

**The Impact of the CATCH Early Childhood Program on Young Children's Physical
Activity, Nutrition, and Food Behaviour**

by

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Abstract

Initially funded in 1988, the CATCH (Coordinated Approach To Child Health) program is a school-based health promotion and childhood obesity prevention program. It was designed to improve physical activity (PA) and healthy food choices in school-aged children. The program has since expanded to include the CATCH Early Childhood (CEC) program, developed for preschool-aged children (ages 3-5 years). The CEC program incorporates preschool-based enhanced PA, nutrition, family educational components, and staff learning materials in a health promotion program aimed at young children. The program is one of the few interventions that includes nutrition, PA, and family/staff components targeting young children (e.g. < 5 years). This thesis evaluated the impact of CEC programming on young children's nutrition behaviours, food knowledge, and PA levels before and after implementation of the CEC program. Registered Early Childhood Educators (RECEs) were trained and implemented the program for 6-months. Our results demonstrated some significant findings relevant to preschooler program development, but do not directly support the implementation of the CEC program specifically. This study adds to the current body of literature around early intervention programs within daycare settings, but further research is needed to quantify whether all components of the CEC program can positively impact health outcomes (e.g. nutritional choices and PA behaviours) among this cohort.

Keywords: Early Childhood, Healthy Child Development, Nutrition Behaviours, Food Knowledge, Physical Activity.

CO-AUTHORSHIP STATEMENT

Chapter IV is presented as a manuscript for publication.

Author contributions:

Desiree D. Duguay assisted with the conceptualization of the study, led the collection of data, conducted all data analyses, wrote the manuscript, and revised it according to co-author comments.

Dr. Sandra C. Dorman conceptualized the study, supervised the collection of data, assisted with data analyses and interpretation of results, reviewed the manuscript, proposed various refinements to the draft and approved the document.

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1.0 Chapter 1:

INTRODUCTION

1.1 Early Childhood

Early childhood, defined as the period from birth to 8 years of age (UNESCO, 2017), is a key developmental stage during which young children begin to learn about healthful eating and physical activity (PA). Some theorists (e.g. Dovey, et al. 2008) suggest that early childhood is, in fact, a sensitive period for the acquisition of food and PA behaviours due to the rapid development of cognitive, physical, and social-emotional skills and abilities during this time. Rapid brain growth is accompanied by a surge in cognitive development (including language capabilities), gross and fine motor skills, and an enhanced understanding of “self” and sociability (Adolph & Berger. 2006). As such, children are uniquely sensitive to ecological influences in the environments they occupy (Ungar, 2015).

Families and child-care settings are important social environments within which food-related and PA behaviours among young children are developed. Bronfenbrenner’s ecological systems theory (Bronfenbrenner, 1994; Darling, 2007;) looks at a child’s development within the context of the system of relationships that form the child’s environment (e.g. how the environment effects growth and development).

Bronfenbrenner states that as a child develops, the interaction within the environment becomes more complex. This complexity can arise as the child’s physical and cognitive structures grow and mature (Paquette & Ryan. 2001). Therefore, he created an environmental subsystem to understand human behaviour throughout the developmental life span of individuals across cultures (Bronfenbrenner, 1994). These subsystems are

different aspects/levels of the environment that influence children's development, e.g. microsystem, mesosystem, exosystem, macrosystem and chronosystem. Within the ecological framework, the microsystem is the closest layer to the child and contains structures in which the child receives direct contact (e.g. family and daycare environment). This subsystem encompasses the relationships and interactions a child has with her immediate surroundings.

In the home environment, parents model lifestyle practices (e.g. food behaviours, smoking, PA, etc.) as well as pass on hereditary factors, both of which impact healthy child development (Birch & Ventura. 2009; Fuller, et al. 2005; Scaglioni, et al. 2011). Thus, healthy behaviours, including eating and activity patterns, develop in the early social interactions in the home. Parents' customary practices and parent-child relations greatly influence lifetime behaviours, including food preferences, intake patterns, diet quality, sedentary behaviours (e.g. electronic devices, awake in minimal movements) and physical activity level (Savage, et al. 2007).

Although the home environment plays a critical role in shaping a child's lifestyle choices (Campbell & Crawford. 2001; Drewnowski, et al. 2012), daycares and early childhood educators are an important secondary source of influence on health behaviours in children (Goldfield, et al. 2012; Lyn, et al. 2014). Research indicates that more than half of Canadian children between the ages of 6 months and 5 years of age are enrolled in some type of childcare setting, averaging 29 hours/week in this arrangement (Adamo, et al. 2014; Goldfield, et al. 2012; Ward, 2010). Therefore, like schools, daycares are a potential microenvironment for community-based health promotion interventions, including PA and nutrition interventions.

In the childcare setting, Registered Early Childhood Educators (RECEs) are the professionals who specialize in the education and supervision of children (College of Early Childhood Educators, 2017). Ultimately they are responsible for organizing the learning environment and for overseeing activities for children, which promote emotional, cognitive, social and physical development (Philips & Lowenstein. 2011). This can include PA and nutrition behaviours, however, RECEs do not receive formal training in these areas as a component of their educational program (Dunn, et al. 2006). The education curricula and requirements for RECEs differ significantly across Canada, and limited daycare Centres have recognized the importance of regular PA (Active for Life, 2017). Accordingly, if communities want to focus on health interventions in this environment, it would be necessary that RECEs be provided with training in health promotion and health behaviours specific to this age group. Likewise, daycares should have access to a validated health program to use, which would both educate, and provide appropriate tools to educate children in daycare.

1.2 Childhood Obesity

Health behaviours are linked to current and lifetime health outcomes (Ling, et al. 2016), and there is a strong link between childhood health and adult health outcomes (Singh, et al. 2008; Whitaker, et al. 1997). One measure of health is Body Mass Index, which is often used to assess individual and group obesity rates (Nuttall, 2015). Obesity is related to many health problems across the lifespan, and therefore efforts to promote health in children often focus on weight management.

In particular, healthy PA levels and diets are imperative to establish in the early

years because they set the standard for life-long behaviours (Hesketh & Campbell, 2010; Tremblay, al. 2012). The promotion of positive health practices is an acknowledged component of healthy childhood development (Queen’s Printer for Ontario, 2014), and may prevent obesity and obesity-related health problems across the lifespan (Campbell & Hesketh, 2010). A considerable amount of evidence supports that body weight, dietary habits, and PA are linked between early childhood and adulthood (e.g. Hoelscher, et al. 2010; Tremblay, et al. 2012). The World Health Organization (WHO) defines obesity and overweight as “abnormal or excessive fat accumulation that may impair health” (WHO, 2017). For adults, overweight is defined as a BMI greater than or equal to 25, and obesity is a BMI greater than or equal to 30. Overweight for children 5-19 years is a BMI-for-age greater than 1 standard deviation above the WHO Growth Reference median, and obesity is greater than 2 standard deviations above the WHO Growth Reference median. Lastly, for children under 5 years of age, appropriate body composition is determined using the WHO Child Growth Standards (WHO, 2017). The Growth Standards allow clinicians to plot anthropometric measurements on a standardized reference chart. More specifically a weight-for-height index is used to assess growth status, and is, therefore, an indicator that reflects body weight in proportion to attained growth in height (WHO, 2017). Using this tool, overweight for children under the age of 5 years is characterized as greater than 2 standard deviations above the WHO Child Growth Standards median, and obesity is weight-for-height greater than 3 standard deviations above the WHO Child Growth Standards median (WHO, 2017). Although overweight and obesity have been defined in other, or slightly different ways (e.g. CDC, 2016; Chinn & Rona, 2009), the Canadian Paediatric Society has based their definitions of overweight and obesity off of the WHO

guidelines (Marchand, 2010).

Children typically experience fairly steady growth in height and weight during the early years; this leads to a stable Body Mass Index (BMI) value. BMI typically increases from birth to age one year, and then gradually decreases until it reaches a minimum value around 5-7 years. This point is called the Adiposity Rebound (AR) (Boonpleng, et al. 2012; Rolland-Cachera, et al. 1984; Srdić, et al. 2012; Whitaker, et al. 1998). Therefore, the adiposity rebound (AR) precedes this second rise in the BMI curve (Rolland-Cachera, et al. 2006). Researchers have noted however, that an earlier increase in adiposity rebound, around 3 years of age, increases the likelihood that individuals will be obese in adulthood, independent of parent obesity and the BMI at AR (Rolland-Cachera, et al. 2006; Whitaker, et al. 1998). Obesity in adulthood is associated with poorer health status and health outcomes, and increases the risk for developing chronic and irreversible diseases, including, but not limited to: cardiovascular disease, Type II diabetes, and arthritis (Gonzalez-Suarez, et al. 2009). Since health behaviours (e.g. sedentary behaviour and dietary intake) are linked to health outcomes (Ling, et al. 2016), and given that there is a strong link between childhood health, early AR and adult health outcomes (Singh, et al. 2008; Whitaker, et al. 1997), it is important to consider the implementation of intervention programs aimed at optimizing health practices amongst young children (e.g. <5 years of age) to prevent early increases in BMI and promote healthy child development.

1.3 Early Childhood Health Promotion

Prior to 2003, limited scientific research addressed the preschool or childcare settings, in part because young children have traditionally been less accessible for community-based health interventions (e.g. children under 5 years have traditionally stayed at home). However, there has been increased interest in the impact of child-care arrangements on children's development, with the increase in maternal employment and two-income earner families since 2003. Overall, based on the Labour Force Survey (LFS) in Canada, 82% of women in the core working ages of 25 to 54 years participated in the labour market in 2015. This compared to 21.6% of women in 1950 and 65.2% in 1983 (Statistics Canada, 2017). More specifically, in Canada, the employment rate of mothers with children under the age of 6 years has increased significantly (Kottelenberg, et al. 2013), from 31 percent in 1976 to 66.5% percent in 2009 (Statistics Canada, 2017). Similarly, 64.4% of women with children less than age 3 years were employed, and 69.7% of women whose youngest child was from 3-5 years of age were working in 2009. Further, more than half (54%) of parents used some form of child-care arrangement (e.g. nannies, home daycares, daycare centres, preschool programs, and before and after school services), and 70% of parents used full-time care. Full-time care is characterized by a minimum of 30 hours a week of in-care supervision for children aged 4 years and under (Sinha, 2014). Furthermore, three types of daycare arrangements are most commonly used for children aged 4 years and under: daycare centres (33%), home daycare (31%) and private arrangements (e.g. grandparents, other relatives or nannies) (28%).

Over the last few decades, widespread rates of childhood-onset overweight and obesity have tripled (Adamo, et al. 2014; Fung, et al. 2012). About 43 million (6.7%) (35 million in developing countries) preschool children worldwide are overweight or obese; this number is estimated to reach 60 million by 2020 (de Onis, et al. 2010; Ling, et al. 2016;). Accordingly, available literature has focused on early childhood obesity-prevention programs as a developing research area (Hesketh & Campbell. 2010; Ling, et al. 2016). Given this, health professionals are only beginning to understand the problem, and are starting to place preschooler's PA patterns and nutrition behaviours at the forefront of health prevention and promotion (Adamo, et al. 2014; Chow, et al. 2015).

1.4 Preschooler Health Intervention Research

Birch & Ventura (2009) were one of the first groups to recognize the gap in health policy for preschooler health. This review described the current primary prevention approaches for childhood obesity, and the evidence for their impact. Their paper highlights the need for the development and expansion of early intervention programming, which should include efforts at engaging the home and the childcare setting. The review by Birch & Ventura (2009) focused primarily on eating habits, however, PA behaviour is recognized as being equally important. For many years, it was largely assumed that the preschool population was sufficiently active but we now know that this notion is inaccurate (Timmons, et al. 2007; Tremblay, et al. 2012). Therefore, health programs for preschool-aged children should include opportunities for both structured PAs and unstructured free-play (Ward, et al. 2010). Young children who are provided with an abundant of opportunities for free-play have both a higher mean activity

level and greater activity intensity (Brockman, et al. 2010; Janssen, 2014).

Likewise, Hesketh & Campbell (2010) directed a systematic review of the literature to measure the efficacy of early intervention programs aimed at preventing obesity, promoting healthy eating and PA, and/or reducing sedentary behaviours in young children (e.g. birth to 5 years). Twenty-three studies were included, and early intervention programs were delivered through a variety of settings (e.g. preschool/childcare, home, group, primary care and mixed settings), although the majority were preschool/childcare settings. Additionally, the authors reported that 17 of the 23 studies were published from 2003 onward; 14 involved multi-layered programs and 15 were led in the United States. Early intervention programs conducted in the preschool/childcare setting, received the highest quality ratings. Further, the review highlighted that most of the preschool/childcare-based studies did not include a parental component. The authors concluded that for a successful intervention, it was paramount that parental caregivers actively immerse themselves in the program to help support and create meaningful changes in children's overall health behaviours (Hesketh & Campbell. 2010).

Ling, et al. (2016) conducted a more recent systematic review, which included 32 randomized controlled trials that examined health interventions among children aged 2-5 years. There were 29 unique interventions summarized in the review; three intervention had more than one paper written on the same study, e.g. one article presenting the protocol, one on the intervention effects. Publication dates for the 29 eligible studies ranged from 2003 to 2014. The authors investigated two intervention characteristics for overweight/obesity: 1) prevention interventions (23 studies) implemented in the home, school (e.g. preschools, daycare or childcare centers, and nurseries), and/or community

(e.g. churches, community centers and primary care clinics); and 2) management interventions (6 studies) implemented in a community-based setting (e.g. outpatient clinic, children's hospital, healthcare center and primary care clinic). Accordingly, the authors reported that seven of the eight interventions found to be effective had targeted both PA and nutrition among children, and the three interventions with sustained effects also incorporated both a PA and a nutrition element. In regards to the management interventions, authors described that of the four interventions with significant post-intervention effects, three included a PA and a nutrition component, one targeted electronic use by children (e.g. screen-time, computer), and one PA and nutrition intervention that showed a 12 month follow-up effect (e.g. weight loss). Ling and colleagues (2016) concluded that intervention programs targeting both parents and children through interactive education and hands-on experiences with nutrition and PA might be promising approaches for prevention interventions.

1.5 Coordinated Approach to Child Health Early Childhood (CEC) Program

The Coordinated Approach to Child Health Early Childhood (CEC) program was developed in 2011 as an extension to the School-Based CATCH program, to improve healthy eating and PA in preschool-aged children. The program components target both RECEs within the daycare setting and caregivers. The literature suggests that this is the optimal combination of components to incur meaningful health outcomes in this population. However, to date, this program has not been adequately validated in this population of children. Therefore, the purpose of this thesis was to assess the CEC program as a potential strategy to improve the health behaviours of preschool-aged

children, specifically for its potential impact on children's nutritional choices and PA behaviours.

2.0 Chapter 2:

REVIEW OF LITERATURE

2.1 Definitions & Guidelines

2.1a Physical Activity

The health benefits of PA for children are well established (e.g. Tremblay, et al. 2012). Routine PA may encourage children to obtain and maintain quality health and well-being. According to the WHO, PA is defined as “any bodily movement produced by skeletal muscles that require energy expenditure” (WHO, 2017). In addition, moderate-intensity PA is characterized as “any activity that necessitates a moderate amount of effort and noticeably accelerates the heart rate, e.g. brisk walking, dancing and gardening”; and vigorous-intensity PA requires “a large amount of effort and causes rapid breathing and a substantial increase in heart rate, e.g. aerobics, running and competitive sports” (WHO, 2017).

Particularly, infants (less than 1 year) should accumulate PA through interactive floor-based play, which means being active through tummy time, reaching and/or grasping small toys, playing or rolling on the floor and crawling around the home. In addition, toddlers (aged 1-2 years) and preschoolers (aged 2-4 years) should engage in a variety of activities among different environments, and activities that develop movement skills. For instance, climbing stairs and moving around the home, playing outside and exploring their environment, would constitute “movement skills” (Tremblay, et al. 2012).

PA guidelines for children describe the amount and types of PA that offer health benefits (Public Health Agency of Canada, 2011). The Canadian Society for Exercise Physiology (CSEP) guidelines are the commonly used and accepted “standard” for

children's PA levels throughout Canada. The guidelines state that young children aged 0-4 years (consisting of toddlers aged 1-2 years and preschoolers aged 3-4 years) should accumulate daily, a minimum of 180 minutes of PA at any intensity, spread throughout the day. Additionally, the guidelines recommend a progression towards a minimum of 60 minutes of energetic play by 5 years of age. Accordingly, standards for older children (5-11 years) recommend an accumulation of at least 60 minutes of moderate-to-vigorous-intensity PA (MVPA), daily. Step count targets corresponding to these guidelines are estimated to be 6,000 steps daily for children aged 3-5 years, and 12,000 steps daily for children aged 6-19 years (Colley, et al. 2012; Gabel, et al. 2012).

Despite guidelines for daily PA, evidence suggests that Canadian children (and some age groups in particular) are not achieving these recommended levels (Goldfield, et al. 2012; Temple, et al. 2009). Active Healthy Kids Canada (AHKC) is a national charitable organization established in 1994, with the mandate to encourage all children and youth to be more physically active. Since 2005, AHKC has issued a Report Card per annum regarding PA patterns among Canadian children and youth. In 2014, AHKC started reducing its operations, and ParticipACTION assumed the leadership of the Report Card. Correspondingly, the ParticipACTION Report Card (formerly the AHKC Report Card) provides a comprehensive assessment of the current state of PA for children and youth in Canada (True Sport, 2016). The report outcome from 2016 indicated a letter grade of D minus for overall PA in Canada; results were also reflective of CSEP standards. More specifically, 70% of 3 to 4 year olds met the daily recommendation of overall PA, while only 9% of 5 to 17 year olds met the daily recommendation of at least 60 minutes of MVPA (ParticipACTION, 2016).

2.1b Nutrition

Satisfying the nutritional needs of children is essential for healthy growth and development. Infants rely on breast milk or commercial formula after birth; nutritional value is dependent on these milks (Schwartz, et al. 2011). However, nutrition guidelines advise exclusive breastfeeding from birth to 6 months of age (Health Canada, 2015) with additional vitamin D supplementation (Godel, 2007). Older infants require other sources of nourishment. Accordingly, complementary solid foods that are energy-dense and rich in nutrients (including iron) should be introduced from 6 months of age onwards (Government of Canada, 2014). The progression towards solid foods and beverages is a natural stage in young children's development and is ideal for meeting growing requirements (Canadian Pediatric Society, 2015).

Young children can start consuming regular meals and snacks from 1 year of age (Health Canada, 2015). Serving guidelines and portion sizes typically follow the recommendations of Eating Well with Canada's Food Guide (Health Canada, 2015). According to the Guide, preschoolers (24 months of age onwards) follow the recommendations for children 2-3 years. Children of this age require: 4 servings of vegetables and fruit, 3 servings of grain products, 2 servings of dairy or dairy alternatives, and 1 serving of meat or meat alternatives daily. Children aged 4-8 years require: 5 servings of vegetables and fruit, 4 servings of grain products, 2 servings of dairy or dairy alternatives, and 1 serving of meat or meat alternatives daily. An additional serving per food group is recommended for older children 9-13 years. While there are no formal Food Guide recommendations for very young children (e.g. toddlers under 2

years), serving suggestions follow the principles for children of 24 months. Since preschoolers and young children have small stomach sizes, servings can be separated into smaller groups and offered throughout the day (Health Canada, 2011).

In addition to the above-mentioned food groups (e.g. Vegetables and Fruits; Grain Products; Milk and Alternatives; and Meat and Alternatives) there are two other sections: Oils and Fats, and Beverages. To begin with, the Guide recommends a small amount (e.g. 30 to 45 mL) of unsaturated fat per day (e.g. canola, flaxseed and olive vegetable oils), which includes oil used for cooking, salad dressings, margarine and mayonnaise. The Guide also advises to limit foods and beverages high in calories, saturated fat and sugar or salt (sodium) such as cakes, cookies, ice cream and candies. Second, the Guide advocates drinking water regularly as a choice of beverage, as water is calorie-free and helps keep young children and older adults hydrated. Alternatively, healthy beverage selections are milk, fortified soy beverages and 100% juice. However, subsequent beverage options are to be quantified in the recommended number of Food Guide Servings per day. Finally, the Guide reports limiting consumption of soft, sport, energy and fruit drinks, punches, sweetened hot and cold beverages and alcohol, as these beverages can be high in calories and low in nutrients.

Canada's Food Guide also provides recommendations for caloric intake dependent on activity levels for age and gender (Health Canada, 2015). Estimated energy requirements for young children 2-3 years are 1100, 1250, and 1400 calories per day for physical inactivity, low, and high activity levels for girls; boys of the same age require 1100, 1350, and 1500 calories across activity levels. Requirements for children 4-5 years of age are approximately 100-150 calories higher for each level of specified activity, with

boys requiring more energy than girls as intensity levels increase. Portion sizes, amount of daily eating times and consumption, and the energy density of foods consumed affect total energy intake (Fox, et al. 2006).

The Canadian Community Health Survey, Cycle 2.2 Nutrition (CCHS 2.2), provides food and nutrient intake data for Canadian children (e.g. 1 to 8 years of age) (Health Canada, 2012). Results from the CCHS 2.2 indicate that 14.5% of 2 to 8 year olds were considered overweight, and a further 7.6 % obese. Thus, 1 in 5 Canadian children have energy intakes that exceed their energy expenditure. Similarly, 51.7% of 1- to 3- year olds had total fat intakes within the Acceptable Macronutrient Distribution Ranges (AMDR), while 47% had intakes below the recommended range. The median sodium intake of the 1 to 3 and the 4 to 8 year old Canadian children exceeded their respective Adequate Intakes (AIs). Moreover, 77% of 1 to 3 year olds and 93% of 4 to 8 year olds had regular intakes of sodium exceeding the Tolerable Upper Intake Level (UL) set for their age group (1500 mg and 1900 mg/d, respectively). This data suggests that 1- to 8 year old Canadian children are at an increased risk for adverse health effects due to their sodium intake. Within both children's age groups, fewer than five percent had inadequate intakes of vitamin A, vitamin B6, vitamin B12, vitamin C, niacin, riboflavin, thiamin, folate, zinc, phosphorus, magnesium, calcium (ages 1 to 3 only) and iron. Whereas for vitamin D, 86.0% of 1 to 3 year old children and 92.7% of 4 to 8 year old children had usual intakes below the Estimated Average Requirement (EAR). Lastly, the AIs for fiber have been set at 14g/1000 kcal/day for all age groups (e.g.1 year and over). Results of the assessment demonstrate that the median intake of dietary fiber of the 1- to 3- year olds was 9.9 g/d, while it reached 13.4 g/d among the 4 to 8 year olds.

2.2 Physical Activity (PA) & Nutrition

2.2a Benefits

Regular PA and adequate nutrition promotes healthy childhood development and positive adult outcomes (O'Dwyer, et al. 2013). Research has frequently affirmed that regular PA prevents childhood obesity, and is one of the many benefits of active living (Metcalf, 2012). Similarly, a systematic review by Timmons, et al. (2012) found that increased PA is positively associated with improved measures of adiposity and motor skill development among toddlers and preschool-aged children. However, there are additional benefits to the physical and psychosocial health of young children as a result of PA behaviours (Tucker, 2008). Appropriate practices in PA improve musculoskeletal health and fitness, and several components of cardiovascular health (Janssen & LeBlanc, 2010; WHO, 2017). Children who are physically fit have improved sleep patterns, are more capable of managing physical and emotional challenges (Galland & Mitchell, 2010), and show concomitant decreases in both anxiety and depression (Active Healthy Kids Canada, 2012; Lobstein, et al. 2004). Furthermore, PA can assist with social skills development, such as social interaction and integration, and self-confidence/expression (Copeland, et al. 2011; WHO, 2017).

Children who are inactive are at risk for a host of negative outcomes across the life span. Lack of PA has been associated with diabetes, cardiovascular disease, osteoporosis and some types of cancer later in life (Center on the Developing Child at Harvard University, 2010; Lobstein, et al. 2004). A lack of adequate activity in childhood may also lead to obesity, which has become a significant public health challenge (Chow,

et al. 2015; Janssen, 2014). The number of overweight children worldwide under the age of 5 years in 2015 is estimated to be over 42 million (WHO, 2015), which has long-term consequences as a result of its persistence into adulthood (Bromfield, 2009). Childhood obesity may reverse the steady increase in life expectancy found in recent years, and certain health conditions once applicable merely to adults is now affecting children (Daniels, 2006; Public Health Agency of Canada, 2016). Similarly, overweight and obese children are at an increased risk for non-communicable diseases, such as Type II diabetes, and coronary heart disease (Brown, et al. 2009). For example, studies have proposed that inactivity (low fitness levels) and additional adiposity during preschool could possibly influence the development of cardiovascular disease (Timmons, et al. 2012).

Nutrition is likewise critical for healthy childhood development. The early years (e.g. birth to 5 years of age) are a vital period marked by rapid and dramatic post-natal growth (Rosales, et al. 2009). A healthy diet supports normal physical growth (e.g. muscle and bone growth) and biological processes (Queens Printer for Ontario, 2014). Adequate nutrition is also linked to healthy brain development; the relationship between nutrient availability and brain development during infancy has been clearly established (Prado, 2012; Rosales, et al. 2009). In addition to the benefits to physical health, healthy dietary patterns are associated with the acquisition of cognitive skills such as memory, creativity and problem-solving abilities (Prado & Dewey. 2012; Rosales, et al. 2009), and studies suggest that a healthy breakfast promotes learning and academic performance (Taras, 2005). On the other hand, poor nutrition negatively impacts all aspects of development (Galvan, et al. 2013). The consequences of inadequate nourishment may

include: stunted physical growth, activity limitations, immunological and cognitive deficits, and increased risk of eating disorders and obesity (Wilson, 2013). Combined with poor activity levels, an inadequate diet may exacerbate health-related problems, including obesity, across the lifespan (Adamo, et al. 2014). A balanced diet may assist in reversing the steady increase of obesity, thereby improving health in later life.

2.3 Determinants of Physical Activity and Nutrition Behaviours

2.3a Home Environment

PA is a recognized component of a healthy lifestyle and an influencing factor on lifelong health (Adamo, et al. 2014; Center on the Developing Child at Harvard University, 2010). The health benefits of PA during the early years have not always been addressed; there has been a lack of scientific research for young children (Timmons, et al. 2012). This may be due to traditional beliefs that children in general are active enough, and consequently, rather healthy (Godfiled, et al. 2012; Timmons, et al. 2012;). However, mounting evidence suggests that this is not the case. Behavioural habits, including PA and sedentary behaviours, are formed in early childhood (Soini, et al. 2014) and are shaped by the social and physical environments in which children spend time (Adamo, et al. 2014). The early years are a time when PA is strongly influenced by parents and the home environment (Timmons, et al. 2012). While engagement in self-selected activities increase as children age (Burdette, et al. 2004), parents are responsible for the provision of appropriate PA opportunities and spaces (e.g. for play), encouragement and support via role modeling, and for setting guidelines for screen-time (Campbell, et al. 2001; Carson, et al. 2013). As reported by CSEP guidelines (CSEP, 2017), screen-time (e.g.

watching TV and playing passive video or computer games) for children under 2 years of age is not recommended, and for those 2- to 4- years of age, screen-time should be limited to under 1- hour per day; less is better. Studies have provided evidence of a positive association between screen-time and sedentary behavior (Carson, et al. 2013). In addition, Spurrier, et al. (2008) found that high parental PA, larger backyard play space, more outdoor play equipment and minimal screen-time were positively associated with increased total active outdoor play by the child. However, they did not find a relationship between structured PAs (e.g. kindergym) and total outside playtime, which suggests that time spent in active-play is independent of organized activity for young children. This is in contrast to school-aged children, where studies show that structured PA is a key component in achieving recommended daily PA levels as children age, particularly amongst girls (Vander Ploeg, et al. 2014). Active-play is therefore recognized as a key, contributing factor in total PA levels for young children (Brockman, et al. 2010).

