios, Y. (2014). Concepts and strategies on how to train and motivate teachers to implement a kindergarten-based, family-involved intervention to prevent obesity in early childhood. The ToyBox-study. *Obesity Reviews, 15*(S3), 40-47.

Pearce, A., Li, L., Abbas, J., Ferguson, B., Graham, H., & Law, C. (2010). Is childcare associated with the risk of overweight and obesity in the early years? Findings from the UK Millennium Cohort Study. *International Journal of Obesity, 34*(7), 1160.

Peden, M. E., Jones, R., Costa, S., Ellis, Y., & Okely, A. D. (2017). Relationship between children's physical activity, sedentary behavior, and childcare environments: a cross sectional study. *Preventive Medicine Reports, 6*, 171-176.

Pérez-Escamilla, R., Obbagy, J. E., Altman, J. M., Essery, E. V., McGrane, M. M., Wong, Y. P., . . . Williams, C. L. (2012). Dietary energy density and body weight in adults and children: a systematic review. *Journal of the Academy of Nutrition and Dietetics, 112*(5), 671-684.

Petersen, M. E., & Kies, C. (1972). Nutrition knowledge and attitudes of early elementary teachers. *Journal of Nutrition Education, 4*(1), 11-15.

Physical Activity and Health Alliance. (2010). Physical activity recommendations for birth-18 years in the UK. Retrieved from http://www.paha.org.uk/Resource/physical-activity-recommendations-for-birth-18-years-in-the-uk

Piernas, C., & Popkin, B. M. (2011). Increased portion sizes from energy-dense foods affect total energy intake at eating occasions in US children and adolescents: patterns and trends by age group and sociodemographic characteristics, 1977–2006. *The American Journal of Clinical Nutrition, 94*(5), 1324-1332.

Pigou, D. S. (2013). *Child-centred physical activity: effect on motor skill development in toddlers: a thesis presented in partial fulfilment for the requirements of a Master of Science in Sport and Exercise Science at Massey University, Albany, New Zealand.* (Master of Science in Sport and Exercise Science), Massey University, Auckland.

Pizzi, M. A., & Vroman, K. (2013). Childhood obesity: effects on children's participation, mental health, and psychosocial development. *Occupational Therapy in Health Care, 27*(2), 99-112.

Poutziouris, P., Smyrnios, K., & Klein, S. (2008). *Handbook of research on family business*. Cheltenham: Edward Elgar Publishing.

Proctor, M. H., Moore, L. L., Gao, D., Cupples, L. A., Bradlee, M. L., Hood, M. Y., & Ellison, R. C. (2003). Television viewing and change in body fat from preschool to early adolescence: The Framingham Children's Study. *International Journal of Obesity, 27*(7), 827.

Public Health England. (2017a). Guidance: the eatwell guide. Retrieved from https://www.gov.uk/government/publications/the-eatwell-guide

Public Health England. (2017b). Pre-school vaccinations: guide to vaccinations from 2 to 5 years. Retrieved from https://www.gov.uk/government/publications/pre-school-vaccinations-a-guide-to-vaccinations-from-2-to-5-years

Pulgarón, E. R. (2013). Childhood obesity: a review of increased risk for physical and psychological comorbidities. *Clinical Therapeutics, 35*(1), A18-A32.

Reilly, J. J. (2005). Descriptive epidemiology and health consequences of childhood obesity. *Best Practice & Research Clinical Endocrinology & Metabolism, 19*(3), 327-341.

Reilly, J. J. (2008). Physical activity, sedentary behaviour and energy balance in the preschool child: opportunities for early obesity prevention. *Proceedings of the Nutrition Society, 67*(03), 317-325.

Roberto, C. A., Swinburn, B., Hawkes, C., Huang, T. T., Costa, S. A., Ashe, M., . . . Brownell, K. D. (2015). Patchy progress on obesity prevention: emerging examples, entrenched barriers, and new thinking. *The Lancet, 385*(9985), 2400-2409.

Robinson, L. E., Stodden, D. F., Barnett, L. M., Lopes, V. P., Logan, S. W., Rodrigues, L. P., & D'Hondt, E. (2015). Motor competence and its effect on positive developmental trajectories of health. *Sports Medicine, 45*(9), 1273-1284.

Rosenthal, R. (1991). *Meta-analytic procedures for social research* (Vol. 6). Newbury Park: Sage Publications.

Ruottinen, S., Lagström, H. K., Niinikoski, H., Rönnemaa, T., Saarinen, M., Pahkala, K. A., . . . Simell, O. (2010). Dietary fiber does not displace energy but is associated with decreased serum cholesterol concentrations in healthy children. *The American Journal Of Clinical Nutrition, 91*(3), 651-661.

Rusby, J. C., Crowley, R., Jones, L. B., & Smolkowski, K. (2017). Providing opportunities to learn in home-based child care settings: observations of learning contexts and behavior. *Early Education and Development, 28*(6), 715-726.

Russell, C. G., Taki, S., Laws, R., Azadi, L., Campbell, K. J., Elliott, R., . . . Denney-Wilson, E. (2016). Effects of parent and child behaviours on overweight and obesity in infants and young children from disadvantaged backgrounds: systematic review with narrative synthesis. *BMC Public Health, 16*(1), 151.

Rust, J., & Golombok, S. (2014). *Modern psychometrics: the science of psychological assessment (second edition)*. London: Routledge.

Salas, M. M. S., Nascimento, G. G., Vargas-Ferreira, F., Tarquinio, S. B. C., Huysmans, M. C. D. N. J. M., & Demarco, F. F. (2015). Diet influenced tooth erosion prevalence in children and adolescents: results of a meta-analysis and meta-regression. *Journal of dentistry, 43*(8), 865-875.

Schwartz, C., Scholtens, P. A. M. J., Lalanne, A., Weenen, H., & Nicklaus, S. (2011). Development of healthy eating habits early in life. Review of recent evidence and selected guidelines. *Appetite, 57*(3), 796-807.

Scragg, R., Quigley, R., & Taylor, R. (2006). *Does watching TV contribute to increased body weight and obesity in children*. Wellington: Scientific Committee of the Agencies for Nutrition Action.

Seifert, S. M., Schaechter, J. L., Hershorin, E. R., & Lipshultz, S. E. (2011). Health effects of energy drinks on children, adolescents, and young adults. *Pediatrics, 127*(3), 511-528.

Sharma, S., Dortch, K. S., Byrd-Williams, C., Truxillio, J. B., Rahman, G. A., Bonsu, P., & Hoelscher, D. (2013). Nutrition-related knowledge, attitudes, and dietary behaviors among head start teachers in Texas: a cross-sectional study. *Journal of the Academy of Nutrition and Dietetics, 113*(4), 558-562.

Shloim, N., Edelson, L. R., Martin, N., & Hetherington, M. M. (2015). Parenting styles, feeding styles, feeding practices, and weight status in 4–12 year-old children: a systematic review of the literature. *Frontiers in Psychology, 6*.

Sigman-Grant, M., Christiansen, E., Fernandez, G., Fletcher, J., Johnson, S. L., Branen, L., & Price, B. A. (2011). Child care provider training and a supportive feeding environment in child care settings in 4 states, 2003. *Preventing Chronic Disease, 8*(5), A113.

Silk, K. J., Sherry, J., Winn, B., Keesecker, N., Horodynski, M. A., & Sayir, A. (2008). Increasing nutrition literacy: testing the effectiveness of print, web site, and game modalities. *Journal of Nutrition Education and Behavior, 40*(1), 3-10.

Simmonds, M., Llewellyn, A., Owen, C., & Woolacott, N. (2016). Predicting adult obesity from childhood obesity: a systematic review and meta-analysis. *Obesity Reviews, 17*(2), 95-107.

Sisson, S. B., Krampe, M., Anundson, K., & Castle, S. (2016). Obesity prevention and obesogenic behavior interventions in child care: a systematic review. *Preventive Medicine, 87*, 57-69.

Sisson, S. B., Li, J., Arnold, S. H., Lora, K. R., Stoner, J. A., DeGrace, B., . . . Stephens, L. (2015). Obesogenic child care center environment and obesity in preschool children. *Journal of the Academy of Nutrition and Dietetics, 115*(9), A76.

Sisson, S. B., Li, J., Stoner, J. A., Lora, K. R., Campbell, J. E., Arnold, S. H., . . . Stephens, L. (2016). Obesogenic environments in tribally-affiliated childcare centers and corresponding obesity rates in preschool children. *Preventive Medicine Reports, 3*, 151-158.

Skouteris, H., McCabe, M., Swinburn, B., Newgreen, V., Sacher, P., & Chadwick, P. (2011). Parental influence and obesity prevention in pre-schoolers: a systematic review of interventions. *Obesity Reviews, 12*(5), 315-328.

Slavin, J. L., & Lloyd, B. (2012). Health benefits of fruits and vegetables. *Advances in Nutrition: An International Review Journal, 3*(4), 506-516.

Soh, P., Ferguson, E. L., McKenzie, J. E., Homs, M. Y. V., & Gibson, R. S. (2004). Iron deficiency and risk factors for lower iron stores in 6–24-month-old New Zealanders. *European Journal of Clinical Nutrition, 58*(1), 71-79.

Soliah, L. A., Newell, G. K., Vaden, A. G., & Dayton, A. D. (1983). Establishing the need for nutrition education: II. Elementary teachers' nutrition knowledge, attitudes, and practices. *Journal of the American Dietetic Association, 83*(4), 447-453.

Sport New Zealand. (2015). Guidelines for children and young people aged 5 to 18 years. Retrieved from http://www.sportnz.org.nz/managing-sport/guides/guidelines-for-children-and-young-people-aged-5-to-18-years--2

Sports New Zealand. (2012). *Developing fundamental movement skills manual - Introduction*. Wellington: Sport New Zealand.

Spronk, I., Kullen, C., Burdon, C., & O'Connor, H. (2014). Relationship between nutrition knowledge and dietary intake. *British Journal of Nutrition, 111*(10), 1713-1726.

Stodden, D., Langendorfer, S., & Roberton, M. A. (2009). The association between motor skill competence and physical fitness in young adults. *Research Quarterly for Exercise and Sport, 80*(2), 223-229.

Story, M., Kaphingst, K. M., & French, S. (2006). The role of child care settings in obesity prevention. *The Future of Children, 16*(1), 143-168.

Swain, M. (2013). Knowledge. In W. Dubitzky, O. Wolkenhauer, K.-H. Cho, & H. Yokota (Eds.), *Encyclopedia of Systems Biology* (pp. 1072-1073). New York, NY: Springer New York.

Swinburn, B., Egger, G., & Raza, F. (1999). Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Preventive Medicine, 29*(6), 563-570.

Swinburn, B., Sacks, G., & Ravussin, E. (2009). Increased food energy supply is more than sufficient to explain the US epidemic of obesity. *The American Journal of Clinical Nutrition, 90*(6), 1453-1456.

Szajewska, H., & Ruszczyński, M. (2010). Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe. *Critical Reviews in Food Science and Nutrition, 50*(2), 113-119.

Taylor, C. M., Wernimont, S. M., Northstone, K., & Emmett, P. M. (2015). Picky/fussy eating in children: review of definitions, assessment, prevalence and dietary intakes. *Appetite, 95*, 349-359.

Taylor, R. W., Williams, S. M., Farmer, V. L., & Taylor, B. J. (2013). Changes in physical activity over time in young children: a longitudinal study using accelerometers. *PLoS One, 8*(11), e81567.

Te Morenga, L., Mallard, S., & Mann, J. (2013). Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. *Bmj, 346*, e7492.

Tremblay, M. S., LeBlanc, A. G., Carson, V., Choquette, L., Connor Gorber, S., Dillman, C., . . . Janssen, I. (2012). Canadian physical activity guidelines for the early years (aged 0–4 years). *Applied Physiology, Nutrition, and Metabolism, 37*(2), 345-356.

Trost, S. G., Messner, L., Fitzgerald, K., & Roths, B. (2009). Nutrition and physical activity policies and practices in family child care homes. *American Journal of Preventive Medicine, 37*(6), 537-540.

Trost, S. G., Ward, D. S., & Senso, M. (2010). Effects of child care policy and environment on physical activity. *Medicine and Science in Sports and Exercise, 42*(3), 520-525.

United States Department of Agriculture. (2015). ChooseMyPlate.gov. Retrieved from https://www.choosemyplate.gov/health-and-nutrition-information

United States Department of Agriculture. (2017). Choose My Plate. Retrieved from https://www.cnpp.usda.gov/MyPyramid

Unusan, N. (2007). Effects of a food and nutrition course on the self-reported knowledge and behavior of preschool teacher candidates. *Early Childhood Education Journal, 34*(5), 323-327.

Utter, J., Denny, S., Robinson, E., Fleming, T., Ameratunga, S., & Grant, S. (2013). Family meals among New Zealand young people: relationships with eating behaviors and body mass index. *Journal of Nutrition Education and Behavior, 45*(1), 3-11.

Valdes, J., Rodríguez-Artalejo, F., Aguilar, L., Jaen-Casquero, M. B., & Royo-Bordonada, M. Á. (2013). Frequency of family meals and childhood overweight: a systematic review. *Pediatric Obesity, 8*(1).

Van der Horst, K., Ferrage, A., & Rytz, A. (2014). Involving children in meal preparation. Effects on food intake. *Appetite, 79*, 18-24.

Vanderloo, L. M. (2014). Screen-viewing among preschoolers in childcare: a systematic review. *BMC Pediatrics, 14*(1), 1.

Vanderloo, L. M., Tucker, P., Johnson, A. M., Burke, S. M., & Irwin, J. D. (2015). Environmental influences on preschoolers' physical activity levels in various early-learning facilities. *Research Quarterly for Exercise and Sport, 86*(4), 360-370.

Vanderloo, L. M., Tucker, P., Johnson, A. M., van Zandvoort, M. M., Burke, S. M., & Irwin, J. D. (2014). The influence of centre-based childcare on preschoolers' physical activity levels: a cross-sectional study. *International Journal of Environmental Research and Public Health, 11*(2), 1794-1802.

Wang, Y., & Lim, H. (2012). The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. *International Review of Psychiatry, 24*(3), 176-188. doi:10.3109/09540261.2012.688195

Wang, Y., & Lobstein, T. (2006). Worldwide trends in childhood overweight and obesity. *International Journal of Pediatric Obesity, 1*(1), 11-25.

Weaver, C. M., Gordon, C. M., Janz, K. F., Kalkwarf, H. J., Lappe, J. M., Lewis, R., . . . Zemel, B. S. (2016). The National Osteoporosis Foundation's position statement on peak bone mass development and lifestyle factors: a systematic review and implementation recommendations. *Osteoporosis International, 27*(4), 1281-1386.

Whitebook, M. (2003). *Early education quality: higher teacher qualifications for better living environments. A review of the literature*. Berkeley: University of California at Berkeley.

Whitebook, M., McLean, C., & Austin, L. J. E. (2016). *Early Childhood Workforce Index: 2016*. Berkeley: University of California at Berkeley.

Whitehead, M. (2013). Definition of physical literacy and clarification of related issues. *ICSSPE Bulletin, 65*(1.2).

Williams, H. G., Pfeiffer, K. A., O'neill, J. R., Dowda, M., McIver, K. L., Brown, W. H., & Pate, R. R. (2008). Motor skill performance and physical activity in preschool children. *Obesity, 16*(6), 1421-1426.

Wood, E., & Attfield, J. (2005). *Play, learning and the early childhood curriculum (second edition)*. London: Sage Publications.

World Health Organization. (2012). *Prioritizing areas for action in the field of population-based prevention of childhood obesity: a set of tools for Member States to determine and identify priority areas for action*. Switzerland: World Health Organization.

World Health Organization. (2014, 29 October 2014). Commission on ending childhood obesity - facts and figures on childhood obesity. Retrieved from http://www.who.int/end-childhood-obesity/facts/en/

World Health Organization. (2016a). Fact Sheet: Obesity and overweight. Retrieved from http://www.who.int/mediacentre/factsheets/fs311/en/

World Health Organization. (2016b). *Final Report of the Commission on Ending Childhood Obesity*. Switzerland: World Health Organization.

World Health Organization. (2016c). Obesity and overweight: fact sheet. Retrieved from http://www.who.int/mediacentre/factsheets/fs311/en/

World Health Organization. (2016d). Physical activity and young people. Retrieved from http://www.who.int/dietphysicalactivity/factsheet_young_people/en/

World Health Organization. (no date-a). Nutrition. Retrieved from http://www.who.int/topics/nutrition/en/

World Health Organization. (no date-b). What is moderate-intensity and vigorous-intensity physical activity? Retrieved from http://www.who.int/dietphysicalactivity/physical_activity_intensity/en/

Worsley, A. (2002). Nutrition knowledge and food consumption: Can nutrition knowledge change food behaviour? *Asia Pacific Journal of Clinical Nutrition, 11*(s3).

Young, I. D. (1997). Guidelines for school health programs to promote lifelong healthy eating. *Journal of School Health, 67*(0), 0-9.

Zahir, N., Heyman, M. B., & Wojcicki, J. M. (2013). No association between childcare and obesity at age 4 in low-income Latino children. *Pediatric Obesity, 8*(2).

Zinn, C., Schofield, G., & Wall, C. (2005). Development of a psychometrically valid and reliable sports nutrition knowledge questionnaire. *Journal of Science and Medicine in Sport, 8*(3), 346-351.

Zlatevska, N., Dubelaar, C., & Holden, S. S. (2014). Sizing up the effect of portion size on consumption: A meta-analytic review. *Journal of Marketing, 78*(3), 140-154.

APPENDICES

Appendix A: Additional background and study protocol

The following section outlines additional background, methods and study protocols for the ECE teachers' nutrition and physical activity knowledge for pre-schoolers study.

