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The Influence of a Centrally-Procured School Food Program on Consumption and Instances of Fruits and Vegetables in School-Age Children

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ABSTRACT

Background: In Canada, 70% of youth are not meeting the recommended five servings of fruits and vegetables (FV) daily. School nutrition programs are one strategy for improving dietary habits in youth.

Methods: A two-year pilot cluster randomized controlled trial was implemented within Southwestern Ontario to assess how a ten-week centrally-procured school food program (CPSFP) influences students' consumption and instances of FV compared to the traditional school nutrition program (TSNP).

Results: Children were 9-13 years of age; 30 schools received the CPSFP and 30 received the TSNP. Vegetable consumption did not change with the CPSFP (mean=0.0; *SD*=1.0) or the TSNP (mean=0.0; SD=1.0; *p*=0.94). Fruit consumption did not change with the CPSFP (mean=0.0; *SD*=1.4) and decreased by 0.1 servings (*SD*=1.4) with the TSNP (*p*=0.06). Instances of vegetables and fruit were similar between groups.

Conclusions: The CPSFP resulted in no significant change in consumption or instances of FV.

Keywords: nutrition program, food program, fruit, vegetables, eating behaviour, child health, school-age children, health promotion

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

Abbreviation	Meaning
BSD	Balanced School Day
CFG	Canada's Food Guide
CPSFP	Centrally-Procured School Food Program
DILQ	Day in the Life Questionnaire
FFQ	Food Frequency Questionnaire
ICC	Intracluster Correlation Coefficient
OSNP	Ontario Student Nutrition Program
OSNP-SW	Ontario Student Nutrition Program – Southwest Region
PEAS	Pupils-Eating-At-School
RCT	Randomized Controlled Trial
SES	Socioeconomic Status
TSD	Traditional School Day
TSNP	Traditional School Nutrition Program

CHAPTER 1

INTRODUCTION

Adolescence, characterized as 10 to 19 years of age, is a stage in life where a balanced nutritious diet is essential for continued growth both physically and mentally (1,2). Adolescents who consume diets of a higher quality, and are well-nourished, have been found to perform well academically (3-5), have higher attention capacities (6), and better mental health (7) than children who consume poorer diets (3-7). Conversely, excess calories, fats, salt, and sugars, with minimal consumption of fruits and vegetables, increase one's risk for numerous chronic diseases, including obesity, heart disease, stroke, diabetes, and several cancers (8,9). As less than one third of Canadian children consume the daily recommended five servings of fruits and vegetables established by Canada's Food Guide (CFG; 10-13), it is important to implement strategies that improve healthy eating early in childhood.

School nutrition programs are one strategy for improving healthy eating behaviours in youth, as research has shown that nutrition programs implemented in Canadian schools have led to increased consumption of fruits and vegetables (14-19) and improved overall diet quality (17,20). To date, school nutrition programs have varied in the nutritional quality, variety, and amount of food offered (14-25), and studies assessing such programs have lacked strong experimental designs. For example, some studies have not used an appropriate dietary intake measurement method for youth, using a Food Frequency Questionnaire (FFQ) to calculate food consumption (14,15,17,21,22). FFQs require the recollection of past events, which can be difficult for some youth and may

lead to over-reporting (26). Several studies used small sample sizes (n=10 to n=122) (16,20-23,25), including one study that did not meet the sample size required to detect an intervention effect, thus impacting their statistical power (16). Moreover, many studies did not include a control group (20-23,25), where it cannot be determined whether the changes observed were due to the intervention itself or other factors, such as age, gender, or external influences (23). Due to the variability in the characteristics of the nutrition programs and study designs, additional research is needed with more thorough evaluations and experimental methods.