Parental behaviours and attitudes regarding food and nutrition similarly influence children's dietary patterns (Schwartz, et al. 2011). Preschool children develop foundational food and nutrition related behaviours. Essentially, children learn more at this time than during any other developmental period (Birch & Ventura. 2009), in part because it is during this developmental stage that children first acquire an appreciation for tastes and preferences as they transition to complementary foods and acquire independence through self-feeding (Allen & Myers. 2006). However, parents are responsible for food introduction and selection and can therefore meaningfully control food choices (Birch, 1980; Savage, et al. 2007). Children have limited independence in choosing food (Brug, et al. 2008; Fuller, et al. 2005), and so parents influence their

child's preferences and eating behaviours by deciding which foods to offer them (Peters, et al. 2012). Young children do not have the innate ability to choose a well-balanced diet (Allen & Myers. 2006); knowledge of food and healthy choices are dependent on exposure and control by adults (Allen & Myers. 2006; Cooke, 2007;), and experiences with food have an effect on preferences and consumption (Nicklas, et al. 2001). Likewise, children may acquire preferences for healthy or unhealthy choices by observing (and mimicking) eating behaviours of parents (Birch & Fisher. 1998). For example, the availability of a variety of foods within a food group in the home is positively associated with young children's intake of these foods (e.g. fruits and vegetables). Similarly, restricting access to high fat or sugar snacks is related to higher fruit and vegetable intake (Spurrier, et al. 2008). Supporting this, Wind, et al. (2006) showed that children who were frequently offered fruit and who observed parents eating fruit daily, consumed more fruit themselves and had a higher preference for fruit consumption. Positive role modeling of healthy food consumption is thus recognized as important in fostering healthful eating habits (Fox, 2004; Savage, et al. 2007; Taylor, et al. 2004).

2.3b Early Childhood Settings

The early years are a period where caregivers are the primary providers and educators (Peters, 2012), and therefore the most influential in a young child's learning and development (International Child Development Initiatives and Bernard Van Leer Foundation, 2012). As discussed above, parents, as the most common primary caregiver, have a key role in encouraging positive PA and dietary patterns (Shaeffer, 2007). However, many children receive non-parental care, daily, from RECEs in daycare

facilities, and these providers are therefore a second key caregiver for influencing children's learning (Gordon, et al. 2008; Rentzon & Sakellariou. 2011).

High quality childcare offers positive learning experiences that encourage emotional, cognitive, social and physical development amongst children, and can therefore also play a significant role in promoting healthy behaviours (Best Start Expert Panel on Early Learning, 2007; Rentzon & Sakellariou. 2011). The daycare setting does provide opportunities for the adoption of a physically active lifestyle, but to date, applications are unstructured and variations exist between centres (Adamo, et al. 2014). The amount and quality of PA depends largely on the size of indoor and outdoor play space, availability of equipment and toys, total group size, child-caregiver ratio, education and training of staff and the specific daycare program (de Schipper, 2006).

Research shows that Canadian children in daycares may not be achieving required levels of PA (Anderson, 2008; Obeid, et al. 2011; van Zandvoort, et al. 2010). One study led by Timmons and colleagues (2007) reported that PA in preschool aged children is characterized by short bouts of movement, devoting minimal time in MVPA. Likewise, Benham-Deal (2005) found that young children engaged in short durations of MVPA; on average, an episode lasted 5-10 minutes and ~20% of this time was spent at vigorous intensities. Similarly, Temple and colleagues (2009) found that 3- to 5-year old children spent 7.2 hours in childcare and the mean rate of MVPA was 1.76 min/h. Accordingly, studies have outlined the substantial inter-individual variability in PA levels; certain children attain high levels of PA, and others only reach low levels (Button, et al. 2013). Research evidence shows that the majority of PA is of light intensity, with child engagement in sedentary behaviours for long periods throughout the day (Timmons, et al.

2012).

However, uncertainty exists around the amount of PA levels young children are receiving for several reasons. First, preschool children are an under-studied population compared to school-based children. Second, PA requirements for daycares are vague or non-existent. For example, Ontario regulations do stipulate requirements for total time spent outdoors, but they are not specific about the nature of outdoor activities. In addition, despite the fact that the outdoors is where free-play and gross motor activity are most likely to occur (Burdette, et al. 2004), it is recognized that requirements for physical space (indoors and out) are often inadequate for achieving optimal active-play (Childcare Resource and Research Unit, 2013). In some childcare centres, indoor spaces are small and constrict PA; spaces are sometimes confined intentionally to limit active movement. Due to safety concerns, play areas are set up to eliminate narrow pathways where children might want to run (Active for life, 2017).

Furthermore, there are no preschool-specific PA guidelines (Obeid, et al. 2011), merely the recognition of the benefits of free-play and structured activity (e.g. increases MVPA) (Brockman, et al. 2010). So although unstructured free-play is essential for healthy development (e.g. brain and motor development, and long-term confidence in PA) (Active for Life, 2017; DeMarco, et al. 2015), direction for childcare providers around the nature of free-play (e.g. intensity) required for health benefits is needed.

Daycares can also influence children's eating habits, since most provide meals to children and usually in a communal setting, wherein children eat together. Therefore like the home environment, the daycare centre (e.g. RECEs) chooses the selection and

frequency of foods to be offered to the children on a regular basis, thereby influencing their taste development and preferences (Peters, et al. 2012).

Licensed daycares are required to follow the nutrition guidelines set forth by the government in the *Child Care and Early Years Act, 2014* (Queens Printer for Ontario, 2017). The foods provided should meet the requirements set out in the Health Canada documents “Eating Well with Canada’s Food Guide”, “Eating Well with Canada’s Food Guide – First Nations, Inuit and Métis” or “Nutrition for Healthy Term Infants” (Ontario, 2017). Regulations also require the provision of foods and snacks that are low in fat and sugars (Public Health Services, 2012; Queen’s Printer for Ontario, 2017). Menu-planning and nutrition guidelines should therefore ensure that children are exposed to and have opportunities to consume a variety of healthy foods. However, setting practices and policies vary, and therefore children’s eating is influenced by the availability and accessibility of foods, meal structure, and food modeling (Nicklas, et al. 2001). For example, food consumption may vary by day of the week, children may eat more fruits and vegetables in daycares that offer more of these types of food, and delivery style (e.g. “family-style” meal service) regulates or controls children’s eating (Nicklas, et al. 2001). Practices such as provider training and food consumption modeling also affect children’s consumption patterns. Evidence suggests that preschoolers are more likely to eat foods after observing an adult role model (Savage, et al. 2007). In the daycare setting, this is most often the RECEs, who may be eating the same foods as provided to the children (Gubbels, et al. 2015).

Given that daycare settings and RECEs interact regularly with young children during a key developmental timeframe, which may meaningfully influence their lifelong

dietary habits and food preferences, targeted education for providers and interventions aimed at the promotion of healthy eating are warranted.

2.4 Early Intervention Programs

2.4a Interventions for Improving Physical Activity & Nutrition

Embedding healthy behaviours in our youngest cohort of children is an important community goal. Daycare centres provide a focal point for intervention and obesity prevention (Adamo, et al. 2014) as many children spend a significant amount of time in a childcare setting (Adamo, et al. 2014; Lyn, et al. 2014). The limited research available to date has demonstrated positive outcomes from combined PA and nutrition program implementation in daycares (e.g. Belanger, et al. 2016). Many of these studies are best summarized in a meta-analysis conducted by Gordon, et al. (2013). This review examined the effectiveness of PA interventions for PA participation among preschool-aged children. The authors also evaluated which intervention characteristics influenced MVPA, for instance, the location of play (e.g. indoor vs. outdoor) and nature of PA (e.g. unstructured vs. structured). Fifteen independent studies containing a total of 2,618 participants met the criteria for inclusion in this meta-analysis of studies published between 2004 and 2011; none of the studies were conducted in Canada. Their findings indicated an increase in PA, specifically engagement in MVPA, during outdoor play vs. indoor play post-intervention. They also found that MVPA was higher during unstructured playtime as compared to structured activity time.

One of the positive studies reported in this review was that done by Fitzgibbon, et al. (2002), who designed a community-based ‘Hip-Hip-to-Health Jr.’ obesity-prevention

program, and evaluated the program's effectiveness with a 5 year randomized controlled intervention. The Hip-Hip-to-Health Jr. program focused on 3 to 5 year old African-American and Latino children enrolled in 24 Head-Start programs in the Chicago Metropolitan area. The program included a dietary and PA curriculum, as well as a parent component (e.g. weekly newsletters, homework assignments and aerobic classes) to target both home and childcare environments. Results from the 1 and 2 year follow-ups demonstrated positive trends with regards to decreasing BMI status as children aged (Fitzgibbon, et al. 2005).

After this meta-analysis was published, a study by Farfan-Ramirez, et al. (2011) investigated the '*Nutrition Matters!*' (*NM!*) nutrition education program, with goals that included increasing fruits and vegetable consumption and PA activity in preschool-aged children. The program was implemented between the months of April and June at 18 Early Childhood sites. The evaluation measured eating behaviours using a pre/post-test design, with observations conducted before and after '*NM!*' lessons. The results showed an increase in children's willingness to try fruits and vegetables after implementation of the '*NM!*' nutrition education program. Children were also more open to trying foods when they were able to actively participate in nutrition and gardening-based activities.

In Canada, few nutrition education programs have been implemented and evaluated in preschool aged children (Birch & Ventura. 2009); they have also not simultaneously involved daycare centres and home-care providers (Adamo, et al. 2014). This is unfortunate given evidence suggesting that interventions should target both families and preschool environments: the home environment is associated with young

children's PA and dietary patterns (Spurrier, et al. 2008) and preschool settings are well-positioned to promote healthful behaviours (Natale, et al. 2014).

2.4b Coordinated Approach to Child Health (CATCH)

The CATCH (Coordinated Approach to Child Health) program is a school-based health promotion and childhood obesity prevention program. It was designed to improve PA and food choices in school-aged children (6-14 years) (Luepker, et al. 1996). CATCH was initially funded in 1988, and continues to be evaluated and improved by researchers with the University of Texas, School of Public Health (About Education, 2016).

FlagHouse joined the CATCH team in 1998 as the publisher and distributor of the CATCH program. It was originally conceptualized to promote cardiovascular health at an early age (Child and Adolescent Trial for Cardiovascular Health) (Perry, et al. 1990), but the current CATCH programming reflects a broader health perspective. This program for schools is based on the Coordinated School Health (CSH) model (Centers for Disease Control and Prevention, 2015) for health behaviour education in the school setting. The model integrates eight components considered essential for a healthful lifestyle (health education, physical education, health services, nutrition services, counselling and social services, healthy and safe school environment, health promotion for staff, and family/community involvement) (CATCH, 2016). The Whole School, Whole Community, Whole Child (WSCC) model expands on the eight components of CSH, and emphasizes a collaborative approach to improving child health in schools (Centers for Disease Control and Prevention, 2015). Consistent with the WSCC approach, CATCH programming was developed to involve parents, school personnel, and community partners in teaching children about healthful decisions around PA and food behaviours.

CATCH thus employs a holistic approach to child health promotion; the coordinated approach reinforces lessons and skills around health concepts (CATCH, 2015). The primary objective is to create changes in children's environments to support healthful decision-making, and to influence health policy and practice to this end. This program is available in Canada and has been modified accordingly (e.g. to reflect Canada's Food Guide and Canadian PA standards).

In 2004, CATCH expanded beyond the school setting in the form of a program developed for the after-school care setting and childcare. Health messaging was coordinated between all components of the programs to maximally impact children's food knowledge and health behaviours (CATCH, 2016). CATCH Kids Club (CKC) was developed as an after-school program comprising lessons related to nutrition, PA and screen-time reduction, hands-on snack preparation, and structured PAs. Further, CATCH-Early Childhood (CEC) extends the WSCC model to include early childcare in the community. Like CATCH, the CEC program involves parents, staff personnel, and community partners in teaching children about healthful decisions, e.g. around PA and food behaviours. However, the resources and delivery model was modified for this younger cohort. To date, approximately 120 academic papers have been written that examine the impact of CATCH programming, and the program has been implemented in 10,000 schools/communities across the United States (pre-K, K-8 and after school settings). CATCH curriculum has also been implemented in other countries, including Canada.

The most comprehensive analysis of CATCH involved a field trial performed by Luepker, et al. (1996). This was a parallel study design comparing 5,106 third grade

students in 96 public schools from 12 school districts. The CATCH interventions began in the school year of 1991-1992, and continued as students progressed through to grade 5 (1993-1994). The study included 56 intervention schools and 40 control schools. The Nutrition Data System of the University of Minnesota, Nutrition Coding Center analyzed recipes and menus of the “Eat Smart Program” component at baseline (in spring of grade 4) and at follow-up. The software provided information regarding micronutrient and macronutrient content. Additionally, the System for Observing Fitness Instruction (SOFIT) was used to evaluate the physical education program component (CATCH PE) during the 6 semesters; each school had two visits from evaluators to observe the type and intensity of children’s activities, and the behaviours of PE specialists and teachers in PE classrooms. A class-administered Health Behavior Questionnaire (HBQ) was used as a measure of factors concomitant with diet, exercise, and smoking at baseline (spring of grade 3 and 4) and at follow-up. The HBQ also included psychosocial questions on dietary knowledge, intentions, usual food choices, social reinforcement and support, and self-efficacy. Further, a 24-Hour Dietary Recall was used to assess total daily fat and nutrient intake at baseline and follow-up. The self-administered physical activity checklist (SA-PAC) was administered only in grade 5, to evaluate the type, duration and intensity of selected leisure time and screen-time (e.g. television and video games). Lastly, children participated in an aerobic fitness test using a 9-minute distance run. The primary finding from this study was that total fat available for consumption in meals was reduced in intervention group school lunches (38.7% to 31.9%) as compared with control group lunches (38.9% to 36.2%) at follow-up.

Nadar, et al. (1999) conducted a 3 year follow-up of this intervention study to

examine the long-term dietary and PA behaviours of grade 8 students who participated in the elementary school CATCH intervention. In grade 8, 3,714 students had parental consent to participate in the follow-up (of the 5,106 original study participants). For the remaining students (1,392), parents refused consent, did not respond, the students were living out of study centre limits, or were lost to follow-up. Overall, the findings showed improvements in PA, and long-term (e.g. 3-year) follow-up results showed sustainability regarding daily vigorous PA in grade 8 students (Nader, et al. 1999). Intervention students reported a mean of 30.2 minutes spent in daily vigorous PA compared to a mean for control students of 22.1 minutes. The response scores from the HBQ instrument about healthy food choices (food intentions) and knowledge (food knowledge) showed significantly higher results for intervention schools, and effects were sustained over the 3 years (Edmundson, et al. 1996). The statistically significant differences at follow-up between experimental and control students were observed to be narrowing over time, indicating that this intervention program may not be effective in the long-term.

A separate study conducted by McKenzie, et al. (1996) measured 3rd grade students in 96 elementary schools during the fall of 1991, and followed them through until the end of 5th grade in June 1994. All 96 of the recruited elementary schools remained in the study over the 3-year study period. The total CATCH intervention included a food service intervention, CATCH PE, tobacco and classroom curriculum promoting cardio-vascular health and school policy, and a home/family component. Investigators used SOFIT to evaluate the amount of time children spent in MVPA, and simultaneously measured the lesson content of PE classes. Additionally, homeroom teachers measured the frequency and duration of PE classes using a physical activity

record of classes (PARC) form. The 9-minute distance run was also used to measure individual cardiovascular fitness, and participants estimated their total PA from the previous day, both in and out of school, using the SA-PAC. Results showed that children in the CATCH intervention schools engaged in more MVPA during PE classes, in contrast to control groups. Specifically, MVPA in intervention schools increased from 37.4 % at baseline to 51.9% after the lessons. Additionally, children in intervention schools had higher estimated energy expenditure (2.49 kcal/kg vs. 2.26 kcal/kg, $P = 0.002$) and a higher energy expenditure rate (0.0085 kcal/kg/min vs. 0.0078 kcal/kg/min, $P = 0.002$) compared to control groups. Lastly, for the SA-PAC checklist, children among intervention schools reported having spent more time in vigorous PA minutes per day than control schools (58.6 minutes vs. 46.5 minutes, $P = 0.003$).

Later, McKenzie, et al. (2003) conducted a follow-up study (5 to 7 years post-intervention) of the main CATCH trial to assess sustainability of the PE component in former intervention/control schools through direct observation. This post intervention, follow-up study was entitled “CATCH-ON”. Researchers performed analyses of only the PE-related data that was collected in 56 former CATCH intervention schools, and 20 randomly selected (from 40) former control schools. The data had been obtained through systematic observations and the administration of questionnaires to school staff during the 1998-1999 school year. Overall, researchers found that results were similar across grades, and there were no significant changes from CATCH to CATCH-ON at any grade level in intervention schools for the three activity variables.

With the continuation of disseminating CATCH programming, Coleman, et al. (2005) evaluated CATCH curriculum in an El Paso community (El Paso CATCH) using

an untreated, matched control group design with repeated dependent pre-test and post-test samples. Participants included in the study were 896 third-grade children (473 students from control schools and 423 students from El Paso CATCH schools; although researchers reported that 152 students were lost to follow-up). The investigators used BMI, the 9-minute run test, and anthropometry measurements for health outcomes (e.g. overweight and obesity). The SOFIT instrument was also used for the assessment of PA in PE classes, and participating schools were observed for two days in two weeks per semester in a non-consecutive order (August-September in fall; April-May in spring) of the school year. In other words, there were a total of eight observation periods per year per school. Lastly, researchers assessed cafeteria meal quality by collecting school breakfast and lunch menus (including recipes) for five consecutive days during each semester in every year of the study. Follow-up was performed in 4th and 5th grade (only for aerobic fitness), and children were also measured in the 6th grade. Coleman and colleagues (2005) reported that girls in the control schools had an increase in health risk (e.g. overweight) from the 3rd (26%) to 5th (39%) grades, and so did girls in intervention schools (30%-32%). However, the increase in the intervention schools was significantly lower (2%) as compared to the control schools (13%). There was also an increase for boys in the intervention schools of 1% (40%-41%), and this was less than the 9% (40% to 49%) increase for boys among the control sites.

When the after-care program, CATCH Kids Club (CKC), was established in 2004, Kelder, et al. (2004) conducted a pilot study to examine the potential benefits of the program for elementary-school children (grades K-5). CKC was developed to offer an alternative to school-based health education through after-school child-care programs.

The CKC intervention was evaluated in 16 after-school programs in Texas, with 258 participants tested at baseline, and 182 evaluated at the time of post-test measurement. Measures used to assess the effectiveness of the program were the System for Observing Fitness Instruction Time (SOFIT), the After-School Student Questionnaire (ASSQ), and post-intervention focus groups with after-school staff. A modified version of the ASSQ was used prior to and after the intervention period to examine dietary intake for selected foods, healthy behaviours and nutrition knowledge, and food intentions. Reported findings from the ASSQ instrument showed that food knowledge was the only element to have had a significant increase after the intervention, and two other variables were approaching statistical significance (for increases in vegetable intake and eating fruit for lunch, $p < 0.10$). Investigators also found that post-test CKC intervention children increased their levels of MVPA (e.g. intervention 56.8% and control 31.3% at follow-up). In addition, a decrease in standing (-26% intervention effect, $p = 0.027$) and a non-statistically significant decrease in sitting (intervention effect -22%; $p = 0.125$) were reported. However, the CKC was also found to decrease the amount of unstructured free-play (by 64 minutes) while increasing game-play (by 30 minutes), which suggests that specific CATCH activities achieve increased PA through structured play.

Slusser, et al. (2013) also conducted a pilot study to measure the efficacy of the CKC intervention among 3rd and 5th graders residing in Los Angeles County, which is classified as the biggest county in the United States. The dietary intake, nutrition knowledge and PA of students were measured by employing a pretest-posttest quasi-experimental (comparison group) research design, among a convenience sample of eight after-school sites (e.g. four intervention and four control sites). Investigators collected

baseline data in September, and follow-up measures were completed at the end of the school year in June. There was a total sample of 121 students, 73 from intervention sites and 45 from control sites. Accordingly, a modified version of the CKC questionnaire was used to evaluate the impact of the program on students' PA knowledge, perceptions and behaviours. Further, the Day in the Life Questionnaire was employed to assess fruit, vegetable and snack food intake, and the Previous Day Physical Activity Recall (PDPAR) was used to measure PA patterns. Lastly, the BMI percentile (and associated BMI z-score) for each child was calculated. Findings revealed a statistically significant increase in children's nutrition knowledge over time ($p = 0.009$), and a decrease in junk food consumption ($p = .035$) between intervention and control sites. Intervention children consumed less junk food. Interestingly, researchers did note an increase in fruit juice consumption among intervention students, although consumption was less than that of the control students. Further, researchers reported a significant decrease in the percentage of students that were classified as overweight or obese in the intervention group as compared to the control group. Specifically, the percentage of overweight or obese children decreased by 3.1% (from 40.6% to 37.5%) in the intervention group, as opposed to 2.0% (from 46.7% to 44.7%) for the comparison group ($p = 0.000$). Lastly, there were no statistically significant differences reported between the intervention and comparison groups concerning PA and nutrition knowledge, attitudes, or behaviours.

In Canada, Sharpe, et al. (2011) conducted CKC program implementation in 330 after-school sites across Ontario, and that included approximately 8,000 children. This project was a large-scale, community agency-led initiative with overall intentions to increase health recognition and PA behaviours by using CKC as a multidimensional

health intervention. The CKC intervention was introduced in two separate agencies, the YMCA and Boys and Girls Club (BGC), through a phased implementation process; 76 sites adopted CKC in April 2008, 106 sites in September 2008, and 148 sites in December 2008 (280 sites were YMCA, and 50 were BGC). Similar to previous studies on CATCH and CKC, this study used a pretest/ post-test quasi-experimental comparative research design. Data was collected at 40 sites (22 YMCA and 6 BGC), and 12 separate YMCA comparison sites at baseline (September 2008) and post-intervention (May/June 2009). The measure used in this study was the SOFIT instrument in order to evaluate the PA levels of participants and lesson content quality. The findings showed that CKC implementation increased total time spent engaging in MVPA, with all post-intervention sites measuring above 50% of time spent in vigorous activity. Additionally, CKC sites reported significantly less free-play and increased game-play at post-intervention than at baseline.

Overall, research examining the implementation of the CATCH and CKC programs has been positive, and suggests that the related program developed for preschoolers (CEC) may also have positive health outcomes for this cohort.

2.4c CATCH Early Childhood (CEC)

CATCH Early Childhood (CEC), for preschool children (ages 3-5 years), is the newest component developed in association with the CATCH program. A team consisting of CATCH-curriculum experts, master trainers, and national and local preschool experts developed the CEC program (Sharma, et al. 2011). This program was modeled after the original CATCH to incorporate preschool-based PA, nutrition, and family components in a health promotion program aimed at young children (Sharma, et

al. 2011). The program was developed to coincide with early learning requirements and dietary and PA recommendations for preschoolers (see Sharma, et al. 2011), and program objectives are based on Social Cognitive Theory (SCT) (Bandura, 1986). SCT suggests that most health behaviours are social behaviours that are learned in a social context. Strategies from SCT used in developing program objectives and messages include: increasing behavioural capability (e.g. knowledge and skills), providing reinforcement of healthy eating and PA behaviours, and increasing self-efficacy and outcome expectations toward making healthy food- and behavioural choices through observational learning (CATCH, 2017). The program components include: (1) classroom curricula around nutrition (“It’s Fun to Be Healthy!”) consisting of “Good Food Kids” and “Garden Kids”. Good Food Kids contains nine interactive lessons aimed at promoting healthy eating habits (e.g. increased intake of fruit and vegetables), while Garden Kids has 10 lessons focused on educating children about the fundamentals of good gardening (e.g. how to produce and nurture nutritious foods); (2) structured physical activities (CEC Physical Activity Box) designed to promote motor development and increase PA levels, including MVPA. There are over 120, teacher-led physical activities that can be done indoors or outdoors, and adapted to meet the needs of children with physical disabilities; and (3) family education that includes nine “tip-sheets” for parents to help incorporate healthy nutrition and PA into home routines (CATCH, 2017).

The CEC program components and objectives (along with SCT constructs) are outlined in Sharma, et al. (2011) and are available for purchase for implementation through Flaghouse Inc. Nutrition lesson objectives seek to increase children’s knowledge of healthful food selections, values regarding health and nutrition, and self-efficacy

around food choice and preparation. For example, children are taught to identify “go” foods and refrain from “whoa” foods, and to understand the importance of eating healthy snacks as opposed to sugar-sweetened foods. PA lesson objectives target classroom management, prepare children for more vigorous exercise, and promote muscular strength and motor skills. Children are introduced to basic rules and expectations around activity, and led through “warm-up”, “go”, and “cool down” activities. Last, the parent tip sheets focus on positive eating and activity practices at home as implemented by parents. Objectives are to promote knowledge of daily recommendations for food group consumption (e.g. number of servings), and to understand the benefits of healthy foods and snacking habits to a child’s diet. Teacher training around these CEC objectives and the delivery of intervention content is considered integral to the success of the program (see Sharma, et al. 2011).

Preliminary studies of the CEC program are few, but positive (see CATCH PRE-K, 2016). Dunn-Carver and colleagues (2013) implemented the PA component of the program in four childcare centres (Vermont, USA) for 10 weeks. Evaluation results showed increases in total time spent in MVPA from baseline (34.5%) to follow-up (39.3%) for children in three of the four centres studied (although statistically non-significant). Likewise, Sharma, et al. (2011) evaluated the pilot implementation of CEC for low-income children in two Head Start centres (Texas, USA) for six weeks. Positive trends were found for fruit, 100% fruit juice and vegetable intake, and average minutes spent in PA. However, children were consuming more fruits and juice in comparison to vegetables at baseline and post-intervention (<20% of vegetables and >60% of fruits and juice served). Dietary intake was measured using direct observation; food on plates

(before, during and after eating meals) was recorded using coding sheets, and food leftover was recorded using measuring cups. Moreover, the PA component showed mixed results. At baseline, 72.1% of total time in active movement was spent in light PA, and 27.9% in moderate-to-vigorous physical activity (MVPA). Post-intervention, 84.9% of the active time was spent in light PA and 15.1% in MVPA. PA levels were measured using a modified version of the validated SOFIT instrument, SOFIT-P (System for Observing Fitness Instruction Time for Preschoolers), which measures PA levels, indoor and outdoor activity and type of PA through direct observation. The authors claimed that implementation of activities did not take place as planned (in explanation for the low MVPA levels), and hence children were exposed to less PA opportunities post-intervention. In addition the authors felt that seasonal variation restricted outdoor PA for children, and teachers were unaware that activities could be integrated indoors. Furthermore, participating centres did not have physical education time or gymnasium space.

A follow-up study currently “under review” on the implementation of CEC in the Texas Head Start sites (Sharma, et al. 2014) showed more promising results, particularly for MVPA. For example, a statistically significant increase in time spent in MVPA was found for the intervention group compared to the control group. In addition, consumption of fruits and vegetables increased (Sharma, et al. 2012), and overweight and obesity decreased (by 4%) for children in the intervention group; no corresponding change was observed for the control group. However, further studies need to confirm this pattern of results.