Background on aims and objectives

After searching the literature, a need was identified for a study to measure and describe ECE teachers' nutrition and physical activity knowledge for pre-schoolers in New Zealand, which formed the study's aim. In order to achieve this, a secondary objective was to design and validate a nutrition knowledge questionnaire via psychometric testing (as no appropriate tool was available). This testing method is recommended for validating nutrition knowledge questionnaire, with content and construct validity being the most important (Rust & Golombok, 2014). The Ministry of Health *Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2-18 years)* are the main New Zealand nutrition guidelines for pre-schoolers, therefore, it was important to specify in the study objectives that these would be used as the benchmark for teachers' knowledge.

Study design

A cross-sectional study was chosen due to the descriptive and preliminary nature the study, and to align with preceding studies that are mostly descriptive or cross-sectional. The study followed a timeline (Table A. 1) and study protocol (Figure A. 2).

Table A. 1. ECE teachers' nutrition knowledge and related perspectives study timeline

	Year 1 & 2: from May 2016-Oct 2017																	
Project Tasks	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Planning/literature search																		
Draft/submit research proposal																		
Questionnaire design, validation																		
Data collection																		
Data analysis																		
Draft final report																		
Submission of these (Oct 28th)																		

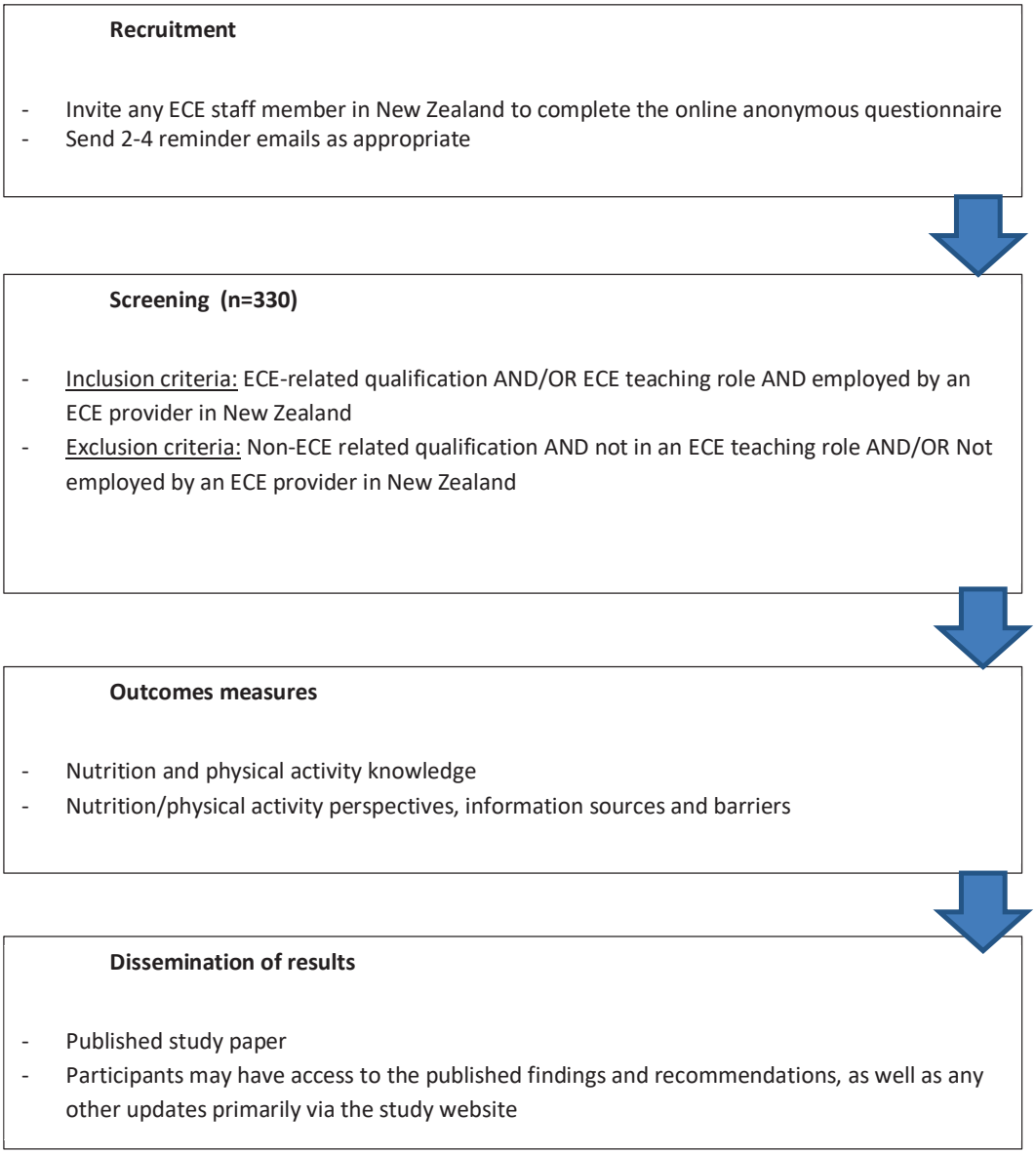

Figure A. 1. ECE teachers' nutrition knowledge and related perspectives for pre-schoolers' study protocol flow diagram

Ethical approval

This research was conducted by researchers from the School of Sport, Exercise and Nutrition, Massey University. This study was reviewed and approved by the Massey University Ethics Committee: Northern, application 15/36. Informed consent was online submission of the questionnaire.

Study population

Sample size

The study aimed to collect completed questionnaires from at least 330 ECE teachers. This was determined by the mean ± SD sample size of 323 ± 373 of studies investigating ECE teachers' nutrition knowledge and who were also clear in only sampling ECE teachers (Derscheid et al., 2010; Gillis & Sabry, 1980; Jones & Zidenberg-Cherr, 2015; Nahikian-Nelms, 1997; O'Dea, 2016; Petersen & Kies, 1972; Sharma et al., 2013; Soliah et al., 1983). The large standard deviation shows the great variability in sample sizes between studies. Therefore, it was decided to round up the mean value to nearest ten in order to be conservative and improve statistical power.

Inclusion criteria

The study objectives determined the inclusion criteria outline in Figure A. 1. An ECE teacher was defined as an ECE staff member that held an approved NZ ECE-related qualification, and/or identified themselves as a qualified teacher due to grey areas with regards to what classifies a qualified or registered teacher in New Zealand. According to Kane et al. (2005), in 1990, a licencing point system was implemented in New Zealand that allowed partially qualified ECE staff with varied formal training (e.g. certificates, modules) and experience, to reach the benchmark of a Diploma of Teaching. ECE teachers that already had a two-year qualification were grand-parented into this system, so further training was not required. In 2000, this system was phased out and it was a requirement that new teachers had to attain the Diploma of Teacher (ECE) in order to be qualified and register, however, existing teachers had an extended amount of time to upgrade to a level 7 diploma (Kane et al., 2005). Today the benchmark qualification needed to become a qualified ECE teacher includes a Bachelor of Teaching (ECE), a Diploma of Teaching (ECE), or an equivalent ECE teaching qualification as Level 7 or above recognised by the Education Council of New Zealand (Ministry of Education, 2017a). However, some teachers may still have the two-year Diploma described in the 90's, thus expanding study criteria was necessary.

It was a requirement that participants either selected “qualified teacher” or specified an ECE-related qualification because it could not be assumed that a participant who selected “other” (yet did not elaborate on this) and selected “manager role” had ECE qualifications, and it is not a requirement by law that childcare managers have ECE teacher qualifications. Despite consideration that only including ECE teachers from licensed centres (as listed in the Ministry of Education ECE directory (August 2017)) may improve generalisability, we chose not to use this in inclusion criteria as study objectives focused on ECE teachers, rather than the ECE provider. Moreover, not all previous studies have only included licensed ECE centres, and excluding unlicensed centres may evade interesting comparisons between each setting.

Recruitment

To maximise study reach and recruitment, large ECE organizations were first invited to distribute the questionnaire to their centres. Following this, independent centres (found using Google searches and the Ministry of Education ECE directory) were individually contacted. Massey University published a press release for the study on the university website to invite ECE staff to participate and inform the public of the research. This led to the study being featured on two radio shows (one live interview) and the North Shore Times paper. Social media (Facebook), the study website and online noticeboards were also used to invite participants. Although using an intermediary between the researchers and ECE centres was useful, the most successful and effective methods for recruiting ECE centres was by the researcher personally inviting each ECE centre via e-mail. Facebook was less effective, with most ECE centres not responding to Facebook messages. Finally, all ECE staff were invited to participate with the potential to use this data at a later date.

Statistical analysis

As some data appeared normal, all data was treated as normal and analysed using parametric tests. In addition, according to the Central Limit Theorem, when the sample size is large, the distribution of the sample means will approach a normal distribution (Anderson, 2010), therefore, the large sample size assumed normality. Mean ± SD was reported to align

with previous studies (Gillis & Sabry, 1980; Jones & Zidenberg-Cherr, 2015; Nahikian-Nelms, 1997; O'Dea, 2016; Petersen & Kies, 1972; Soliah et al., 1983), thus improving comparability and readability of findings. Dummy variables were used for ordinal or categorical data in regression analysis. There was no missing data for nutrition knowledge items due to forced responses. Following a previous study (Zinn et al., 2005), not sure and choose not to answer responses were given a 0 score, so were not excluded. Responses for participant variables and perspective responses that were not sure, other or choose not to answer were excluded from variance, correlation, and regression analysis unless "other" was considered a variable in its own right (e.g. qualification level "other").

Appendix B: Supplementary results

Table B. 1. Number and percentage of items correct by participants (n=386)

		Participants	
	Score (%)†	n	%‡
Total	<18.5 (<50)	25	6.5
	18.5-21.8 (50-59)	121	31.3
	21.9-25.5 (60-69)	189	49.0
	25.6-29.2 (70-79)	47	12.2
	29.3-32.9 (80-89)§	4	1.0
	33-36.6 (90-99)	0	0.0
	37 (100)	0	0.0
Servings	0 (0)	18	4.7
	1 (16.7)	86	22.3
	2 (33.3)	127	32.9
	3 (50)	102	26.4
	4 (66.7)	41	10.6
	5 (83.3)	11	2.8
	6 (100)	1	0.3
Food choices	<12.5 (<50)	8	2.1
	12.6-14.8 (50-59)	19	4.9
	14.9-17.3 (60-69)	124	32.1
	17.4-19.8 (70-79)	137	35.5
	19.9-22.3 (80-89)	94	24.4
	22.4-24.8 (90-99)	4	1.0
	25 (100)	0	0.0
Portions	0 (0)	89	23.1
	1 (20)	88	22.8
	2 (40)	97	25.1
	3 (60)	61	15.8
	4 (80)	36	9.3
	5 (100)	15	3.9
Resources	0 (0)	122	31.6
	1 (50)	137	35.5
	2 (100)	127	32.9

†Percentage of the questionnaire correct.
‡Percentage of the participants that obtained the score.
§The highest score was 30 (81% correct); n=3.
Note. Question scoring was: correct response: +1; incorrect response: 0; unsure response or choose not to answer: 0
Maximum possible scores: total=37; servings=6; food choices=25; portions=5; resource=1.

Table B. 2. Responses for servings sub-category items (n=386)

Servings		Correct	None per day	At least 1	At least 2	At least 3	At least 4	At least 5	At least 6	At least 7	Not sure
fruit	n	0	29	177	95	19	59	3	0	4	
	%	0	7.5	45.9	24.6	4.9	15.3	0.8	0	1.0	
vegetables	n	0	21	89	172	32	64	3	1	4	
	%	0	5.4	23.1	44.6	8.3	16.6	0.8	0.3	1.0	
breads and cereals	n	4	97	156	71	31	4	5	0	18	
	%	1.0	25.1	40.4	18.4	8.0	1.0	1.3	0	4.7	
meats/meat alternatives	n	0	185	136	47	5			1	12	
	%	0	47.9	35.2	12.2	1.3			0.3	3.1	
milk/milk alternative	n	1	96	178	81	14	5		0	11	
	%	0.3	24.9	46.1	21.0	3.6	1.3		0	2.8	

		Never	Rarely	Some days	Most days	Every day	Not sure	Choose not to answer
Wholegrains	n	4	11	57	118	162	21	13
	%	1.0	2.8	14.8	30.6	42.0	5.4	3.4

Note. Question scoring was: correct response: +1; incorrect response: 0; unsure response or choose not to answer: 0. Maximum possible score=6.

Table B. 3. Responses for food choices (n=386)

		Never	Occasional (< once per week)	Sometimes	Everyday	Not sure	Choose not to answer
suitable drinks							
Water	n	1			384	1	
	%	0.3			99.5	0.3	
Cow's milk (or alternative)	n	1	6	61	317	1	
	%	0.3	1.6	15.8	82.1	0.3	
Flavoured milk	n	146	203	36			1
	%	37.8	52.6	9.3			0.3
Fizzy drinks (including diet drinks)	n	339	45	2			
	%	87.8	11.7	0.5			
Cordial or fruit drinks	n	194	171	18	1	2	
	%	50.3	44.3	4.7	0.3	0.5	
Tea/coffee	n	380	5		1		
	%	98.4	1.3		0.3		
Sports/energy drinks	n	384	2				
	%	99.5	0.5				
everyday drinks (select image)							
Potato crisps, corn snacks or chips (e.g. burger rings, rashuns, etc.)	n	76	244	66			
	%	19.7	63.2	17.1			
Fruit	n		3		383		
	%		0.8		99.2		

Chocolate coated or cream filled biscuits	**n**	109	243	31	1	2	
	%	28.2	63.0	8.0	0.3	0.5	
Biscuits (e.g. plain, semi-sweet, gingernut, shortbread)	**n**	18	197	162	9		
	%	4.7	51.0	42.0	2.3		
Yoghurt pottle (all types)	**n**	3	28	209	145		1
	%	0.8	7.3	54.1	37.6		0.3
Vegetable sticks	**n**	1		15	366	3	1
	%	0.3		3.9	94.8	0.8	0.3
Nuts (all types)	**n**	23	32	145	170	15	1
	%	6.0	8.3	37.6	44.0	3.9	0.3
Hard dried fruits (e.g. banana chips)	**n**	26	111	210	31	8	
	%	6.7	28.8	54.4	8.0	2.1	
Soft dried fruits (e.g. raisins)	**n**	10	94	228	53	1	
	%	2.6	24.4	59.1	13.7	0.3	
Ice-cream	**n**	45	271	67	2	1	
	%	11.7	70.2	17.4	0.5	0.3	
Cheese (e.g. cheddar, colby, etc.)	**n**	2	14	148	219	2	1
	%	0.5	3.6	38.3	56.7	0.5	0.3
Pastries (e.g. mini meat pie/sausage roll)	**n**	66	248	68	1	3	
	%	17.1	64.2	17.6	0.3	0.8	
Plain crackers or crisp breads	**n**	1	44	202	136	3	
	%	0.3	11.4	52.3	35.2	0.8	
everyday drinks (select image)		**Yes**	**No**	**Not sure**	**Choose not to answer**	**Comments**	
Orange juice	**n**	7	379				
	%	1.8	98.2				
Dilute orange juice	**n**	79	307				
	%	20.5	79.5				
Cow's milk	**n**	339	47				
	%	87.8	12.2				
Coke Zero	**n**	0	386				
	%	0.0	100				
Flavoured milk	**n**	15	371				
	%	3.9	36.1				
Fruit Drink	**n**	6	380				
	%	1.6	98.4				
Water	**n**	381	5				
	%	98.7	1.3				
Powerade	**n**	0	386				
	%	0.0	100				
Flavoured water	**n**	11	375				
	%	2.8	97.2				
V-zero	**n**	0	386				
	%	0.0	100				
Coconut water	**n**	60	326				
	%	15.5	84.5				
Other drinks							
	n	64	293	0	29	Cow's milk alternatives (almond,	

						soy, goat, oat, rice): 22 (6); Breast milk: 6 (2); Herbal tea: 4 (1); Energy drinks: 1 (0); Fruit/vege smoothies 4 (1); Kombucha/probiotics: 2 (1); Fresh squeezed juice: 6 (2); Milo: 6 (2); Toddler milk: 2 (1); Repeated option from previous question: 11 (3)
	%	17.0	76.0	0.0	8.0	
Other snacks						
	n	96	211	79		Avocado: 3 (1); Hummus/dips: 11 (3); Blissballs: 4 (1); Home baking: 9 (2); Sandwiches/toast: 8 (2); Popcorn: 9 (2); eggs: 5 (2); meat: 4 (1); Sushi/seaweed: 4 (1); pancakes/pikelets: 2 (1): pasta: 2 (1); seeds: 1 (0): Pretzel: 2 (1); oats/muesli: 1 (0); muesli bars: 4 (1); repeated option from previous question: 12 (3)
	%	25.0	55.0	21.0		
Healthy lunchbox						
Chicken nuggets	**n**	5	381			
	%	1.3	98.7			
Cheese	**n**	363	23			
	%	94.0	6.0			
Potato crisps	**n**	5	381			
	%	1.3	98.7			
Wholemeal bread	**n**	369	17			
	%	95.6	4.4			
Tomato	**n**	379	7			
	%	98.2	1.8			
Fruit roll up	**n**	7	379			
	%	1.8	98.2			
Lettuce	**n**	365	12			
	%	94.6	5.4			
Mandarin	**n**	379	7			
	%	98.2	1.8			
Fruit muesli bar	**n**	73	313			
	%	18.9	81.1			
Not sure	**n**	4	382			

	%	1.0	99.0	

Note. Question scoring was: correct response: +1; incorrect response: 0; unsure response or choose not to answer: 0.
Maximum possible scores: total = 37; servings = 6; food choices = 25; portions = 5; resource = 1.

Table B. 4. ECE teachers' responses for "How many snacks should a pre-schooler have per day?" (n=386)

		None per day	At least 1	At least 2	At least 3	At least 4	At least 5	At least 6	More than 6 per day	Not sure	Choose not to answer
Snack frequency	**n**	5	20	170	135	25	6	8	2	13	2
	%	1.3	5.2	44.0	35.0	6.5	1.6	2.1	0.5	3.4	0.5

Note. Question scoring was: correct response: +1; incorrect response: 0; unsure response or choose not to answer: 0.