Currently, several schools within Southwestern Ontario have partnered with the Ontario Student Nutrition Program – Southwest Region (OSNP-SW) to provide students with a school snack or meal program that offers fruits or vegetables, dairy products, meat and alternatives, or grain products three to five days per week. The OSNP-SW provides funding and support for the implementation of a Healthy Snack Program, a Blended Program, or a Meal Program (Breakfast or Lunch) in schools in Southwestern Ontario. The Healthy Snack Program provides students with at least one CFG serving of fruits or vegetables, and one CFG serving of dairy products, meat and alternatives, or grain products. The Blended Program is similar to the Healthy Snack Program in that students are provided with one CFG serving of fruits or vegetables, although there are at least two other food groups available for students who wish to have more food. The Meal Programs run by OSNP are typically Breakfast Programs, as most schools do not possess cafeteria facilities. The Breakfast Program may offer hot or cold breakfasts through their Traditional Program, or prepackaged meals through their "Grab and Go" Program. In each Breakfast Program, students are provided with a minimum of three food groups: one

serving of fruits or vegetables, one serving of dairy products, and one serving of either grain products or meat and alternatives.

The programs designed by OSNP are based on nutritional guidelines proposed by the Ministry of Children and Youth Services, which states that a fruit or vegetable should be offered with every snack/meal and that Ontario grown produce should be chosen as much as possible. The guidelines also indicate that a meal should contain one serving from three out of the four CFG food groups, including one serving from the vegetables and fruit food group, as well as one serving from the milk and alternatives food group. Additionally, a snack should contain one serving from two out of the four CFG food groups, one of which must be the vegetables and fruit food group. The nutritional value of a meal can be improved through offering choices from each of the four food groups, while a snack can be improved by offering choices from three of the four food groups. Finally, the guidelines state that drinking water should always be available and offered (27).

In the traditional school nutrition program (TSNP), schools independently run the program and have volunteers purchase and prepare the snacks. However, the food purchased may not always align with the program nutritional guidelines set forth by the Ministry of Children and Youth Services, which can lead to variation in the nutritional quality of food provided to students.

In order to streamline the process of such programs, a centrally-procured school food program (CPSFP) was implemented to ensure that all participating schools are provided with the same nutritional quality and sources of food. Specifically, the CPSFP involves the OSNP purchasing and delivering all the healthy snacks to the schools, which

include locally-sourced fruits and vegetables, rather than having volunteers from each school source, purchase, and transport snacks specific to their own school on an individual basis.

The CPSFP is a naturally-occurring intervention, such that the execution of the program, including the selection and quantity of food provided, is beyond the control of the research team. The CPSFP allows the OSNP to control the nutritional quality of the food offered through the snack programs by having them directly deliver the produce to the schools. Through the CPSFP, children will be provided with fresh, healthy snacks based on a dietitian-approved menu, including locally-sourced fruits and vegetables, once per day. The CPSFP consistently provides foods of high nutrient quality that follows the 2016 Student Nutrition Program Guidelines implemented by the Ministry of Children and Youth Services. The aim of the CPSFP is to improve the nutritional quality of the food provided in current school snack programs, while also obtaining a greater proportion of the food for the program from local farmers through the formulation of local food procurement strategies. Whereas the TSNP does not consider geographical origins when purchasing food, the CPSFP requires a minimum of 20% of the food provided through the program to be locally sourced. Thus, the CPSFP is not only of benefit to students and schools, but to local farmers as well. Through the formulation of local food procurement strategies, the CPSFP aims to strengthen Ontario's food system, redirecting the savings from this cost-effective approach to local farmers.

Study Objectives and Hypothesis

This study contributes to the existing literature by evaluating how the CPSFP influences student nutrition compared to the traditional school nutrition program (TSNP). Our objective was to assess changes in:

a. Quantity of fruit and vegetable consumption; and
b. Instances of fruit and vegetable consumption

over a ten-week period in children ages 9-13 that are attending a sample of schools within the Thames Valley District School Board and the London District Catholic School Board.

Quantity of fruit and vegetable consumption is defined as the total CFG servings consumed during the school day. Instances of fruits or vegetables is classified as the number of nutrition breaks within the school day where a fruit or vegetable was consumed, with the highest value possible being three instances based on the number of nutrition breaks within a school day.

As the CPSFP will provide participating schools with equal access to a wide variety of fruits and vegetables, it was hypothesized that the new CPSFP would result in a larger increase in daily consumption and instances of fruits and vegetables compared to the TSNP.