2.5 Study Rationale

While practitioners debate over the best way to promote the adoption and maintenance of healthy behaviours, the best solution will likely incorporate aspects of both healthful eating and regular PA. Likewise, parents influence healthy behaviours in children, and daycare environments can improve and support PA patterns and nutrition among early learning children. Specifically, since many children attend daycare, providers are well positioned to promote health. The CEC program is a promising intervention designed to encourage healthy PA and nutrition while incorporating parental and RECE educational materials. However, it is critical to evaluate any proposed interventions prior to adoption on a wider scale. In addition, while positive impacts have been associated with CEC, further studies are needed to clarify findings. Paradoxically, CEC was shown to decrease the amount of MVPA in preschool children (Sharma, et al. 2011), while the CATCH program was found to decrease unstructured free time while increasing game time in older children (Kelder, et al. 2004). While this had a positive effect in school-aged children, it may not be the desired outcome for preschool-aged children, and may also explain the decreases in MVPA for that age group in the Sharma, et al. (2011) study. Since free-play constitutes a large part of the PA accumulated by preschool-aged children, it is possible that CEC programming needs to be modified prior to implementation in this younger age group. Indeed, the Canadian Society for Exercise Physiology (CSEP) guidelines suggests that toddlers (aged 1-2 years) and preschoolers (aged 3-4 years) should accumulate, minimally, 180 minutes of PA at any intensity spread throughout the day, and incorporate a variety of activities in different environments, such as activities that develop movement skills, with the progression

towards at least 60 minutes of energetic play by 5 years of age. Scaling down the CATCH programming from school-aged children to preschool-aged children may require less active structured play via CEC programming, and the maintenance of existing free play opportunities.

2.6 Study Purpose

The purpose of the current study was to evaluate the impact of CEC implementation on young children's nutritional choices and PA behaviours. More specifically, this study sought to compare outcomes between two daycare centres: i) control centre; and ii) intervention centre, and to: (1) determine the amount and type(s) of food children consumed; (2) quantify food knowledge and healthy food choices; and (3) measure children's average, total daily step counts, and average daily step counts during outside play (all before and after implementation of the CEC program in the intervention group).

2.7 Hypotheses

- 1) Pre-intervention, there will be no difference in any of the measures between the control and intervention groups;
- 2) Post-intervention, food consumption of healthy foods, specifically fruits and vegetables will increase in the intervention group only;

- 3) Post-intervention, parents will report increased consumption of healthy foods, specifically fruit and vegetables on the NutriSTEP® parent perception questionnaire for the intervention group only;
- 4) Post intervention, children will be better able to distinguish the healthy and unhealthy foods and be more likely to select the healthy food item in the intervention group only;
- 5) Post intervention, children will be more active (increase in overall step counts) in both groups (due to aging/development); however this change would be enhanced in the intervention group.

2.8 References

Active for Life (2017). Early childhood centres: making physical literacy the norm. Retrieved from <http://activeforlife.com/early-childhood-physical-literacy-norm/>

Active Healthy Kids Canada, (2012). Is active play extinct? The active healthy kids Canada 2012 Report Card on Physical Activity for Children and Youth. Toronto, ON: Active Healthy Kids Canada.

Adamo, K.B., Barrowman, N., Naylor, P.J., Yaya, S., Harvey, A., et al. (2014). Activity begins in childhood (ABC) – Inspiring healthy active behaviour in preschoolers: Study protocol for a cluster randomized controlled trial. *Trials*, 15(305). Retrieved from <https://doi.org/10.1186/1745-6215-15-305>

Adolph, K. E. & Berger, S. A. (2006). Motor development. In W. Damon & R. Lerner (Series Eds.) & D. Kuhn & R. S. Siegler (Vol. Eds.), *Handbook of child psychology: Vol 2: Cognition, perception, and language* (6th ed.) New York: Wiley, pp. 161-213.

Allen, R. & Myers, A. (2006). Nutrition in toddlers. *American Family Physician*, 74(9), 1527-1532.

Anderson, L. (2008). Physical activity of preschool aged children in child care settings final report. Mount Royal College. Retrieved from www.mroyal.ca

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Retrieved from <http://psycnet.apa.org/psycinfo/1985-98423-000/>

Belanger, M., Humbert, L., Vatanparast, H., Ward, S., Muhajarine, N., et al. (2016). A multilevel intervention to increase physical activity and improve healthy eating and physical literacy among young children (ages 3-5) attending early childcare centres: the Healthy Start-Départ Santé cluster randomised controlled trial study protocol. *BMC Public Health*, 16(313). Retrieved from <https://doi.org/10.1186/s12889-016-2973-5>

Benham-Deal, T. (2005). Preschools children's accumulated and sustained physical activity. *Perceptual and Motor Skills*, 100, 443-450.

Best Start Expert Panel on Early Learning. (2007). Early learning for every child today: A framework for Ontario early childhood settings. Retrieved from <http://www.edu.gov.on.ca/childcare/oelf/continuum/continuum.pdf>

Birch, L.L. (1980). Effects of peer models' food choices and eating behaviors on preschoolers' food preferences. *Child Development*, 51(2), 489-496.

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

- Birch, L.L., & Ventura, A.K. (2009). Preventing childhood obesity: what works? *International Journal of Obesity*, 33, S74-S81. doi: 1038/ijo.2009.22
- Boonpleng, W., Park, C.G., Gallo, & A.M. (2012). Timing of adiposity rebound: A step toward preventing obesity. *Pediatric Nursing*, 38(1), 37-42.
- Brockman, R., Jago, R., & Fox, K. R. (2010). The contribution of active play to the physical activity of primary school children. *Preventive Medicine*, 51(2), 144–147. doi:10.1016/j.ypmed.2010.05.012.
- Bromfield, P.V. (2009). Childhood obesity: psychosocial outcomes and the role of weight bias and stigma. *Educational Psychology in Practice*, 25(3), 193-209. <http://dx.doi.org/10.1080/02667360903151759>
- Bronfenbrenner, U. (1994). Ecological models of human development. *International Encyclopaedia of Education*, 3(2), 1643-1647.
- Brown, W.H., Pfeiffer, K.A., McIver, K.L., Dowda, M., Addy, C.L., & Pate, R.R. (2009). Social and environmental factors associated with preschoolers' non-sedentary physical activity. *Society for Research in Child Development*, 80(1), 45-58. doi:10.1111/j.1467-8624.2008.01245.x
- Brug, J., Tak, N., te Velde, S.J., Bere, E., de Burdeaudhuij, I. (2008). Taste preferences, liking and other factors related to fruit and vegetable intakes among schoolchildren: results from observational studies. *British Journal of Nutrition*, 1, S7-S14. doi:10.1017/S0007114508892458
- Burdette, H.L., Whitaker, R.C., & Daniels, S.R. (2004). Parental report of outdoor playtime as a measure of physical activity in preschool-aged Children. *American Medical Association*, 158, 353-357.
- Button, B., Trites, S, & Janssen, I. (2013) Relations between the school physical environment and school social capital with student physical activity levels. *BMC Public Health*, 13(1191).
- Campbell, K., & Crawford, D. (2001). Family food environments as determinants of preschool-aged children's eating behaviours: implications for obesity prevention policy. A review. *Australian Journal of Nutrition and Dietetics*, 58(1), 19-25.
- Canadian Paediatric Society, (2015). Vitamin D supplementation: Recommendations for Canadian mothers and infants. Retrieved from <http://www.cps.ca/documents/position/vitamin-d>

Carson, V., Tremblay, M.S., Spence, J.C., Timmons, B.W., & Janssen, I. (2013). The Canadian Sedentary Behaviour Guidelines for the Early Years (zero to four years of age) and screen time among children from Kingston, Ontario. *Paediatr Child Health*, 8(1).

CATCH, (2017). PRE-K. Retrieved from <https://catchinfo.org/programs/pre-k/>

CATCH, (2017). The CDC Model. Retrieved from <https://catchinfo.org/research/the-cdc-model/>

Centers for Disease Control and Prevention, (2015). Adolescent and school health: coordinated school health (CSH). Retrieved from <http://www.cdc.gov/healthyyouth/cshp/>

Centers for Disease Control and Prevention, (2015). Adolescent school health: whole school, whole community, whole child (WSCC). Retrieved from <https://www.cdc.gov/healthyyouth/wsc/index.htm>

Centers for Disease Control and Prevention, (2016). Defining childhood obesity. Retrieved from <https://www.cdc.gov/obesity/childhood/defining.html>

Center on the Developing Child at Harvard University, (2010). The foundations of lifelong health are built in early childhood. Retrieved from <http://www.developingchild.harvard.edu>

Childcare Resource and Research Unit, (2013). Physical activity in Canadian early childhood education and care. Retrieved from <http://www.childcarecanada.org/resources/issue-files/physical-activity-canadian-early-childhood-education-and-care>

Chinn, S., & Rona, R.J. (2009). International definitions of overweight and obesity for children: a lasting solution? *Ann Hum Biol*, 29, 3, 306-3013. Retrieved from <https://doi.org/10.1080/03014460110085340>

Chow, B.C., McKenzie, T.L., & Louie, L. (2015). Children's physical activity and associated variables during preschool physical education. *Advances in Physical Education*, 5, 39-49. Retrieved from <http://dx.doi.org/10.4236/ape.2015.51005>

Coleman, K.J., Tiller, C.L. Sanchez, J., Heath, A.M., Sy O., Milliken, G., et al. (2005). Prevention of the epidemic increase in child risk of overweight in low-income schools: The El Paso coordinated approach to child health. *Arch Pediatr Adolesc Med*, 159(3), 217-224. doi:10.1001/archpedi.159.3.217

College of Early Childhood Educators, (2017). Retrieved from <https://www.college-ecce.ca/en>

- Colley, R.C., Janssen, I., & Tremblay, M.S. (2012). Daily step target to measure adherence to physical activity guidelines in children. *American College of Sports Medicine*, 977-982. doi: 10.1249/MSS.0b013e31823f23b1
- Cooke, L. (2007). The importance of exposure for healthy eating in childhood: A review. *Journal of Human Nutrition and Dietetics*, 20(4), 294-301. doi: 10.1111/j.1365-277X.2007.00804.x
- Copeland, K.A., Kendeigh, C.A, Saelens, B.E., Kalkwarf, H.J., & Sherman, S.N. (2012). Physical activity in child-care centers: do teachers hold the key to the playground? *Oxford University Press*, 27(1), 81-100.
- Darling, N. (2007). Ecological Systems Theory: The Person in the centre of the circles. *Research in Human Development*, 4, 203-217. doi:10.1080/15427600701663023
- Daniels, R.S. (2006). The consequences of childhood overweight and obesity. *The future of Children*, 16(1), 47-67. doi:10.1353/foc.2006.0004
- DeMarco, A.C., Zeisel, S., & Odom, S. L. (2015). An evaluation of a program to increase physical activity for young children in child care. *Early Education and Development*, 26(1), 1-21. doi: 10.1080/10409289.2014.932237
- de Onis, M., Blössner, M., & Borghi, E. (2010). Global prevalence and trends of overweight and obesity among preschool children. *Am J Clin Nutr*, 92, 1257–1264.
- Drewnowski, A., Mennella, J.A., Johnson, S.L., Bellisle, F. (2012). Sweetness and food preference. *J. Nutr*, 142, 1142S–1148S. doi:10.3945/jn.111.149575
- De Schipper, E. J., Marianne Riksen-Walraven, J. & Geurts, S. A. E. (2006). Effects of child-caregiver ratio on the interactions between caregivers and children in child-care centers: An experimental study. *Child Development*, 77, 861–874. doi:10.1111/j.1467-8624.2006.00907.x
- Dovey, T.M., Staples, P.A., Gibson, E.L., & Halford, J.C. (2008). Food neophobia and ‘picky/fussy’ eating in children: a review. *Appetite*, 50, 181–193.
- Dunn-Carver, M., Pope, L., Dana, G., Dorwaldt A., Flynn, B., Bunn, J., & Harvey-Berino J. (2013). Evaluation of a teacher-led physical activity curriculum to increase preschooler physical activity. *Open Journal of Preventive Medicine*, 3(1), 141-147.
- Dunn, C., Thomas, C., Ward, D., Pegram, L., Webber, K., et al. (2006). Design and implementation of a nutrition and physical activity curriculum for child care settings. *Preventing Chronic Disease*, 3(2), A58.

Edmundson, E., Parcel, G.S., Perry, C.L., Feldmen, H.A., Smyth, M., et al. (1996). The effects of the child and adolescent trial for cardiovascular health and intervention on psychosocial determinants of cardiovascular disease risk behavior among third-grade students. *American Journal of Health Promotion*, 10(3), 217-25.

Farfan-Ramirez, L., Diemoz, L., Gong, E.J., & Lagura, M.A. (2011). Curriculum intervention in preschool children: Nutrition Matters! *Journal of Nutrition Education Behaviour*, 43, S162-S165. doi:10.1016/j.jneb.2011.03.007

Fitzgibbon, M.L., Stolley, M.R., Dyer, A.R., VanHorn, L., & Kaufer Christoffel, K. (2002). A community-based obesity prevention program for minority children: Rationale and study design for hip-hop to health Jr. *Preventive Medicine*, 34, 289–297. doi:10.1006/pmed.2001.0977

Fitzgibbon, M.L., Stolley, M.R., Schiffer, L., VanHorn, L., Kaufer Christoffel, K., & Dyer, Allan. (2005). Two-year follow-up results for hip-hop to health Jr.: A randomized controlled trial for overnight prevention in preschool minority children. *Journal of Pediatrics*, 146(5), 618-25. doi:10.1016/j.jpeds.2004.12.019

Fox, M. K., Pac, S., Devaney, B., & Jankowski, L. (2004). Feeding infants and toddlers study: What foods are infants and toddlers eating? *Journal of the American Dietetic Association*, 104(1), S22-S30. doi: 10.1016/j.jada.2003.10.026

Fuller, C., Keller, L., Olson, J., & Plymale, A. (2005). Helping preschoolers become healthy eaters. *Journal of Pediatric Health Care*, 19(3), 178-182. doi:10.1016/j.pedhc.2005.03.007.

Fung, C., Kuhle, S., Lu, C., Purcell, M. Schwarts, M., et al. (2012). From "best practice" to "next practice": the effectiveness of school-based health promotion in improving healthy eating and physical activity and preventing childhood obesity. *International Journal of Behavioral Nutrition and Physical Activity*, 9, 27. <https://doi.org/10.1186/1479-5868-9-27>

Gabel, L., Proudfoot, N. A., Obeid, J., Macdonald M.J., Bray, S.R., et al. (2012). Step count targets corresponding to new physical activity guidelines for the early years. *American College of Sports Medicine*, 314-318. doi: 10.1249/MSS.0b013e318271765a

Galland, B.C., & Mitchell, E.A. (2010). Helping children sleep. *Arch Dis Child*, 95, 850-853. doi:85010.1136/adc.2009.162974

Galvan, M., Uauy, R., Corvalan, C., Lopez-Rodriguez, G., & Kain, J. (2013). Determinants of cognitive development of low SES children in Chile: A post-transitional country with rising childhood. *Maternal Child Health J*, 17, 1243–1251. doi:10.1007/s10995-012-1121-9

Godel, J.C. (2007). Vitamin D supplementation: Recommendations for Canadian mothers and infants. *Paediatric Child Health*, 12(7), 583-9. Reaffirmed: Jan 30 2015.

Goldfiled, 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.
doi:10.3390/ijerph9041326

Gonzalez-Suarez, C., Worley, A., Grimmer-Somers, K., & Dones, V. (2009). School-based interventions on childhood obesity: A meta-analysis. *American Journal of Preventive Medicine*, 37(5) doi:10.1016/j.amepre.2009.07.012

Gordon, C., Forer, B., Hyatt, D., Japel, C., & Krashinsky, M. (2008). New evidence about child care in Canada: Use patterns, affordability and quality. *IRPP Choices*, 14(12).

Gordon, E.S., Tucker, P., Burke, S.M. & Carron, A.V. (2013). Effectiveness of physical activity interventions for preschoolers: A meta-analysis. *Research Quarterly for Exercise and Sport*, 84(3), 287-294. doi: 10.1080/02701367.2013.813894

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, 2161-2175. doi:10.3390/nu7042161

Health Canada, (2017). Food and nutrition: Canada's food guide. Retrieved from <http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/order-commander/index-eng.php#3>

Health Canada, (2015). Nutrition for health term infants: Recommendations from birth to six months. Retrieved from <http://www.hc-sc.gc.ca/fn-an/nutrition/infant-nourisson/recom/index-eng.php>

Health Canada, (2012). Food and Nutrition: Do Canadian children meet their nutrient requirements through food intake alone? Retrieved from <http://www.hc-sc.gc.ca/fn-an/surveill/nutrition/commun/art-nutr-child-enf-eng.php#a7>

Hesketh, K.D., & Campbell, K.J. (2010). Intervention to prevent obesity in 0-5 year olds: An updated systematic review of the literature. *Childhood Obesity*, 18(1), S27-S35. doi:10.1038/oby.2009.429

Hoelscher, D.M., Springer, A.E., Ranjit, N., Perry, C.L., Evans, A.E., et al. (2010). Reductions in child obesity among disadvantaged school children with community involvement: the Travis County CATCH Trial. *Obesity*, 18(S1), S36-S44. doi: 10.1038/oby.2009.430

International Child Development Initiatives and Bernard Van Leer Foundation, (2012). Parental Involvement In Early Learning: A review of research, policy and good practice.

Retrieved from <http://icdi.nl/media/uploads/publications/parental-involvement-in-early-learning.pdf>

Janssen, I. (2014). Active play: An important physical activity strategy in the fight against obesity. *Canadian Public Health Challenge*, 105(1), e22-e27.

Janssen, I., & LeBlanc, A.G. (2012). 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, 40. <https://doi.org/10.1186/1479-5868-7-40>

Kelder, S., Hoelscher, D.M, Barroso, C.S., Walker, J.L., Cribb, P, et al. (2004). The CATCH Kids Club: a pilot after-school study for improving elementary students' nutrition and physical activity. *Public Health Nutrition*, 8(2), 133-140.

Kottelenberg, M.J., & Lehrer S.F. (2013). New evidence on the impacts of access to and attending universal child-care in Canada. *Canadian Public Policy*, 39(2), 263-286. Retrieved from <https://doi.org/10.3138/CP.39.2.263>

Ling, J., Robbins, L.B., & Wenc, F. (2016). Interventions to prevent and manage overweight or obesity in preschool children: A systematic review. *International Journal of Nursing Studies*, 53, 270-289. Retrieved from <http://dx.doi.org/10.1016/j.ijnurstu.2015.10.017>

Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: a crisis in public health. *Obesity Reviews*, 5(1), 4-85.

Luepker, R.V., Perry, C.L., McKinlay, S.M., Nader, P.R., Parcel, G.S., et al. (1996). Outcomes of a field trial to improve children's dietary patterns and physical activity: The child and adolescent trial for cardiovascular health (CATCH). *Children's Diet and Physical Activity*, 275(10), 768-776. doi: 10.1079/PHN2004678

Lyn, R., Evers, S., Davis, J., Maalouf, J., & Griffin, M. (2014). Barriers and supports to implementing a nutrition and physical activity intervention in child care: Directors' perspectives. *Journal of Nutrition Education Behaviour*, 46(3), 171-180.

Marchand, V. (2010). Promoting optimal monitoring of child growth in Canada: Using the new World Health Organization growth charts. *Paediatric Child Health*, 15(2), 77-9, Reaffirmed: 2016.

McKenzie, T.L., Nader, P.R., Strikmiller, P., Yang, M., Stone, E., et al. (1996). School physical education: Effect of the child and adolescent trial for cardiovascular health. *Preventive Medicine*, 25, 423-431. doi:10.1006/pmed.1996.0074

- McKenzie, T.L., Li, D., Derby, C., Webber, L.S., Luepker, R.V., et al. (2003). Maintenance of effects of the CATCH physical education program: Results from the CATCH-ON study. *Health Education and Behavior*, 30, 447-462.
- Nader, P.R., Stone, E.J., Lytle, L.A., Perry, C.L., Osganian, S.K., et al. (1999). Three-year maintenance of improved diet and physical activity: the CATCH cohort. Child and adolescent trial for cardiovascular health. *Archives Pediatric Adolescence Med*, 153, 695-70.
- Natale, R.A., Messiah, S.E., Asfour, L., Uhlhorn, S.B., Delamater, A., et al. (2014). Role modeling as an early childhood obesity prevention strategy: Effect of parents and teachers on preschool children's healthy lifestyle habits. *Journal of Developmental Behavioural Pediatrics*, 35, 378-387.
- Nicklas, T.A., Baranowski, T., Baranowski, J.C., Cullen, K., Rittenberry, L., et al. (2001). Family and child-care provider influences on preschool children's fruit, juice, and vegetable consumption. *Nutrition Reviews*, 59(7), 224-235. Retrieved from doi:<http://dx.doi.org/10.1111/j.1753-4887.2001.tb07014.x>
- Nuttall, F.Q. (2015). Body Mass Index: Obesity, BMI, and health: A critical review. *Nutrition Today*, 50:3, 117-128. doi: 10.1097/NT.0000000000000092
- Obeid, J., Nguyen, T., Gabel, L., & Timmons, B.W. (2011). Physical activity in Ontario preschoolers: prevalence and measurement issues. *Applied Physiology, Nutrition, and Metabolism*, 36(2), 291-297.
- O'Dwyer, M.V., Fairclough, S. J., Ridgers, N. D., Knowles, Z. R., Fowweather, L., et al. (2013). Effect of a school-based active play intervention on sedentary time and physical activity in preschool children. *Oxford University Press*, 28(6), 931-942.
- ParticipACTION, (2016). Are Canadian kids too tired to move? The 2016 ParticipACTION report card on physical activity for children and youth. Toronto. Retrieved from <https://www.participaction.com/en-ca/thought-leadership/report-card/2016>
- Paquette, D., & Ryan, J. (2001). Bronfenbrenners Ecological Systems Theory. Retrieved from http://www.floridahealth.gov/AlternateSites/CMS-Kids/providers/early_steps/training/documents/bronfenbrenners_ecological.pdf
- Perry, C.L., Stone, E.J., Parcel, G.S., Ellison, R.C., Nader, P.R., et al. (1990). School-based cardiovascular health promotion: the child and adolescent trial for cardiovascular health (CATCH). *Journal of School Health*, 60(8), 406-13.

- Peters, J., Sinna, N., Campbell, K., & Lynch, J. (2012). Parental influences on the diets of 2–5-year-old children: systematic review of interventions. *Early Child Development and Care*, 182(7), 837-857. doi: 10.1080/03004430.2011.586698
- Philips, D., & Lowenstein, A.E. (2011). Early Care, Education, and child Development. *Annual Reviews Psychology*, 62, 483-500. doi: 10.1146/annurev.psych.031809.130707.
- Prado, E., & Dewey, K. (2012). Nutrition and brain development in early life. *Alive & Thrive Technical Brief Issue 4*.
- Public Health Agency of Canada, (2016). Childhood obesity. Retrieved from <https://www.canada.ca/en/public-health/services/health-promotion/healthy-living/curbing-childhood-obesity-federal-provincial-territorial-framework/childhood-obesity.html>
- Public Health Agency of Canada, (2011). Physical activity. Retrieved from <https://www.canada.ca/en/public-health/services/health-promotion/healthy-living/physical-activity.html>
- Queens Printer for Ontario, (2017). Child care and early years act, 2014, S.O. 2014, c. 11, Sched. Retrieved from <https://www.ontario.ca/laws/statute/14c11?search=child+care+and+early+years+act#top>
- Queen’s Printer for Ontario, (2014). Excerpts from “ELECT”: A framework for Ontario early childhood settings. Retrieved from <http://www.edu.gov.on.ca/childcare/ExcerptsFromELECT.pdf>
- Rentzou, K., & Sakellariou, M. (2011). The quality of early childhood educators: Children’s interaction in Greek child care centers. *Early Childhood Education Journal*, 38:367–376. doi:10.1007/s10643-010-0403-3.
- Rolland-Cachera, M.F., Deheeger, M., Maillot, M., & Bellisle, F. (2006). Early adiposity rebound: causes and consequences for obesity in children and adults. *International Journal of Obesity*, 30, S11-S17. doi:10.1038/sj.ijo.0803514
- Rolland-Cachera, M.F., Deheeger, M., Bellisle F., Sempe, M., Guilloud-Bataille, M., et al. (1984). Adiposity rebound in children: a simple indicator for predicting obesity. *American Journal of Clinical Nutrition*, 39, 129–135.
- Rosales, F.J., Reznick, S.J., & Zeisel, S.H. (2009). Understanding the role of nutrition in the brain & behavioral development of toddlers and preschool children: Identifying and overcoming methodological barriers. *Nutritional Neuroscience*, 12(5), 190-202. doi:10.1179/147683009X423454

Savage, J.S., Fisher, J.O., & Birch, L.L. (2007). Parental influence on eating behavior: Conception to adolescence. *J Law Med Ethics*, 35(1), 22–34. doi:10.1111/j.1748-720X.2007.00111.x

Scaglioni, S., Arrizza, C., Vecchi, F., & Tedeschi, S. (2011). Determinants of children's eating behaviors. *American Journal of Clinical Nutrition*, 94, 2006S–11S.

Shaeffer, C. (2007). A study of the influences of nutrition, physical activity, income, and family lifestyle choices on the overweight of elementary-age children (Doctoral Dissertation). Retrieved from Social Sciences databases (UMI No. 3259721)

Sharpe, E.K., Forrester, S., & Mandigo, J. (2011). Engaging community providers to create more active after-school environments: results from the Ontario CATCH Kids Club Implementation Project. *Journal of Physical Activity and Health*, 8(1), S26-S31.

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, 796–807. doi: 10.1016/j.appet.2011.05.316

Sharma, S., Chuang, R.J., & Hedberg, A.M. (2011). Pilot-testing CATCH early childhood: A preschool-based healthy nutrition and physical activity program. *American Journal of Health Education*, 42(1), 12-23.

Sharma, S.V., Chuang, R., & Rahman, G. (2012). Results of pilot testing CATCH early childhood in Head Start preschoolers in Texas international [abstract]. In: Society for Behavioral Nutrition and Physical Activity (ISBPA). *Poster Sessions*. SES Influence on and Physical Activity. P.159

Sharma, et al. (2014). The CATCH early childhood program increases moderate-to-vigorous physical activity among low-income preschoolers: results from a pilot study. *Under Review*.

Sinha, M. (2014). Spotlight on Canadians: Results from the general social survey. Child care in Canada. *Statistics Canada*, Catalogue no. 89-652-X — No. 005 ISBN 978-1-100-24896-7.

Singh, A.S., Mulder, C., Twisk, J.W., van Mechelen, W., & Chinapaw, M.J. (2008). Tracking of childhood overweight into adulthood: A systematic review of the literature. *Obes Rev*, 9, 474–488.

Slusser, W.M, Sharif, M.A.Z., Erausquin, J.T, Kinsler, J.J., Collin, D., et al. (2013). Improving overweight among at-risk minority youth: results of a pilot intervention in after-school programs. *J Health Care for the Poor and Underserved*, 24(2), 12-24.

Soini, A., Villberg, J., Saakslähti, A., Gubbels, J., Mehtala, A., et al. (2014). Directly observed physical activity among 3-year-olds in Finnish childcare. *Springer*, 46, 253–269.

Spurrier, N.J., Magarey, A.A., Golley, R., Curnow, F., & Sawyer M.G. (2008). Relationships between the home environment and physical activity and dietary patterns of preschool children: a cross-sectional study. *International Journal of Behavioral Nutritional and Physical Activity*, 5, 31. doi:10.1186/1479-5868-5-31

Srdić, B., Obradović, B., Dimitrić, G., Stokić, E., & Babović. S.S. (2012). Relationship between body mass index and body fat in children—age and gender differences. *Obesity Research & Clinical Practice*, 6, e167-e173.

Statistics Canada, 2017. Women and paid work. Retrieved from <http://www.statcan.gc.ca/pub/89-503-x/2015001/article/14694-eng.htm>

Taras, H. 2005. Nutrition and student performance at school. *Journal of School Health*, 75(6), 199-213.