Table B. 5. Linear regression analysis for nutrition knowledge scores and qualification level, current role, age and years of experience (n=377)†

Score	Variables	B	SE B	β	B CI [25th, 75th percentiles]
total	(Constant)	21.23	0.62		[20.02, 22.44]
	Sub-degree vs. Bachelors	0.57	0.32	0.10	[-0.07, 1.21]
	Sub-degree vs. post-graduate	0.56	0.58	0.05	[-0.57, 1.69]
	Sub-degree vs. other	-0.30	1.00	-0.02	[-2.26, 1.67]
	Teacher vs. manager/teacher	0.07	0.64	0.01	[-1.18, 1.33]
	Teacher vs. other	0.38	0.47	0.04	[-0.54, 1.31]
	Age	0.02	0.02	0.07	[-0.01, 0.05]
	Years of experience	0.03	0.05	0.04	[-0.07, 0.13]
servings					
	(Constant)	2.49	0.25		[2.00, 2.98]
	Sub-degree vs. Bachelors	0.12	0.13	0.05	[-0.14, 0.38]
	Sub-degree vs. post-graduate	0.04	0.23	0.01	[-0.42, 0.50]
	Sub-degree vs. other	-0.21	0.41	-0.03	[-1.01, 0.59]
	Teacher vs. manager/teacher	-0.02	0.26	0.00	[-0.53, 0.49]
	Teacher vs. other	-0.21	0.19	-0.06	[-0.58, 0.17]
	Age	-0.01	0.01	-0.10	[-0.02, 0.00]
	Years of experience	0.01	0.02	0.04	[-0.03, 0.06]
food choices					
	(Constant)	17.36	0.49		[16.40, 18.33]
	Sub-degree vs. Bachelors	0.16	0.26	0.03	[-0.35, 0.66]
	Sub-degree vs. post-graduate	0.38	0.46	0.05	[-0.53, 1.28]
	Sub-degree vs. other	-1.32	0.80	-0.09	[-2.88, 0.24]
	Teacher vs. manager/teacher	-0.12	0.51	-0.01	[-1.12, 0.88]

	Teacher vs. other	-0.31	0.37	-0.04	[-1.04, 0.43]
	Age	0.01	0.01	0.06	[-0.01, 0.04]
	Years of experience	0.02	0.04	0.02	[-0.06, 0.09]
portions					
	(Constant)	1.39	0.31		[0.79, 1.99]
	Sub-degree vs. Bachelors	0.14	0.16	0.05	[-0.18, 0.45]
	Sub-degree vs. post-graduate	-0.11	0.28	-0.02	[-0.68, 0.45]
	Sub-degree vs. other	0.49	0.49	0.05	[-0.48, 1.46]
	Teacher vs. manager/teacher	0.09	0.32	0.01	[-0.54, 0.71]
	Teacher vs. other	0.23	0.23	0.05	[-0.22, 0.69]
	Age	0.00	0.01	-0.02	[-0.02, 0.01]
	Years of experience	0.04	0.02	0.10	[-0.01, 0.09]
resource					
	(Constant)	0.30	0.09		[0.13, 0.47]
	Sub-degree vs. Bachelors	-0.02	0.05	-0.02	[-0.11, 0.07]
	Sub-degree vs. post-graduate	0.01	0.08	0.01	[-0.15, 0.17]
	Sub-degree vs. other	0.10	0.14	0.04	[-0.18, 0.37]
	Teacher vs. manager/teacher	-0.05	0.09	-0.03	[-0.23, 0.12]
	Teacher vs. other	0.01	0.07	0.01	[-0.12, 0.14]
	Age	0.00	0.00	0.06	[0.00, 0.01]
	Years of experience	0.02	0.01	0.13*	[0.00, 0.03]

* $p<0.05$.

†Participants who selected "Choose not to answer" for age (n=9) were omitted from analysis.

Note. $R^2=0.02$ for total score, $R^2=0.02$ for servings, $R^2=0.02$ for servings, $R^2=0.02$ for portions, $R^2=0.03$ for resource. No perfect multicollinearity.

Abbreviations: vs., versus; B, unstandardised coefficients; SE B, standard errors for coefficients; β, standardised coefficients; B CI; 95% confidence intervals for the coefficients.

Table B. 6. Nutrition and physical activity perspectives (7-point Likert scale; strongly disagree=1 to strongly agree=7)

NUTRITION		Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree	Score Mean ± SD
Mealtimes should be fun (n=385)	n	1.0	3.0	6.0	20.0	64.0	109.0	182.0	6.11 ± 1.08
	%	0.3	0.8	1.6	5.2	16.6	28.2	47.2	
Pre-schoolers should eat together (n=386)	n	2.0	4.0	4.0	23.0	62.0	131.0	160.0	6.04 ± 1.10
	%	0.5	1.0	1.0	6.0	16.1	33.9	41.5	
Snacks should be low in sugar (n=386)	n	3.0	0.0	1.0	2.0	25.0	107.0	248.0	6.52 ± 0.82
	%	0.8	0.0	0.3	0.5	6.5	27.7	64.2	
Pre-schoolers should have a choice of a variety of foods at mealtimes (n=385)	n	1.0	7.0	11.0	19.0	54.0	135.0	158.0	6.00 ± 1.17
	%	0.3	1.8	2.8	4.9	14.0	35.0	40.9	
Pre-schoolers should always eat all the food on their plate (n=385)	n	54.0	121.0	80.0	49.0	56.0	17.0	8.0	3.04 ± 1.52
	%	14.0	31.3	20.7	12.7	14.5	4.4	2.1	
ECE teachers should role model healthy eating to pre-schoolers (n=383)	n	0.0	0.0	1.0	3.0	13.0	110.0	256.0	6.61 ± 0.62
	%	0.0	0.0	0.3	0.8	3.4	28.5	66.3	
ECE teachers should eat with pre-schoolers (n=384)	n	4.0	15.0	9.0	47.0	81.0	126.0	102.0	5.53 ± 1.36
	%	1.0	3.9	2.3	12.2	21.0	32.6	26.4	
ECE teachers should talk to pre-schoolers about what they are eating (n=385)	n	1.0	3.0	2.0	7.0	19.0	122.0	231.0	6.45 ± 0.87
	%	0.3	0.8	0.5	1.8	4.9	31.6	59.8	
ECE teachers should encourage pre-schoolers to try new foods (n=385)	n	1.0	0.0	1.0	5.0	23.0	142.0	213.0	6.45 ± 0.75
	%	0.3	0.0	0.3	1.3	6.0	36.8	55.2	
It is important that pre-schoolers are involved in an edible garden in ECE settings (n=385)	n	1.0	0.0	0.0	13.0	52.0	143.0	176.0	6.25 ± 0.83
	%	0.3	0.0	0.0	3.4	13.5	37.0	45.6	
ECE teachers play a vital role in promoting nutrition to preschoolers (n=385)	n	0.0	1.0	1.0	7.0	25.0	140.0	211.0	6.43 ± 0.75
	%	0.0	0.3	0.3	1.8	6.5	36.3	54.7	
A pre-schooler's healthy eating is more of the parent's responsibility (n=386)	n	14.0	36.0	46.0	75.0	108.0	66.0	41.0	4.53 ± 1.57
	%	3.6	9.3	11.9	19.4	28.0	17.1	10.6	
Childcare centres have a role in supporting parents with information and ideas on healthy eating (n=384)	n	3.0	2.0	2.0	10.0	52.0	155.0	162.0	6.18 ± 0.93
	%	0.8	0.5	0.5	2.6	13.5	40.2	42.0	
The food children eat in my centre provides them with the right fuel they need for the day (n=370)	n	3.0	4.0	17.0	20.0	55.0	119.0	152.0	5.93 ± 1.25
	%	0.8	1.0	4.4	5.2	14.2	30.8	39.4	

I feel confident having conversations with parents about food and nutrition (n=377)	**n**	2.0	5.0	17.0	21.0	83.0	132.0	117.0	5.76 ± 1.21
	%	0.5	1.3	4.4	5.4	21.5	34.2	30.3	
Celebrations and events in our centre should support healthy eating messages (n=382)	**n**	0.0	5.0	14.0	32.0	82.0	139.0	110.0	5.74 ± 1.15
	%	0.0	1.3	3.6	8.3	21.2	36.0	28.5	
Healthy eating education is part of Tē-whariki and can support other areas of learning (n=378)	**n**	2.0	0.0	1.0	12.0	41.0	159.0	163.0	6.22 ± 0.88
	%	0.5	0.0	0.3	3.1	10.6	41.2	42.2	
PHYSICAL ACTIVITY									
I am able to define the term "physical activity" (n=386)	**n**	0.0	3.0	2.0	2.0	33.0	206.0	140.0	6.22 ± 0.77
	%	0.0	0.8	0.5	0.5	8.5	53.4	36.3	
I am able to define the term "fundamental movement skills" (n=376)	**n**	1.0	4.0	11.0	11.0	66.0	172.0	111.0	5.92 ± 1.04
	%	0.3	1.0	2.8	2.8	17.1	44.6	28.8	
Physical activity is important for all pre-schoolers' brain and motor skill development (n=386)	**n**	0.0	0.0	5.0	0.0	0.0	71.0	310.0	6.79 ± 0.44
	%	0.0	0.0	1.3	0.0	0.0	18.4	80.3	
I know what activities will develop specific movement skills (n=383)	**n**	4.0	9.0	0.0	8.0	77.0	155.0	130.0	5.96 ± 1.00
	%	1.0	2.3	0.0	2.1	19.9	40.2	33.7	
I understand the difference between structured and unstructured play (n=384)	**n**	1.0	0.0	1.0	2.0	19.0	144.0	217.0	6.49 ± 0.68
	%	0.3	0.0	0.3	0.5	4.9	37.3	56.2	
ECE teachers play a vital role in promoting pre-schoolers' physical activity and development (n=385)	**n**	1.0	0.0	1.0	3.0	17.0	113.0	250.0	6.57 ± 0.70
	%	0.3	0.0	0.3	0.8	4.4	29.3	64.8	
A pre-schooler's physical activity and development is more of the parent's responsibility (n=384)	**n**	27.0	63.0	54.0	112.0	64.0	36.0	28.0	3.89 ± 1.62
	%	7.0	16.3	14.0	29.0	16.6	9.3	7.3	
I have the skills and abilities I need to support children's physical activity and development (n=383)	**n**	0.0	1.0	4.0	7.0	64.0	158.0	149.0	6.14 ± 0.86
	%	0.0	0.3	1.0	1.8	16.6	40.9	38.6	

Table B. 7. Analysis of variance (ANOVA) and correlation analysis of ECE teachers' nutrition and physical activity perspectives and age, qualification, employment role and years of experience

Variable †		ANOVA					Pearson's correlation coefficient†, r	Spearman's correlation coefficient, r_s	P-value
		df	MS	F	P-value	Effect size (*r*)			
Age	Mealtimes should be fun (n=384)	4, 371	1.18	1.01	0.401		0.06		0.268
	Pre-schoolers should eat together (n=385)	4, 372	1.72	1.42	0.226		-0.08		0.14
	Snacks should be low in sugar (n=385)	4, 372	0.89	1.32	0.263		0.09		0.077
	Pre-schoolers should have a choice of a variety of foods at mealtimes (n=384)	4, 371	1.58	1.15	0.332		0.02		0.695
	Pre-schoolers should always eat all the food on their plate (n=384)	4, 371	1.00	0.45	0.775		-0.08		0.104
	ECE teachers should role model healthy eating to pre-schoolers (n=382)	4, 369	0.75	2.04	0.089		0.04		0.422
	ECE teachers should eat with pre-schoolers (n=383)[a]	4, 370	5.97	3.35	0.010	0.12	0.12		0.016
	ECE teachers should talk to pre-schoolers about what they are eating (n=384)	4, 371	1.09	1.55	0.186		0.08		0.104
	ECE teachers should encourage pre-schoolers to try new foods (n=384)	4, 371	0.36	0.64	0.637		-0.01		0.933
	It is important that pre-schoolers are involved in an edible garden in ECE settings (n=384)[b]	4, 371	2.08	3.15	0.015	0.18	0.12		0.02*
	ECE teachers play a vital role in promoting nutrition to pre-schoolers (n=384)	4, 371	0.51	0.91	0.459		0.07		0.151
	A pre-schooler's healthy eating is more of the parent's responsibility (n=385)[c]	4, 372	6.38	2.67	0.032	0.17	-0.08		0.105

	Childcare centres have a role in supporting parents with information and ideas on healthy eating (n=383)	4, 370	0.15	0.16	0.957	0.01		0.809
	The food children eat in my centre provides them with the right fuel they need for the day (n=369)	4, 356	1.05	0.67	0.615	-0.06		0.261
	I feel confident having conversations with parents about food and nutrition (n=376)	4, 363	0.92	0.65	0.630	0.09		0.094
	Celebrations and events in our centre should support healthy eating messages (n=381)	4, 368	0.64	0.49	0.742	0.03		0.544
	Healthy eating education is part of Tē-whariki and can support other areas of learning (n=377)	4, 364	1.57	2.03	0.090	0.04		0.444
	I am able to define the term "physical activity" (n=385)	4, 372	0.76	1.28	0.279	0.11		0.029
	I am able to define the term "fundamental movement skills" (n=375)	4, 362	2.39	2.21	0.068	0.15		0.003
	Physical activity is important for all pre-schoolers' brain and motor skill development (n=385)	4, 372	0.25	1.31	0.266	0.09		0.093
	I know what activities will develop specific movement skills (n=382)	4, 369	1.28	1.26	0.284	0.11		0.027
	I understand the difference between structured and unstructured play (n=383)	4, 370	0.84	1.81	0.125	0.12		0.041
	ECE teachers play a vital role in promoting pre-schoolers' physical activity and development (n=384)	4, 371	0.87	1.97	0.098	0.14		0.009
	A pre-schooler's physical activity and development is more of the parent's responsibility (n=383)	4, 370	3.64	1.41	0.229	-0.02		0.746
	I have the skills and abilities I need to support children's physical activity and development (n=382)	4, 369	1.55	2.11	0.079	0.13		0.010
Qualification	Mealtimes should be fun (n=384)	3, 381	0.70	0.60	0.617		-0.04	0.398
	Pre-schoolers should eat together (n=385)	3, 382	0.77	0.64	0.591		0.03	0.629

	Snacks should be low in sugar (n=385)	3, 382	0.19	0.27	0.844	-0.04	0.458
	Pre-schoolers should have a choice of a variety of foods at mealtimes (n=384)	3, 381	1.70	1.25	0.293	0.01	0.852
	Pre-schoolers should always eat all the food on their plate (n=384)	3, 381	5.80	2.53	0.057	0.02	0.693
	ECE teachers should role model healthy eating to pre-schoolers (n=382)	3, 379	0.68	1.77	0.152	-0.01	0.946
	ECE teachers should eat with pre-schoolers (n=383)	3, 380	3.60	1.96	0.119	-0.03	0.527
	ECE teachers should talk to pre-schoolers about what they are eating (n=384)	3, 381	0.20	0.27	0.847	-0.05	0.328
	ECE teachers should encourage pre-schoolers to try new foods (n=384)	3, 381	0.61	1.09	0.352	0.04	0.467
	It is important that pre-schoolers are involved in an edible garden in ECE settings (n=384)	3, 381	0.12	0.17	0.919	-0.02	0.68
	ECE teachers play a vital role in promoting nutrition to pre-schoolers (n=384)	3, 381	0.03	0.05	0.987	-0.02	0.693
	A pre-schooler's healthy eating is more of the parent's responsibility (n=385)	3, 382	4.41	1.80	0.147	0.04	0.389
	Childcare centres have a role in supporting parents with information and ideas on healthy eating (n=383)	3, 380	0.91	1.04	0.373	-0.01	0.955
	The food children eat in my centre provides them with the right fuel they need for the day (n=369)	3, 366	1.48	0.95	0.418	-0.06	0.291
	I feel confident having conversations with parents about food and nutrition (n=376)	3, 373	2.10	1.45	0.227	-0.07	0.181
	Celebrations and events in our centre should support healthy eating messages (n=381)	3, 378	1.00	0.76	0.518	-0.01	0.816
	Healthy eating education is part of Tē-whariki and can support other areas of learning	3, 374	0.43	0.56	0.643	0.01	0.797
	I am able to define the term "physical activity" (n=385)	3, 382	0.59	1.00	0.395	-0.09	0.067

	I am able to define the term "fundamental movement skills" (n=375)	3, 372	0.08	0.07	0.976		-0.02	0.700
	Physical activity is important for all pre-schoolers' brain and motor skill development (n=385)	3, 382	0.26	1.36	0.255		0.05	0.288
	I know what activities will develop specific movement skills (n=382)	3, 379	0.24	0.24	0.870		-0.01	0.851
	I understand the difference between structured and unstructured play (n=383)	3, 380	0.44	0.95	0.418		0.01	0.860
	ECE teachers play a vital role in promoting pre-schoolers' physical activity and development (n=384)	3, 381	0.26	0.53	0.659		0.01	0.866
	A pre-schooler's physical activity and development is more of the parent's responsibility (n=383)	3, 380	2.34	0.89	0.445		0.04	0.435
	I have the skills and abilities I need to support children's physical activity and development (n=382)	3, 379	0.56	0.75	0.521		-0.08	0.114
Employment role	Mealtimes should be fun (n=384)	2, 382	0.28	0.24	0.786		0.10	0.060
	Pre-schoolers should eat together (n=385)	2, 383	0.19	0.16	0.853		-0.01	0.987
	Snacks should be low in sugar (n=385)	2, 383	0.84	1.25	0.288		0.08	0.123
	Pre-schoolers should have a choice of a variety of foods at mealtimes (n=384)	2, 382	0.91	0.67	0.515		0.08	0.098
	Pre-schoolers should always eat all the food on their plate (n=384)	2, 382	0.74	0.32	0.727		-0.02	0.706
	ECE teachers should role model healthy eating to pre-schoolers (n=382)[d]	2, 380	1.58	4.17	0.016	0.15	0.09	0.088
	ECE teachers should eat with pre-schoolers (n=383)	2, 381	1.70	0.92	0.401		0.02	0.722
	ECE teachers should talk to pre-schoolers about what they are eating (n=384))	2, 382	2.06	2.76	0.065		0.08	0.116
	ECE teachers should encourage pre-schoolers to try new foods (n=384)	2, 382	1.00	1.80	0.166		-0.01	0.933