Rationale

While several schools in Ontario provide school nutrition programs, the nutritional quality and sources of food offered varies by school (28), and no standardized school nutrition program currently exists in Canada (29-31). Accordingly, there is an opportunity to improve existing school nutrition programs and set the foundation for a

standardized program that can improve children's dietary habits (and related health issues) by improving access to nutritious food. In contrast to previous snack programs and the current TSNP in Ontario where volunteers purchase and prepare the snacks, the new CPSFP is a naturally-occurring intervention which ensures all food provided comes from one organization and is based off a pre-set menu, controlling the nutritional quality and variety of the food offered and giving schools equal access to produce.

Including the potentially improved nutritional quality of the program, this study contributes to our understanding of snack program interventions by being the first large-scale school snack program to be reported on in Canada. This study included 60 schools located within the Thames Valley region in Southwestern Ontario, of which 30 schools participated as control schools to ensure an accurate assessment of the intervention's effectiveness was completed. This study also introduced a new tool called the "Pupils-Eating-At-School (PEAS) Survey" for measuring dietary intake, that upon validation, may have the potential to become an effective, and more efficient, alternative to the gold-standard of direct food observation.

If successful, this new CPSFP will aid in our understanding of how to improve children's diets by demonstrating the positive impact a CPSFP can have on children's dietary consumption habits. If the CPSFP is unsuccessful at increasing consumption or instances of fruits and vegetables compared to the TSNP, the study will provide further knowledge about which components are effective within a school nutrition program and push for further research within this area.

Organization of the Thesis

Following the introduction, this document includes four chapters. *Chapter 2* provides a detailed literature review of studies that analyzed school nutrition programs implemented within Canada. This review focuses on components of school nutrition programs that were found to successfully influence students' nutrition knowledge, attitudes towards fruits and vegetables, preferences towards and willingness to try fruits and vegetables, fruit and vegetable consumption, fruit and vegetable variety, milk and alternative consumption, and diet quality. *Chapter 3* describes the methodology, data collection, and statistical analyses used for my thesis. *Chapter 4* presents the results of this study; particularly a comparative analysis of changes in consumption and instances of fruits and vegetables between the CPSFP and the TSNP. *Chapter 5* includes the discussion, strengths and limitations of the present study, suggestions for future research, and concluding remarks.

CHAPTER 2

DIET QUALITY, SCHOOL NUTRITION PROGRAMS, AND CHILDREN'S HEALTH

Fruits and vegetables are heavily promoted for their health benefits, as they contain a wide range of micronutrients that increase protection against several chronic diseases, including coronary heart disease and cancer (29,32,33). Despite these health benefits, 70% of children are not meeting the minimum Canada's Food Guide (CFG) recommendation of five servings of fruits and vegetables per day (10-13). Alternately, many children consume foods high in calories, fats, salt, and sugars (10,34).

The determinants of dietary habits among youth are multifaceted, with four factors playing a major role. First, parents influence their child's food preferences through what they purchase and prepare within the home, which in turn influences their child's consumption habits (35-38). Children are more likely to select foods they are familiar with (39), with foods consumed in the home directly linked with their food preferences (23,25). Second, food insecurity, where roughly one in six Canadian children live in a household unable to provide nutritious foods (40), is associated with inadequate fruit and vegetable consumption among youth. For families living in poverty, the price of food becomes a major consideration in what gets purchased, usually resulting in a selection of foods higher in calories and lower in cost (41). Third, diet quality of youth is influenced by their peers, as children may fear that eating differently than their peers will result in being laughed at or excluded from a group (42). Hence, children are more likely to consume foods similar to what they see their peers eating (42-44). Fourth, the school

environment influences a child's eating habits through the food provided at school, nutrition and health curricula, teacher and peer modelling, school nutritional policies (35), and even school schedule. School schedule may be a balanced school day (BSD) schedule where students receive two 45-minute breaks broken up into 20 minutes for eating and 25 minutes for recess (45), or a traditional school day (TSD) schedule where students receive 20 minutes for eating with 40 minutes for recess, plus two 15-minute recesses for snacks and/or activities (45,46). Neilson et al. (12) compared packed lunches between students in BSD and TSD schools, finding that the schedule of the school may influence how a student's lunch is packed, with students attending BSD schools found to have higher servings of milk and alternatives, sugar-sweetened beverages, and snacks packed in their lunches compared to children attending schools with a TSD schedule (12).