Taylor, L.J., Gallagher, M., & McCullough, F.S.W. (2004). The role of parental influence and additional factors in the determination of food choices for pre-school children. *International Journal of Consumer Studies*, 28(4), 337-346.

Temple, V.A., Naylor, P-J., Rhodes, R.E., & Higgins, J.W. (2009). Physical activity of children in family childcare. *Applied. Physiology Nutrition and Metabolism*, 34, 794–798. doi:10.1139/H09-061

Timmons, B.W., Leblanc, A.G., Carson, V., Gorber, S.C., Dillman, C., et al. (2012). Systematic review of physical activity and health in the early years (aged 0–4 years). *NRC Research Press*, 37, 773–792.

Timmons, B.W., Patti-Jean, T., & Pfeiffer, K. A. (2007). Physical activity for preschool children – how much and how? *Applied Physiology Nutrition and Metabolism*. 32, S122–S134. doi:10.1139/H07-112

Tremblay, L, Boudreau-Lariviere, C., & Cimon-Lambert, K. (2012). Promoting physical activity in preschoolers: A review of the guidelines, barriers, and facilitators for implementation of policies and practices. *Canadian Psychology*, 53(4), 280-290. doi: 10.1037/a0030210

Tremblay, M.S., LeBlanc, A.G., Carson, V., Choquette, L., Gorber, S.C., et al. (2012). Canadian physical activity guidelines for the early years (aged 0-4 years). *Applied Physiology Nutrition and Metabolism*, 37, 345–356. doi:10.1139/H2012-018

True Sport, (2016). Active healthy kids Canada. Retrieved from <http://truesportpur.ca/active-healthy-kids-canada>

Tucker, P. (2008). The physical activity levels of preschool-aged children: A systematic review. *Early Childhood Research Quarterly*, 23, 547-558. doi:10.1016/j.ecresq.2008.08.005

Ungar, M. (2015), Practitioner Review: Diagnosing childhood resilience – a systemic approach to the diagnosis of adaptation in adverse social and physical ecologies. *Journal Child Psychology Psychiatry*, 56, 4–17. doi:10.1111/jcpp.12306

UNESCO. (2017). Early Childhood Care and Education. Retrieved from <http://en.unesco.org/themes/early-childhood-care-and-education>

Vander Ploeg, K.A., Maximova, K., McGavock, J., Davis, W., & Veugelers, P. (2014). Do school-based physical activity interventions increase or reduce inequalities in health? *Social Science & Medicine*, 112, 80-87.

Van Zandvoort, M., Tucker, M., Irwin, J.D., & Burke, S.M. (2010). Physical activity at daycare: issues, challenges and perspectives. *Early years*, 30(2), 175-188. Retrieved from <http://dx.doi.org/10.1080/09575141003667282>

Ward, D.S. (2010). Physical activity in young children: The role of child care. *Medicine & Science in Sports & Exercise*, 42(3), 499-501.

Whitaker, R.C., Pepe, M.S., Wright, J.A., Seidel, K.D., & Dietz, W.H. (1998). Early adiposity rebound and the risk of adult obesity. *Pediatrics*, 101(3), 1-6.

Whitaker, R.C., Wright, J.A., Pepe, M.S., Seidel, K.D., & Dietz, W.H. (1997). Predicting obesity in young adulthood from childhood to parental obesity. *New England Journal of Medicine*, 337(13), 869-73. doi:10.1056/NEJM199709253371301

WHO, 2017. Child growth standards: The WHO child growth standards. Retrieved from <http://www.who.int/childgrowth/standards/en/>

WHO, 2017. Child growth standards: The WHO child growth standards: Methods and development. Retrieved from http://www.who.int/childgrowth/standards/technical_report/en/

WHO, 2017. Global strategy on diet, physical activity and health: Childhood obesity and overweight. Retrieved from <http://www.who.int/dietphysicalactivity/childhood/en/>

WHO, 2017. Global strategy on diet, physical activity and health: What is overweight and obesity? Retrieved from http://www.who.int/dietphysicalactivity/childhood_what/en/

WHO, 2017. Global strategy on diet, physical activity and health: What is moderate-intensity and vigorous-intensity physical activity? Retrieved from http://www.who.int/dietphysicalactivity/physical_activity_intensity/en/

WHO, (2017). Global strategy on diet, physical activity and health: Physical activity and young people. Retrieved from http://www.who.int/dietphysicalactivity/factsheet_young_people/en/

WHO, 2017. Health topics: Physical activity. Retrieved from http://www.who.int/topics/physical_activity/en/

Wind, M., de Bourdeaudhuij, I., te Velde, S.J., Sandvik, C., Due, P., et al. (2006). Correlated of fruit and vegetable consumption among 11-year-old Belgian-Flemish and Dutch schoolchildren. *Journal of Nutrition Education Behaviour*, 38(4), 211-21. doi:10.1016/j.pmedr.2017.05.011

Wilson, K. (2013). What is the importance of good nutrition for kids? Healthy eating by Demand Media. Retrieved from <http://healthyeating.sfgate.com/importance-good-nutrition-kids-6236.html>

3.0 Chapter 3:

METHODS

3.1 Participants

A convenience sample of children and their families from two daycare centres in the same urban, geographic area within a Canadian context was obtained. The geographic area was chosen based on accessibility: both daycare centres (intervention and control) were within walking distance from each other, and served predominantly middle- to upper-income families. A total of 51 children (30 males and 21 females) and their parents were recruited. During pre-intervention data collection, children ranged in age from 1.13 to 3.75 years. Although the CEC program was designed for children aged 3-5 years, we decided to include toddlers (18 months – 2.5 years) in this study in order to increase sample size. Within the sample, 30 out of 34 potential children comprised the intervention group, and 21 out of a potential 22, the control group. There was a 91% response rate for participation.

During post-measurement, 37 children (21 males and 16 females) ranging in age from 1.71 to 4.32 years participated (pooled sample). Within the sample, 22 children comprised the intervention group, and 15, the control group. There were 14 participants lost at follow-up due to moving out of the catchment area, illness, and family vacations and/or because they no longer attended the Centres. The children's birthdays were obtained from parents to provide accurate age groupings. No child was excluded for any reason except lack of parental/guardian consent. Time was also allocated before data collection for parents to ask questions or raise concerns regarding the study. An identification number was then assigned to each child (and parent) to ensure the

confidentiality of responses. The data were kept separate from any personal information gathered and could only be linked through the use of the identification numbers.

Parental/guardian consent was obtained for all participants and the Institutional Ethics Board approved this study (see Appendix A).

3.2 Study Design

Two daycares participated in this study. One daycare served as the CEC program intervention group (n=30), the other the control group (n=21). Measures were collected over five days at two times: before (Time 1) and after (Time 2) the CEC program intervention. Following the baseline testing, the CEC program was introduced to the intervention daycare, following a full-day training session for all RECEs and Centre Directors. The control daycare followed its regular programming; measures were collected in parallel with those of the intervention group at Time 1 (October, 2014) and Time 2 (May, 2015). The research team sought to collect data in the fall and spring to avoid potential impact of seasonal variation (e.g. winter months) that has confounded previous studies (Sharma, et al. 2011). This six-month time period has been used in other studies that have evaluated the CATCH program (e.g. Kelder, et al. 2004).

3.3 Procedure

Four measures were collected during the five-day, pre- and post-data collection periods.

First, for each day (Monday through Friday), food items were digitally photographed to assess dietary intake and portion sizes. The two daycare centres in this

study operated on a four-week rotation of meals, which allowed the research team to return for post-data collection on a week that had the same meal plan. Each daycare centre also had cooks who prepared snacks and lunch throughout the day. The model used is family-style serving, in which the RECE staff served the children from a communal bowl. However, no standards were in place regarding portion sizes, which may lead to variability in the size of the portions being served. On rare occasions the children served themselves. The availability of second servings and the types of food being offered are determined by the on-going operations of the daycare centres. In the current study, the children were not aware of whether or not second servings would be available on any given day.

To examine the types of foods that were provided and consumed, foods were categorized into food groups aligned with Eating Well with Canada's Food Guide (Health Canada, 2017). As children were originally assigned an identification number prior to the study period, labels were also created and placed (sticker) on the table where the participants sat and ate their meals. Consequently, the number on the label matched the identification number assigned to each participant. Additional labels identified the day of the week (e.g. Monday), serving amounts (e.g. first, second or third serving), and food items remaining (e.g. food served to the children which they did not eat). The amount and type of food served to each child at snacks and lunch were photographed with the labels, after serving and after eating (e.g. food left over). Researchers also accounted for second or third servings, and plate waste from subsequent servings.

Photos of food items were captured three times a day: at morning snack (between 8:30-9:00am), lunch (between 11:30-12:00pm) and afternoon snack (between 3:30-

4:00pm). Prior to each meal, the research team told participants that pictures of the food on their plates would be taken, and researchers photographed the food served to each participant. A second photo captured any leftover foods. After capturing food items, the photos were uploaded to a password-protected computer and saved on a hard drive. Photographs were later visually assessed to determine how much and which types of food (as outlined by Eating Well with Canada's Food Guide, Health Canada, 2017) were consumed. Nasco Food Replicas were used as a guide during the assessment; these are realistic replicas modelled after real foods, and a substitute to demonstrate actual food items (Nasco, 2017). The daycare menus were used as a complimentary guide to food intake data in order to add more thoroughness to the assessment. The number of food servings (food consumed) was derived from the recommended number of food guide servings for children aged 2-3 and 4-8 years, and the reference amount of one food guide serving, e.g. portion (millimetres or grams) for each type of food.

Second, parents were provided with the appropriate NutriSTEP® questionnaire for their child's age (e.g. either the version for preschoolers, or the version for toddlers) during both the pre- and post-data collection. Parents had the option to take the questionnaire home with them to complete. Once the NutriSTEP® questionnaire was completed, parents returned it to the researchers at the daycare centres. This questionnaire was used as a secondary method to assess dietary intake and serving amounts (the first being the food photographs).

Third, children were guided through the Preschool Snack Selection Instrument (PSS) via interviews held on one of the five days during both the pre- and post-data collection. This survey was used to assess children's understanding of healthy and

unhealthy food choices. Children were individually interviewed in their respective classrooms, in a quiet spot away from their peers to avoid distractions and input from other children. The researcher began the survey by reading the definitions for “healthy” and “unhealthy” foods. After the definitions were read, the researcher proceeded to the first section of the survey. The child was shown photos of foods, alone and in pairs, and in three sections of questions: 1) for each of the 18 food items (9 healthy and 9 unhealthy) shown, the researcher asked: “What is this food?” and then recorded the answer provided by the child. If the child did not identify the food at all, or identified the food incorrectly, the researcher provided the child with the correct answer; 2) the children were then shown 9 pairings of food; each pair had one healthy and one non-healthy food choice, and children were asked: “If you could choose a snack from this pair, would you choose A (e.g. chocolate) or B (e.g. broccoli)?” This question was repeated for each food pair. To prevent any potential patterns, such as the healthy food always being presented on the same side, the healthy and unhealthy foods were randomly alternated from left and right. The child was instructed that they could either verbalize their response or point to the corresponding food item. The children were not provided feedback about their choices; 3) lastly, the child was told to “Point to the healthy food choice – that is, the food that helps keep your heart, muscles, and bones strong.” This was repeated for the same nine pairs that were previously presented. The children were not provided with feedback about their choices.

Fourth, children were asked to wear the Yamax SW-200 electronic pedometer device all day for five consecutive days during both the pre- and post-data collections. All children in this study were ambulatory. Upon arrival to the daycare, pedometers were

reset to zero and attached to the child's waistband on the right hip. If a participant was wearing incompatible clothing (e.g. dress without a waistband), pedometers were not attached for that day.

Attached to the pedometer was a leash with a metal clamp, which secured the pedometer if it fell off the waistband of the child during play. Pedometers were also taped shut to prevent children from pressing the reset button of the pedometer. Research supports site placement either on the right or left hip, rather than at the small of the child's back (Oliver, et al. 2007).

Step counts were then logged at 9:00am, before and after outside play, before naptime and at the end of the day (4:00pm), when pedometers were removed.

3.4 Measures

3.4a Food Photography

In the present study, photos of food offered to, and consumed by children were taken with an iPod touch, 5th generation, 5-megapixel camera that captured food items in a well-timed manner, e.g. children did not have to wait an appreciable time before they could eat. Researchers never handled food items; this process minimized disruption of the eating environment. This approach addresses the limitations of previous studies in which direct visual examinations have been used to evaluate food consumption among young children (e.g. Livingstone, et al. 2004).

Direct visual estimation has been classified as the "gold standard" in measuring food intake across centre-based childcare settings; it has been validated as one of the few accurate measures of food intake (Ball, et al. 2007; Williamson, et al. 2004). Ball, et al.

(2007) noted a substantial cost to train field observers in terms of the amount of time needed to train field-observations to ensure accuracy, and the small number of children who can be observed at one time. However, study findings have demonstrated the utility of using digital photography to evaluate food consumption in naturalistic settings (e.g. Martin, et al. 2007; Williamson, et al. 2004).

3.4b NutriSTEP® Questionnaire

The Nutrition Screening Tool for Every Preschooler® (NutriSTEP®) is a community-based, parent-administered nutrition screening tool (Simpson, et al. 2008). Two versions are available: one version is intended for preschool children 3-5 years of age, and the other for toddlers 18-35 months of age. The toddler version is adapted from the NutriSTEP® for preschoolers (see Appendix B).

The questionnaire consists of 17 nutrition-screening questions based on Canada's Food Guide (Simpson, et al. 2008). The preschool version includes five questions focused on the frequency of food group intake, and the remaining 12 capture physical growth, fluid intake, physical activity and sedentary behaviour, and factors influencing food intake (e.g. food security, feeding environment). An example item is: "My child usually eats grain products". The toddler version includes four items on the frequency of food group intake. However, this version also takes into account nutritional issues exclusive to children of toddler age, and includes items that assess changes in milk consumption, the introduction of table foods, the consumption of juices and sweetened beverages, and the parent-toddler feeding relationship (Whyte, 2012). An example item is: "My child drinks from a baby bottle with a nipple".

The 17 items on both versions of the tool have two to five response options (e.g. “once a day or less” to “more than three times a day”), and range in score from 0 to 4. Question responses are summed to offer a total index score (ranging from 0-68), where higher scores indicate greater nutritional risk. In the current study, the first five items from the preschool version of the tool, and the first four items in the toddler version were used. These questions mirror healthy food and nutrient intake around the number of servings from the four food groups, and how they reflect recommendations set out by Eating Well with Canada’s Food Guide (Health Canada, 2017). One of the preschool “fruits and vegetable” items was removed in order to correspond to the number of items in the toddler version of the measure. The response values for each item were reverse scored in order for higher scores to reflect the healthier option. The total score ranged from 0-16. An example item is: “My child usually eats grain products”.

The NutriSTEP® has been shown to produce reliable and valid results (Simpson, et al. 2008). The criterion validity for the preschool version has been tested by comparing it to the expert ratings of nutrition risk by a Registered Dietician (RD) (Simpson, et al. 2008). Reliability has been examined using the test-retest method (Simpson, et al. 2008). Results of prior studies have also shown that the toddler version is construct-valid and reliable (Simpson, et al. 2013).

3.4c Preschool Snack Selection (PSS) Instrument

Each child was individually interviewed using a modified version of the Preschool Snack Selection (PSS) instrument, as described in Sigman-Grant, et al. (2014), during Time 1 and 2 of the study. This tool evaluates children’s food knowledge, and has been used with preschool-aged children to evaluate their ability to identify individual

food items (knowledge), and indicate their preferences between food pairs consisting of a healthy food and an unhealthy food and to distinguish the healthy food item (Sigman-Grant, et al. 2014) (see Appendix C).

The survey consists of 18 food items, nine healthy foods and nine unhealthy foods and takes, on average, 10-15 minutes to administer. Each healthy food item is paired with an unhealthy food item to create a total of nine food pairs. For the purpose of this study, two food types were replaced to better represent Canadian culture (jicama and ice cream sundae, for eggplant and ice cream cone, respectively). Food items were individually printed on a standard sheet of white paper to fit the entire page. The images were selected based on how “life-like” they were, and how they would most commonly be presented to children at mealtimes, e.g. a typical portion size or cut up into pieces.

The PSS instrument has three sections: knowledge, preference, and distinguish foods. The first section (knowledge) pertains to the child’s ability to correctly identify each individual food item. The child is simply asked, “What is this food?” If the food is not identified or identified incorrectly, the correct answer is provided to the child immediately after an incorrect response is provided. As each food item is presented, it is recorded whether the child answered “correctly,” “incorrectly,” or “does not know/ no-response given” (inattentive, distracted or disinterested). A score of 1 is assigned to every “correct” answer whereas a score of 0 is assigned to every “incorrect” answer. The “does not know” and “no-response given” answers are coded as 0. Scores are summed and range from 0-9 for the healthy foods and 0-9 unhealthy foods alike, for a total score of up to 18.

The second section of the survey assesses the child's food preferences. Participants are shown each of the nine food pairs, and asked: "If you could choose a snack from this pair, would you choose A or B?" For each pair, a score of 1 is assigned to every food preference that is consistent with the healthy food option whereas a score of 0 is assigned to every food preference that is the same as the unhealthy food option. A score of 0 is assigned to the "does not know/no-response given" answers. This section is scored from 0-9.

The third and final section of the survey captures the child's ability to distinguish between healthy and unhealthy foods. For each of the nine pairs of food items, the child is instructed to: "Point to the healthy food choice – the food that helps keep your heart, muscles, and bones strong." The food pairs are identical and in the same order as the food pairs for the second section of the survey. For each pair, a score of 1 is assigned to every food distinction that is considered the healthy food option ("correct"), whereas a score of 0 is assigned to every food distinction that is inconsistent with the healthy food option ("incorrect"); a score of 0 is also assigned for "does not know/non-response". This section is also scored from 0-9.

The content validity of the PSS instrument was confirmed by four experts in nutrition and early childhood education in the Sigman-Grant, et al. (2014) study. However, test-retest reliability was not measured in this study. There are also limited instruments available to test criterion or construct validity (Sigman-Grant, et al. 2014).

3.4d Yamax SW-200 Pedometer

The Yamax SW-200 electronic pedometer was used to estimate children's average total and outdoor (during outside play) daily step counts between 9:00am -4:00 pm. This time frame was selected so that daily step counts would be comparable across children. A segmented approach was used to sub-qualify step counts. Specifically, step counts were logged at defined periods throughout the day: before and after outside play, before afternoon nap, and end-of-day. This process allowed for researchers to assess the total number of step counts achieved during indoor and outdoor play.

Pedometers are a non-invasive, easy to use means of assessing PA, specifically ambulatory activity in young children. The device is typically attached in an upright position to the belt or waistband of clothing, and measures the number of steps taken within a defined period of time (Schneider, et al. 2004). The pedometer shows the output (steps) on an LCD display, which reflects the impact of one's feet hitting the ground. Specifically, a horizontal, spring-suspended lever arm moves up-and-down with each step, opening and closing an electric circuit that counts steps (Bassett, et al. 2010). The instrument provides a total step count during sampling periods, but does not give information on activity intensity, nor does it discriminate between different modes of activity.

Pedometer reliability and site placement have been previously studied, and results support placement on the right or the left side of the waist to obtain the most accurate reading (Loprinzi, et al. 2011; McNamara, et al. 2010; Oliver, et al. 2007). The reliability of pedometers worn at the back has not been established in young children (Oliver, et al. 2007). Additionally, pedometers are often selected as a research tool to

measure PA due to the unobtrusive, small and lightweight device, as well as affordability, reliability and validity in assessing PA in young children (Louie, et al. 2003; Mckee, et al. 2005; Rowe, et al. 2004). Oliver, et al. (2007) summarized six studies, which provided indication of feasibility in using pedometers with preschool aged-children. The Yamax SW-200 is the only pedometer that has been assessed for validity with preschool aged children (Oliver, et al. 2007).

3.5 References

- Ball, S.C., Benjamin, S.E., & Ward, D.S. (2007). Development and reliability of an observation method to assess food intake of young children. *Journal of the American Dietetic Association*, 107, 656-661. doi:10.1016/j.jada.2007.01.003
- Bassett, D.R., Wyatt, H.R., Thompson, H., Peters, J.C., & Hill, J.O. (2010). Pedometer-measured physical activity and health behaviors in United States adults. *Medical Science and Sports Exercise*, 42(10), 119-1825. doi:10.1249/MSS.0b013e3181dc2e54
- Health Canada. (2017). Food and nutrition: Canada's food guide. Retrieved from <http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/order-commander/index-eng.php#3>
- Livingstone, M. B. E., Robson, P. J., & Wallace, J. M. W. (2004). Issues in dietary intake assessment of children and adolescents. *British Journal of Nutrition*, 92(2), S213–S222. doi:10.1079/BJN20041169
- Loprinzi, P.D., & Cardinal, J. (2011). Measuring children's physical activity and sedentary behaviors. *Journal of Exercise Science & Fitness*, 9(1), 15-23. Retrieved from [https://doi.org/10.1016/S1728-869X\(11\)60002-6](https://doi.org/10.1016/S1728-869X(11)60002-6)
- Louie, L., & Chan, L. (2003). The use of pedometry to evaluate the physical activity levels among preschool children in Hong Kong. *Early Child Development and Care*, 173(1), 97-107.
- Martin, C.K., Newton, R.L.J., Anton, S.D., Allen, H.R., Alfonso, A., et al. (2007). Measurement of children's food intake with digital photography and the effects of second servings upon food intake. *Eating Behaviour*, 8(2), 148-56. doi:10.1016/j.eatbeh.2006.03.003
- McNamara, E., Hudson, Z., & Taylor, S.J. (2010). Measuring activity levels of young people: the validity of pedometers. *Br Med Bull*, 95(1), 121–37. doi: 10.1093/bmb/ldq016
- Mckee, D.P., Boreham, C.A.G., Murphy, M.H., & Nevill, A.M. (2005). Validation of digiwalker pedometer for measuring physical activity in young children. *Pediatric Exercise Science*, 17, 345-52.
- Nasco, (2017). Nutrition teaching aids. Retrieved from <https://www.enasco.com/t/Nutrition/Life-form-Replicas>
- Oliver, M., Schofield, G.M., & Kolt, G. (2007). Physical activity in preschoolers: Understanding prevalence and measurement issues. *Sports Medicine*, 37(12), 1045-1070.
- Rowe, D.A., Mahar, M.T., Raedeke, T.D., & Lore, J. (2004). Measuring physical activity in children with pedometers: Reliability, reactivity, and replacement of missing data.

Pediatric Exercise Science, 16, 343-354.

Schneider, P.L., Crouter, S.E., & Bassett, D.R. (2004). Pedometer measures of free-living physical activity: Comparison of 13 models. *Medical Science & Sports Exercise*, 36(2), 331-5. doi: 10.1249/01.MSS.0000113486.60548.E9

Sharma, S., Chuang, R.J., & Hedberg, A.M. (2011). Pilot-testing CATCH early childhood: A preschool-based healthy nutrition and physical activity program. *American Journal of Health Education*, 42(1), 12-23.

Sigman-Grant, M., Byington, T.A., Lindsay, A.R., Lu, M., Mobley, A.R., et al (2014). Preschoolers can distinguish between healthy and unhealthy foods: The all 4 kids study. *J Nutrition Education Behaviour*, 46, 121-127.

Simpson, R. J.A., Keller, H.H., Rysdale, L.A., & Beyers, J.E. (2008). Nutrition screening tool for every preschooler (NutriSTEP™): validation and test-retest reliability of a parent-administered questionnaire assessing nutrition risk of preschoolers. *European Journal of Clinical Nutrition*, 62, 770–780.

Simpson, J.R., Whyte, K., Lac, J., Rysdale, L., Keller, H., et al. (2013). Validation of toddler NutriSTEP®. *FASEB J*, 27, 617-5.

Whyte, K., Rysdale, L., Keller, H., Beyers, J., & Simpson, J.R. (2012). Test-retest and construct validity of Toddler NutriSTEP®. *Applied Physiology & Nutrient Metabolism*, 37(3), 595.

Williamson, D.A., Allen, H.R., Marin, P.D., Alfonso, A., Gerald, B., et al. (2004). Digital photography: A new method for estimating food intake in cafeteria settings. *Eating Weight Disord*, 9, 24-28.

4.0 Chapter 4:

MANUSCRIPT

The Impact of the CATCH Early Childhood Program on Young Children's Physical Activity, Nutrition, and Food Behaviour.

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4.1 Abstract

Background: The CATCH Early Childhood (CEC) program was designed to encourage healthy behaviours in preschoolers through nutrition and enhanced physical activity (PA). **Purpose:** This study sought to examine the impact of CEC implementation on preschoolers' nutritional choices and PA behaviours. **Methods:** Fifty-one children (ages 1.13 to 3.75) and their caregivers were recruited from two daycare centres (intervention: $n=30$; control $n=21$). Registered Early Childhood Educators (RECEs) were trained and implemented the program for 6-months. A pre-post design measured: average quantity/type of foods consumed; parental perception of food behaviours; children's food knowledge; and children's average daily step counts. **Results:** Fruit/vegetables consumption decreased over time in the intervention group ($p=0.049$). No differences in parental perceptions of fruit and vegetable consumption were found between groups ($p=0.230$), nor over time ($p=0.996$). Intervention children identified more unhealthy foods than control children ($p=0.047$). Average, total daily and outside step counts increased over time for all participants. **Discussion:** The CEC program may enhance food knowledge, but potential longer-term effects on food or PA behaviours are unclear. **Translation to Health Education Practice:** Food guidelines limiting unhealthy food choices should be implemented across daycare centres. Further inquiry is required regarding outdoor play, structured play, and free-play in this cohort to optimize recommendations in the childcare setting.

4.2 Background

4.2a Early Childhood

Early childhood, defined as the period from birth to eight years of age,¹ is a key developmental stage during which young children begin to learn about healthful eating and physical activity (PA). Some theorists² suggest that early childhood is a sensitive period for the acquisition of food and PA behaviours due to the rapid development of cognitive, physical, and social-emotional skills and abilities during this time. Rapid brain growth is accompanied by a surge in cognitive development (including language capabilities), gross and fine motor skills, and an enhanced understanding of “self” and sociability.³ As such, children are uniquely susceptible to ecological influences in the environments they occupy.⁴ Children’s health behaviours are strongly influenced by caregivers; more so than during other developmental stages (e.g. later childhood, adolescent, adult).⁵ This is in part due to an innate receptiveness towards caregiver practices, but also because of dependency upon caregivers regarding ‘what’ is available to them in terms of food and environmental settings.