	It is important that pre-schoolers are involved in an edible garden in ECE settings (n=384)	2, 382	1.41	2.06	0.129		0.10	0.046
	ECE teachers play a vital role in promoting nutrition to pre-schoolers (n=384)[e]	2, 382	3.98	7.23	0.001	0.19	0.20	<0.001
	A pre-schooler's healthy eating is more of the parent's responsibility (n=385)	2, 383	3.11	1.26	0.285		-0.07	0.161
	Childcare centres have a role in supporting parents with information and ideas on healthy eating (n=383)[f]	2, 381	3.96	4.62	0.010	0.15	0.17	0.001
	The food children eat in my centre provides them with the right fuel they need for the day (n=369)[g]	2, 367	7.52	4.91	0.008	0.16	0.16	0.002
	I feel confident having conversations with parents about food and nutrition (n=376)[h]	2, 374	7.00	4.92	0.008	0.16	0.17	0.001
	Celebrations and events in our centre should support healthy eating messages (n=381)	2, 379	2.46	1.88	0.154		0.10	0.055
	Healthy eating education is part of Tē-whariki and can support other areas of learning[i]	2, 375	3.10	4.06	0.018	0.15	0.18	0.001
	I am able to define the term "physical activity" (n=385)	2, 383	0.03	0.04	0.956		0.01	0.803
	I am able to define the term "fundamental movement skills" (n=375)	2, 383	0.25	0.23	0.793		-0.01	0.905
	Physical activity is important for all pre-schoolers' brain and motor skill development (n=385)[j]	2, 383	0.67	3.55	0.030	0.13	0.13	0.012
	I know what activities will develop specific movement skills (n=383=2)	2, 380	0.25	0.24	0.783		0.06	0.216
	I understand the difference between structured and unstructured play (n=383)[k]	2, 381	1.55	3.37	0.035	0.13	0.13	0.011
	ECE teachers play a vital role in promoting pre-schoolers' physical activity and development (n=384)[l]	2, 382	1.73	3.58	0.029	0.14	0.06	0.273
	A pre-schooler's physical activity and development is more of the parent's responsibility (n=383)	2, 381	3.28	1.25	0.287		0.01	0.962

	I have the skills and abilities I need to support children's physical activity and development (n=382)	2, 380	1.22	1.64	0.195			0.12	0.015
Years of experience	Mealtimes should be fun (n=384)[m]	2, 382	4.23	3.68	0.026	0.14	0.13		0.014
	Pre-schoolers should eat together (n=385)	2, 383	0.94	0.78	0.459		-0.01		0.958
	Snacks should be low in sugar (n=385)	2, 383	1.25	1.86	0.158		0.12		0.020
	Pre-schoolers should have a choice of a variety of foods at mealtimes (n=384)	2, 382	0.13	0.09	0.911		<0.01		1.000
	Pre-schoolers should always eat all the food on their plate (n=374)[n]	2, 382	8.86	3.88	0.022	0.14	-0.10		0.044
	ECE teachers should role model healthy eating to pre-schoolers (n=382)	2, 380	0.34	0.89	0.413		0.10		0.058
	ECE teachers should eat with pre-schoolers (n=383)	2, 381	5.48	3.00	0.051		0.11		0.031
	ECE teachers should talk to pre-schoolers about what they are eating (n=384)[o]	2, 382	4.23	5.75	0.003	0.17	0.19		<0.001
	ECE teachers should encourage pre-schoolers to try new foods (n=384)	2, 382	0.06	0.11	0.892		0.03		0.568
	It is important that pre-schoolers are involved in an edible garden in ECE settings (n=384)	2, 382	0.90	1.30	0.274		0.09		0.087
	ECE teachers play a vital role in promoting nutrition to pre-schoolers (n=384)	2, 382	0.48	0.84	0.434		0.10		0.041
	A pre-schooler's healthy eating is more of the parent's responsibility (n=384)	2, 382	2.20	0.89	0.412		0.02		0.640
	Childcare centres have a role in supporting parents with information and ideas on healthy eating (n=383)	2, 381	0.85	0.97	0.381		0.08		0.111
	The food children eat in my centre provides them with the right fuel they need for the day (n=369)	2, 367	0.50	0.32	0.728		0.01		0.788
	I feel confident having conversations with parents about food and nutrition (n=376)[p]	2, 374	4.78	3.33	0.037*	0.13	0.13		0.010

	Celebrations and events in our centre should support healthy eating messages (n=381)	2, 379	0.98	0.74	0.476		0.03	0.601
	Healthy eating education is part of Tē-whariki and can support other areas of learning (n=377)	2, 375	0.18	0.24	0.789		-0.01	0.810
	I am able to define the term "physical activity" (n=385)	2, 383	1.24	2.11	0.123		0.08	0.126
	I am able to define the term "fundamental movement skills" (n=375)	2, 373	2.76	2.57	0.078		0.13	0.013
	Physical activity is important for all pre-schoolers' brain and motor skill development (n=385)	2, 373	0.33	1.71	0.183		0.10	0.047
	I know what activities will develop specific movement skills (n=382)	2, 380	2.74	2.75	0.065		0.11	0.036
	I understand the difference between structured and unstructured play (n=383)	2, 381	1.14	2.47	0.086		0.13	0.012
	ECE teachers play a vital role in promoting pre-schoolers' physical activity and development (n=384)	2, 382	1.59	3.27	0.039		0.13	0.012
	A pre-schooler's physical activity and development is more of the parent's responsibility (n=383)	2, 381	0.48	0.18	0.832		0.01	0.977
	I have the skills and abilities I need to support children's physical activity and development (n=382)[q]	2, 380	3.90	5.35	0.005	0.17	0.17	0.001

† n=386 for each variable (except age, n=377)

[a, c] Post hoc test showed 20-29-years and 30-39-years differed significantly ($p<0.05$); 20-29-years and 40-49-year olds differed significantly ($p<0.05$); other age groups did not significantly differ

[b] Post hoc test showed 20-29-years and 40-49-years differed significantly ($p<0.05$); other age groups did not significantly differ

[d] Post hoc test showed 20-29-years and 50-59-years differed significantly ($p<0.05$); other age groups did not significantly differ

[e] Post hoc test showed manager/teacher group differed significantly from all other groups ($p<0.05$); remaining groups did not significantly differ

[f, h, i, j] Post hoc test showed manager/teacher and qualified teacher group differed significantly ($p<0.05$); remaining groups did not significantly differ

[g, k, p] Post hoc test was unable to show where the difference was

[l] Post hoc test showed manager/teacher and other (unspecified) group differed significantly ($p<0.05$); remaining groups did not significantly differ

[m, o, q] Post hoc test showed ≤ 3 years differed significantly ($p<0.05$) that all other groups; other groups did not significantly differ

[n] Post hoc test showed 4-10-years and 11+ years groups differed significantly ($p<0.05$); other groups did not significantly differ

Note. Effect size (r) calculated using r^2=√between group effect/total amount of variance

Abbreviations: df, degrees of freedom; MS, mean square; F; f-ratio

Table B. 8. Linear regression analysis of nutrition and physical activity perspectives and qualification level, current role, age and years of experience

		B	SE B	β	P-value	B CI 25th	R^2
Mealtimes should be fun (n=376)	(Constant)	5.82	0.23		<0.001	[5.36, 6.28]	
	Sub-degree vs. Bachelors	-0.08	0.12	-0.04	0.526	[-0.32, 0.16]	
	Sub-degree vs. post-graduate	0.16	0.22	0.04	0.451	[-0.26, 0.59]	
	Sub-degree vs. other	0.00	0.38	0.00	0.999	[-0.74, 0.74]	
	Teacher vs. manager/teacher	0.20	0.24	0.04	0.411	[-0.28, 0.68]	
	Teacher vs. other	0.05	0.18	0.02	0.773	[-0.30, 0.40]	
	Age	0.00	0.01	-0.03	0.656	[-0.01, 0.01]	
	Years of experience	0.05	0.02	0.15	0.016	[0.01, 0.08]	
							0.02
Pre-schoolers should eat together (n=377)	(Constant)	6.29	0.24		<0.001	[5.82, 6.76]	
	Sub-degree vs. Bachelors	-0.02	0.13	-0.01	0.866	[-0.27, 0.23]	
	Sub-degree vs. post-graduate	0.28	0.22	0.07	0.208	[-0.16, 0.72]	
	Sub-degree vs. other	-0.13	0.39	-0.02	0.730	[-0.90, 0.63]	
	Teacher vs. manager/teacher	-0.01	0.25	0.00	0.970	[-0.50, 0.48]	
	Teacher vs. other	-0.06	0.18	-0.02	0.742	[-0.42, 0.30]	
	Age	-0.01	0.01	-0.11	0.073	[-0.02, 0.00]	
	Years of experience	0.02	0.02	0.06	0.347	[-0.02, 0.06]	
							0.01
Snacks should be low in sugar (n=377)	(Constant)	6.12	0.18		<0.001	[5.77, 6.47]	
	Sub-degree vs. Bachelors	0.08	0.09	0.05	0.385	[-0.10, 0.27]	

	Sub-degree vs. post-graduate	0.17	0.17	0.06	0.302	[-0.16, 0.50]	
	Sub-degree vs. other	0.27	0.29	0.05	0.358	[-0.30, 0.84]	
	Teacher vs. manager/teacher	0.06	0.19	0.02	0.765	[-0.31, 0.42]	
	Teacher vs. other	0.18	0.14	0.07	0.196	[-0.09, 0.44]	
	Age	0.00	0.00	0.05	0.454	[-0.01, 0.01]	
	Years of experience	0.02	0.01	0.08	0.166	[-0.01, 0.05]	
							0.02
Pre-schoolers should have a choice of a variety of foods at mealtimes (n=376)	(Constant)	5.84	0.25		<0.001	[5.34, 6.34]	
	Sub-degree vs. Bachelors	0.12	0.13	0.05	0.366	[-0.14, 0.38]	
	Sub-degree vs. post-graduate	0.28	0.24	0.07	0.242	[-0.19, 0.75]	
	Sub-degree vs. other	-0.75	0.41	-0.10	0.069	[-1.56, 0.06]	
	Teacher vs. manager/teacher	0.26	0.26	0.05	0.323	[-0.26, 0.78]	
	Teacher vs. other	0.21	0.19	0.06	0.270	[-0.17, 0.59]	
	Age	0.00	0.01	0.03	0.658	[-0.01, 0.01]	
	Years of experience	-0.01	0.02	-0.02	0.691	[-0.05, 0.03]	
							0.02
Pre-schoolers should always eat all the food on their plate (n=376)	(Constant)	3.34	0.32		<0.001	[2.71, 3.98]	
	Sub-degree vs. Bachelors	0.18	0.17	0.06	0.300	[-0.16, 0.51]	
	Sub-degree vs. post-graduate	-0.42	0.30	-0.08	0.162	[-1.02, 0.17]	
	Sub-degree vs. other	0.66	0.52	0.07	0.208	[-0.37, 1.69]	
	Teacher vs. manager/teacher	-0.01	0.34	0.00	0.987	[-0.66, 0.65]	
	Teacher vs. other	-0.12	0.25	-0.03	0.617	[-0.61, 0.36]	
	Age	-0.01	0.01	-0.04	0.491	[-0.02, 0.01]	
	Years of experience	-0.02	0.03	-0.04	0.467	[-0.07, 0.03]	
							0.03

ECE teachers should role model healthy eating to pre-schoolers (n=374)	(Constant)	6.45	0.13		<0.001	[6.19, 6.71]	
	Sub-degree vs. Bachelors	0.05	0.07	0.04	0.450	[-0.08, 0.19]	
	Sub-degree vs. post-graduate	0.13	0.13	0.06	0.308	[-0.12, 0.38]	
	Sub-degree vs. other	-0.08	0.21	-0.02	0.716	[-0.50, 0.34]	
	Teacher vs. manager/teacher	-0.01	0.14	0.00	0.935	[-0.28, 0.26]	
	Teacher vs. other	0.24	0.10	0.13	0.017	[0.04, 0.44]	
	Age	0.00	0.00	-0.01	0.914	[-0.01, 0.01]	
	Years of experience	0.01	0.01	0.07	0.258	[-0.01, 0.03]	
							0.03
ECE teachers should eat with pre-schoolers (n=375)	(Constant)	5.12	0.29		<0.001	[4.55, 5.70]	
	Sub-degree vs. Bachelors	-0.19	0.15	-0.07	0.216	[-0.49, 0.11]	
	Sub-degree vs. post-graduate	0.16	0.28	0.03	0.569	[-0.39, 0.70]	
	Sub-degree vs. other	-0.55	0.47	-0.06	0.247	[-1.48, 0.38]	
	Teacher vs. manager/teacher	-0.16	0.30	-0.03	0.606	[-0.75, 0.44]	
	Teacher vs. other	0.13	0.22	0.03	0.566	[-0.31, 0.56]	
	Age	0.01	0.01	0.09	0.143	[0.00, 0.02]	
	Years of experience	0.01	0.02	0.03	0.585	[-0.03, 0.06]	
							0.03
ECE teachers should talk to pre-schoolers about what they are eating (n=376)	(Constant)	6.07	0.18		<0.001	[5.71, 6.42]	
	Sub-degree vs. Bachelors	0.06	0.09	0.04	0.507	[-0.12, 0.25]	
	Sub-degree vs. post-graduate	-0.09	0.17	-0.03	0.597	[-0.43, 0.25]	
	Sub-degree vs. other	0.29	0.29	0.05	0.319	[-0.28, 0.87]	
	Teacher vs. manager/teacher	-0.25	0.19	-0.07	0.190	[-0.61, 0.12]	
	Teacher vs. other	0.15	0.14	0.06	0.284	[-0.12, 0.42]	
	Age	0.00	0.00	0.00	0.996	[-0.01, 0.01]	

	Years of experience	0.04	0.01	0.16	0.007	[0.01, 0.07]	0.04
ECE teachers should encourage pre-schoolers to try new foods (n=376)	(Constant)	6.35	0.16		<0.001	[6.03, 6.67]	
	Sub-degree vs. Bachelors	0.12	0.09	0.08	0.151	[-0.05, 0.29]	
	Sub-degree vs. post-graduate	0.14	0.15	0.05	0.377	[-0.17, 0.44]	
	Sub-degree vs. other	-0.06	0.26	-0.01	0.829	[-0.58, 0.46]	
	Teacher vs. manager/teacher	-0.23	0.17	-0.07	0.171	[-0.56, 0.10]	
	Teacher vs. other	0.07	0.12	0.03	0.564	[-0.17, 0.31]	
	Age	0.00	0.00	-0.02	0.755	[-0.01, 0.01]	
	Years of experience	0.01	0.01	0.03	0.586	[-0.02, 0.03]	0.02
It is important that pre-schoolers are involved in an edible garden in ECE settings (n=376)	(Constant)	5.87	0.18		<0.001	[5.52, 6.22]	
	Sub-degree vs. Bachelors	0.03	0.09	0.02	0.779	[-0.16, 0.21]	
	Sub-degree vs. post-graduate	0.04	0.17	0.01	0.815	[-0.29, 0.37]	
	Sub-degree vs. other	-0.10	0.29	-0.02	0.718	[-0.67, 0.46]	
	Teacher vs. manager/teacher	0.12	0.18	0.04	0.505	[-0.24, 0.49]	
	Teacher vs. other	0.21	0.14	0.08	0.117	[-0.05, 0.48]	
	Age	0.01	0.00	0.09	0.131	[0.00, 0.02]	
	Years of experience	0.01	0.01	0.04	0.564	[-0.02, 0.04]	0.02
ECE teachers play a vital role in promoting nutrition to pre-schoolers (n=376)	(Constant)	6.16	0.16		<0.001	[5.84, 6.48]	
	Sub-degree vs. Bachelors	0.02	0.08	0.01	0.826	[-0.15, 0.19]	
	Sub-degree vs. post-graduate	0.12	0.15	0.04	0.443	[-0.18, 0.42]	
	Sub-degree vs. other	0.14	0.26	0.03	0.603	[-0.38, 0.65]	

	Teacher vs. manager/teacher	0.32	0.17	0.10	0.058	[-0.01, 0.65]	
	Teacher vs. other	0.41	0.12	0.17	0.001	[0.17, 0.65]	
	Age	0.00	0.00	0.02	0.688	[-0.01, 0.01]	
	Years of experience	0.01	0.01	0.06	0.289	[-0.01, 0.04]	0.05
A pre-schooler's healthy eating is more of the parent's responsibility (n=377)	(Constant)	4.61	0.34		<0.001	[3.95, 5.27]	
	Sub-degree vs. Bachelors	0.33	0.18	0.10	0.064	[-0.02, 0.67]	
	Sub-degree vs. post-graduate	-0.11	0.31	-0.02	0.720	[-0.73, 0.50]	
	Sub-degree vs. other	0.45	0.54	0.04	0.411	[-0.62, 1.52]	
	Teacher vs. manager/teacher	-0.67	0.35	-0.10	0.054	[-1.36, 0.01]	
	Teacher vs. other	-0.14	0.25	-0.03	0.579	[-0.64, 0.36]	
	Age	-0.02	0.01	-0.11	0.058	[-0.03, 0.00]	
	Years of experience	0.04	0.03	0.10	0.112	[-0.01, 0.10]	0.04
Childcare centres have a role in supporting parents with information and ideas on healthy eating (n=375)	(Constant)	5.95	0.20		<0.001	[5.55, 6.35]	
	Sub-degree vs. Bachelors	0.16	0.11	0.08	0.139	[-0.05, 0.37]	
	Sub-degree vs. post-graduate	-0.03	0.19	-0.01	0.881	[-0.41, 0.35]	
	Sub-degree vs. other	0.05	0.33	0.01	0.876	[-0.60, 0.70]	
	Teacher vs. manager/teacher	0.17	0.21	0.04	0.431	[-0.25, 0.58]	
	Teacher vs. other	0.41	0.15	0.14	0.008	[0.11, 0.72]	
	Age	0.00	0.00	-0.02	0.713	[-0.01, 0.01]	
	Years of experience	0.02	0.02	0.06	0.289	[-0.02, 0.05]	0.04
The food children eat in my centre provides them with the right fuel they need for the day (n=361)	(Constant)	6.10	0.27		<0.001	[5.56, 6.64]	