A child's diet can have implications for the remainder of life, as poor eating habits that develop during childhood can carry into adolescence and adulthood (35,47). Consequently, it is imperative for strategies to be implemented that can aid in improving diets early in life. As children spend most of their day at school, school nutrition programs have become of interest as an intervention for promoting and improving healthy eating practices in youth (35,48).

This chapter provides a review of school nutrition programs studied within Canada. Specifically, it will discuss factors known to influence healthy eating habits such as nutritional knowledge, attitudes towards fruits and vegetables, preferences towards and willingness to try fruits and vegetables, fruit and vegetable consumption, fruit and vegetable variety, milk and alternative consumption, as well as school policies and diet quality. Each section will discuss the strategies conducted by previous school nutrition

programs for targeting each factor, including which strategies were found to be successful and/or unsuccessful at improving such factors. The literature review will further discuss the limitations of these studies that impacted their overall success.

A search of PubMed, EMBASE, and CINHAL was conducted for articles on school nutrition programs published after 1990, when the first school nutrition policy was established (49). The articles were reviewed for eligibility through titles and abstracts, and subsequently full texts if relevant. Articles discussing school nutrition programs conducted in Canada and their influence on child health outcomes were included. Specifically, quantitative studies discussing school nutrition programs that contained a primary evaluation, assessment, or analysis of the program, and reported on an outcome related to children's dietary behaviours such as nutritional knowledge, preferences towards fruits and vegetables, and/or consumption habits among school-age children (i.e., ages 6 to 14 years of age) were included. References from selected studies were also reviewed for articles that may have been missed through the database search. The following search terms were used in various combinations: snack program, food program, nutrition program, nutrition intervention, fruit and vegetable program, healthy eating intervention, intervention, youth, children, health, healthy eating, consumption, fruit and vegetable, eating behaviour, child heath, health promotion, knowledge, preference, attitude, school, and Canada. After exclusion of irrelevant articles and removal of duplicates, 13 articles were selected for full review that discussed 11 different school nutrition programs implemented in Canada.

School Nutrition Programs in Canada and Their Impact on Children's Health

In Canada, few school nutritional policies exist and there is no standardized school nutrition program (29,30,31). To date, eleven school nutrition programs have been implemented and studied within Canada. Each program had a distinctive design, ranging from six weeks in length to three years, and assessed changes in nutritional knowledge, attitudes towards fruits and vegetables, preferences towards and willingness to try fruits and vegetables, fruit and vegetable consumption, fruit and vegetable variety, milk and alternative consumption, and/or diet quality, among children between the ages of 6 to 14 years (14-25,50). Several of these programs aimed to provide high-quality, nutrient-dense foods to children, including a wide variety of fruits and vegetables, whole grains, protein sources, and milk and alternatives (14-17,20-23,25). Some programs also incorporated lessons on healthy eating into the curriculum, promoting healthy eating, physical activity, fruits and vegetables, and milk and alternatives, through interactive activities, cooking workshops, and storytelling (14-16,20,21,23-25). Students who took part in these programs had an increase in preference for (16,20,23,25) and consumption of fruits and vegetables (14-19), as well as consumption of foods lower in fat, lower in sugar, and higher in fiber (20). Participants also gained higher nutritional knowledge, particularly in regard to the nutritional content of food, food transformation, cooking procedures (24), adequate milk and alternatives intake (21), and foods low or high in dietary fats (20), lending support for the use of school nutrition programs in improving children's health.

Nutrition Knowledge

To observe a change in diet, a behavioural change must also occur. Several key factors are involved in behaviour change, including knowledge, perceived self-efficacy, outcome expectations, health goals, and perceived facilitators and barriers (51,52). Knowledge sets the foundation for change. People have little reason to engage in behavioural changes without the knowledge that their current behaviours can affect their health (51). School nutrition programs which incorporated nutrition into the school curriculum through cooking workshops, storytelling, and interactive activities, all demonstrated an increase in knowledge amongst the children who participated (20,21,23,24), suggesting that having hands-on experience and interactive activities within a nutrition program may be beneficial if an increase in nutrition knowledge is desired.