The primary influence on children’s health behaviours comes from the home environment.^{6,7} Parents provide opportunities, ‘model’ lifestyle practices (e.g. food behaviours, smoking, PA, etc.), as well as pass on hereditary factors, all of which impact healthy child development.⁷⁻⁹ Thus, healthy behaviours, including eating and activity patterns, develop in the earliest social interactions in the home. Parents’ customary practices and parent-child relations therefore greatly influence lifetime behaviours, including food preferences, intake patterns, diet quality, sedentary behaviours (e.g. use of electronic devices, being awake with minimal movements) and physical activity level.¹⁰

Although the home environment plays a critical role in shaping a child's lifestyle choices,^{11,12} daycares and early childhood educators are an important secondary source of influence on health behaviours in children.^{5,13}

4.2b Early Childhood Care

There has been increased interest in the impact of child-care arrangements on children's development, with the increase in maternal employment and two-income earner families since 2003. Overall, based on the Labour Force Survey (LFS) in Canada, 82% of women in the core working ages of 25 to 54 years participated in the labour market in 2015. This compared to 21.6% of women in 1950 and 65.2% in 1983¹⁴. More specifically, in Canada, the employment rate of mothers with children under the age of 6 years has increased significantly,¹⁵ from 31 percent in 1976 to 66.5% percent in 2009.¹⁴ Similarly, 64.4% of women with children less than age 3 were employed, and 69.7% of women whose youngest child was from 3-5 years of age, were working in 2009. Further, more than half (54%) of parents used some form of child-care arrangement (e.g. nannies, home daycares, daycare centres, preschool programs, and before and after school services), and 70% of parents used full-time care. Full-time care is characterized by a minimum of 30-hours a week of in-care supervision for children aged 4 years and under.¹⁶ Furthermore, three types of daycare arrangements are most commonly used for children aged 4 years and under: daycare centres (33%), home daycare (31%) and private arrangements (e.g. grandparents, other relatives or nannies) (28%). In the childcare setting, Registered Early Childhood Educators (RECEs) are the professionals who specialize in the education and supervision of the children.¹⁷ Ultimately they are

responsible for organizing the learning environment and for overseeing activities for children, which promote emotional, cognitive, social, and physical development.^{18,19}

Responsibilities can also include PA and nutrition behaviours, however, within Canada, RECEs do not receive formal training in these areas as a component of their educational program.²⁰ The education curricula and requirements for RECEs vary across Canada, and few programs have recognized the importance of regular PA.²¹ Accordingly, if communities want to focus on health interventions in this environment, it would be necessary that RECEs be provided with training in health promotion and health behaviours specific to this age group. Likewise, daycares should have access to a validated health program to use, which would provide appropriate strategies and tools to use to educate children in daycare.

4.2c Early Childhood Health Promotion Research

Prior to 2003, limited scientific research addressed the preschool or childcare settings, in part because young children had traditionally been less accessible for community-based health interventions (e.g. children under 5 years had stayed at home). Likewise, for many years it was largely assumed that the preschool population was sufficiently active.^{22,23} However, over the last few decades, widespread rates of childhood-onset overweight and obesity have tripled.^{24,25} About 43 million (6.7%) (35 million in developing countries) preschool children worldwide are overweight or obese; this number is estimated to reach 60 million by 2020.^{26,27} Accordingly, available literature has focused on early childhood obesity-prevention programs as a developing research area.^{26,28} Given this, health professionals are only beginning to understand the

problem, and are starting to place preschooler's PA patterns and nutrition behaviours at the forefront of health promotion efforts.^{24,29}

The CATCH Early Childhood (CEC) program is an extension of the Coordinated Approach To Children's Health (CATCH) school-based program. The program is designed specifically for preschoolers (3-5 years), to nurture enjoyment towards PA behaviours, and includes a classroom curriculum that incorporates garden-based learning and nutrition concepts.

The CATCH program for grades K-8 has been well studied since its inception;³⁰ however, little research has examined the CEC program.³¹ Sharma, et al. (2011) were the first to evaluate the pilot implementation of CEC.³² They examined the program for low-income children in two daycare centres for 6-weeks. Positive trends were found for fruit, 100% fruit juice, and vegetable intake, and average minutes spent in PA. However, children were consuming more fruits and juice in comparison to vegetables at both baseline and post-intervention (<20% of vegetables and >60% of fruits and juice served). Moreover, the PA component showed mixed results. At baseline, 72.1% of total time in active movement was spent in light physical activity, and 27.9% in moderate-to-vigorous physical activity (MVPA). Post-intervention, 84.9% of the active time was spent in light physical activity and 15.1% in MVPA.³²

The Sharma, et al. (2011) study findings may be due to the cross-application of the PA component from the CATCH to the CEC program. Previous research on CATCH showed that this program decreased total unstructured free time, while increasing structured play time.³³ While this may have a positive effect for school-aged children, it may not be the desired outcome amongst preschool-aged children. Free play constitutes a

large part of the physical activity accumulated by preschool-aged children, whereas school-age children have been shown to have progressive declines in PA levels during free-play with age.²³ Indeed, the Canadian Society for Exercise Physiology (CSEP) guidelines suggests that toddlers (aged 1-2 years) and preschoolers (aged 3-4 years) should accumulate a minimum of at least 180 minutes of physical activity at any intensity spread throughout the day, and incorporate a variety of activities in different environments, such as activities that develop movement skills, with a progression towards 60 minutes of energetic play by 5 years of age.³⁴ It is possible that CEC programming needs to be re-examined for implementation in this younger age group to address this aspect. Scaling down the CATCH programming from school-aged children to preschool-aged children may require less structured play in CEC programming, and maintenance or expansion of unstructured (free) play opportunities.

4.2d Purpose

The purpose of this study was to compare outcomes between two daycare centres: i) a control centre, and ii) intervention centre, and to: (1) determine the amount and type(s) of food children consumed; (2) quantify food knowledge and healthy food choices; and (3) measure children's average, total daily step counts, and average daily step counts during outside play (all before and after implementation of the CEC program in the intervention group).

4.3 Methods

4.3a Sample

A convenience sample of 51 children and their parents were recruited from two daycare centres. The centres were located in the same geographic area within a Canadian context, and served predominantly middle- to upper-income families. The geographic area was chosen based on accessibility; both recruited daycare sites were within walking distance from each other. Parental/guardian consent was obtained for all participants and the study was Institutional Ethics Board approved.

During pre-intervention data collection, 30 out of 34 potential children comprised the intervention group, and 21 out of a potential 22, the control group. There was a 91% response rate for participation. During post- measurement, there were 22 children in the intervention group, and 15 in the control group. There were 14 participants lost at follow-up due to moving out of the catchment area, illness, family vacations, and/or because they no longer attended the Centres.

The daycare centres operated on the same daily schedule, and had a similar pre-determined four-week rotation of meals. The average time children spent in their respective classrooms was approximately 7 hours a day, with arrival time being 9:00am and departure, 4:00pm. Children were served three meals per day: morning snack, lunch and afternoon snack. Both sites had cooks who prepared snacks and lunch throughout the day. The model used was family-style serving, in which the staff served the children from a communal bowl. The daily schedule at both sites was organized into 30-45 minute segments that included structured and unstructured indoor-play (e.g. circle and story time, arts and crafts, and table toys), outdoor free-play, meal, and nap times.

The CEC program was implemented in one daycare centre for a period of 6-months (October, 2014-May, 2015). This daycare served as the intervention group, and measures were collected during a 5-day period before (Time 1) and after (Time 2) the CEC intervention. The CEC program was not implemented in the second daycare, and this setting served as the control group. Following the pre-intervention testing, the CEC program was introduced through a full-day training session with all Registered Early Childhood Educators (RECEs) and Centre Directors. The control daycare followed its regular programming, and measures were collected in parallel with those of the intervention group at Time 1 (October, 2014) and Time 2 (May, 2015).

4.3b Intervention Overview

The CEC program for preschool children (3-5 years) is the newest component of the CATCH programs. CEC was modeled after the original CATCH school-based program to incorporate preschool-based PA, nutrition, and family components in a health promotion program aimed at young children.³² It was developed to coincide with early learning requirements and dietary and PA recommendations for preschoolers, and program objectives are based on Social Cognitive Theory (SCT).³⁵ The program components include: (1) classroom curricula around nutrition (“It’s Fun to Be Healthy!”) consisting of “Good Food Kids” and “Garden Kids”. Good Food Kids contains nine interactive lessons aimed at promoting healthy eating habits (e.g. increased intake of fruit and vegetables), while Garden Kids has 10 lessons focused on educating children about the fundamentals of good gardening (e.g. how to produce and nurture nutritious foods); (2) structured PAs (CEC Physical Activity Box) designed to promote motor development and increase PA levels, including MVPA. There are over 120 teacher-led PA lessons that

can be given indoors or outdoors, and adapted to meet the needs of children with physical disabilities; and (3) family education that includes nine “tip-sheets” for parents to help incorporate healthy nutrition and PA into home routines.³⁶ Details on the CEC program components and objectives (along with SCT constructs) are outlined in Sharma, et al. (2011).³²

4.4 Measures

Four measures were used to examine the impact of CEC implementation on children’s food consumption, food knowledge and nutritional choices, and PA. These were: i) food photography; ii) the NutriSTEP® Questionnaire; iii) the Preschool Snack Selection Instrument (PSS); and iv) step counts using electronic pedometers.

4.4a Food Consumption

Food items were digitally photographed with an iPod touch 5th generation 5-megapixel camera to assess dietary intake and portion sizes. Photographs were visually assessed for how much and which types of food (as outlined by Eating Well with Canada’s Food Guide³⁷) had been consumed. Nasco Life/form Replicas were used as a guide during the assessment. The Replicas are modelled after real foods and are a proven substitute to demonstrate actual food items.³⁸ The daycare menus were used as a complimentary guide to food intake data, to add more thoroughness to the assessment.

Direct visual estimation has been classified as the “gold standard” in measuring food intake across centre-based childcare settings.^{39,40} The number of food servings (food consumed) was derived from the recommended number of Canada Food Guide servings

for children aged 2-3 and 4-8 years, and reference amounts of one food guide serving, e.g. in terms of portion (millimetres or grams).³⁷

Food photography (food items consumed) data was inputted and stored in the NutriBase 17 Professional Nutrition and Fitness Software using the metric system as the system of measurement. Food recipes were also created to determine the amount of servings per meal (e.g. 1 serving of Bow Tie Pasta = 41.8g); ingredients were also broken down by measurement. Overall daily and weekly averages for each child's food type/consumption were calculated to determine total number of servings for each food group. This was afterwards compared to the recommended number of food guide servings chart, which shows how many servings of each of the four food groups are recommended for consumption each day.

4.4b Parental Assessment of Food Consumption

The Nutrition Screening Tool for Every Preschooler (NutriSTEP®) is a community-based, parent-administered nutrition-screening tool⁴¹. The tool consists of 17 nutrition-screening questions that include topics such as food and nutrient intake (e.g. based on Eating Well with Canada's Food Guide), physical growth, developmental and physical capabilities, physical activity, food security and the feeding environment⁴¹. Two versions are available: one version is intended for toddlers 18-35 months of age, and the other for preschool children 3-5 years of age. The 17 items on both versions of the tool have two to five response options (e.g. "once a day or less" to "more than three times a day"), and range in score from 0 to 4. Question responses are summed to obtain a total score ranging from 0-68. This tool has been shown to have adequate reliability and validity for toddler⁴² and preschooler⁴¹ populations.

In the current study, the first four items on both the toddler and preschool versions of the instrument were used. These questions assess parent self-report of children's food behaviours in the home environment, and correspond to healthy food and nutrient intake from the four food groups, as set forth by Eating Well with Canada's Food Guide.³⁷ An example item is: "My child usually eats grain products".

4.4c Food Knowledge and Nutritional Choices

Each child was tested using a modified version of the Preschool Snack Selection (PSS) instrument⁴³ at both the pre- and post-intervention time points. For the purpose of this study, two food types were replaced to better represent Canadian culture (jicama and ice cream sundae, for eggplant and ice cream cone, respectively). This tool assesses children's food knowledge, and has been used with preschool-aged children to evaluate their abilities to identify food items, indicate their food preferences between food pairs consisting of a healthy food and an unhealthy food, and to evaluate their ability to distinguish between healthy and unhealthy foods.⁴³ The PSS consists of 18 food items (9 healthy, and 9 unhealthy foods) and has three sections: knowledge, preference, and distinguishing foods. The child was shown photos of foods, alone and in pairs, and in three sections of questions: 1) for each of the 18 food items (9 healthy and 9 unhealthy) shown, 2) children were then shown 9 pairings of food; each pair had one healthy and one non-healthy food choice, 3) lastly, the child was told to "Point to the healthy food choice – that is, the food that helps keep your heart, muscles, and bones strong." A score of "1" is assigned to each food that is correctly identified in the "knowledge" section, whereas a score of "0" is given for foods that are not correctly identified. Similarly, for the "preference" and "choice" sections, a score of "1" is assigned for the selection of

healthy foods and “0” for the selection of unhealthy foods chosen in each section. Scores are summed to obtain a total score ranging from 0-18 for the knowledge section, and ranged from 0-9 for the preference, and 0-9 for the distinguish sections of the instrument.

4.4d Physical Activity

All children in this study were ambulatory. The Yamax SW-200 electronic pedometer was used to estimate children’s average total and outdoor (during outside play) daily step counts between 9:00am-4:00 pm. This time frame was selected so that daily step counts would be comparable across children. A segmented approach was used to sub-qualify step counts. Specifically, step counts were logged at defined periods throughout the day: before and after outside play, before afternoon nap, and end-of-day. This process allowed for researchers to assess the total number of step counts achieved during indoor and outdoor play.

Pedometers were secured to the right side of the child’s hip, as per manufacturer recommendations and were taped shut to prevent children from pressing the reset button of the pedometer. Pedometers were set to zero when attached and step counts were then logged at 9:00am, before and after outside play, before naptime, and at the end of the day (4:00pm) when pedometers were removed.

4.4e Data Analyses

Analyses were conducted for the food consumption servings, NutriSTEP® Questionnaire, PSS instrument, and average total- and outside- daily step counts using IBM SPSS Statistics (Version 22.0).

In order to adequately reflect typical food consumption and daily activity data, a minimum of three days of complete data sets were used. Therefore any day when a child

did not eat all three meals provided by the Centre and/or attended daycare late (after 9:00am) and/or left early (before 4:00pm), the food and pedometer data for that day were excluded from the analysis. Additionally, any children who did not have a minimum of three days of data due to absenteeism were also excluded from analysis.

The response options for the first four items on the NutriSTEP® questionnaires (for healthy food servings/consumption) ranged from 0-4. The response values were reverse scored so that higher scores reflected the healthier option. Average scores for each of the four items were used in all analyses.

For each section on the PSS instrument, any response other than “correct” or “incorrect” was recoded as “did not know” or “no response”. A score of 1 was assigned to every “correct” answer whereas a score of 0 was assigned to every “incorrect” response, and “does not know/ “no-response” answers. Values were summed to obtain a total score that ranged from 0-18 for the knowledge section (9 for healthy and 9 for unhealthy foods). Total scores for preference and choice ranged from 0-9 for each, respectively.

Pedometer devices quantified children’s daily step counts between 9:00am-4:00 pm. For each of the five days of pre- and post-data collection, daily averages were calculated per child for: total step counts; and total, outdoor-play step counts.

4.4f Statistical Analysis

Descriptive statistics were generated for all measures. A series of 2 x 2 mixed analyses of variance (ANOVAs) were conducted to examine the effects of the CEC program over time on all measures. The between-subject factor consisted of program (intervention versus control), and the within-subject factor was time (pre- and post CEC

programming). This model regressed the outcome of interest on its baseline values, and was used to obtain main and interaction effects for intervention exposure (intervention site and control site) over time for all measures. Simple-effects testing using Bonferroni-adjusted pairwise comparisons were performed for statistically significant interactions. For all analyses, statistical significance is reported at levels less than alpha 0.05.

4.5 Results

A total of 51 (91% response rate) children (30 male, 21 female) with an age range of 1.13 to 3.75 years (M=2.48; SD=0.74) participated in the pre-intervention data collection. Thirty-seven children (21 male and 16 female) ranging in age from 1.71 to 4.32 years (M=2.97; SD= 0.76) participated at post-measurement (e.g. 6-months after pre-intervention data collection; pooled sample). Descriptive statistics for the intervention and control children at pre- and post-measurement are shown in Table 1.

Table 1: Number of participants and mean age for participants in the intervention and control groups at baseline and follow-up

	Intervention Group		Control Group	
	Pre	Post	Pre	Post
N	30	22	21	15
Mean Age (SD)	2.46 (0.73)	3.05 (0.75)	2.52 (0.77)	2.86 (0.79)

4.5a Food Consumption

The average food servings consumed by intervention and control children (pre/post measurement) according to food group are presented in Table 2 and Figures 1-4.

Table 2: Means and standard deviations for number of servings consumed by Eating Well with Canada's Food Guide (CFG) food group (pre- and post- measurement)

CFG Food Group	Intervention		Control	
	Pre	Post	Pre	Post
Grain Products ⁺ (DR: 3)	2.20 (0.79)	1.83 (0.47)	1.71 (0.61)	1.98 (0.82)
Milk and Alternatives* ^ψ ⁺ (DR: 2)	1.35 (0.40)	1.58 (0.50)	0.61 (0.23)	1.14 (0.28)
Fruit/Vegetables * ^ψ (DR: 4)	2.02 (0.48)	1.46 (0.37)	2.28 (0.74)	2.26 (0.58)
Meat and Alternatives ⁺ (DR: 1)	0.41 (0.25)	0.33 (0.13)	0.33 (0.16)	0.70 (0.24)

Based on participants with complete data pre/post (intervention n=18; control n=12)

DR: total daily recommended number of servings for children

*Statistically significant (p<0.05) main effect of time (pre/post)

^ψ Statistically significant (p<0.05) main effect of group (control/intervention)

⁺Statistically significant (p<0.05) interactions between time (pre/post) and group (control/intervention)

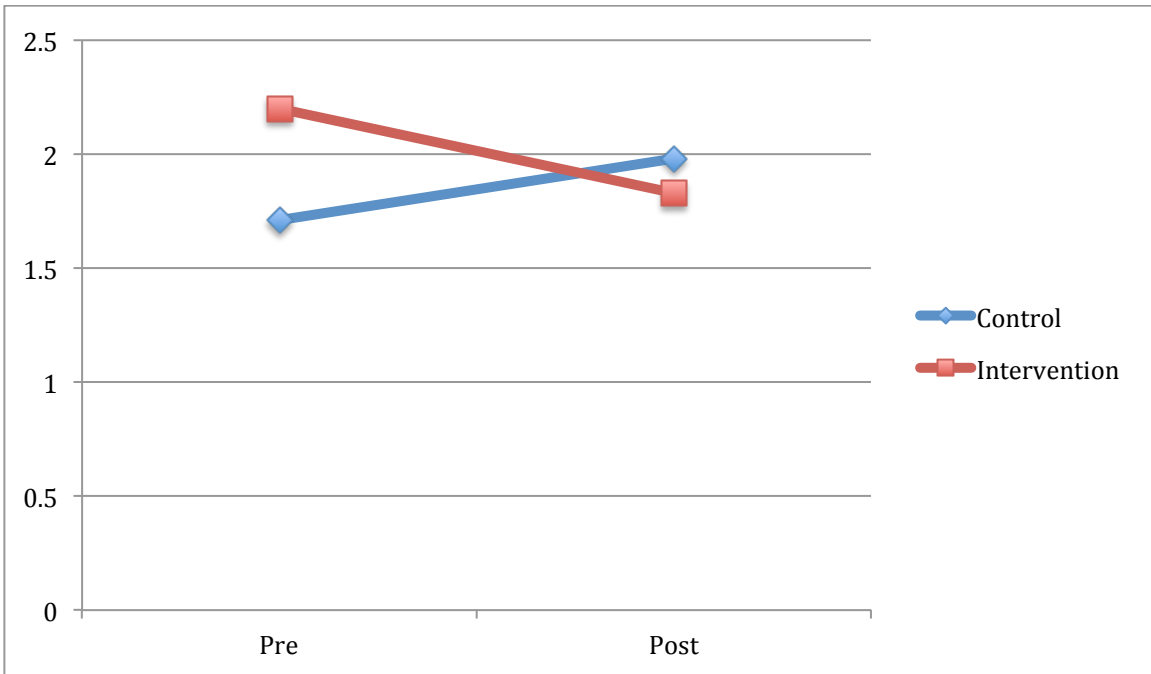


Figure 1: Mean grain consumption pre- and post-intervention for the control and intervention

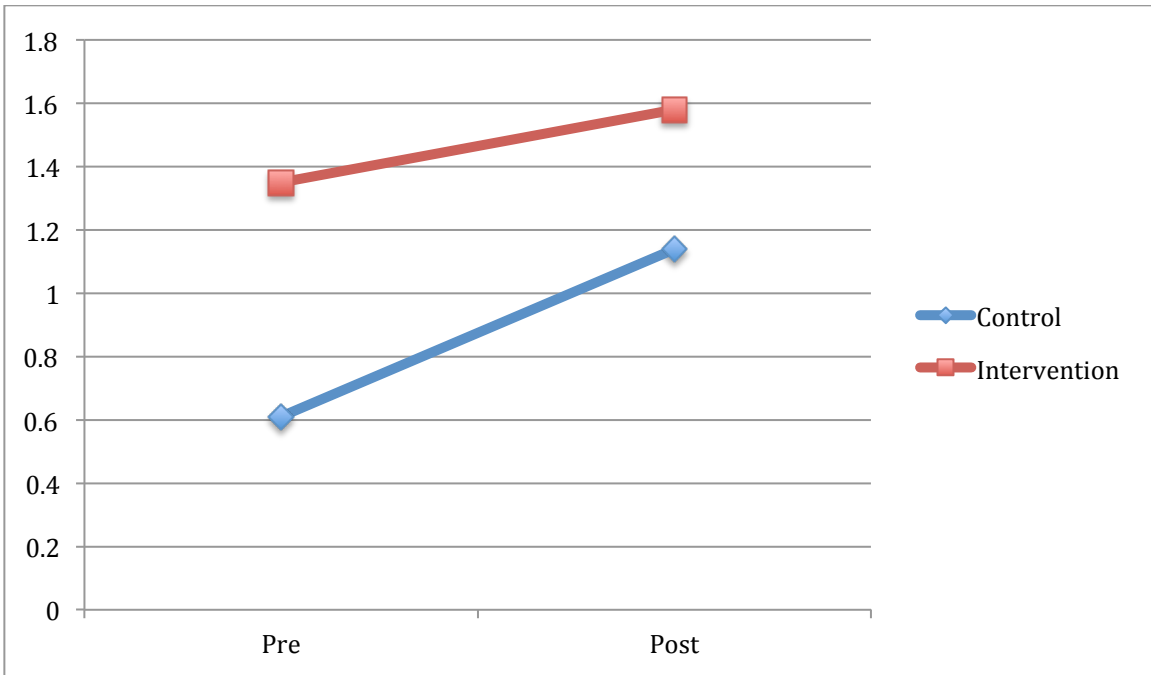


Figure 2: Milk and alternatives consumption pre- and post-intervention for the control and intervention groups

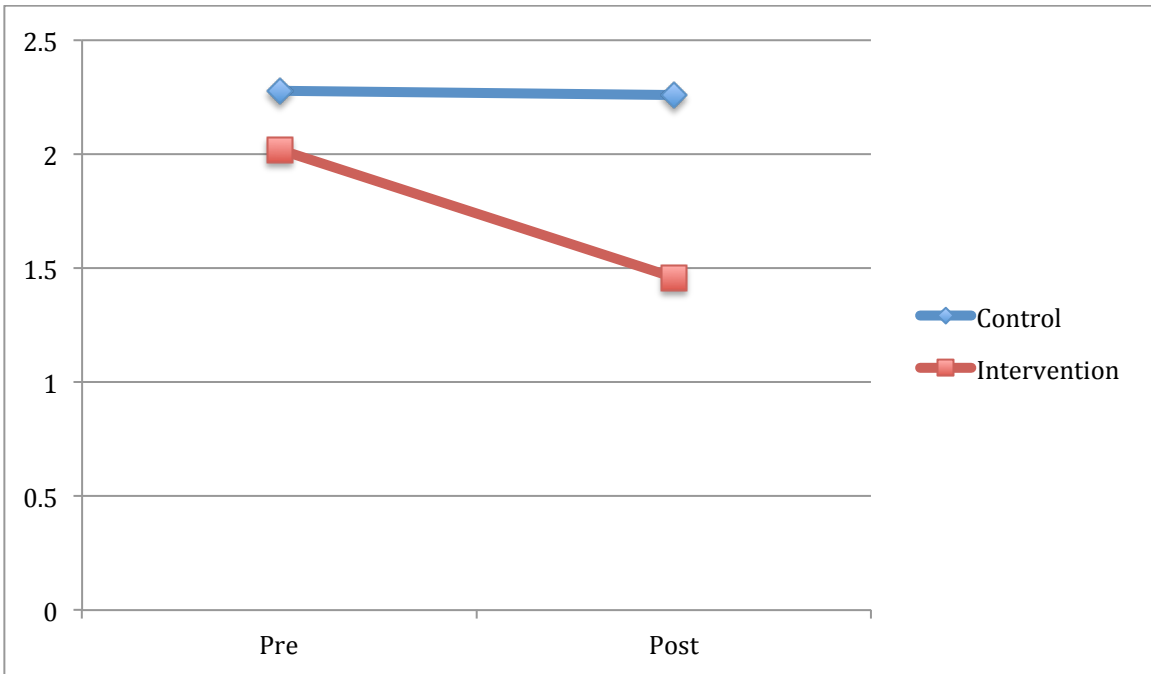


Figure 3: Fruit and vegetable consumption pre- and post-intervention for the control and intervention groups

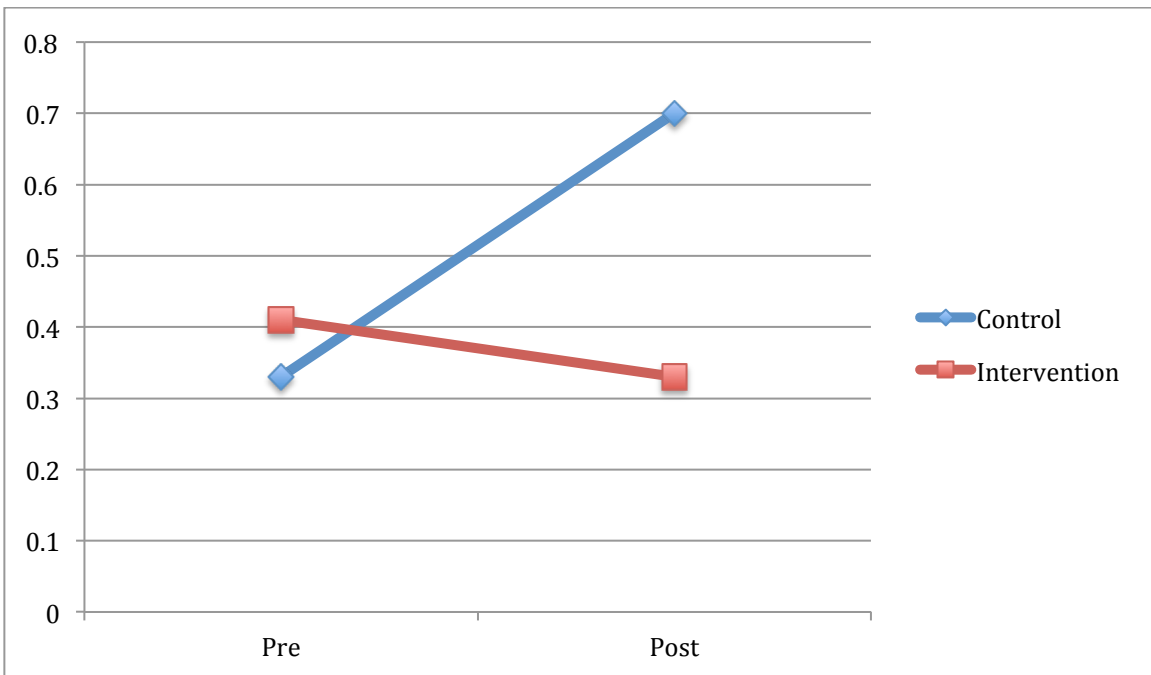


Figure 4: Meat and alternatives consumption pre- and post-intervention for the control and intervention groups

Grain Consumption: showed no main effect for time ($F(1,28)=0.19, p=0.664$) or program ($F(1,28)=0.58, p=0.451$). However, there was an interaction between program and time ($F(1,28)=7.70, p=0.010, \eta^2=0.21$). Grain product consumption decreased for intervention children ($p=0.017$), and increased for control children from pre- to post-measurement (Table 2).