	Sub-degree vs. Bachelors	0.03	0.14	0.01	0.852	[-0.26, 0.31]	
	Sub-degree vs. post-graduate	-0.20	0.26	-0.04	0.440	[-0.71, 0.31]	
	Sub-degree vs. other	-0.51	0.44	-0.06	0.247	[-1.37, 0.35]	
	Teacher vs. manager/teacher	0.66	0.28	0.13	0.020	[0.11, 1.21]	
	Teacher vs. other	0.45	0.21	0.12	0.028	[0.05, 0.86]	
	Age	-0.01	0.01	-0.10	0.124	[-0.02, 0.00]	
	Years of experience	0.02	0.02	0.05	0.394	[-0.03, 0.06]	
							0.04
I feel confident having conversations with parents about food and nutrition (n=368)	(Constant)	5.25	0.26		<0.001	[4.74, 5.75]	
	Sub-degree vs. Bachelors	0.10	0.13	0.04	0.440	[-0.16, 0.37]	
	Sub-degree vs. post-graduate	-0.28	0.24	-0.06	0.245	[-0.77, 0.20]	
	Sub-degree vs. other	-0.08	0.41	-0.01	0.838	[-0.90, 0.73]	
	Teacher vs. manager/teacher	0.46	0.26	0.09	0.080	[-0.06, 0.98]	
	Teacher vs. other	0.47	0.19	0.13	0.015	[0.09, 0.85]	
	Age	0.01	0.01	0.05	0.404	[-0.01, 0.02]	
	Years of experience	0.02	0.02	0.06	0.298	[-0.02, 0.06]	
							0.05
Celebrations and events in our centre should support healthy eating messages (n=373)	(Constant)	5.53	0.25		<0.001	[5.04, 6.02]	
	Sub-degree vs. Bachelors	0.13	0.13	0.06	0.328	[-0.13, 0.38]	
	Sub-degree vs. post-graduate	-0.07	0.23	-0.02	0.751	[-0.53, 0.38]	
	Sub-degree vs. other	-0.27	0.42	-0.03	0.518	[-1.11, 0.56]	
	Teacher vs. manager/teacher	0.34	0.26	0.07	0.190	[-0.17, 0.84]	
	Teacher vs. other	0.30	0.19	0.08	0.117	[-0.07, 0.66]	
	Age	0.00	0.01	0.04	0.511	[-0.01, 0.02]	

	Years of experience	-0.01	0.02	-0.02	0.797	[-0.05, 0.03]	0.02
Healthy eating education is part of Tē-whariki and can support other areas of learning (n=369)	(Constant)	6.05	0.19		<0.001	[5.67, 6.42]	
	Sub-degree vs. Bachelors	0.10	0.10	0.06	0.323	[-0.10, 0.30]	
	Sub-degree vs. post-graduate	0.24	0.18	0.07	0.185	[-0.12, 0.60]	
	Sub-degree vs. other	-0.23	0.33	-0.04	0.492	[-0.87, 0.42]	
	Teacher vs. manager/teacher	0.30	0.20	0.08	0.127	[-0.09, 0.69]	
	Teacher vs. other	0.41	0.15	0.15	0.005	[0.12, 0.69]	
	Age	0.00	0.00	0.06	0.303	[0.00, 0.01]	
	Years of experience	-0.02	0.02	-0.07	0.276	[-0.05, 0.01]	0.03

Note. Significant at P<0.05.
Abbreviations: vs., versus; B, unstandardised coefficients; SE B, standard errors for coefficients; β, standardised coefficients; B CI; 95% confidence intervals for the coefficients.

Table B. 9. Pearson's correlation analysis of ECE teachers' nutrition knowledge perspectives and overall nutrition knowledge scores

Variable†		Total nutrition knowledge score (n=386)
Total nutrition knowledge score	Pearson Correlation (*r*) *p*-value (2-tailed)	1
Mealtimes should be fun	Pearson Correlation (*r*) *p*-value (2-tailed)	0.09 0.065
Pre-schoolers should eat together	Pearson Correlation (*r*) *p*-value (2-tailed)	0.05 0.374
Snacks should be low in sugar	Pearson Correlation (*r*) *p*-value (2-tailed)	-0.06 0.252
Pre-schoolers should have a choice of a variety of foods at mealtimes	Pearson Correlation (*r*) *p*-value (2-tailed)	0.04 0.458
Pre-schoolers should always eat all the food on their plate	Pearson Correlation (*r*) *p*-value (2-tailed)	0.01 0.914
ECE teachers should role model healthy eating to pre-schoolers	Pearson Correlation (*r*) *p*-value (2-tailed)	-0.05 0.376
ECE teachers should eat with pre-schoolers	Pearson Correlation (*r*) *p*-value (2-tailed)	0.04 0.383
ECE teachers should talk to pre-schoolers about what they are eating	Pearson Correlation (*r*) *p*-value (2-tailed)	0.06 0.242
ECE teachers should encourage pre-schoolers to try new foods	Pearson Correlation (*r*) *p*-value (2-tailed)	0.01 0.847
It is important that pre-schoolers are involved in an edible garden in ECE settings	Pearson Correlation (*r*) *p*-value (2-tailed)	-0.01 0.779
ECE teachers play a vital role in promoting nutrition to preschoolers	Pearson Correlation (*r*) *p*-value (2-tailed)	0.03 0.615
A pre-schooler's healthy eating is more of the parent's responsibility	Pearson Correlation (*r*) *p*-value (2-tailed)	-0.04 0.440
Childcare centres have a role in supporting parents with information and ideas on healthy eating	Pearson Correlation (*r*) *p*-value (2-tailed)	-0.04 0.450
The food children eat in my centre provides them with the right fuel they need for the day	Pearson Correlation (*r*)	-0.04

	p-value (2-tailed)	0.477
I feel confident having conversations with parents about food and nutrition	Pearson Correlation (*r*)	0.09
	p-value (2-tailed)	0.090
Celebrations and events in our centre should support healthy eating messages	Pearson Correlation (*r*)	-0.05
	p-value (2-tailed)	0.329
Healthy eating education is part of Tē-whariki and can support other areas of learning	Pearson Correlation (*r*)	0.01
	p-value (2-tailed)	0.839

†Participants who selected choose not to answer were omitted from analysis

Table B. 10. Linear regression analysis of nutrition and physical activity perspectives and overall nutrition knowledge scores (n=357)†

Variable	B	SE B	β	P-value	B CI [25th, 95th percentile]
(Constant)	24.50	2.16		<0.000	[20.26, 28.74]
Mealtimes should be fun	0.20	0.16	0.08	0.227	[-0.12, 0.52]
Pre-schoolers should eat together	0.18	0.16	0.07	0.256	[-0.13, 0.49]
Snacks should be low in sugar	-0.29	0.20	-0.09	0.143	[-0.69, 0.10]
Pre-schoolers should have a choice of a variety of foods at mealtimes	-0.02	0.15	-0.01	0.892	[-0.31, 0.27]
Pre-schoolers should always eat all the food on their plate	-0.01	0.10	-0.01	0.897	[-0.22, 0.19]
ECE teachers should role model healthy eating to preschoolers	-0.25	0.28	-0.06	0.372	[-0.81, 0.31]
ECE teachers should eat with preschoolers	0.03	0.13	0.01	0.847	[-0.23, 0.28]
ECE teachers should talk to preschoolers about what they are eating	0.30	0.23	0.09	0.193	[-0.15, 0.76]
ECE teachers should encourage preschoolers to try new foods	-0.18	0.27	-0.05	0.514	[-0.70, 0.35]
It is important that preschoolers are involved in an edible garden in ECE settings	-0.11	0.21	-0.03	0.589	[-0.53, 0.30]
ECE teachers play a vital role in promoting nutrition to preschoolers	0.12	0.27	0.03	0.661	[-0.41, 0.65]
A pre-schooler's healthy eating is more of the parent's responsibility	-0.08	0.10	-0.04	0.439	[-0.28, 0.12]
Childcare centres have a role in supporting parents with information and ideas on healthy eating	-0.28	0.23	-0.09	0.226	[-0.74, 0.18]
The food children eat in my centre provides them with the right fuel they need for the day	-0.16	0.13	-0.07	0.214	[-0.42, 0.10]
I feel confident having conversations with parents about food and nutrition	0.34	0.15	0.15	0.019	[0.06, 0.63]
Celebrations and events in our centre should support healthy eating messages	-0.22	0.15	-0.09	0.136	[-0.52, 0.07]
Healthy eating education is part of Tē-whariki and can support other areas of learning	0.14	0.23	0.04	0.537	[-0.31, 0.59]

†Participants who selected "Choose not to answer" responses were omitted from analysis. Note. R^2=0.23, Adjusted R^2=0.01, P<0.05.

Abbreviations: B, unstandardised coefficients; SE B, standard errors for coefficients; β, standardised coefficients; B CI; 95% confidence intervals for the coefficients

Table B. 11. Sources that ECE teachers report using to find information about nutrition and physical activity†

Nutrition information sources	n	%
Ministry of Health	311	80.6
Ministry of Education	126	32.6
Family/whānau	132	34.2
Friends	55	14.2
Heart Foundation NZ	300	78.0
Internet/Google search	205	53.0
ECE colleagues	165	42.7
Plunket nurse	193	50.0
Registered Dietitian	186	48.0
Doctor	71	18.4
Regional Public Health service	149	38.6
Choose not to answer	4	1.0
Other‡		
- ECE chef	1	0.3
- ECE nutrition courses	1	0.3
- Sports Waikato	2	0.5
- Nutritionist	1	0.3
- Anything that doesn't follow the food pyramid	1	0.3
Physical activity information sources		
The Ministry of Health	239	61.9
The Ministry of Education	205	53.1
Sport New Zealand	266	68.9
Heart Foundation NZ	244	63.2
Family/whānau	87	23.0
Friends	62	16.1
Internet/Google search	218	56.5
ECE colleagues	182	47.2
Plunket nurse	66	17.1
Registered Dietitian	16	4.1
Doctor	31	8.0
Regional Public Health service	65	16.8
Choose not to answer	6	1.6
Other‡		
- Resources/PD provided by centre	4	1.0
- Personal studies	3	0.8
- Sport Bay of plenty	3	0.8
- Moving smart	4	1.0
- Under 5 energise	1	0.3
- Jumping Beans	1	0.3
- ECE occupational and physiotherapist	1	0.3
- Bikewise	1	0.3
- Don't know	1	0.3
- Sport Southland	1	0.3

†Does not total 100% because participants could select more than one option.
‡Responses were categorised into themes identified by the researchers.

Table B. 12. ECE teachers' perceived barriers for nutrition and physical activity in ECE†

Barriers for ECE centres promoting healthy eating	n	%
Lack of staff training	130	33.7
Insufficient funds	119	31.0
Insufficient time to teach nutrition	70	18.1
Lack of support from parents/families/whānau	195	50.5
Lack of support from colleagues	56	14.5
Lack of resources/information on healthy food for children	77	19.9
Sales of unhealthy (high fat, salt or sugar) foods as fundraisers	104	26.9
Lack of staff confidence talking about nutrition	97	25.1
Concerns about food intolerance or allergies	117	30.3
No, there are no factors that make is challenging within an ECE to promote healthy eating to preschoolers	59	15.0
Choose not to answer	16	4.1
Celebrations (i.e. birthdays)	1	0.3
Other‡		
- Food brought from home/convenience packs (no control)	10	2.6
- Conflicting ideas amongst ECE staff	2	0.5
- Confusing messages in media	1	0.3
- Dietary habits or obesity in staff	2	0.5
- Language barriers/culture	4	1.0
- Belief that current guidelines are inappropriate (e.g. recommends too many grains)	2	0.5
- Home habits and poverty	7	1.8
- Lack of staff understanding		
- Lack of whānau/parent education/knowledge	5	1.3
- Food policies	3	0.8
- High cost of fruit and vegetables	2	0.5
- Advertising of unhealthy foods in society	1	0.3
Barriers for promoting physical activity in ECE		
Lack of staff training	122	32.0
Insufficient funds	75	19.4
Insufficient time to teach physical activity	41	10.6
Lack of staff confidence to teach physical activity	133	34.0
Lack of support from parents/families/whānau	44	11.4
Lack of support from colleagues	49	12.7
Lack of resources/information on physical activity for children	104	26.9
Limited opportunity/space for physical education	138	36.0
Limited storage	131	33.9
Safety concerns of management/staff	79	20.0
Safety concerns of parents	100	26.0
Insufficient staffing to supervise active play	65	16.8

No, there are no factors that make it challenging within an ECE to promote physical activity to preschoolers	96	25.0
Choose not answer	18	4.7
Other‡	11	2.8
- weather	3	0.8
- Parents limit physical activity at home (e.g. screen time)	1	0.3
Barriers for ECE teacher's nutrition knowledge		
Lack of staff training	75	19.0
Insufficient funds	36	9.3
Lack of support from parents/families/whānau	51	13.2
Lack of support from colleagues	27	7.0
Nutrition policies in my centre	27	7.0
Lack of resources/information on healthy food for children	48	12.0
Lack of confidence talking about nutrition	55	14.0
Confusing nutrition messages in the media	112	32.0
No, there are no factors that make it difficult for me to know about healthy eating for preschoolers	163	42.0
Choose not to answer	23	6.0
Other‡	18	4.9
- Food allergies/intolerance	1	0.3
- Biases from parenting own children	1	0.3
- Insufficient time to learn	2	0.5
- Lack of agreement with current guidelines (e.g. low fat, high fibre diets)	1	0.3
Barriers for ECE teachers' physical activity knowledge		
Lack of staff training	62	16.1
Insufficient funds	39	10.1
Insufficient time to teach physical activity	44	11.4
Lack of confidence to teach physical activity	49	12.7
Lack of support from parents/families/whānau	21	5.4
Lack of support from colleagues	26	6.7
Lack of resources/information on physical activity for children	81	21.0
Physical activity policies in my centre	17	4.4
No, I do not experience any challenges to knowing about physical activity guidelines for preschoolers	199	52.0
Choose not answer	35	9.1
Other‡		
- Lack of space	5	1.3
- Safety concerns	4	1.0
- Lack of equipment	1	0.3
- Lack of time to research and implement	1	0.3

†Does not total 100% because participants could select more than one option.

‡Responses were categorised into themes identified by the researchers.

Table B. 13. Themes and evidence examples identified in ECE teachers' additional comments about nutrition for pre-schoolers

Theme	Meaning	n†	Examples from data‡
Collaboration with parents/ whanau	Refers to teachers and parents working together to support children's healthy eating (includes issues of poverty, culture, roles, busy lifestyles)	8	*"Again, the costs of healthy food as well as the availability of healthy food for parents is an issue. Also, it's not about a lack of support from parents/families/whānau but rather lack of knowledge from their end, paired with the belief they put something nice into their child's lunch box, something their child likes (chippy bags, cookies, chocolate fingers, marshmallows - "killing with kindness"). It's a very 'hairy' issue for ECE teachers (Who are we to judge the parents?)."*
			"I am disappointed parents feel the need to give their children 'treat food' everyday."
			"It is really about getting parents and whānau on board. Many parents reward children with food." *"We find that even with sharing information with parents regularly, having a policy in place, sharing recipes, etc, parents still disregard it. We cook preservative, additive, sugar free food and provide healthy well balanced meals, make our own bread. grow veg, have chickens for eggs etc., involve the children as much as we can but at the end of the day I think parents as first teachers are the most important, especially when it comes down to what is in the 3-5 year olds lunchboxes. Majority are healthy, perhaps wealth plays a factor from what I can see."*
			"We know we should be promoting health eating at preschool. However we also like to celebrate birthdays etc so we do find we have a lot of cake etc. at preschool. The children at our preschool are always on the move running and play they are encouraged to dance and go on walks so we focus more on getting moving at our preschool and eating in moderation. It's hard to get the balance right and we as a team somewhat go if the parent put the food in the child's lunch box then they are happy for their child to eat it. Is it our role to stop children??"
			"I try to talk to parents if a lunch box is inappropriate but it is very easy to offend so you have to be tactful." *"Sometimes it is challenging to talk to parents about healthy eating practices because of their family habits and the perceived idea that eating healthily is more expensive for them, many have excuses such as time, children won't eat it etc, so it is often difficult to change those bad habits without causing offence. Maybe some parent workshops might be useful."*
			"Parents may be resistant to advice given or will comply in terms of food bought to the centre but revert to unhealthy eating at home."
			"our whānau provide all the food for the children so while we educate and have discussions we don't have a lot of control of the packet food and crap that can sneak in."
Convenience/packet foods	Refers to the prominence of easily accessible	6	*"From my experience parents are often time poor so they choose the convenience of pre-packaged foods that are highly processed and high in fats and sugars. Children develop an 'addiction' to these foods and are reluctant to try new foods and particularly fresh foods. The Government needs to make some better decisions around the taxation*

	high fat/sugar/salt foods in children's lunch boxes		*of fruit and veg and the prolific advertising of junk food targeted at young children on TV but also in terms of enticing packaging."*
Confusing messages in the media/food marketing	Refers to conflicting messages in the media and market place	12	*"Parents fall into the trap of misleading advertising campaigns and convenience food (packets, pies and two minute noodles) rather than a healthy sandwich."*
			"In my ECE Centre we don't provide meals as our tamariki bring their lunchboxes daily. Majority of these lunches are full of packaged, highly processed items which are convenient to source by busy working parents. I feel as parents often make choices based on confusing media info in regards to which items are 'good' or contain vitamins and minerals needed by growing bodies. Good example of those would be lollies containing fruit juice or muesli bars covered in chocolate."
			"The government needs to change its food pyramid and start promoting the consumption of more vegetables, nuts, eggs, etc. - real food - instead of diets based on grains. This needs to be promoted far and wide."
			"There is an increasing amount of parents with very inaccurate & potentially damaging information about nutrition. An almost obsession with 'real' or clean/pure food (implying other food is dirty) I have observed children & parents becoming very anxious about what they can & cannot eat. They tell other children that what they are eating isn't clean & is bad for them. Some of them sneak eat food from their friends & beg us not to tell their parents. These children do not have allergies or intolerances but their parents believe it healthier for them not to have sugar/dairy/wheat/gluten/any processed food at all they have been told this by holistic health gurus who have done 'certificates'. There seems to be a distrust of the public health system, doctors & official advice. It seems to correlate with the anti-vaccination trend & is very concerning and seems to be getting more of an issue. Some centres have issues with too much unhealthy food, our centre seems to have an issue with food anxiety given by parents."
			"I am glad there is a growing awareness of the importance of food and nutrition in ECE. A point of frustration for me is dairy, and how detrimental it is to overall health (not only this, the human body can't absorb calcium from cow's milk after age 2 so why it is promoted as a health food is extremely frustrating). The media has so much power- if people actually researched the effects of cow's milk on the body they would still be unlikely to believe it as the media portrays it as a health food. Propagandas at its finest, and it all comes back to revenue unfortunately. Thanks for letting me participate in this survey, you are doing a good thing by researching nutrition ECE centres provide children. Parents need to know their children are getting their nutritional needs met , especially for children who spend a great deal of time in ECE environments."
Lack of knowledge/ confidence	Refers to staff or parents lack of nutrition knowledge	7	*"I think it [nutrition] needs to be included more in initial teacher training to build teachers confidence to discuss nutrition with parents and children. It is part of Te Whāriki to promote healthy eating and how to look after our body*

	or confidence knowing about/teaching nutrition		*but with limited resources and a lack of knowledge teachers don't feel informed enough to confidently provide children and families with information."*
			"Teacher education is important as they need the confidence to talk/discuss with parents. Being confident/respectful in discussion healthy eating is important."
			"I find that cultural difference can play a part in inhibiting the ability to provide nutritional information to some families. The cost and lack of understanding is a huge part in this as well."
			"There is a huge difference between what a 2 year old and a 5 year old eat. This has influenced my answers as I work mainly with 3 and 4 year olds."
			"There can be a significant difference between healthy portion sizes for a 2 year old and a near 5 year old."
Role modelling	Refers to teachers not role modelling healthy lifestyles	2	*"Would be nice if teachers could role model and eat a small amount of food with the children."*
			"It is hard when the manager of a centre has the view that we can't educate whānau about nutrition and does not role model healthy eating but wants a Healthy Heart award..."
Resources/ funding	Refers to teachers desiring more nutrition resources or requiring more funding	3	*"Come up with some good comprehensive guidelines for everybody to use. Pre-schoolers are not small adults and they have different dietary requirements to adults."*
			"I have found that there is lots of resources out there that have been great to use in Early childhood, but I would like to see more interactive games or resources that teach 2-5 year olds about portion sizes and about occasional, sometimes and everyday food that they can eat. It would be also great if there are resources that explain very simply the benefits of eating everyday foods rather than eating occasional food."
			"More incentives for centres to go healthy and child friendly resources."
Positive comments	Includes teachers demonstrating positive knowledge/perspect ives about nutrition, are supportive of the current research, or are working in	22	*"Yes, I work in a centre where families provide food, I love that you are doing this, I always find it interesting that we write healthy eating policies but quite often just rely on our own personal knowledge when it comes to what as teachers we see as 'healthy choices' for lunch boxes. I personally am not sure about calorie and the exact needs of preschoolers, also lots of teachers see diet as having a direct effect on behaviour information around poor diet and health and well-being implications would be great too. The heart foundation is great to work with but they are the only organisation that I have really had anything to do with around nutrition."*

	supportive ECE environments	
		"We would recommend that all ECE centres participated in Heart Foundation awards. As a team we learnt a lot and were able to support parents with resources." *"The Centre has now registered and participating in the www.knowmeeatme.co.nz programme and finding this useful as is the heart foundation information and awards."*
		"We are lucky in our community to have a nutritionist come and visit our Kindergarten and teach children, staff and whānau about healthy eating. We are also participating in the 'Under 5 Energize' programme."
		"I am really pleased that this research is underway. We have some real issues with children's food in ECE settings. We also have an issue with the health of teachers - many of whom are severely overweight."

†When comments fell into more than one category, +1 was given to each category.
‡Evidence may fall into more than one category, but are presented as per relevancy.

Table B. 14. Themes and evidence examples identified in ECE teachers' additional comments about physical activity for pre-schoolers

Theme	Meaning	n†	Examples from data‡
Safety concerns	Refers to a fear child injury from physical activity	5	*"Safety concerns of parents is becoming more of an issue - unwilling to let their children take risks but the key issue is the space children have to run free!!"*
			"Health and safety is a huge factor in encouraging children to be physical. With all the matting and not encouraging children to take risks, it is a challenge. Once we climbed trees but now this is hugely frowned upon and we are all so worried about health and safety. While we are busy minimizing risk, we take away the adventure of physical play from children. We need to have play structures that will challenge them. I agree that safety is a huge factor but there is a point, where we have become too afraid, we need to let children be children, the way we were."
			"For children to fully develop their large muscle groups often involves 'risk taking' and pushing out their own boundaries - this is challenging to do with children when parents say "I don't want John on the climbing bars, it's too high" "I don't want Jane jumping off the boxes, what if they fall". Minimising risks and maximising health benefits often becomes a fine balancing act especially while considering parents' wishes!"
			"Policies can sometimes get in the way. We are an all season kindergarten and do not wrap our children in cotton wool, instead we support children to physically challenge themselves and take calculated risk."
Space/equipment	Refers to a lack of space or equipment for physical activity	6	*"Centre planning needs to factor in adequate space for physical activity. Too many centres are getting built with tiny play grounds, cramped play spaces cluttered with fixed equipment that doesn't allow space to run and kick a ball."*
Knowledge	Refers to a lack of knowledge or need for physical activity training	2	*"I believe that there needs to be more professional knowledge in ECE for teachers about the importance of brain development and its relationship to learning. Many teachers are unaware of the fundamentals which need to develop which then enable a child to be prepared for the more formal learning once they enter school. Many teachers, particularly in privately owned centres where the owners do not have an educational background, are pressured to 'teach' and focus on performance tasks rather than foundational skills."*
			"Should make a huge part of ECE curriculum and train teacher."
			"Training can involve experts coming in, but then teachers stop teaching physical activity as they "leave it to the experts". Physical activity can be readily happening, so it reduces the perspective that intentionality is required."
Role modelling	Refers to teachers role modelling healthy lifestyles	3	*"Physically inactive staff provide role models e.g. sitting on the edge of the sandpit. Rugby is not the only sport in the world!"*

			"Really hard to do if there are only a couple of staff role modelling and supporting physical activity. If 3/4 staff are obese and don't do any physical activity pretty hard to model to kids. Over the years I have noticed physical challenges and activity in centres decreasing."
			"Our children spend a lot of time outside and so are fairly active throughout the day. What sticks out is a child who finds it difficult to keep up with the group. They are usually over weight."
Resources/funding	Refers to a lack of or desire for more resources/funding	2	*"Sometimes we want resources but the good quality educational safe resources are extremely expensive."*
Positive	Highlights positive physical activity perspectives or practices	25§	*"I currently work in centres that have great outdoor spaces with room to move and nature."*
			"Our children are always on the move. We go out for big walks in the community and encourage dancing and physical movement during our day. We are lucky however to have a very big play ground making this much easier for us."
			"I'm interested and will find out more."
			"We utilise the expertise of Jenny Dravitski who works for Sport Tasman, and we love to have her into kindergarten for sessions with the children. We run a foundation skills programme and each term we choose one skill that we focus on for the term. This includes session with Jenny, also using the information of ways we can introduce these skills to the children. We also set up activities for the children to participate in during session to extend their capabilities and skills. This is done in a fun way so children want to try. We also have an amazing reserve behind our kindergarten which we use to have 'team games' and physical activities in. We feel very lucky to have this facility and the support we get from Sport Tasman and the parents as well."

†When comments fell into more than one category, +1 was given to each category
‡Evidence may fall into more than one category, but are presented as per relevancy
§Four comments related to a lack of adequate space

Table B. 15. Sample characteristics for ECE questionnaire validation study (n=91)

	Nutrition students (n=40)	Non-nutrition students (n=51)	Total	
	n	n	n	%
Gender†				
Male	5	8	13	14.3
Female	35	42	77	84.6
Age, y				
16-24	27	26	53	58.2
25-34	8	14	22	24.2
35-44	3	5	8	8.8
45-54	1	3	4	4.4
55-64	1	2	3	3.3
65-74	0	0	0	0
75+	0	1	1	1.1
Ethnicity‡				
NZ Maori	2	0	2	2.2
Pacific Island	1	2	3	3.3
NZ European/Pakeha	25	36	61	67
Other European	4	7	11	12.1
Asian/Indian	6	5	11	12.1
Other	5	2	7	7.7

†One participant chose not to answer.
‡Does not total 100% because participants could select more than one option.
Note. Five nutrition students did not complete the questionnaire twice (demographic information was not needed for test-retest reliability); n=35.
Abbreviations: NZ, New Zealand; y, years.

INTRODUCTION

Nutrition and physical activity knowledge and perspective questionnaire within ECE

Thank you for taking time to complete this anonymous questionnaire. It should take approximately 15 minutes to complete. The information you provide will be kept confidential.

Please answer all questions yourself. If you do not know the answer, mark "not sure". **Please do not guess.**
This is **not a test.** Your answers will help us identify what is known about nutrition and physical activity for children aged 2-5 years.

If you would like further information about the study and your rights, please click the following link: http://ecenutritionknowledge.wordpress.com

Committee Approval Statement *This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application 15/36. If you have any concerns about the conduct of this research, please contact Mr Jeremy Hubbard, Chair, Massey University Human Ethics Committee: Southern A, telephone 04 801 5799, X 63487, email humanethicsoutha@massey.ac.nz.*

End of Block

SERVINGS

We want to know about SERVINGS of food groups

Note: Serving sizes are provided next to each question
A serving does not necessarily need to be eaten all in one sitting but can be spread throughout the day

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Examples of 1 serving:

- 1 apple, pear, banana or orange
- 2 small apricots or plums
- ½ cup of fresh fruit salad
- ½ cup of stewed or canned fruit

1. How many servings of fruit should a 2-5 year old child eat each day? (Please choose one from the drop-down box)
   - O None per day (1)
   - O At least 1 (2)
   - O At least 2 (3)
   - O At least 3 (4)
   - O At least 4 (5)
   - O At least 5 (6)
   - O At least 6 (7)
   - O At least 7 (8)
   - O At least 8 (9)
   - O At least 9 (10)
   - O At least 10 (11)
   - O Not sure (12)

Examples of 1 serving:

- 1 medium potato, taro or kumara
- ½ cup of cooked vegetables
- ½ cup of salad
- 1 tomato or carrot

2. How many servings of vegetables should a 2-5 year old child eat each day?
(Please choose one from the drop-down box)
   - O None per day (1)
   - O At least 1 (2)
   - O At least 2 (3)
   - O At least 3 (4)
   - O At least 4 (5)
   - O At least 5 (6)
   - O At least 6 (7)
   - O At least 7 (8)
   - O At least 8 (9)
   - O At least 9 (10)
   - O At least 10 (11)
   - O Not sure (12)

What is one serving?

- 1 roll
- 1 medium slice of bread
- 1 cup of cornflakes or rice bubbles or 2 breakfast wheat biscuits
- ½ cup porridge
- 1 cup of cooked pasta, noodles or rice
- 1 cup of cassava or tapioca

3 (a). How many servings of breads and cereals should a 2-5 year old child eat each day? (Please choose one from the drop-down box)

- O None per day (1)
- O At least 1 (2)
- O At least 2 (3)
- O At least 3 (4)
- O At least 4 (5)
- O At least 5 (6)
- O At least 6 (7)
- O At least 7 (8)
- O At least 8 (9)
- O At least 9 (10)
- O At least 10 (11)
- O Not sure (12)

---

3 (b). How often should a healthy 2-5 year old child eat wholegrain types of breads and cereals?
(Please choose one from the drop-down box)

- O Never (1)
- O Rarely (2)
- O Some days (3)
- O Most days (4)
- O Every day (5)
- O Not sure (6)
- O Choose not to answer (7)

Examples of 1 serving:

- 2 slices of cooked lean meat, e.g. roast lamb, chicken, beef or pork
- ¾ cup of mince or casserole
- 1 medium fillet of fish or steak
- 2 chicken drumsticks or 1 chicken leg
- 1 medium pāua or kina
- 1 egg
- 3/4 cup baked beans
- ¾ cup of tofu

4. How many servings of meats, chicken, seafood, eggs, legumes, nuts and seeds should a 2-5 year old child eat each day? (Please choose one from the drop-down box)

- O None per day (1)
- O At least 1 (2)
- O At least 2 (3)
- O At least 3 (4)
- O At least 4 (5)
- O At least 5 (6)
- O At least 6 (7)
- O At least 7 (8)
- O At least 8 (9)
- O At least 9 (10)
- O At least 10 (11)
- O Not sure (12)

What is one serving?

- 1 cup of reduced- or low-fat milk (250ml)
- 1 pottle of reduced- or low-fat yoghurt
- 2 slices or ½ cup of grated cheese, e.g. edam

5. How many servings of milk, milk products and calcium-fortified milk alternatives should a 2-5 year old eat each day? (Please choose one from the drop-down box)

- O None per day (1)
- O At least 1 (2)
- O At least 2 (3)
- O At least 3 (4)
- O At least 4 (5)
- O At least 5 (6)
- O At least 6 (7)
- O At least 7 (8)
- O At least 8 (9)
- O At least 9 (10)
- O At least 10 (11)
- O Not sure (12)

End of Block

FOOD CHOICES

We want to know about FOOD CHOICES

6 (a). Which of the following beverages are suitable for 2-5 year old children? (Please select one for each)

	Never (1)	Occasional (less than once per week) (2)	Sometimes (3)	Everyday (4)	Not sure (5)	Choose not to answer (6)
Water (Q6a_1)	O	O	O	O	O	O
Cow's milk (or alternative) (Q6a_2)	O	O	O	O	O	O
Flavoured milk based drinks (Q6a_3)	O	O	O	O	O	O
Fizzy drinks (including diet drinks) (Q6a_4)	O	O	O	O	O	O
Cordial or fruit drinks (Q6a_5)	O	O	O	O	O	O
Tea or coffee (Q6a_6)	O	O	O	O	O	O
Sports or energy drinks (Q6a_7)	O	O	O	O	O	O

6 (b). Which of the following beverages do you think would be appropriate to give to healthy 2-5 year old child <u>everyday</u> (Please select all that apply):

Orange juice	Dilute orange juice	Cow's milk	Coke Zero	Flavoured milk	Fruit drink	Water	Powerade	Flavoured water	V Zero	Coconut water	Not sure
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)

---

6 (c). Are there any other beverages that you think are suitable for 2-5 year old children? (Please select one)

- O Yes (please specify): (1) _____
- O No (2)
- O Choose not to answer (3)

---

7 (a). Which of the following snacks are suitable for 2-5 year old children? (Please select one for each)

	Never (1)	Occasional (less than once per week) (2)	Sometimes (3)	Everyday (4)	Not sure (5)	Choose not to answer (6)
Potato crisps, corn snacks or chips (e.g. burger rings, rashuns, etc) (Q7a_1)	O	O	O	O	O	O
Fruit (Q7a_2)	O	O	O	O	O	O
Chocolate coated or cream filled biscuits (Q7a_3)	O	O	O	O	O	O
Biscuits (e.g. plain, semi-sweet, gingernut, shortbread) (Q7a_4)	O	O	O	O	O	O
Yoghurt pottle (all types) (Q7a_5)	O	O	O	O	O	O
Vegetable sticks (Q7a_6)	O	O	O	O	O	O
Nuts (all types) (Q7a_7)	O	O	O	O	O	O
Hard dried fruits (e.g. banana chips) (Q7a_8)	O	O	O	O	O	O
Soft dried fruits (e.g. raisins) (Q7a_9)	O	O	O	O	O	O
Ice-cream (Q7a_10)	O	O	O	O	O	O
Cheese (e.g. cheddar, colby, etc) (Q7a_11)	O	O	O	O	O	O
Pastries (e.g. mini meat pie/sausage roll) (Q7a_12)	O	O	O	O	O	O
Plain crackers or crispbreads (Q7a_13)	O	O	O	O	O	O

Q7b 7 (b). Are there any other snacks that you think are suitable for 2-5 year old children? (Please select one)

- O Yes (please specify) (1) _____
- O No (2)
- O Choose not to answer (3)

---

7 (c). How many snacks should a preschooler have per day?