Milk/Alternatives Consumption: showed an increase over time for all participants ($M_{pre}=1.05, SD_{pre}=0.50; M_{post}=1.41, SD_{post}=0.48$) ($F(1,28)=34.22, p=0.0001, \eta^2=0.51$), and intervention children consumed more milk products ($M=1.47, SD=0.08$) than control children ($M=0.88, SD=0.10$) ($F(1,28)=21.109, p=0.0001, \eta^2=0.43$). There was also an interaction between program and time ($F(1,28)=5.07, p=0.032, \eta^2=0.08$). Although intervention children had higher milk product consumption at the pre- ($p=0.000$) and post- ($p=0.008$) time periods than the control, control children showed a larger increase from pre- to post-measurement (~1/2 serving) than the intervention children (~1/4 of a serving).

Fruit/Vegetables consumption: main effects were found for time ($F(1,28)=4.22, p=0.049, \eta^2=0.12$) and program ($F(1,28)=14.29, p=0.001, \eta^2=0.34$). Consumption for all participants decreased over time ($M_{pre}=2.15, SD_{pre}=0.61; M_{post}=1.86, SD_{post}=0.48$), and control children consumed more fruits and vegetables overall ($M=2.27, SD=0.51$) compared to intervention children ($M=1.74, SD=0.43$). There was no statistically significant interaction between program and time.

Meat/Alternatives consumption: effects were found for time ($F(1,28)=8.80, p=0.006, \eta^2=0.15$) and program ($F(1,28)=7.09, p=0.013, \eta^2=0.20$), as well as their interaction ($F(1,28)=20.36, p=0.000, \eta^2=0.36$). Consumption of meat/meat alternatives increased from pre-measurement ($M_{pre}=0.38, SD_{pre}=0.22$) to post-measurement ($M_{post}=0.52, SD_{post}=0.26$) for all children; yet a higher level of consumption was observed for control ($M=0.52, SD=0.04$) as opposed to intervention children ($M=0.37, SD=0.04$). Control children consumed more meat products at the time of post measurement (as compared to their baseline time point, $p=0.000$), and as compared to intervention children at post-data collection ($p=0.000$).

4.5b Parent Perceptions (NutriSTEP® Questionnaire)

Means and standard deviations for the NutriSTEP® Canada Food Guide (CFG) items that correspond to the four food groups (pre/post measurement) are presented in Table 3.

Grain Consumption: showed a main effect for time ($F(1,32)=5.28, p=0.028, \eta^2=0.14$). The frequency of grain consumption increased over time for all children ($M_{pre}=1.47, SD_{pre}=0.75; M_{post}=1.76, SD_{post}=0.92$), as reported by parents. However, there was no effect for program ($F(1,32)=0.89, p=0.103$), nor was there an interaction between program and time ($F(1,32)=0.912, p=0.347$).

Milk/Alternative consumption: showed no main effect for time ($F(1,32)=1.90, p=0.177$), whereas there was an effect for program ($F(1,32)=5.68, p=0.023, \eta^2=0.15$) as reported by

parents. The parents of control participants reported a greater consumption of milk products for these children ($M=3.00$, $SD=1.26$) than the parents of intervention children ($M=2.23$, $SD=1.28$). There was no interaction between program and time ($F(1,32)=0.063$, $p=0.804$).

Fruit/Vegetable consumption: no effects were found for time ($F(1,32)=0.002$, $p=0.969$) or program ($F(1,32)=1.50$, $p=0.230$) as reported by parents. There was also no interaction between program and time ($F(1,32)=1.12$, $p=0.299$).

Meat/Alternatives: no effects were found for time ($F(1,32)=0.76$, $p=0.388$) or program ($F(1,32)=0.69$, $p=0.412$) as reported by parents. There was also no interaction between program and time ($F(1,32)=2.92$, $p=0.097$).

Table 3: Pre and post mean values and standard deviations for the parent report of food group servings based on the NutriSTEP® Canada Food Guide.

CFG Food Group**	Intervention		Control	
	Pre	Post	Pre	Post
Grain Products (DR: 3)	1.33 (0.58)	1.57 (0.51)	1.69 (0.95)	2.08 (1.32)
Milk and Alternatives (DR: 2)	2.33 (1.32)	2.00 (1.27)	3.23 (1.30)	3.00 (1.16)
Fruit/Vegetables (DR: 4)	2.67 (0.80)	2.81 (0.93)	3.15 (0.80)	3.00 (1.00)
Meat and Alternatives (DR: 1)	3.10 (0.70)	3.33 (0.66)	3.08 (0.49)	3.00 (0.71)

* Based on participants with complete data pre/post (intervention n=21; control n=13)

**Recoded scale options are:

Grain products=0 (less than 2x/day); 1 (2-3 x/day); 2 (4-5 x/day); 4 (more than 5x/day)

Milk products=0 (once a day/or less); 1 (2 x/day); 2 (3 x/day); 4 (more than 3x/day)

Fruit/vegetables=0 (not at all); 1 (once/day); 2 (2 x/day); 3 (3-4 x/day); 4 (more than 3-4x/day)

Meat and alternatives=0 (not at all); 1 (few times/week); 2 (once/day); 3 (2 x/day); 4 (more than 2 x/day)

DR: total Daily recommended number of servings for children

Table 4: Parent report vs. actual food group consumption at daycare for the intervention and control groups at baseline and follow-up.

	Intervention				Control			
	Baseline		Follow-Up		Baseline		Follow-Up	
	PR	Actual	PR	Actual	PR	Actual	PR	Actual
Grain Product DR=3	1.33	2.20	1.57	1.83	1.69	1.71	2.08	1.98
Milk and Alternatives DR=2	2.33	1.35	2.00	1.58	3.23	0.61	3.00	1.14
Fruit / Vegetables DR=4	2.67	2.02	2.81	1.46	3.15	2.28	3.00	2.26
Meat and Alternatives DR=1	3.10	0.41	3.33	0.33	3.08	0.33	3.00	0.70

PR= Parent report of food consumption (*number of servings as assessed by the NutriSTEP®)

DR= Total daily recommended number of servings for children

4.5c Food Knowledge and Choice (Preschool Snack Selection (PSS) Instrument)

Means and standard deviations for the knowledge, preference and distinguish sections of the PSS by intervention and control children (pre/post measurement) are presented in Table 5. Percentages of children *correctly identifying more than half* of the healthy and unhealthy food options for the knowledge, preference and distinguish sections of the PSS by intervention and control children (pre/post measurement) are presented in Table 5.

Table 5: Percentage of study participants identifying more than half of the healthy and unhealthy food options (score of 5 or more)

Scale	Intervention		Control	
	Pre (%) (range**)	Post (%) (range**)	Pre (%) (range**)	Post (%) (range**)
Knowledge (healthy) /9	68.5 (0-7)	94.7 (3-8)	42.8 (0-7)	64.3 (0-8)
Knowledge (unhealthy) /9	52.7 (0-8)	84.3 (2-9)	42.8 (0-8)	42.9 (0-8)
Preference (for healthy) /9	23.1 (1-5)	0 (1-4)	9.1 (0-5)	9.1 (0-5)
Distinguish (healthy vs. unhealthy) /9	15.4 (1-6)	30.8 (1-9)	25.0 (2-7)	62.5 (3-8)

*Based on participants with complete data pre/post:

Knowledge: intervention (n=19); control (n=14)

Preference: intervention n=13; control n=11

Distinguish: intervention n=13; control n=8

**Range of scores on a scale of 0-9

Section 1: Knowledge - Healthy food items: an effect for time was found; all children showed an increase in ability to correctly identify food items post intervention ($F(1,31)=21.18, p=0.0001, \eta^2=0.40$) ($M_{pre}=3.97, SD_{pre}=2.76; M_{post}=5.79, SD_{post}=2.04$).

There was no effect for program or interaction between program and time. Pre-

intervention scores showed that 69% of intervention children and 43% of control children correctly identified more than half of the healthy foods. The percentages increased to 95% of intervention, and 64% of control children, respectively, at the time of post-measurement.

Section 1: Knowledge - Unhealthy food items: an effect for time was found; all children showed an increase in ability to correctly identify food items post intervention ($F(1,31)=16.37, p=0.0001, \eta^2=0.34$) ($M_{pre}=3.42, SD_{pre}=3.12; M_{post}=5.21, SD_{post}=2.74$). There was also an effect for program ($F(1,31)=4.28, p=0.047, \eta^2=0.14$); intervention children correctly identified more unhealthy foods ($M=5.12, SD=2.58$) than control children ($M=3.25, SD=3.02$). There was no interaction between program and time for knowledge of unhealthy foods. Approximately 53% of intervention children and 43% of control children correctly identified more than half of the unhealthy foods at pre-intervention. The majority of intervention children (84%) correctly identified more than half of these foods at post-measurement as opposed to 43% of control children (Table 5).

Section 2: Food preference: no main effect for time ($F(1,22)=0.08, p=0.781$) or program ($F(1,22)=0.292, p=0.594$) was found. There was also no interaction between program and time. Few children preferred the healthy option; approximately 23% of intervention and 9% of control children indicated preference for more than half of the healthy options at pre-intervention. None of the intervention children, and 9% of the control reported preference for more than half of the healthy options at post-measurement.

Section 3: Food Distinction: an effect for time was found ($F(1,19)=5.71, p=0.027, \eta^2=0.23$) and program ($F(1,19)=5.90, p=0.025, \eta^2=0.24$). Children's ability to distinguish which food items were considered healthy increased over time ($M_{pre}=3.05, SD_{pre}=1.80; M_{post}=4.81, SD_{post}=2.50$). The control group also chose more healthy food choices than the intervention children ($M=5.75, SD=2.82$ versus $M=3.88, SD=1.81$). Additionally, there was no interaction between time and program for food choice.

Approximately 15% of the intervention and 25% of the control children correctly identified more than half of the healthy options at baseline. These increased at post-measurement to 31% and 63% of intervention and control children, respectively.

4.5d Physical Activity

Total and average, total daily outside steps for the intervention and control groups (pre/post measurement) are presented in Figures 5 and 6.

Total daily step counts: an effect for time was found ($F(1,26)=6.16, p=0.02, \eta^2=0.19$) and for program ($F(1,26)=6.91, p=0.014, \eta^2=0.21$). Step counts increased over time for all participants ($M_{pre}=5,179.44, SD_{pre}=1,501.92; M_{post}=5,979.59, SD_{post}=1,713.99$). In addition, the intervention children had a higher average total number of step counts ($M=6084.81, SD=1640.50$) as compared to control children ($M=4813.62, SD=1244.51$), regardless of measurement time point. There was no interaction between time and program for daily step counts ($F(1,26)=0.035, p=0.853$).

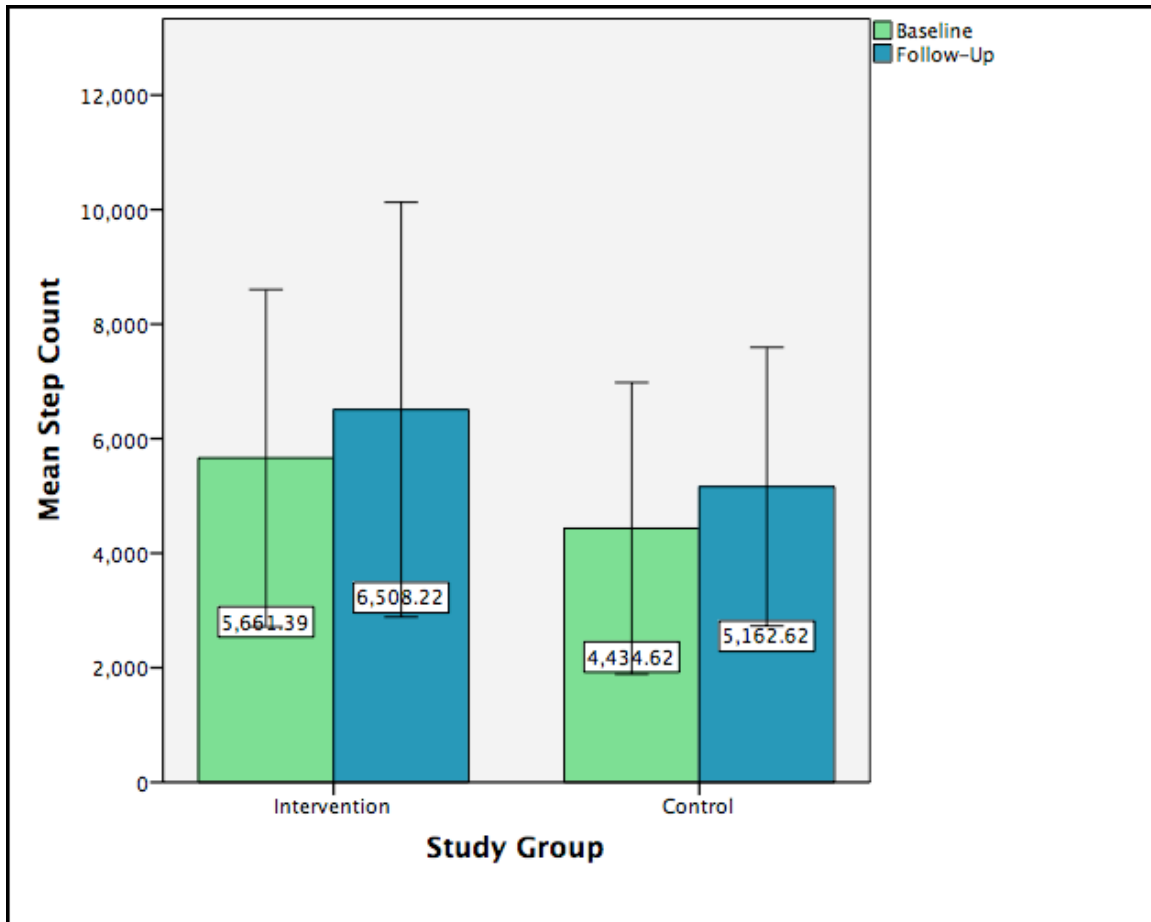


Figure 5: Mean total step counts for the intervention and control groups with error bars representing two standard deviations

* Based on participants with complete data pre/post (intervention n=17; control n=11)

Average, outside step counts: an effect for time was found ($F(1, 26)=26.17, p=0.0001, \eta^2=0.49$); all participants saw an increase in outside step counts ($M_{pre}=2,423.95, SD_{pre}=510.45; M_{post}=3,417.70, SD_{post}=1,074.48$). There was also a main effect for program ($F(1, 26)=9.19, p=0.005, \eta^2=0.26$). There was no interaction between time and program for average outside step counts ($F(1,26)=0.283, p=0.599$).

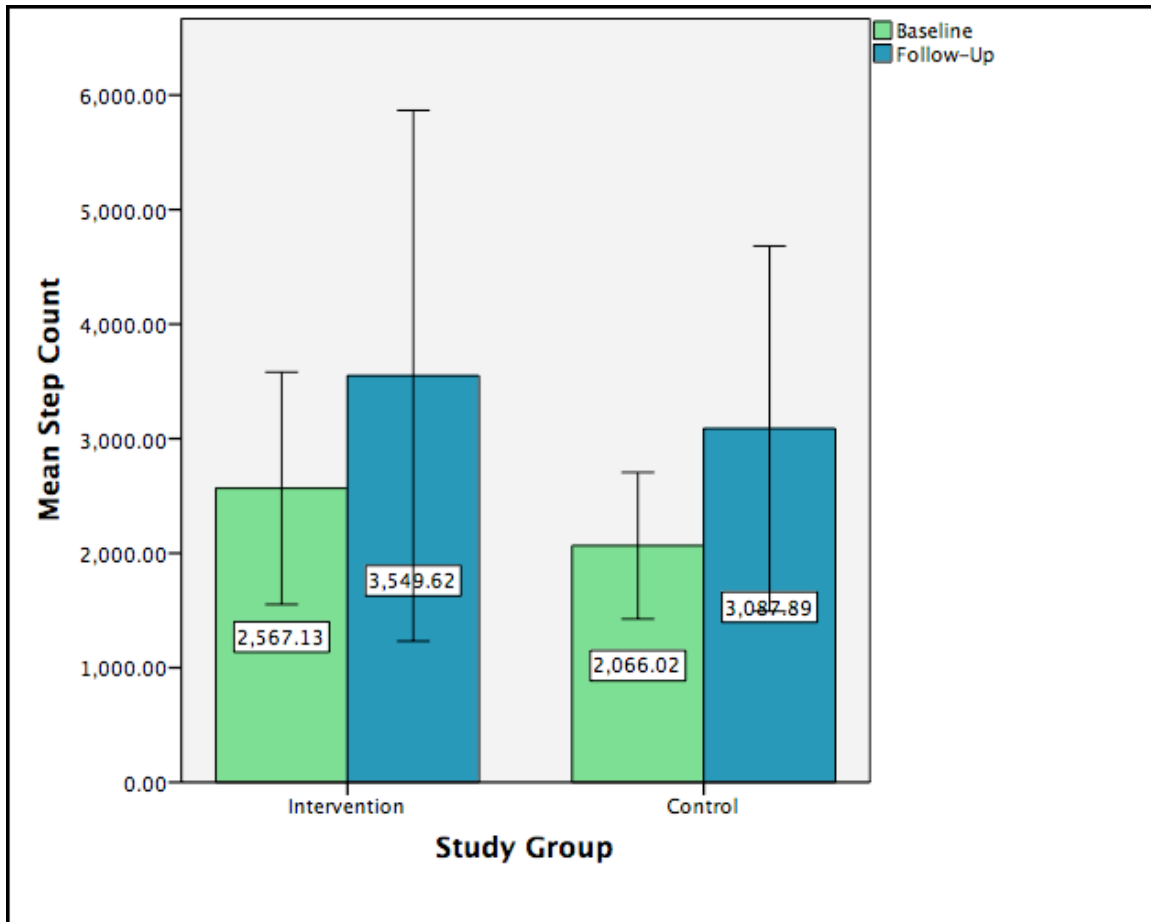


Figure 6: Mean outside step counts for the intervention and control groups with error bars representing two standard deviations

* Based on participants with complete data pre/post (intervention n=17; control n=11)

4.6 Discussion

As rates of enrolment in child care centres increase,⁴⁴ an opportunity arises whereby communities can positively influence the health of its youngest members. The child-care setting is an important environment within which PA and food-related behaviours among young children are developed. Given that early health behaviours have immediate and long-term impacts on children’s overall health, and a larger percentage of children attend daycares, Centre providers are well-positioned to promote community-

based nutrition and PA initiatives. However, the development of programs specific to the early childcare setting and pertaining to food and activity are required; these programs should be based on research to guide best practices.

The CEC intervention is one of the few programs, which includes nutrition, PA, and family/community components in a health promotion program targeting young children (e.g. < 5 years). The aim of this study was to assess the CEC program's impact on children's nutrition behaviours, food knowledge, and PA levels.

4.6a Food consumption

Food consumption was examined for children before and after implementation of the CEC program. The types of food consumed by participants were assessed via direct visual estimation using food photography.^{44,45} Results showed statistically significant increases (pre/post) in the consumption of dairy products and meat/alternatives for all children. However, whereas intervention children consumed more milk products, control children ate more servings, on average, of meat products, grains, and fruits/vegetables. In addition, and contrary to expectations, fruit and vegetable consumption, in fact, decreased over the pre- to post-measurement period for both groups of children. We had originally hypothesized that the intervention group at post-measurement would have consumed more healthy foods, specifically fruits and vegetables after CEC programming. However, we did not find this congruence.

Despite the increased consumption patterns observed, the amount of food intake across all food groups from pre- to post- measurement for both study groups was less than ½ of a serving. Furthermore, this increase in food consumption across groups may be due to the growth of children over the 6-months of the trial. Growth spurts are most

common during the first year of life and puberty; however, growth spurts can occur at any time, but are less apparent.⁴⁶ Young children aged 2-4 years add around 2-3 inches in height, and up to 4 pounds a year.⁴⁷ Children start to feel appetite more frequently during this time. Alternatively, given that total step counts increased for all children post intervention, this may reflect a natural self-regulation whereby children are consuming more kilocalories to offset enhanced energy expenditure. Given these results, the CEC program did not appear to have a meaningful effect in modifying food behaviours for our group of intervention children. Although there were some statistically significant changes, results may not be clinically meaningful, and must therefore be interpreted with caution.

When comparing the number of servings of food consumed at daycare compared to Canada Food Guide's recommended daily servings, it is clear that daycares are having a meaningful impact on children's daily nutritional intake. In fact all children were consuming approximately 1-1.5 servings of their daily, recommended milk/milk alternatives servings (2 servings) and half of their daily, recommended consumption of fruit and vegetables (4 servings) while at daycare.

Optimum nutrition in this age group is important, as growing bodies require all essential micronutrients and in sufficient supply; these nutrients primarily come from the intake of fruit, vegetables and dairy products which contain a multitude of vitamins, minerals and other healthy components (e.g. dietary fibre, phytochemicals). Additionally, recommended levels of dairy intake (e.g. milk) will ensure that young children are attaining appropriate levels of vitamin D and calcium, which in turn, will promote the healthy development of bones and teeth⁴⁸. Optimum nutrition also supports young

children to engage in learning^{11,49} and PA,¹¹ and achieve and maintain a healthy weight, which should enhance immediate and long-term health outcomes.⁵⁰ Early educators can have social influences on young children's food consumption patterns while in childcare, by way of staff behaviours (e.g. offering / available foods and serving amounts), values and beliefs regarding healthy lifestyles. Despite the fact that this intervention program did not show consistent statistically significant improvements in consumption patterns, we would recommend that RECEs have nutrition training as a component of their program, including their potential to impact children's long term health. Future research should examine how effective these programs are at instilling knowledge amongst workers. More research with respect to daycare staff feeding practices is required.

4.6b Parental Perceptions of Food Consumption

The NutriSTEP® parent-administered questionnaire was used to quantify children's food consumption patterns according to the parent (e.g. home feeding environment behaviours). Given that the CEC program has an educational component for parents, as well as instruction for children, we wanted to see whether there were any differences noted by the parents in food consumption patterns at home. Interest was exclusively around the number of servings from the four food groups the parents reported their children to consume. We originally hypothesized that parents would report higher food consumption from pre- to post- measurement for the intervention group, based on the parent-educational component of the intervention. Unfortunately, this was not found.

Results indicated no meaningful differences between the intervention and control groups. Frequency of grain consumption increased over time for all children, yet there was no group effect for grains. In the home setting, parents of control children reported

higher consumption of dairy (~3 to more than 3 servings daily) than the intervention group (~3 servings daily). Fruit and vegetable, and meat and alternatives consumption increased post-measurement for intervention participations. However, the changes in average scale scores might be considered negligible (e.g. 0.10-0.20 average change), and were statistically non-significant. These results may suggest that the CEC parent information pamphlets had no meaningful effect on food behaviours in the home, and that any impact on children in the daycare setting may not have extended to the home environment.

There was some discrepancy observed between what parents reported, and what children were actually consuming in the daycare environment. Parents, in general, reported greater consumption of each type of food for children in both groups and at both time points in the study than what children consumed. Since children would eat more food in a day than what was actually measured at the daycare, it is difficult to assess the accuracy of food consumption as reported by parents in this study, e.g. especially if they were reporting “daily” consumption. Furthermore, research shows that parents may not be a reliable source of information when seeking food consumption patterns⁵¹. Social-desirability among parents may lead to inaccurate reporting of healthy and unhealthy food consumption. In addition, it has also been recognised that reporting accuracy of dietary intake is relative to cognitive ability^{52,53}. Conceptually, before the age of 12 years, children’s recall skills, ability to estimate, indicate portion size and knowledge of foods is limited⁵⁴. More research is needed around tools that evaluate food consumption patterns of young children, and specifically, methods that accurately capture parent reporting. Eliminating misreporting of dietary intake of young children can lead to

positive health outcomes by reducing potentially unhealthy or at-risk behaviours.

Interestingly, when examining servings in the context of Canada's Food Guide recommendations for children aged 1-4 years, the children appear to be eating more meat/meat alternatives daily than recommended (~3+ servings daily), and are under-consuming fruits and vegetables (~2-3/4 servings daily) as reported by parents. This is reflective of the Canadian population^{55,56} and underlines the significant potential contribution of daycares in preschooler nutrition. For instance, all children ate on average 2 servings daily (or half of their daily recommended servings) of fruit and vegetables, and only ~1/2 of their daily recommended servings of meat/alternative foods at daycare. However, parents reported the consumption of daily grains at approximately 4-5 servings/day, while both daycares provided 2 servings of grains daily. Future research should examine food consumption patterns at daycare after implementation of a diet designed to enhance optimum nutrition in preschoolers.

4.6c Food Knowledge and Choice

We originally hypothesized that the intervention children would show improvement in their ability to distinguish healthy and unhealthy food items and would prefer healthy food choices after the intervention, based on increased knowledge of foods from the CEC programming. However, although food knowledge improved, preference for unhealthy foods remained.

Results for the PSS instrument indicated that the children were able to identify most foods, and were equally able to identify healthy and unhealthy foods. However, when given a choice between healthy and unhealthy foods few children preferred the healthy food options, even when, in the intervention group, there was an increased

awareness (knowledge) of which foods were healthy and which foods were considered ‘whoa’ foods (unhealthy). This indicates that knowledge of a food’s relative healthiness does not correspond to food preferences in this age group, which may reflect the children’s stage of development, e.g. difficulties in conceptualizing the long-term effects of short-term choices^{57,58}. According to Sigman-Grant et al. (2014), preschoolers may not be able to associate eating healthy to the abstract concept of health and future well-being and illness⁴². Therefore, providing young children with the definitions linking healthy and unhealthy eating to their bodies may not be sufficient to ensuring healthy preferences. Furthermore, previous research has shown that taste is a determinant of choice,⁵⁹ and that young children base what they believe to be healthy on their taste preferences⁴². This is supported by the current findings since the scores for preference and choice were low (indicating that the children preferred and chose the unhealthy food more frequently than the healthy food), regardless of the elevated knowledge scores. These findings are consistent with the *All 4 Kids Study*⁴² that included slightly older children between the ages of 3- and 5- years old. Not only did knowledge of healthy and unhealthy foods increase over time for all children, the intervention children correctly identified more foods (healthy and unhealthy) after the intervention compared to the control group. Despite this ability to distinguish healthy from unhealthy foods, preference for unhealthy foods was still observed.

The CEC classroom curriculum, which teaches about and promotes healthy eating behaviours, may have had an effect in this age group, despite the younger age, on average, of the sample for the current study. Although observed increases in food knowledge may be due other variables, e.g. to maturation effects, curricula for

preschoolers that addresses nutrition (e.g. slow, go and whoa foods), should be a program component for children of this age. Furthermore, this highlights the need for policy development, which would emphasize the provision of *only* healthy food options to children in childcare settings. Daycare policies that limit the number of non-food items offered to children would better ensure the consumption of healthy foods, at least while they are in attendance in these settings.

4.6d Physical Activity

The PA component of the CEC program was examined by using pedometers to measure children's average, total daily step counts, and average daily step counts during outside play. We hypothesized that the intervention children would be more active (increase in overall steps counts) than the control participants at post-measurement. Based on our findings, this hypothesis was not accepted.

Results showed statistically significant increases in total daily and outside step counts from pre- to post- measurement for both intervention and control children. In addition, a group effect was found; the intervention children took more steps (total and outside step counts) overall than control participants. However, given these results, it is unclear as to whether the improvements for intervention children were due to CEC programming. Intervention children had a higher number of step counts at both time points, which may reflect the characteristics of the play space available to the intervention children; this group had a larger outside playground, additional outdoors green space and access to a school track. Control participants did not have the same physical space arrangement. Furthermore, outdoor play largely explains the increase in total daily steps, as ½ of daily steps obtained were during outside play at post-

intervention for both groups. In addition, since early childhood is a period of rapid developmental change, increases in step counts may be attributed to physical maturation and the concomitant improvements in physical abilities (e.g. jumping, running) over the 6-month time period of program implementation. Therefore the utility of the CEC program at enhancing step counts while at daycare is questionable, and future research should examine scheduling changes that enhance outdoor play time while including an assessment of the size of total play space.