- O None per day (1)
- O At least 1 (2)
- O At least 2 (3)
- O At least 3 (4)
- O At least 4 (5)
- O At least 5 (6)
- O At least 6 (7)
- O More than 6 per day (8)
- O Not sure (9)

---

8. Select food items that you think belong in a healthy lunch for a 2-5 year old in an ECE setting (please select all that apply):

☐  **Fried chicken nuggets** (1)

☐  **Cheese** (2)

☐  **Potato crisps** (3)

☐  **Wholemeal bread** (4)

☐  **Tomato** (5)

☐  **Fruit roll up** (6)

☐  **Lettuce** (7)

☐  **Mandarin** (8)

☐ **Fruit & nut muesli bar** (9)

☐ ⊗**Not sure** (10)

---

9 (a). Which of the following is an example of <u>one recommended serving</u> of dairy for a 2-5 year old child? (Please select one)

1/2 cup cow's milk (100-120ml) ○

(1)

1 cup cow's milk (250ml) ○

(2)

Not sure ○

(3)

9 (b). Which of the following is an example of <u>one recommended serving</u> of fruit for a 2-5 year old child? (Please select one)

Half banana ○

(1)

One medium banana ○

(2)

Not sure ○

(3)

---

9 (c). Which of the following is an example of <u>one recommended serving</u> of vegetables for a 2-5 year old child? (Please select one)

Half carrot ○ (1)

One medium carrot ○ (2)

Not sure ○ (3)

---

9 (d). Is the following an example of <u>one portion OR one recommended serving</u> of breads and cereals for a 2-5 year old child? (Please select one)

½ slice of bread

- O One **portion** (1)
- O One **serving** (2)
- O Not sure (3)

---

9 (e). Is the following an example of <u>one portion OR one recommended serving</u> of meat for a 2-5 year old child? (Please select one)

1 chicken drumstick

- O One **portion** (1)
- O One **serving** (2)
- O Not sure (3)

End of Block

Nutrition Perspectives

We want to know about YOUR PERSPECTIVES about feeding

10. Please read each statement below and select the response that best describes your perspective

	Strongly Disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)	Not sure (8)	Choose not to answer (9)
Mealtimes should be fun (Q10_1)	O	O	O	O	O	O	O	O	O
Preschoolers should eat together (Q10_2)	O	O	O	O	O	O	O	O	O
Snacks should be low in sugar (Q10_3)	O	O	O	O	O	O	O	O	O
Preschoolers should have a choice of a variety of foods at mealtimes (Q10_4)	O	O	O	O	O	O	O	O	O
Preschoolers should always eat all the food on their plate (Q10_5)	O	O	O	O	O	O	O	O	O
ECE teachers should role model healthy eating to preschoolers (Q10_6)	O	O	O	O	O	O	O	O	O
ECE teachers should eat with preschoolers (Q10_7)	O	O	O	O	O	O	O	O	O

ECE teachers should talk to preschoolers about what they are eating (Q10_8)	0	0	0	0	0	0	0	0	0
ECE teachers should encourage preschoolers to try new foods (Q10_9)	0	0	0	0	0	0	0	0	0
It is important that preschoolers are involved in an edible garden in ECE settings (Q10_10)	0	0	0	0	0	0	0	0	0
ECE teachers play a vital role in promoting nutrition to preschoolers (Q10_11)	0	0	0	0	0	0	0	0	0
A preschooler's healthy eating is more of the parent's responsibility (Q10_12)	0	0	0	0	0	0	0	0	0
Childcare centres have a role in supporting parents with information and ideas on healthy eating (Q10_13)	0	0	0	0	0	0	0	0	0
The food children eat in my centre provides them with the right fuel	0	0	0	0	0	0	0	0	0

they need for the day (Q10_14)									
I feel confident having conversations with parents about food and nutrition (Q10_15)	o	o	o	o	o	o	o	o	o
Celebrations and events in our centre should support healthy eating messages (Q10_16)	o	o	o	o	o	o	o	o	o
Healthy eating education is part of Tē-whariki and can support other areas of learning (Q10_17)	o	o	o	o	o	o	o	o	o

11. Do we have guidelines from the Ministry of Health for feeding preschoolers? (Please select one)

- o Yes (1)
- o No (2)
- o Not sure (3)
- o Choose not to answer (4)

Display This Question: (Skip-logic)

If 11. Do we have guidelines from the Ministry of Health for feeding preschoolers? (Please select one) = Yes

12. Have **you** used these guidelines? (Please select one)

- o Yes (1)
- o No (2)
- o Not sure (3)
- o Choose not to answer (4)

13. If needed, where would **you** source information about nutrition and feeding practices for 2-5 year olds? (Please select all that apply)

- ☐ Ministry of Health (1)
- ☐ Ministry of Education (2)
- ☐ Family/whānau (3)
- ☐ Friends (4)
- ☐ Heart Foundation NZ (5)
- ☐ Internet/Google search (6)
- ☐ ECE colleagues (7)
- ☐ Plunket nurse (8)
- ☐ Registered Dietitian (9)
- ☐ Doctor (10)
- ☐ Regional Public Health service (11)
- ☐ ⊗Choose not to answer (12)
- ☐ Other (Please specify): (13) _____

---

14. Do any of these factors make it challenging **within ECE services** to promote healthy eating to preschoolers? (Please select all that apply)

- ☐ Lack of staff training (1)
- ☐ Insufficient funds (2)
- ☐ Insufficient time to teach nutrition (3)
- ☐ Lack of support from parents/families/whānau (4)
- ☐ Lack of support from colleagues (5)
- ☐ Lack of resources/information on healthy food for children (6)
- ☐ Sales of unhealthy (high fat, salt or sugar) foods as fundraisers (7)
- ☐ Lack of staff confidence talking about nutrition (8)
- ☐ Concerns about food intolerance or allergies (9)
- ☐ ⊗No, there are no factors that make is challenging within an ECE to promote healthy eating to preschoolers (10)
- ☐ ⊗Choose not to answer (11)
- ☐ Other (please specify): (12) _____

---

15. Are there any factors that make is difficult for **you** to know about healthy eating guidelines for preschoolers? (Please select all that apply)

- ☐ Lack of staff training (1)
- ☐ Insufficient funds (2)
- ☐ Lack of support from parents/families/whānau (3)
- ☐ Lack of support from colleagues (4)
- ☐ Nutrition policies in my centre (5)
- ☐ Lack of resources/information on healthy food for children (6)
- ☐ Lack of confidence talking about nutrition (7)
- ☐ Confusing nutrition messages in the media (8)
- ☐ ⊗No, there are no factors that make it difficult for me to know about healthy eating for preschoolers (9)
- ☐ ⊗Choose not to answer (10)
- ☐ Other (please specify): (11) _____

---

16. Is there anything else that you would like to tell us regarding food, nutrition and feeding practices in ECE?

_____

_____

End of Block

PHYSICAL ACTIVITY

We want to know about YOUR PERSPECTIVES about physical activity

17. Read each statement below and select the response that best describes your perspectives.

	Strongly Disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)	Not sure (8)	Choose not to answer (9)
I am able to define the term "physical activity" (Q17_1)	O	O	O	O	O	O	O	O	O
I am able to define the term "fundamental movement skills" (Q17_2)	O	O	O	O	O	O	O	O	O
Physical activity is important for all preschoolers' brain and motor skill development (Q17_3)	O	O	O	O	O	O	O	O	O
I know what activities will develop specific movement skills (Q17_4)	O	O	O	O	O	O	O	O	O
I understand the difference between structured and unstructured play (Q17_5)	O	O	O	O	O	O	O	O	O
ECE teachers play a vital role in promoting	O	O	O	O	O	O	O	O	O

preschoolers' physical activity and development (Q17_6)									
A preschooler's physical activity and development is more of the parent's responsibility (Q17_7)	O	O	O	O	O	O	O	O	O
I have the skills and abilities I need to support children's physical activity and development (Q17_8)	O	O	O	O	O	O	O	O	O

18. Do we have any New Zealand physical activity guidelines for preschoolers? (Please select one)

- O Yes (1)
- O No (2)
- O Not sure (3)
- O Choose not to answer (4)

Display This Question (Skip-logic)

If 18. Do we have any New Zealand physical activity guidelines for preschoolers? (Please select one) = Yes

19. Have **you** used these guidelines? (Please select one)

- O Yes (1)
- O No (2)
- O Not sure (3)
- O Choose not to answer (4)

20. If needed, where would **you** source information about physical activity for 2-5 year olds? (Please select all that apply)

- ☐ The Ministry of Health (1)
- ☐ The Ministry of Education (2)
- ☐ Sport New Zealand (3)
- ☐ Heart Foundation NZ (4)
- ☐ Family/whānau (5)
- ☐ Friends (6)
- ☐ Internet/Google search (7)
- ☐ ECE colleagues (8)
- ☐ Plunket nurse (9)
- ☐ Registered Dietitian (10)
- ☐ Doctor (11)
- ☐ Regional Public Health service (12)
- ☐ ⊗Choose not to answer (13)
- ☐ Other (please specify): (14) _____

---

21. Do any of these factors make it challenging **within ECE services** to promote physical activity to preschoolers? (Please select all that apply)

- ☐ Lack of staff training (1)
- ☐ Insufficient funds (2)
- ☐ Insufficient time to teach physical activity (3)
- ☐ Lack of staff confidence to teach physical activity (4)
- ☐ Lack of support from parents/families/whānau (5)
- ☐ Lack of support from colleagues (6)
- ☐ Lack of resources/information on physical activity for children (7)
- ☐ Limited opportunity/space for physical education (8)
- ☐ Limited storage (9)
- ☐ Safety concerns of management/staff (10)
- ☐ Safety concerns of parents (11)
- ☐ Insufficient staffing to supervise active play (12)
- ☐ ⊗No, there are no factors that make is challenging within an ECE to promote physical activity to preschoolers (13)
- ☐ ⊗Choose not answer (14)
- ☐ Other (please specify): (15) _____

---

22. Are there any factors that make it challenging for **you** to know about physical activity guidelines for preschoolers? (Please select all that apply)

- ☐ Lack of staff training (1)
- ☐ Insufficient funds (2)
- ☐ Insufficient time to teach physical activity (3)
- ☐ Lack of confidence to teach physical activity (4)
- ☐ Lack of support from parents/families/whānau (5)
- ☐ Lack of support from colleagues (6)
- ☐ Lack of resources/information on physical activity for children (7)
- ☐ Physical activity policies in my centre (8)
- ☐ ⊗No, I do not experience any challenges to knowing about physical activity guidelines for preschoolers (9)
- ☐ ⊗Choose not answer (10)
- ☐ Other (please specify): (11) _____

23. Is there anything else that you would like to tell us regarding physical activity in ECE?

_____

_____

End of Block

Demographics

INFORMATION ABOUT YOU

What is your gender? (Please choose one from the drop-down box)

- ○ Male (1)
- ○ Female (2)
- ○ Other (3)
- ○ Choose not to answer (4)

Which ethnic group(s) do you belong to? (Please select all that apply)

- ☐ New Zealand Māori (1)
- ☐ Cook Island Māori (2)
- ☐ Fijian (3)
- ☐ Niuean (4)
- ☐ Samoan (5)
- ☐ Tokelauan (6)
- ☐ Tongan (7)
- ☐ Other Pacific Island (8)
- ☐ New Zealand European/Pakeha (9)
- ☐ Other European (10)
- ☐ Chinese (11)
- ☐ Other Asian (12)
- ☐ Indian (13)
- ☐ South East Asian (14)
- ☒ Choose not to answer (15)
- ☐ Other (please specify): (16) _____

What is your age in years? (Please enter in the text box below)

_____

Which childcare provider are you currently employed by? (Please choose one from the drop-down box)

- O Other (4)
- O Choose not to answer (5)

Note. The Ministry of Education ECE directory (August 2017) was directly copied into the questionnaire; other and choose not to answer options were available.

If you selected "other" in the previous question, please specify in the text box below:

_____

What is your highest qualification? (Please select one)

- O None (1)
- O School Certificate / NCEA level 1 (2)
- O 6th Form Certificate / NCEA level 2 (3)
- O Playcentre Qualification (Level 3 or higher) (4)
- O 2 year Diploma (e.g. Kindergarten Diploma, PIECCA Diploma etc) (5)
- O 3 year Diploma of Teaching (ECE) (6)
- O Bachelor of Education (Teaching) (ECE) (7)
- O Bachelor degree in another discipline (please specify): (8) _____
- O Graduate Diploma of Teaching (ECE) (9)
- O Post-graduate level qualifications (e.g. PhD, Masters, Honours, Post-graduate diploma etc) (10)
- O Choose not to answer (11)
- O Other (please specify): (12) _____

What is your current role? (Please select one)

- O Teacher in training (1)
- O Qualified teacher (2)
- O Non-qualified teacher (3)
- O Cook/chef (4)
- O Administrator (5)
- O Choose not to answer (6)
- O Other (please specify): (7) _____

What is the total number of years and months that you have worked in early childhood settings? (e.g. 2 years 3 months) (Please select one from each drop-down box)

- O 0 years (1)
- O 1 year (2)
- O 2 years (3)
- O 3 years (4)
- O 4 years (5)
- O 5 years (6)
- O 6 years (7)
- O 7 years (8)
- O 8 years (9)
- O 9 years (10)
- O 10 years (11)
- O 11 + years (12)

and

- O 0 months (1)
- O 1 month (2)
- O 2 months (3)
- O 3 months (4)
- O 4 months (5)
- O 5 months (6)
- O 6 months (7)
- O 7 months (8)
- O 8 months (9)
- O 9 months (10)
- O 10 months (11)
- O 11 months (12)

By submitting your questionnaire, you are consenting to take part in this research. Please click the arrow below to submit. If you would not like to take part, please exit this page by closing the browser window.

Figure C. 1. ECE teachers' nutrition and physical activity questionnaire (sample).
Note: ⊗ means that if participants selects this item, all other items will select off. Numbers in brackets beside options indicate scoring system.

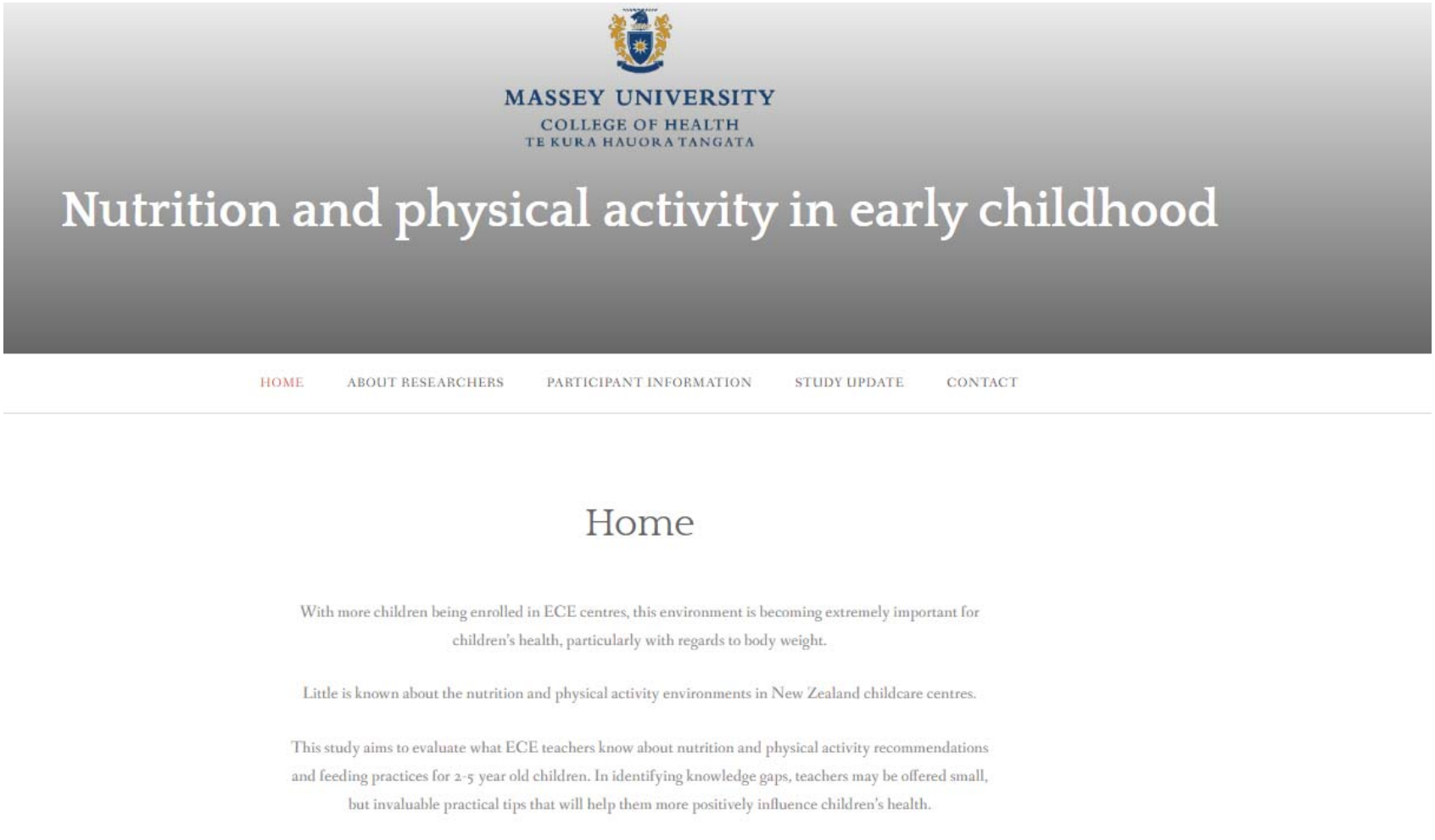

Figure C. 2. ECE teachers' nutrition and physical activity study webpage (homepage)

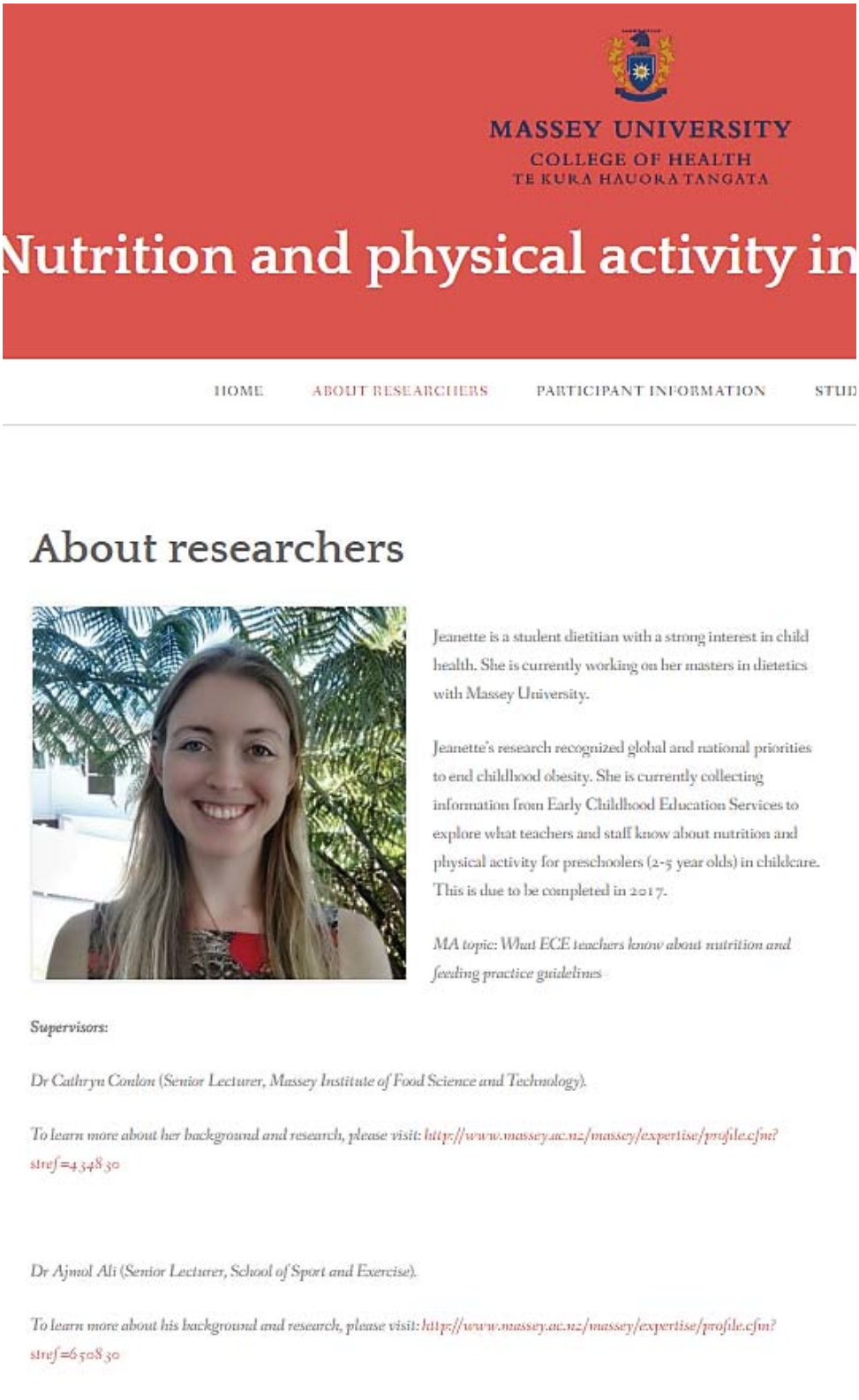

Figure C. 3. ECE teachers' nutrition and physical activity study webpage (about researchers)

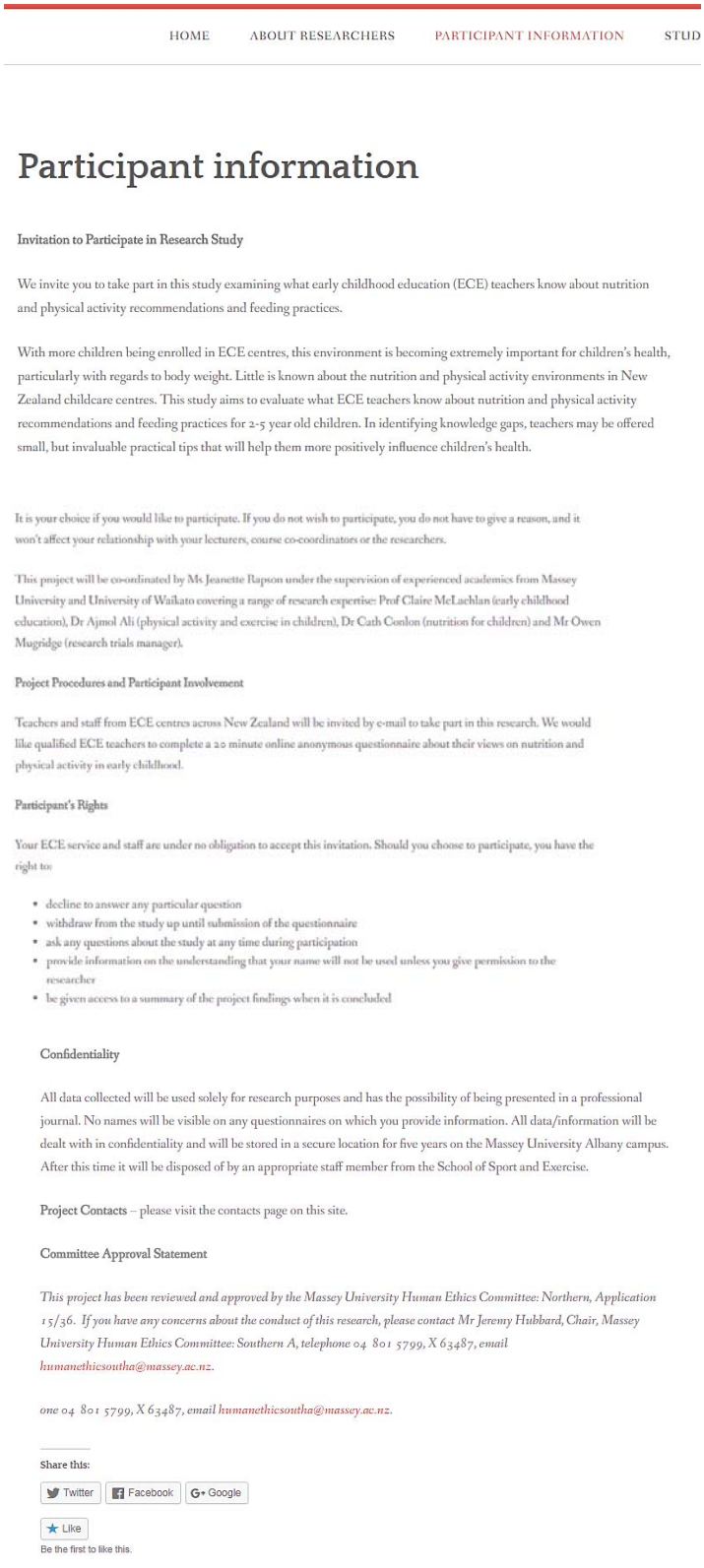

Figure C. 4. ECE teachers' nutrition and physical activity study webpage (participant information)

HOME ABOUT RESEARCHERS PARTICIPANT INFORMATION STUI

Study Update

We have now completed the data collection stage for this study (June 2017-August 2017). The online survey is **now closed.**

We had a great response, which we hope reflects the good relationship between the study and our community. A big thank you to all the participants, we appreciate the time and effort involved in completing online surveys. This study is the first of its kind to be carried out in New Zealand, which makes your contribution valuable to the study's continuing success.

Highlights:

We received overwhelming support from the media, with several invitations to speak on radio networks. Please see the links below to read more.

Press release: https://www.massey.ac.nz/massey/about-massey/news/article.cfm?mnarticle_uuid=FC9F568E-E5F1-4161-80B0-052FCFF0B5E1

RadioLive Interview:http://www.radiolive.co.nz/home/audio/2017/07/getting-better-nutrition-to-early-childhood-education-centres.html

North Shore Times article: https://www.stuff.co.nz/auckland/local-news/north-shore-times/94489233/massey-university-study-explores-teachers-knowledge-of-nutrition-and-exercise

So what next?

We are now in the process of analysing the data. Please watch this space for further updates.

Yours truly,

Jeanette Rapson

Massey University Masters Student in Dietetics, Research Coordinator

Share this:

Twitter Facebook 2 Google

★ Like

Be the first to like this.

Figure C. 5. ECE teachers' nutrition and physical activity study webpage (update page)

Contact

If you have any questions regarding this study, please do not hesitate to contact either of the following people for assistance:

Ms Jeanette Rapson (Project Coordinator)

School of Food and Nutrition, Massey University; 021 077 3419; jeanetterapson7@gmail.com

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Dr Ajmol Ali

School of Sport and Exercise, Massey University; (09) 414 0800 ext.43414; a.ali@massey.ac.nz

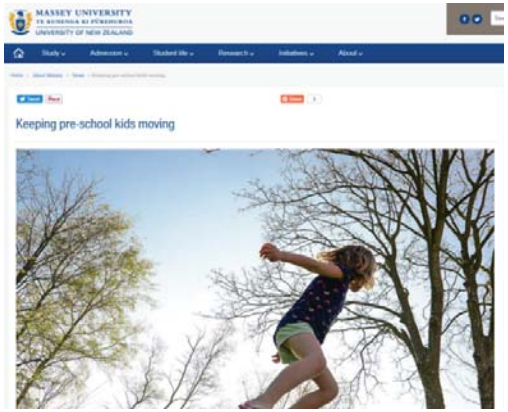
Dr Cathryn Conlon

School of Food and Nutrition, Massey University; (09) 414 0800 ext. 43658; c.conlon@massey.ac.nz

Mr Owen Mugridge (Research Trials Manager)

School of Food and Nutrition, Massey University; 09 213 6650; o.mugridge@massey.ac.nz

Figure C. 6. ECE teachers' nutrition and physical activity study webpage (contact page)



It is predicted more than 70 million infants and children worldwide will be obese by 2025.

Obesity rates in children world-wide are burgeoning, and those attending childcare are more at risk. Now a new Massey University study hopes to discover information that may help design interventions offering simple, practical and relevant tips for early childhood education (ECE) teachers about nutrition and physical activity for pre-schoolers.

Dietetics master's student Jeanette Rapson.

It is predicted more than 70 million infants and children worldwide will be obese by 2025. In New Zealand, one in nine children are obese. Childhood obesity rates have increased from eight per cent in 2006/07 to 11 per cent in 2015/16. Children are more likely to be overweight if attending childcare.

Jeanette Rapson is studying her master's in dietetics at Massey's Auckland campus. She is currently collecting information from ECE centres across New Zealand to explore what teachers and staff know about nutrition and physical activity for pre-schoolers (two to five year-olds) in childcare.

"With more children enrolled in ECE centres, this environment is extremely important for children's health, particularly with regards to body weight. Children who are overweight or obese experience many negative health consequences such as high blood pressure, breathing difficulties, podiatric complications, bone fractures and low self-esteem. These children are also at higher risk of obesity in adulthood, developing other chronic diseases later in life, such as type 2 diabetes and cardiovascular disease."

Ms Rapson hopes her study will improve children's health and give teachers the confidence to support children's nutrition and physical activity. "We hope to inform future health promotion programmes that will offer ECE teachers practical and relevant nutrition and physical activity advice for pre-schoolers. If ECE teachers feel they have good knowledge about nutrition they will be confident in supporting healthy choices."

Predictions of a growing obese population mean an enormous burden with health care costs already stretched. "There are global efforts to eliminate childhood obesity. Many plans stress the importance of targeting schools. Studies show that teachers and their knowledge influence child health, especially since they now spend many hours with children each day. Yet little is known about what ECE teachers know about nutrition and physical activity for pre-schoolers in New Zealand."

The cross-sectional descriptive study uses qualitative and quantitative data. Once a childcare provider agrees to participate in the study, they will be sent a link to distribute to staff. Participation of ECE teachers and other staff is voluntary, regardless of whether their centre has agreed to participate.

The 30-item nutrition and physical activity knowledge questionnaire takes approximately 15 minutes to complete, and is anonymous. The questionnaire is open to participants until July 31. Participants must be New Zealand childcare staff working either part-time, full-time or as casual employees.

Ms Rapson's study, which is being done in conjunction with BestStart Educare and the Heart Foundation, is due to be completed by the end of the year. The research is being supervised by Dr Ajmol Ali from the School of Sport and Exercise and Dr Cathryn Conlon from the School of Food and Nutrition.

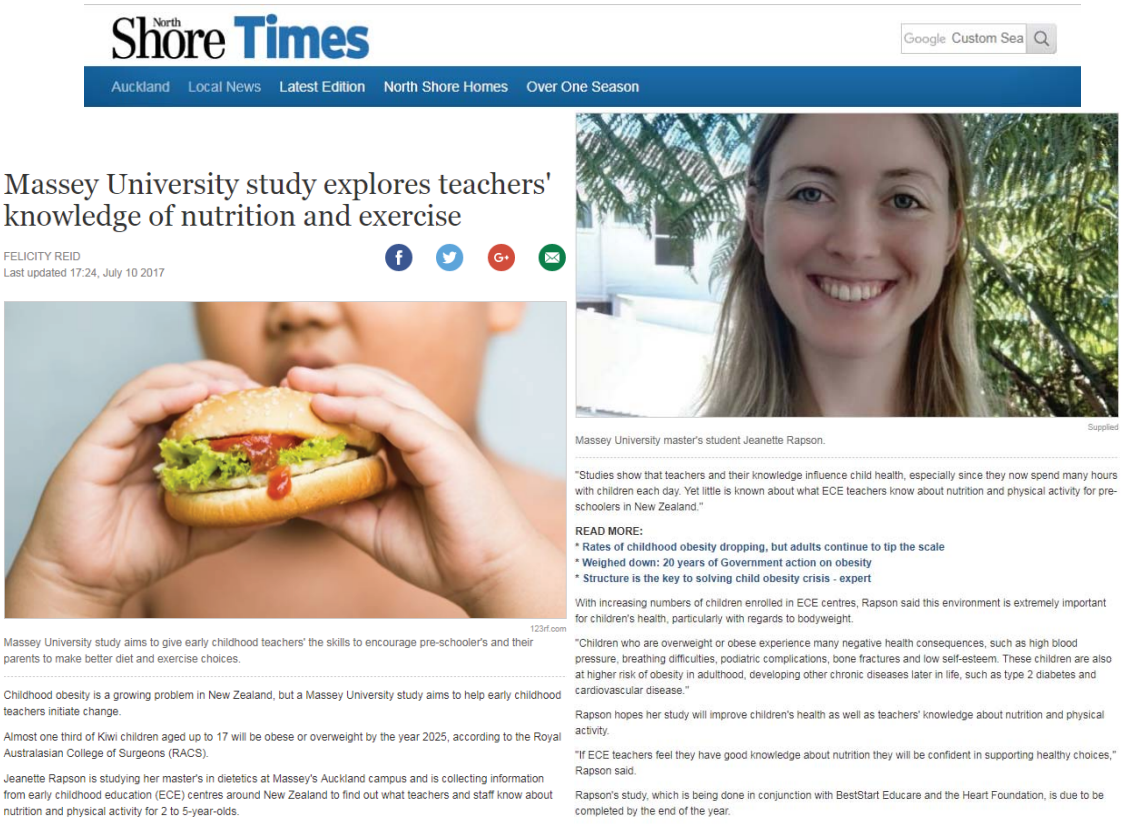
Created: 04/07/2017 | Last updated: 04/07/2017

Page authorised by Assistant Vice-Chancellor External Relations

Figure C. 7. ECE teachers' nutrition and physical activity study press release (Massey University).

Retrieved from https://www.massey.ac.nz/massey/about-massey/news/article.cfm?mnarticle_uuid=FC9F568E-E5F1-4161-80B0-052FCFF0B5E1

Figure C. 8. ECE teachers' nutrition and physical activity study feature on RadioLive (03/08/17). Interview can be viewed: http://www.radiolive.co.nz/home/audio/2017/07/getting-better-nutrition-to-early-childhood-education-centres.html



North Shore Times

Google Custom Sea

Auckland Local News Latest Edition North Shore Homes Over One Season

Massey University study explores teachers' knowledge of nutrition and exercise

FELICITY REID
Last updated 17:24, July 10 2017

123rf.com

Massey University study aims to give early childhood teachers' the skills to encourage pre-schooler's and their parents to make better diet and exercise choices.

Childhood obesity is a growing problem in New Zealand, but a Massey University study aims to help early childhood teachers initiate change.

Almost one third of Kiwi children aged up to 17 will be obese or overweight by the year 2025, according to the Royal Australasian College of Surgeons (RACS).

Jeanette Rapson is studying her master's in dietetics at Massey's Auckland campus and is collecting information from early childhood education (ECE) centres around New Zealand to find out what teachers and staff know about nutrition and physical activity for 2 to 5-year-olds.

Supplied

Massey University master's student Jeanette Rapson.

"Studies show that teachers and their knowledge influence child health, especially since they now spend many hours with children each day. Yet little is known about what ECE teachers know about nutrition and physical activity for pre-schoolers in New Zealand."

READ MORE:
* Rates of childhood obesity dropping, but adults continue to tip the scale
* Weighed down: 20 years of Government action on obesity
* Structure is the key to solving child obesity crisis - expert

With increasing numbers of children enrolled in ECE centres, Rapson said this environment is extremely important for children's health, particularly with regards to bodyweight.

"Children who are overweight or obese experience many negative health consequences, such as high blood pressure, breathing difficulties, podiatric complications, bone fractures and low self-esteem. These children are also at higher risk of obesity in adulthood, developing other chronic diseases later in life, such as type 2 diabetes and cardiovascular disease."

Rapson hopes her study will improve children's health as well as teachers' knowledge about nutrition and physical activity.

"If ECE teachers feel they have good knowledge about nutrition they will be confident in supporting healthy choices," Rapson said.

Rapson's study, which is being done in conjunction with BestStart Educare and the Heart Foundation, is due to be completed by the end of the year.

Figure C. 9. The North Shore Times article for the ECE teachers' nutrition and physical activity study (10/07/17).

Printed in paper and online. Retrieved from: https://www.stuff.co.nz/auckland/local-news/north-shore-times/94489233/massey-university-study-explores-teachers-knowledge-of-nutrition-and-exercise

Figure C. 10. Invitation for participants via facebookLive post; Livenoticeboard.co.nz; the Mike Hosking Breakfast show.
(top to bottom). Radio recording unavailable.