Importantly, in these daycares, this study also shows that the majority of young children were meeting the recommended 6,000 daily steps, which approximates CSEP guidelines of 180 minutes of PA at any intensity throughout the day⁶⁰. Although, Vale et al.⁶¹ state that the threshold of 6,000 daily steps corresponds with light intensity activity. Future research might consider further qualifying activity intensities, particularly between indoor and outdoor spaces.

4.6e Summary

In summary, we conclude that the CEC program may not have induced measureable changes in food consumption or PA levels in the daycare setting, when examined over a 6-month time interval. Although we did find improvements in children's food knowledge, results should be interpreted with caution, given the sample size and other factors that may have influenced the results, e.g. age effects. However, we would also highlight that the single day of training provided hands on training in both engaging children in group-play, and in the importance of healthy eating and eating strategies. We would recommend that concepts from the CEC program be included in the development

of governmental policy, which could shape the regulations under which daycares function.

Specific Recommendations are found under translation.

4.6f Limitations

This research is not without limitations and future work should consider addressing the following: First, the number of cases available for analysis at pre- and post-measurement was quite limited; therefore, the type of analysis (e.g. mixed ANOVA), and a more liberal approach to analysis and interpretation was taken, e.g. no further adjustment (to alpha level) for the number of tests ran. This necessitates caution upon interpretation of the findings of this study. In other words, firm conclusions as to the influence of the CEC intervention cannot be made. Although some findings (e.g. increases in children's food knowledge) are encouraging, a further consideration of statistical significance versus effect size in interpretation is required. At the least, certain results may be clinically meaningful, e.g. increase in milk/milk alternatives consumption. However, such results tended to be true of all children. Future research using larger sample sizes and more sophisticated analyses (e.g. to account for the clustering of children within daycare centres, and sample attrition) are required.

Second, both licensed daycare sites were in the same geographic area within a Canadian context. Consequently, generalizability is limited to other licensed child-care settings and geographical regions; researchers did not gather demographic information from parents, e.g. net family income and education. However, both sites in this study were considered high quality daycare centres that serve predominantly middle- to high-income families. More clinically significant outcomes might have been detected in the

intervention group amongst a larger cohort of low socioeconomic status and low- income children, when targeting PA and nutrition knowledge behaviours^{62,63}.

Third, both of the daycare sites were responsible for providing each child with prepared meals, and are obligated to follow the *Child Care and Early Years Act*, 2014) regulations⁶⁴. Conversely, in other daycare settings, parents may be responsible for menu planning, e.g. packing lunch bags for their children. Further research is needed around the quality of nutrition for both methods (e.g. packed lunches and meals served at daycare) throughout the childcare day. Further, there was no follow-up with staff regarding fidelity towards the implementation of CEC programming; the logistics regarding utilization of lesson plans (e.g. curriculum *It's Fun to be Healthy!*) and structured PAs, such as duration and frequency, were unexplored. Likewise, no follow-up was made on the extent to which tip-sheets were provided to caregivers, and/or if use of the sheets occurred in the home setting by the caregiver. However, this is how the CEC program is designed to be implemented; redevelopment of the program including these aspects might alter the effectiveness of the intervention and should be explored.

Further, we examined the indicators on the NutriSTEP® that capture the frequency of children's intake of servings from the four food groups (Canada's Food Guide³⁶) according to parent report. The entire NutriSTEP® measure was not used as intended, which may have implications for the reliability and validity of the measure. However, in this study, we were interested in the frequency of children's actual consumption versus parental report. In this manner, social desirability bias may have affected parental responses on the items in question. Overall scores were relatively high for both intervention and control groups, pre- and post- data collection periods.

Caregivers may have chosen their answers based on what they predicted the researcher was looking for in terms of responses. In addition, given that the children spend a significant time in the daycare setting, caregivers providing the dietary information may not have had the knowledge of foods served and/or consumed while at the centres.

Caregivers may have reported the amount of food served, and not necessarily how much was consumed. Further examination of what children are consuming outside of the daycare, e.g. a different parent measure other than the NutriSTEP® screening tool, is required. Food frequency surveys are regarded as poor measures of actual food consumption,⁶⁵ particularly when via secondary account (e.g. parental report)³⁹.

Lastly, the effects of maturation on the part of children may have impacted the results. Aging could have led to the increases observed in children's consumption behaviours, nutrition knowledge, and overall step counts. This is also a particular challenge facing all researchers when working with this cohort.

4.7 Translation to Health Education Practice

The present study sought to examine the effectiveness of CEC programming at impacting children's behaviours related to nutrition and PA practices. The CEC program is an intervention program designed to positively impact healthy development in young children, and improve the preschool environment through enhanced PA, nutrition behaviours and parental involvement³². The program is intended for preschool children (aged 3-5 years), and the children in this study ranged in age from approximately 18 months to four years of age. We would argue, however, for the utility of the programming for such a young cohort. Since there is an increasing rate of young children

attending daycare settings,⁴³ the integration of early intervention programs that focus on developing healthy behaviours will enhance health in the long-term. Few studies have investigated the effects of CEC intervention in the early years cohort (e.g. Sharma et al. 2011³²), and the current study adds valuable information to the existing literature. We summarize the following recommendations:

- 1) That the government mandate the inclusion of curriculum in RECE programs to include the following: instruction on nutrition needs of children aged 0-4 years; instruction on the PA needs of children aged 0-4 years; and play-based strategies for group play specific to this age group; annual refreshers and support documentation should also be offered to daycare providers that include an emphasis on the importance of healthy child development, health promotion (healthy nutrition) and disease prevention;
- 2) That the Ontario government set regulations around staff behaviours/feeding practices (e.g. modeling, child involvement, talking about healthy foods) to encourage children's healthy dietary intake and knowledge development around healthy food choices;
- 3) That daycare regulations (*Child Care and Early Years Act*) provide specific guidelines around nutrition quality and practices, including types and portion sizes of foods and beverages offered and consumed by children in childcare settings, such that preschoolers are offered healthy food choices repeatedly and in abundance, and unhealthy food offered infrequently, or excluded entirely from the daycare setting. Clear guidelines that specify menu offerings for daycare centers should be developed, which would include clear limits on unhealthy food choices;

4) That the promotion of PA for preschool-aged children considers their natural activity patterns (e.g. spontaneous and intermittent) for maintenance of PA behaviours, thereby encouraging unstructured free-play, and regulating mandatory outdoor-play with adequate space and equipment (how much, how often), while, in turn, promoting the progression towards at least 60 minutes of energetic play by 5 years of age;

5) That the CEC parental take-home tip-sheets continue to be used in childcare settings to offer a way to reach caregivers to make healthful changes at home by reinforcing and supporting healthful lifestyle habits. In addition, that daycare staffs communicates regularly, sets expectations around parental involvement, and creates structured opportunities to get families involved.

These recommendations will hopefully support policy makers when deciding best practices, and when developing effective early intervention programs that focus on promoting healthful eating behaviours and PA pattern within the daycare environments. Similarly, the integration of early intervention programs should support and promote ongoing healthy child development among young children, to ensure health in the long-term.

4.8 References

1. UNESCO. *Early Childhood Care and Education*. Retrieved from [http://en.unesco.org/themes/early-childhood-care-and-education.](http://en.unesco.org/themes/early-childhood-care-and-education;); 2017.
2. Dovey TM, Staples PA, Gibson EL, Halford JCG. Food neophobia and “picky/fussy” eating in children: a review. *Appetite*. 2008;50(2-3):181-193. doi:10.1016/j.appet.2007.09.009
3. Adolph KE, Berger SA. Motor development. In: *Handbook of Child Psychology, Cognition, Perception, and Language*. John Wiley & Sons; 2006.
4. Ungar M. Practitioner Review: Diagnosing childhood resilience--a systemic approach to the diagnosis of adaptation in adverse social and physical ecologies. *J Child Psychol Psychiatry*. 2015;56(1):4-17. doi:10.1111/jcpp.12306
5. Goldfield GS, Harvey A, Grattan K, Adamo KB. Physical Activity Promotion in the Preschool Years: A Critical Period to Intervene. *Int J Environ Res Public Health*. 2012;9(4):1326-1342. doi:10.3390/ijerph9041326
6. Peters J, Sinn N, Campbell K, Lynch J. Parental influences on the diets of 2–5-year-old children: systematic review of interventions. *Early Child Dev Care*. 2012;182(7):837-857. doi:10.1080/03004430.2011.586698
7. Scaglioni S, Arrizza C, Vecchi F, Tedeschi S. Determinants of children’s eating behavior. *Am J Clin Nutr*. 2011;94(6 Suppl):2006S - 2011S. doi:10.3945/ajcn.110.001685
8. Birch LL, Ventura AK. Preventing childhood obesity: what works? *Int J Obes* 2005. 2009;33 Suppl 1:S74-S81. doi:10.1038/ijo.2009.22
9. Fuller C, Keller L, Olson J, Plymale A. Helping preschoolers become healthy eaters. *J Pediatr Health Care*. 2005;19(3):178-182. doi:10.1016/j.pedhc.2005.03.007
10. Savage JS, Fisher JO, Birch LL. Parental influence on eating behavior: conception to adolescence. *J Law Med Ethics J Am Soc Law Med Ethics*. 2007;35(1):22-34. doi:10.1111/j.1748-720X.2007.00111.x
11. Drewnowski A, Mennella JA, Johnson SL, Bellisle F. Sweetness and food preference. *J Nutr*. 2012;142(6):1142S - 8S. doi:10.3945/jn.111.149575
12. Campbell K, Crawford D. Family food environments as determinants of preschool-aged children’s eating behaviours: implications for obesity prevention policy. A review. *Aust J Nutr Diet*. 2001;58(1):19-25.
13. Lyn R, Evers S, Davis J, Maalouf J, Griffin M. Barriers and supports to implementing a nutrition and physical activity intervention in child care: directors’

perspectives. *J Nutr Educ Behav*. 2014;46(3):171-180.
doi:10.1016/j.jneb.2013.11.003

14. Statistics Canada. *Women and Paid Work*. Retrieved from <http://www.statcan.gc.ca/pub/89-503-x/2015001/article/14694-eng.htm>.; 2017.
15. Kottelenberg MJ, Lehrer SF. *New Evidence on the Impacts of Access to and Attending Universal Childcare in Canada*. National Bureau of Economic Research; 2013. <http://www.nber.org/papers/w18785>.
16. Sinha, M. *Spotlight on Canadians: Results from the General Social Survey. Child Care in Canada*. Statistics Canada; 2014.
17. College of Early Childhood Educators. Retrieved from <https://www.college-ece.ca/en>.; 2017.
18. Phillips DA, Lowenstein AE. Early care, education, and child development. *Annu Rev Psychol*. 2011;62:483-500. doi:10.1146/annurev.psych.031809.130707
19. Rentzou K, Sakellariou M. The Quality of Early Childhood Educators: Children's Interaction in Greek Child Care Centers. *Early Child Educ J*. 2011;38(5):367-376. doi:10.1007/s10643-010-0403-3
20. Dunn C, Thomas C, Ward D, et al. Design and Implementation of a Nutrition and Physical Activity Curriculum for Child Care Settings. *Prev Chronic Dis*. 2006;3(2). <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1563947/>.
21. Active For Life. Early childhood centres: Making physical literacy the norm. <http://activeforlife.com/early-childhood-physical-literacy-norm/>. Published 2017.
22. Tremblay L, Boudreau-Larivière C, Cimon-Lambert K. Promoting physical activity in preschoolers: A review of the guidelines, barriers, and facilitators for implementation of policies and practices. *Can Psychol Can*. 2012;53(4):280.
23. Timmons BW, Naylor P-J, Pfeiffer KA. Physical activity for preschool children: how much and how? *Can J Public Health Rev Can Sante Publique*. 2007;98 Suppl 2:S122-S134.
24. Adamo KB, Barrowman N, Naylor PJ, et al. Activity Begins in Childhood (ABC) - inspiring healthy active behaviour in preschoolers: study protocol for a cluster randomized controlled trial. *Trials*. 2014;15:305. doi:10.1186/1745-6215-15-305
25. Fung C, Kuhle S, Lu C, et al. From “best practice” to “next practice”: the effectiveness of school-based health promotion in improving healthy eating and physical activity and preventing childhood obesity. *Int J Behav Nutr Phys Act*. 2012;9:27. doi:10.1186/1479-5868-9-27

26. Ling J, Robbins LB, Wen F. Interventions to prevent and manage overweight or obesity in preschool children: A systematic review. *Int J Nurs Stud.* 2016;53:270-289. doi:10.1016/j.ijnurstu.2015.10.017
27. de Onis M, Blössner M, Borghi E. Global prevalence and trends of overweight and obesity among preschool children. *Am J Clin Nutr.* 2010;92(5):1257-1264. doi:10.3945/ajcn.2010.29786
28. Hesketh KD, Campbell KJ. Interventions to Prevent Obesity in 0–5 Year Olds: An Updated Systematic Review of the Literature. *Obesity.* 2010;18(S1):S27-S35. doi:10.1038/oby.2009.429
29. Chow BC, McKenzie TL, Louie L. Children’s Physical Activity and Associated Variables during Preschool Physical Education. *Adv Phys Educ.* 2015;05(01):39. doi:10.4236/ape.2015.51005
30. Centers for Disease Control and Prevention. *Prevention Research Centers: Elementary School Program Improves Children’s Physical Activity and Diet.* Retrieved from <https://www.cdc.gov/prc/prevention-strategies/elementary-school-program.htm> Health Sciences North’s vision is to be globally recognized for patient-centred innovation.; 2016.
31. Dunn-Carver M, Pope L, Dana G, et al. Evaluation of a teacher-led physical activity curriculum to increase preschooler physical activity. *Open J Prev Med.* 2013;03(01):141. doi:10.4236/ojpm.2013.31018
32. Sharma S, Chuang R-J, Hedberg AM. Pilot-Testing CATCH Early Childhood: A Preschool-Based Healthy Nutrition and Physical Activity Program. *Am J Health Educ.* 2011;42(1):12-23.
33. Kelder S, Hoelscher DM, Barroso CS, Walker JL, Cribb P, Hu S. The CATCH Kids Club: a pilot after-school study for improving elementary students’ nutrition and physical activity. *Public Health Nutr.* 2005;8(2):133-140.
34. Tremblay MS, Chaput J-P, Adamo KB, et al. Canadian 24-Hour Movement Guidelines for the Early Years (0-4 years): An Integration of Physical Activity, Sedentary Behaviour, and Sleep. *BMC Public Health.* 2017;17(Suppl 5):874. doi:10.1186/s12889-017-4859-6
35. Bandura A. Social foundation of thought and action: A social-cognitive view. *Englewood Cliffs.* 1986.
36. CATCH. *PRE-K.* Retrieved from <http://catchinfo.org/programs/pre-k/>; 2016.
37. Health Canada. *Food and Nutrition: Canada’s Food Guide.* Retrieved from [http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/order-commander/index-eng.php#3](http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/order-commander/index-eng.php#3;).; 2017.

38. Nasco. *Nutrition Teaching Aids*. Retrieved from <https://www.enasco.com/t/Nutrition/Life-form-Replicas.>; 2017.
39. Williamson DA, Allen HR, Martin PD, Alfonso A, Gerald B, Hunt A. Digital photography: A new method for estimating food intake in cafeteria settings. *Eat Weight Disord - Stud Anorex Bulim Obes*. 2004;9(1):24-28. doi:10.1007/BF03325041
40. Ball SC, Benjamin SE, Ward DS. Development and reliability of an observation method to assess food intake of young children in child care. *J Am Diet Assoc*. 2007;107(4):656-661. doi:10.1016/j.jada.2007.01.003
41. Randall Simpson JA, Keller HH, Rysdale LA, Beyers JE. Nutrition Screening Tool for Every Preschooler (NutriSTEP): validation and test-retest reliability of a parent-administered questionnaire assessing nutrition risk of preschoolers. *Eur J Clin Nutr*. 2008;62(6):770-780. doi:10.1038/sj.ejcn.1602780
42. Randall Simpson J, Gumbley J, Whyte K, et al. Development, reliability, and validity testing of Toddler NutriSTEP: a nutrition risk screening questionnaire for children 18-35 months of age. *Appl Physiol Nutr Metab Physiol Appl Nutr Metab*. 2015;40(9):877-886. doi:10.1139/apnm-2015-0048
43. Sigman-Grant M, Byington TA, Lindsay AR, et al. Preschoolers can distinguish between healthy and unhealthy foods: the all 4 kids study. *J Nutr Educ Behav*. 2014;46(2):121-127. doi:10.1016/j.jneb.2013.09.012
44. Tandon PS, Saelens BE, Christakis DA. Active Play Opportunities at Child Care. *Pediatrics*. 2015;135(6):e1425. doi:10.1542/peds.2014-2750
45. Martin CK, Newton RL, Anton SD, et al. Measurement of children's food intake with digital photography and the effects of second servings upon food intake. *Eat Behav*. 2007;8(2):148-156. doi:10.1016/j.eatbeh.2006.03.003
46. Williamson DA, Allen HR, Martin PD, Alfonso AJ, Gerald B, Hunt A. Comparison of digital photography to weighed and visual estimation of portion sizes. *J Am Diet Assoc*. 2003;103(9):1139-1145. doi:10.1053/jada.2003.50567
47. Rogol AD, Clark PA, Roemmich JN. Growth and pubertal development in children and adolescents: effects of diet and physical activity. *Am J Clin Nutr*. 2000;72(2 Suppl):521S - 8S.
48. Baby Center. *Growth Spurts: What You Need to Know?* Retrieved from https://www.babycenter.com/0_growth-sprunts-what-you-need-to-know_3659612.bc.; 2017.
49. Godel JC. Vitamin D supplementation: Recommendations for Canadian mothers and infants. *Paediatr Child Health*. 2007;12(7):583-589. doi:10.1093/pch/12.7.583

50. Taras H. Nutrition and student performance at school. *J Sch Health*. 2005;75(6):199-213. doi:10.1111/j.1746-1561.2005.00025.x
51. Koletzko B, Brands B, Poston L, Godfrey K, Demmelmair H, Early Nutrition Project. Early nutrition programming of long-term health. *Proc Nutr Soc*. 2012;71(3):371-378. doi:10.1017/S0029665112000596
52. van de Gaar VM, Jansen W, van der Kleij MJJ, Raat H. Do children report differently from their parents and from observed data? Cross-sectional data on fruit, water, sugar-sweetened beverages and break-time foods. *BMC Public Health*. 2016;16:341. doi:10.1186/s12889-016-2963-7
53. Rosales FJ, Reznick JS, Zeisel SH. Understanding the Role of Nutrition in the Brain & Behavioral Development of Toddlers and Preschool Children: Identifying and Overcoming Methodological Barriers. *Nutr Neurosci*. 2009;12(5):190-202. doi:10.1179/147683009X423454
54. Singh AS, Mulder C, Twisk JWR, van Mechelen W, Chinapaw MJM. Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obes Rev Off J Int Assoc Study Obes*. 2008;9(5):474-488. doi:10.1111/j.1467-789X.2008.00475.x
55. Livingstone MBE, Robson PJ, Wallace JMW. Issues in dietary intake assessment of children and adolescents. *Br J Nutr*. 2004;92 Suppl 2:S213-S222.
56. Minaker L, Hammond D. Low Frequency of Fruit and Vegetable Consumption Among Canadian Youth: Findings From the 2012/2013 Youth Smoking Survey. *J Sch Health*. 2016;86(2):135-142. doi:10.1111/josh.12359
57. Statistics Canada. *Fruit and Vegetable Consumption*. Retrieved from <http://www.statcan.gc.ca/pub/82-229-x/2009001/deter/fvc-eng.htm>.; 2016.
58. Stang J. Improving the eating patterns of infants and toddlers. *J Am Diet Assoc*. 2006;106(1 Suppl 1):S7-S9. doi:10.1016/j.jada.2005.10.028
59. Fox MK, Pac S, Devaney B, Jankowski L. Feeding infants and toddlers study: What foods are infants and toddlers eating? *J Am Diet Assoc*. 2004;104(1 Suppl 1):s22-s30. doi:10.1016/j.jada.2003.10.026
60. Brug J, Tak NI, te Velde SJ, Bere E, de Bourdeaudhuij I. Taste preferences, liking and other factors related to fruit and vegetable intakes among schoolchildren: results from observational studies. *Br J Nutr*. 2008;99 Suppl 1:S7-S14. doi:10.1017/S0007114508892458
61. Gabel L, Proudfoot NA, Obeid J, et al. Step count targets corresponding to new physical activity guidelines for the early years. *Med Sci Sports Exerc*. 2013;45(2):314-318. doi:10.1249/MSS.0b013e318271765a

62. Vale S, Trost SG, Duncan MJ, Mota J. Step based physical activity guidelines for preschool-aged children. *Prev Med.* 2015;70:78-82. doi:10.1016/j.ypmed.2014.11.008
63. Boelsen-Robinson T, Peeters A, Beauchamp A, Chung A, Gearon E, Backholer K. A systematic review of the effectiveness of whole-of-community interventions by socioeconomic position. *Obes Rev Off J Int Assoc Study Obes.* 2015;16(9):806-816. doi:10.1111/obr.12297
64. Beauchamp A, Backholer K, Magliano D, Peeters A. The effect of obesity prevention interventions according to socioeconomic position: a systematic review. *Obes Rev.* 2014;15(7):541-554. doi:10.1111/obr.12161
65. Queens Printer for Ontario. Retrieved from <https://www.ontario.ca/laws/statute/14c11?search=child+care+and+early+years+act#top>; 2017.
66. Jarman M, Fisk C, Ntani G, et al. Assessing diets of 3 year old children: evaluation of a food frequency questionnaire. *Public Health Nutr.* 2014;17(5):1069-1077. doi:10.1017/S136898001300102X

5.0 Chapter 5:

DISCUSSION

5.1 Summary

The CEC intervention includes preschool-based nutrition, PA, and family/community components in a health promotion program targeting young children. The main objective of this thesis was to examine the impact of the CEC program. Nutrition behaviours and PA levels were compared before and after implementation of the program for children attending centre-based care and compared to a control group. This study, to our knowledge, is one of the few (e.g. Dunn-Carver et al. 2013; Sharma et al. 2011) to have examined CEC implementation. Likewise, this study was one of the first to investigate young children's nutritional choices and food consumption by way of the PSS instrument (Sigman-Grant et al. 2014) and direct-observation (Sharma et al. 2011).

In the current study, our results revealed interesting relationships, and other findings relevant to preschooler program development, but none-the less suggest the CEC program alone may be insufficient to induce meaningful health behaviour change in young children. Results from the food consumption measures are questionable with regard to healthful changes in food consumption, either in the daycare centre or at home, despite some statistically significant changes over time and between groups. Results from the NutriSTEP®, parent-perception questionnaire items indicate that children are consuming a surplus of grains, milk/alternatives and meat/alternatives, and not enough vegetables/fruits. The PSS instrument indicated that few children preferred the healthy food options, when presented side-by-side with unhealthy foods, even though they did

well at identifying both healthy and unhealthy foods. Lastly, results for PA patterns showed that the majority of young children are meeting 6,000 daily steps equating to guidelines of 180 minutes of PA at any intensity throughout the day. Irrespective of intervention, and perhaps more relevant is the time allocated for outdoor-play, and the space available to engage in play.

This chapter is the continuation of the discussion from the paper without duplication in order to expand on additional factors. It includes further discussion around menu planning, feeding-practices, short-tool dietary assessments, and PA behaviours in young children.

5.2 Food Consumption

5.2a Food Photography

It is important to analyse the number of food group servings as well as the types of food being consumed at childcare centres in order to make inferences about the quality of children's diets. The results for the food photography data showed that all of the children, consumed, on average half of the recommended number of servings for each of the four food groups to meet the Eating Well with Canada's Food Guide (CFG) (Health Canada, 2017) during the daycare day. According to the American Dietetic Association (2004), young children enrolled in child care settings on a part-time basis should be consuming a third of their daily nutrient requirements, and full-time children, one half to two thirds of their daily nutrient needs. The intervention group participants were consuming less than ½ of daily recommended grain products, vegetables and fruits, and meat/alternative requirements, and the control group, consumed about half of required

grain product needs, although both groups were consuming sufficient amounts of milk (more than ½ of daily recommended intake). The control group did meet the nutrient requirements for vegetables and fruit (½) and meat and alternatives (⅔) during the daycare day. Despite this, these data suggest that there is opportunity for improvement, particularly given that these daycares were assessed as top performers by the local district health unit.

In Ontario, the childcare and early years system follows the rules and legislations set out by the *Child Care and Early Years Act, 2014* (CCEY), as outlined by the Ontario Ministry of Education. The CCEY came in to effect August 31, 2015, replacing the *Day Nurseries Act* (DNA), a legislation that has not been updated since 1983. The updated Act created new rules governing the childcare system in Ontario (Queen’s Printer for Ontario, 2017). Some of those changes were that staff members must obtain an updated police record check (those working with the vulnerable sector), maintain first-aid certification, and follow the government’s policy statement about early child development. The Act applies to unlicensed childcare programs and home childcare providers contracted by a licensed agency, and licensed home childcare agencies and licensed childcare centres. This modernization of care was established to build a system of high quality care that is seamless and accessible for children and families.

Currently, the standards around meal planning for childcare centres are guided by provincial standards outlined in the CCEY. According to the Act, meal planning/nutrition requirements for a child over the age of one must meet and follow the guidelines set out in the Health Canada documents “Eating Well with Canada’s Food Guide”, “Eating Well with Canada’s Food Guide – First Nations, Inuit and Métis” or “Nutrition for Healthy

Term Infants.” Additionally, for young children attending a home-based childcare, meal planning must be completed in consultation with a parent of the child and a home childcare visitor, and meals/snack planning is to follow the same guidelines as children in centre-based care. Irrespective of this, depending on the centre that the child is attending, variability does exist around dietary intake. First, staff-feeding practices/behaviours vary among childcare settings. For instance, with family-style eating practices, Centre staff serve children from a communal bowl, and they may eat and sit with the children at a table. This is a popular childcare practice in Ontario, whereas in kindergarten and elementary schools this is not the case. Central to this discontinuity is the ongoing debate over whether family-style meals offer better nutrition than home-packed lunches. Home-packed lunches are not required to meet provincial nutrition standards, whereas licensed childcare centres are required to meet the provincial standards. In a recent study by Farris et al. (2014), researchers found that home-packed lunches were less likely than cafeteria-style lunches to contain fruits (54% vs. 67%), vegetables (17% vs. 61%), and milk (20% vs. 96%). Similarly, a study by Pabayo et al. (2012) found that children attending daycare were less likely to consume foods from the “choose least often” category, most likely due to the nutrition standards at child care centres. Therefore, family-style meals in daycare settings can assist with altering some environmental factors, e.g. promote healthy behaviours among preschool-aged children. This practice can also promote healthy food consumption by way of staff modeling and self-serving, as it can support acceptance of novel foods more readily, and children can listen to hunger and satiety cues.

5.2b NutriSTEP® Questionnaire

The NutriSTEP® is a community-based, parent-administered nutrition-screening tool

that represents an integrated approach to assess nutrition behaviours. The nutrition risk-screening tool is simple, easily implemented, and can be used in community-based settings (Simpson et al. 2008). To date, not much is known about short tools that assess dietary intake, and only a few tools exist that target the early years population (Rice et al. 2015; Bell et al. 2013). One factor limiting the accuracy of assessing dietary patterns among young children is their level of cognitive ability to report their own nutrition behaviours, and therefore information is often dependent on caregiver report (Jarman et al. 2014). According to Bell et al. (2013), recent tools have been designed to identify nutritional risk in sick, hospitalised children; few have been developed to screen for nutritional risk in healthy preschoolers. Consequently, knowledge around nutrition practices obtained from this measure is essential, as nutrition patterns are established at an early age and have lasting effects on development.

The early years are understood to be an important period for obesity prevention, and given that childhood nutrition directly impacts growth and development, this screening tool provides parents with awareness and a starting point for early identification of nutritional risk for their child. Accordingly, results from this screening questionnaire could offer a way of understanding the contribution of early life food intake and health status, as well as receiving appropriate referrals to community health services. The simplicity of the tool can be an attractive alternative to data-driven research (e.g. health-care context), as it can be associated with reduced participant burden, data handling and processing, as well as cost (Bell et al. 2013). Alternatively, the instrument can be useful in clinical settings for rapid assessment of food behaviours against food-based dietary guidelines. The NutriSTEP® screening tool can identify eating behaviours that reflect the

current accepted and widely used guidelines (e.g. Eating Well with Canada's Food Guide) and therefore can be associated with health status. However, caution must be exercised regarding the quality of short dietary intake assessment tools, specifically for young children. Further research is required to investigate whether screening tools provide high-quality assessments to predict health outcomes, and whether the screening tools accurately identify nutrition risk.

The NutriSTEP® item results do rely on parent-report, which may not be completely accurate. For example, it is not understood whether or not parents reported on what the child was eating in the home environment, and/or what they believed the child was consuming while at daycare. In addition, the food menu for the day was posted and updated regularly on a chalkboard in both centres, but whether parents were reading the menu information is unclear. Since young children under the age of 7 years are unable to recall, estimate and/or indicate portion sizes (Vereecken & Maes, 2014; Bornhorst et al. 2013; Livingstone et al. 2004) due to their limited cognitive abilities (developmental stage) (Bornhorst et al. 2013), parental reports are required when assessing young children's dietary intake (Vereecken & Maes, 2014). Although caregivers may have the ability to report their child's dietary intake, some issues arise with reliability and accuracy. These limitations include limited knowledge of dietary intake when away from the parent, e.g. childcare setting. Dietary assessment has been associated with misreporting (both under- and over- reporting) (Bornhost et al. 2013). In Fisher et al.'s (2008) study, caregivers overestimated the macronutrient and micronutrient intakes of infants and toddlers when compared to the weighed food record. Reinaerts & colleagues (2007) also found low levels of parental reporting for fruit and vegetable intake. Parental

reports in the current study are similar to the Fisher et al. (2008) and Reinaerts et al. (2007) findings.

5.2c Preschool Snack Selection Instrument

The PSS instrument was used to assess children's nutrition knowledge, preferences and distinction of healthy foods. Overall results showed that few children preferred the healthy food options, when presented side-by-side with unhealthy foods, even though they did well at identifying both healthy and unhealthy foods. Since young children's knowledge around foods can be linked to health outcomes, and in turn influence dietary preferences and food choices in adulthood, it is important for early education integration around foods to help shape early eating behaviours. A study by Wiseman & Harris (2015) reviewed interactive and task-centered techniques used to assess components of food and nutrition knowledge in preschool-aged children. Included, for instance, were strategies such as the use of stimulus material and prompts (e.g. photographs, storybooks and plastic food replicas) and structure play-based activities (e.g. meal-creation tasks, play kitchen observations, board games and role-play). According to Wiseman et al. (2015), instruments used to collect information from young children need to be interactive and appealing to ensure quality information that actively engages children and encourages willing participation. When considering our results, and observations in the field, we conclude that the PSS instrument is an appropriate tool for this age group, and can adequately measure preschoolers nutrition knowledge, their ability to distinguish healthy versus unhealthy foods, and stated food preferences. This tool can be used as an effective measure to investigate program effectiveness and research interventions, ensuring its impact on nutrition education in young children.

Since children of this age are vulnerable to social influences, and health behaviours start early, it is imperative to promote and encourage healthy nutrition early on. More research is, however, needed in order to determine which method is more suitable to measure young children's knowledge, preferences and distinction of healthy foods. In addition, given that young children learn through play and receive tactile input (sensory) through touch, structured-play based activities to gauge food knowledge warrants further investigation.

5.3 Physical Activity

Research in this cohort of children regarding physical activity levels is quite limited, and the debate over appropriate measures to assess PA has been a long-standing issue of concern (Beets et al. 2005). The difficulty is due to young children's PA behaviours being characterized by intermittent, unstructured play; PA is also often spent in low- to moderate-intensity activities. In addition, movement patterns in preschoolers vary in comparison to school-aged children (e.g. wider base of support during gait development and ambulation during recreational activities) (Kohl & Cook, 2013).

Pedometers were used to assess the PA levels of the children in the current study, and the participants, on average, were found to meet the minimum threshold for adequate PA levels. The recommended guidelines state that young children aged 0-4 years (consisting of toddlers aged 1-2 years and preschoolers aged 3-4 years) should accumulate daily, a minimum of 180 minutes of PA at any intensity, spread throughout the day. Step count targets corresponding to these guidelines are estimated to be 6,000 steps daily for children aged 3-5 years (Gabel et al. 2012; Colley et al. 2012). Intervention children and

control children had an increase in total daily and outside step counts from pre- to post-measurement; the intervention children took more steps (total and outside step counts) overall compared to control participants.

Pedometer devices are progressively being used as health behaviour tracking instruments due to their low cost, unobtrusive nature (e.g. small size) and the simplicity of the currency of steps. Studies have concluded that the pedometer is a valid and reliable tool for assessing PA in young children (Oliver et al. 2007; Mckee et al. 2005; Louie & Chan, 2003). The only downfall, however, is that the device is unable to measure intensity, other than as steps per minute (Pagels et al. 2011). The children in our study were not bothered by the pedometer, and looked forward to wearing the device upon arrival to the centres. They would willingly approach the researcher in the morning as a reminder to place the pedometer on their person. There was also no tampering of the device observed (e.g. shaking the device). Compliance of pedometer protocols was generally well received by the young children in this study. As such, based on the results and experiences using pedometers in this study, we recommend that the usage of this device is appropriate for preschool aged children.

Further, the type of play was not measured in this study, and since young children tend to participate in free-play opportunities (Soini et al. 2016), it is difficult to draw conclusions regarding this. In addition, contextual factors (frequency and duration) of dedicated outdoor-play in childcare settings, as well as the time of day should be further examined in order to have a better understanding of PA levels among preschool-aged children. Additionally, since childcare centres have a positive influence on promoting healthy PA behaviours, more research is needed around PA patterns, such as the

accumulation of PA during the weekday or the weekend. These distinct patterns and levels are important to establish as it can assist with intervention planning and programming, and to improve health outcomes. It may be valuable to look at developing specific health promotion programs targeting young girls to ensure that they are accumulating enough PA levels during the childcare day, and in succession achieving health benefits.

In terms of the relationship between PA levels and health outcomes, we recommend, in general, that young children continue with PA in all areas of the childcare day, as more PA will benefit overall health status. In saying that, we recognise that PA patterns for young children are of low-intensity; more weight should be placed on childcare providers regarding their role to encourage PA participation among children in childcare settings. Additionally, we encourage the importance that young children engage in activities of their choosing, but with childcare staff acting as facilitators. Thus, childcare providers serve an important role in fostering healthy child development. Given that PA is a modifiable risk factor for healthy child development, health promotion around active behaviours must be a priority.

5.4 Limitations and Future Directions

The current research is not without limitations. First, this study is of small sample size due to the limited number of children that participated, and that had been available for follow-up assessment. This is problematic for a number of reasons. For example, the type of analysis used (e.g. mixed ANOVA) may not have been the most appropriate (e.g. due to the clustering of children within daycares), a low sample size may have

compromised statistical power to detect differences, etc. A further consideration of statistical significance versus effect size in interpretation is required, as is future research using larger sample sizes and more sophisticated analyses. Additionally, the study-assessed children at one follow-up time point post-intervention, 6-months after. Some studies have implemented intervention programs for shorter periods, e.g. 5 days to 8 weeks (Pate et al, 2016), and others for longer periods (e.g. 13-months), although the benefits of intervention programs have been found to decrease with longer follow-up periods (Nguyen et al 2016). Thus, it is not known whether more concrete differences would have been found with a smaller time frame (e.g. 3-month testing), or with multiple testing points. Additional research is needed on appropriate testing points, and establishing uniformity when measuring the efficacy of early intervention programs among preschool-aged children.

Second, this study relied on a convenience sample of children and their families. There was no inclusion or exclusion criteria identified prior to selecting participants. Third, both licensed daycare sites (e.g. intervention and control group) were in the same geographic area within a Canadian context. Consequently, generalizability may be limited to other licensed child-care settings and geographic regions. For example, we did not gather demographic information from parents, e.g. net family income and education. However, both sites in this study were considered high quality daycare centres that serve predominantly middle- to high- income families, and we had a high response/participation rate. Different strategies may be considered for those of low income when targeting PA and nutrition knowledge behaviours. For instance, a study by Duncan & Magnuson, (2015) reported that attending a good quality daycare centre results

in long-lasting improvements in school readiness and success; however, low-income children are less likely to be immersed in a daycare setting. Therefore, policies should first focus on improving their attendance, since these children are at greater risk for poorer health outcomes. Future research is also needed around intervention program hours of service delivery, and outcomes around those effects.

Additionally, both these daycare sites were responsible for providing each child with prepared meals, and are obligated to follow the *Early Years and Child Care Act* (2014). Conversely, in other daycare settings, parents may be responsible for menu planning, e.g. packing lunch bags for their children. Further research is needed around the quality and types of foods offered in a childcare setting, specifically around home-packed lunches versus family-style meals in daycare settings.

Further, there was no follow-up with staff regarding fidelity towards implementation of CEC programming. In this study, logistics regarding utilization of lesson plans (e.g. curriculum *It's Fun to be Healthy!*) and structured PA, such as duration and frequency, were unexplored. Likewise, no follow-up was made on the extent to which the CEC program tip-sheets were sent home to parents, and/or if tip-sheets were utilized in the home setting. For example, the original CEC pilot study by Sharma et al. (2011) evaluated the feasibility and acceptability of CEC programming post-intervention by conducting two distinct focus groups; one group included teachers (who delivered the program), and the other group was comprised of parents. Investigators also distributed teacher-reported lesson plan evaluation forms concerning the feasibility and acceptability of the classroom curriculum (forms for each of the nine lessons). Parents reported having received the tip-sheets, and found that CEC messaging to introduce healthy eating was

beneficial. As for the teachers, results showed that they were able to incorporate the CEC lessons and activities successfully. Teachers also reported that children responded positively to the activities included in the CEC lessons. Some suggestions for improvements included shortening the length of the classroom lessons, but overall, teachers considered the activities simple to follow by the children, and interesting to participate in. The teachers, however, did not incorporate PA sessions every day as intended. Similarly, results of the nutrition lesson plan evaluation form showed good feasibility and acceptability of the classroom curriculum by teachers.

In the current study, fidelity was not assessed, as the main objective was to investigate children's nutritional choices and activity levels before and after implementation of the program. Thus, the intent was not to investigate program and/or curriculum capacity. Fidelity to program implementation should be considered in future studies that examine the influence of this program on children's PA and nutrition outcomes. The RECEs should receive yearly refreshers (in-service) around CEC programming to keep up-to-date with current trends, and ensure fidelity regarding implementation of the program. Also, both Centres should have a "train-the-trainer" on site to ensure lesson planning and delivery, evaluations, and program development.

Social desirability bias may also be present in this study, since the Toddler and Preschooler NutriSTEP® is a self-administered parent screening tool. Further, we only examined single-indicator items that capture the frequency of children's intake of servings from the four food groups. Overall scores were relatively high for both intervention and control groups, pre- and post- data collection periods. Caregivers may have chosen their answers based on what they predicted the researcher was looking for in

terms of responses. Similarly, relating to the “Preschool Snack Selection” instrument, kids knowledge of food and distinction of healthy foods might be affected by their preferences. We would need to further examine what kids are consuming outside of the daycare, e.g. a different parent measure other than the NutriSTEP® screening tool.

Researchers in this study noted casual observations of interior and exterior spaces and materials that might restrict PA opportunities. The built environment in each daycare differed. For instance, the intervention site had access to an outdoor track, and more green space for outdoor play. Additionally, their indoor preschool room had a more open play area than the control group. The control group, however, had limited outdoor space for both groups (e.g. toddler and preschool), as the outside environment had naturally raised areas of land, and children were not permitted on these prominent sections. Both childcare sites had access to a gymnasium across the street. However this gym was infrequently used. Access to organizational facilities needs to be further investigated for the childcare sector, as more space availability may create favourable PA opportunities for young children.

5.5 Conclusion

In conclusion, implementation of the CEC program as a potential strategy to improve the health behaviours of young children showed some statistically significant changes. However, results may not be meaningful, and must therefore be interpreted with caution. This study adds to the current body of literature around early intervention programs within daycare settings, but further research is needed to quantify whether the CEC program can positively impact nutritional choices and PA behaviours among this cohort.

5.6 References

- American Dietetic Association, (2004). Position of the American dietetic association: Dietary guidance for healthy children aged 2 to 11 years. *Journal of the American Dietetic Association*, 104(4), 660-677. doi: 10.1016/j.jada.2004.01.030
- Beets, M.W., Patton, M.M., & Edwards, S. (2005). The accuracy of pedometer steps and time during walking children. *Medicine Science & Sports Exercise*, 513-520. doi: 10.1249/01.MSS.0000155395.49960.31
- Bell, L.K., Golley, R.K., & Magarey, A.M. (2013). Short tools to assess young children's dietary intake: a systematic review focusing on application to dietary index research. *Journal of Obesity*, 709626. doi: 10.1155/2013/709626
- Börnhorst, C., Huybrechts, I., Ahrens, W., Eiben, G., Michels, N., et al. (2013). Prevalence and determinants of misreporting among European children in proxy-reported 24 h dietary recalls. *British Journal of Nutrition*, 109(7), 1257-1265. doi:10.1017/S0007114512003194
- Brasholt, M., Chawes, B., Kreiner-moller, E., Vahlkvist, S., Sinding, M., et al. (2013). Objective assessment of levels and patterns of physical activity in preschool children. *Pediatric Research*, 74, 333–338. doi:10.1038/pr.2013.99
- Colley, R.C., Janssen, I., & Tremblay, M.S. (2012). Daily step target to measure adherence to physical activity guidelines in children. *American College of Sports Medicine*, 977-982. doi: 10.1249/MSS.0b013e31823f23b1
- Duncan, G.J., & Magnuson, K. (2015). Early childhood interventions for low-income children. *Focus*, 31(2), 1-5.
- Farris, A. R., Misyak, S., Duffey, K. J., Davis, G. C., Hosig, K., et al. (2014). Nutritional comparison of packed and school lunches in pre-kindergarten and kindergarten children following the implementation of the 2012–2013 national school lunch program standards. *Journal of Nutrition Education and Behavior*, 46(6), 621–626.
- Fisher, J.O., Butte, N.F., Mendoza, P.M., Wilson, T.A., Reidy, K.C., et al. (2008). Overestimation of infant and toddler energy intake by 24-h recall compared with weighed food records. *American Journal of Clinical Nutrition*, 88, 407-15. doi:10.3945/ajcn.2008.27309
- Gabel, L., Proudfoot, N. A., Obeid, J., Macdonald M.J., Bray, S.R., et al. (2012). Step count targets corresponding to new physical activity guidelines for the early years. *American College of Sports Medicine*, 314-318. doi: 10.1249/MSS.0b013e318271765a

- Health Canada, (2017). Food and nutrition: Canada's food guide. Retrieved from <http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/order-commander/index-eng.php#3>
- Hesketh, K. R., Griffin, S.J., & van Sluijs, E.M.F. (2015). UK Preschool-aged children's physical activity levels in childcare and at home: a cross-sectional exploration. *International Journal of Behavioral Nutrition and Physical Activity*, 12:123. <https://doi.org/10.1186/s12966-015-0286-1>
- Kohl, H.W. III., & Cook, H.D. (2013). Educating the student body: Taking physical activity and physical education to school. Washington (DC): National Academies Press (US). Retrieved from: <https://www.ncbi.nlm.nih.gov/books/NBK201497/>
- Livingstone, M.B.E., Robson, P.J., & Wallace, J.M.W. (2004). Issues in dietary intake assessment of children and adolescents. *British Journal of Nutrition*, 92(2), S213–S222. doi:10.1079/BJN20041169
- Louie, L., & Chan, L. (2003). The use of pedometry to evaluate the physical activity levels among preschool children in Hong Kong. *Early Child Development and Care*, 173(1), 97-107.
- Mckee, D.P., Boreham, C.A.G., Murphy, M.H., Nevill, A.M. (2005). Validation of digiwalker pedometer for measuring physical activity in young children. *Pediatric Exercise Science*, 17, 345-52.
- Nguyen, S., Häcker, A., Henderson, M., Barnett, T., Mathieu, M., et al. (2016). Physical activity programs with post-intervention follow-up in children: a comprehensive review according to categories of intervention. *International Journal of Environmental Research & Public Health*. 13(7). doi:10.3390/ijerph13070664.
- Oliver, M., Schofield, G.M., & Kolt, G. (2007). Physical activity in preschoolers: Understanding prevalence and measurement issues. *Sports Medicine*, 37(12), 1045-1070.
- Pabayo, R., Spence, J.C., Casey, L., & Storey, K. (2012). Food consumption patterns: In preschool children. *Canadian Journal of Dietary Practical Research*, 73(2), 66-71. doi:10.3148/73.2.2012.66
- Pagels, P., Boldemann, C. & Raustorp, A. (2011). Comparison of pedometer and accelerometer measures of physical activity during preschool time on 3- to 5-year-old children. *Acta Paediatrica*, 100, 116–120. doi:10.1111/j.1651-2227.2010.01962.x
- Pate, R.R. Brown, W.H., Pfeiffer, K.A., Howie, E.K., Saunders, R.P., et al. (2016). An intervention to increase physical activity in children: A randomized controlled trial with 4-Year-Olds in preschools. *American Journal of Preventive Medicine*, 51(1), 12-22.

Queens Printer for Ontario, (2017). Child care and early years act, 2014, S.O. 2014, c. 11, Sched. Retrieved from <https://www.ontario.ca/laws/statute/14c11?search=child+care+and+early+years+act#top>

Reinaerts, E., de Nooijer, J., & de Vries, N.K. (2007). Parental versus child reporting of fruit and vegetable consumption. *International Journal of Behavioral Nutrition and Physical Activity*, 4(33). Retrieved from <https://doi.org/10.1186/1479-5868-4-33>

Rice, N., Gibbons, H., McNulty, B.A., Walton, J., Flynn, A., et al. (2015). Development and validation testing of a short nutrition questionnaire to identify dietary risk factors in preschoolers aged 12–36 months. *Food Nutrition Research*, 59, 27912. doi.10.3402/fnr.v59.27912

Sigman-Grant, M., Byington, T.A., Lindsay, A.R., Lu, M., Mobley, A.R., et al. (2014). Preschoolers can distinguish between healthy and unhealthy foods: The all 4 kids study. *J Nutrition Education Behaviour*, 46, 121-127.

Sharma, S., Chuang, R.J., & Hedberg, A.M. (2011). Pilot-testing CATCH early childhood: A preschool-based healthy nutrition and physical activity program. *American Journal of Health Education*, 42(1), 12-23.

Simpson, R. J.A., Keller, H.H., Rysdale, L.A., & Beyers, J.E. (2008). Nutrition screening tool for every preschooler (NutriSTEP™): validation and test–retest reliability of a parent-administered questionnaire assessing nutrition risk of preschoolers. *European Journal of Clinical Nutrition*, 62, 770–780.

Soini, A., Gubbels, J., Saakslanti, A., Villberg, J., Kremers, S., et al. (2016). A comparison of physical activity levels in childcare contexts among Finnish and Dutch three-year-olds. *European Early Childhood Education Research Journal*, 24(5), 775-7786. doi.org/10.1080/1350293X.2016.1213569

Tucker, P. (2008). The physical activity levels of preschool-aged children: A systematic review. *Early Childhood Research Quarterly*, 23, 547–558. doi:10.1016/j.ecresq.2008.08.005

Vereecken, C., & Maes, L. (2014). Children's food intake: A comparison of children's and parents' reports. *Canadian Journal of Dietetic Practice and Research*, 75(1), 35-40. Retrieved from <https://doi.org/10.3148/75.1.2014.35>

Wiseman, N., & Harris, N. (2015). A systematic review of data collection techniques used to measure preschool children's knowledge of food and nutrition. *Journal of Nutrition Education Behaviour*, 47(4), 345-53. doi: <http://dx.doi.org/10.1016/j.jneb.2015.03.013>

Appendix A: Laurentian University Research Ethic Board Certificate



APPROVAL FOR CONDUCTING RESEARCH INVOLVING HUMAN SUBJECTS

Research Ethics Board – Laurentian University

This letter confirms that the research project identified below has successfully passed the ethics review by the Laurentian University Research Ethics Board (REB). Your ethics approval date, other milestone dates, and any special conditions for your project are indicated below.

TYPE OF APPROVAL / New X / Modifications to project / Time extension	
Name of Principal Investigator and school/department	Sandra Dorman (SHK PI and supervisor) Desiree Duguay (SHK – student investigator) Alison Godwin, Céline Larivière, Diana Urajnik (SHK)
Title of Project	The Impact of the CATCH Early Childhood Program on Pre-Schoolers' Physical Activity, Nutrition and Food Behaviour
REB file number	2014-02-06
Date of original approval of project	June 2, 2014
Date of approval of project modifications or extension (if applicable)	
Final/Interim report due on	June 2, 2015
Conditions placed on project	Final report due on September 30, 2015

During the course of your research, no deviations from, or changes to, the protocol, recruitment or consent forms may be initiated without prior written approval from the REB. If you wish to modify your research project, please refer to the Research Ethics website to complete the appropriate [REB form](#).

All projects must submit a report to REB at least once per year. If involvement with human participants continues for longer than one year (e.g. you have not completed the objectives of the study and have not yet terminated contact with the participants, except for feedback of final results to participants), you must request an extension using the appropriate [REB form](#).

In all cases, please ensure that your research complies with [Tri-Council Policy Statement \(TCPS\)](#). Also please quote your REB file number on all future correspondence with the REB office.

Congratulations and best of luck in conducting your research.

Susan James, Chair
Laurentian University Research Ethics Board

Appendix B: Nutrition Screening Tool for Every Toddler & Preschooler



Child's Name:	Phone Number: ()
Child's Gender: <input type="checkbox"/> Female <input type="checkbox"/> Male	Postal Code:
Child's Date of Birth: (Day / Month / Year)	Screen Date: (Day / Month / Year)
Screen Location/Organization:	

Nutrition Screening Tool for Every Toddler

Instructions

Below are questions about your toddler's (18 to 35 months old) eating and other habits.

- Think about your child's every day habits when answering. Check (✓) only one answer for each question.
- There is a number from 0 to 4 beside each answer. This number is a score for that question. At the bottom of each page is a box for the score for the page. For each page, add up the scores for each question.
- At the end of the questionnaire, you will add the page scores to get a total score.

1. My child usually eats grain products:

Examples are bread, bagels, buns, roti, tortillas, crackers, hot or cold cereals, pasta, and rice.

- 0 More than 5 times a day
- 1 4 to 5 times a day
- 2 2 to 3 times a day
- 4 Less than 2 times a day

2. My child usually has milk products:

Examples are breastmilk, formula, white or chocolate milk, cheese, yogurt, milk pudding and milk substitutes, such as fortified soy beverages.

- 0 More than 3 times a day
- 1 3 times a day
- 2 2 times a day
- 4 Once a day or less

3. My child usually eats vegetables and fruit:

These can be fresh, frozen or canned.

- 0 More than 4 times a day
- 1 3 to 4 times a day
- 2 2 times a day
- 3 Once a day
- 4 Not at all

Total Score for Page 1

4. **My child usually eats meat, fish, poultry or alternatives:**

Alternatives can be eggs, peanut butter, tofu, nuts, and cooked beans, chickpeas and lentils.

- 0 More than 2 times a day
- 1 2 times a day
- 2 Once a day
- 3 A few times a week
- 4 Not at all

Child's Name: _____	Phone Number: _____
Child's Gender: _____	Postal Code: _____
Child's DOB: _____	Screen Date: _____
Screen Location/Organization: _____	



Nutrition Screening Tool for Every Preschooler

Instructions

Below are questions about your preschool child's (3 to 5 year old) eating and other habits.

- Think about your child's every day habits when answering. Check (✓) only one answer for each question.
- There is a number from 0 to 4 beside each answer. This number is a score for that question. At the bottom of each page is a box for the score for the page. For each page, add up the scores for each question.
- At the end of the questionnaire, you will add the page scores to get the total score.

1. My child usually eats grain products:

Examples are bread, bagel, bun, cereal, pasta, rice, roti and tortillas.

- ₀ More than 5 times a day
- ₁ 4 to 5 times a day
- ₂ 2 to 3 times a day
- ₄ Less than 2 times a day

2. My child usually has milk products:

Examples are white or chocolate milk, cheese, yogurt, milk puddings or milk substitutes, such as fortified soy beverages.

- ₀ More than 3 times a day
- ₁ 3 times a day
- ₂ 2 times a day
- ₄ Once a day or less

3. My child usually eats fruit:

- ₀ More than 3 times a day
- ₁ 3 times a day
- ₂ 2 times a day
- ₃ Once a day
- ₄ Not at all

Total Score for Page 1

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4. My child usually eats vegetables:

- ₀ More than 2 times a day
- ₁ 2 times a day
- ₃ Once a day
- ₄ Not at all

5. My child usually eats meat, fish, poultry or alternatives:

Alternatives can be eggs, peanut butter, tofu, nuts, or dried beans, peas and lentils.

- ₀ More than 2 times a day
- ₁ 2 times a day
- ₂ Once a day
- ₃ A few times a week
- ₄ Not at all

Appendix C: Preschool Snack Selection Instrument

PAIR 1

Question 1. What is this food?

HEALTHY	CORRECT	INCORRECT	DOES NOT KNOW	NO-RESPONSE
---------	---------	-----------	---------------	-------------

NON HEALTHY	CORRECT	INCORRECT	DOES NOT KNOW	NO-RESPONSE
-------------	---------	-----------	---------------	-------------

Question 2. If you could choose a snack from this pair, would you choose A or B?

CORRECT	INCORRECT	DOES NOT KNOW	NO-RESPONSE
---------	-----------	---------------	-------------

Question 3. Point to the healthy choice – the food that help keeps your heart, muscles, and bones strong.

CORRECT	INCORRECT	DOEST NOT KNOW	NO-RESPONSE
---------	-----------	----------------	-------------

PAIR 2

Question 1. What is this food?

HEALTHY	CORRECT	INCORRECT	DOES NOT KNOW	NO-RESPONSE
---------	---------	-----------	---------------	-------------

NON HEALTHY	CORRECT	INCORRECT	DOES NOT KNOW	NO-RESPONSE
-------------	---------	-----------	---------------	-------------

Question 2. If you could choose a snack from this pair, would you choose A or B?

CORRECT	INCORRECT	DOES NOT KNOW	NO-RESPONSE
---------	-----------	---------------	-------------

Question 3. Point to the healthy choice – the food that help keeps your heart, muscles, and bones strong.

CORRECT	INCORRECT	DOEST NOT KNOW	NO-RESPONSE
---------	-----------	----------------	-------------