The Petits cuistots – parents en réseaux, or Little Cooks-Parental Networks, program was a community-based initiative involving nutrition workshops with community dietitians (24). This program included eight annual nutrition workshops that each revolved around a different food item and nutrition theme. Nutrition workshops were completed in grade five classrooms among participating schools, where teachers were asked to provide classroom management and program support. Each nutrition workshop was 90 minutes long and included a recipe for food preparation based on the food item and nutrition theme of that workshop, as well as a tasting sample of what was prepared. Information regarding the nutrient content of food and cooking procedures were provided during each workshop. Additionally, each workshop had take-home examples of the cooking experience, including the recipe and taste sample, in order to

invite parents' participation in the nutrition workshop. At the end of the program, children had higher knowledge about the nutritional content of food, food transformation, and cooking procedures compared to grade six students who were not exposed to the program (24).

Gates et al. (21) implemented a comprehensive school nutrition program which provided education on milk and alternatives to students in grades six to eight. The nutrition education component was adapted from the "Power4Bones" program created by the Dairy Farmers of Canada, which involved online modules that teach children about bone-building foods and physical activities through the storytelling of Agent Bones. Gates et al. (21) modified the "Power4Bones" program to include more interactive activities, to better suit students' literacy and numeracy levels, and to eliminate the use of computers due to limited access within the First Nations community. Nutrition lessons were provided to the students for 30 minutes each week for five weeks and also included goal-setting and peer-modeling. Following the five weeks, participants had a significant increase in knowledge with respect to adequate milk and alternatives intake (21).

The EarthBox Kids program provided classrooms at the Kipohtakaw Education Centre in Alexander First Nation Alberta with EarthBoxes to grow vegetables, herbs, and berries (23). Children in grades one to six planted seeds for tomatoes, green beans, beets, lettuce, carrots, green peppers, zucchini, chives, and dill. Each teacher decided how the gardens were to be used as an educational tool in their curriculums, with some choosing to use the harvested vegetables for classroom taste-testing activities. Teachers also used the harvested vegetables to discuss healthy food choices and CFG, while librarians used the EarthBoxes to encourage children to read books about gardens. To test children's

knowledge of fruits and vegetables, participants were asked to write down five fruits and vegetables that they knew. Out of the 66 participants, 65 were able to name five fruits and vegetables after receiving the program for 18 months, compared to only 51 participants at baseline, resulting in a significant improvement in knowledge (p=0.01). The five most commonly mentioned fruits and vegetables were apple, banana, carrot, orange, and strawberry (23).

The Sandy Lake Diabetes Prevention Intervention implemented a curriculum focused on developing knowledge and skills surrounding healthy eating, physical activity, and diabetes education (20). The curriculum consisted of 16 weekly lessons that were 45 minutes in length. To assimilate with the Native North American culture, the curriculum was adapted to include foods and physical activities from the community, while also including lessons from the elders. The main concepts from health education lessons were covered through the storytelling of Missy and Buddy Daaybway as they learned the importance of living a healthy lifestyle to prevent diabetes. Family members were informed about the lessons learned in school through a weekly community radio show, information booths during parent-teacher nights, and letters sent home with students. The program provided opportunities for peers to act as role models through a children's video cooking club where students could demonstrate how to prepare healthy snacks, and a "Diabetes Kids" radio show that aired three times per week. To assess changes in knowledge among students in grades three to five, a health knowledge and behaviour questionnaire was administered that included questions surrounding diabetes, dietary fat, label reading skills, physical activity, and other concepts provided within the lessons. Nutritional knowledge significantly increased from baseline to follow-up,

specifically with knowledge of foods low and high in dietary fats, and curriculum knowledge (20).

The Northern Fruit and Vegetable Pilot Programme (NFVPP) was a 21-week program implemented to promote healthy eating and wellness, while increasing children's awareness of the benefits of eating fruits and vegetables (16). Included within the program was Enhanced Nutrition Education entitled "Paint Your Plate! Create a Masterpiece: Vegetables and Fruit Action Guide for Schools", a comprehensive curriculum-based resource for teachers to incorporate into the classroom. The activities included were to be used to promote fruits and vegetables. Knowledge of participants was assessed by asking them how many servings of fruits and vegetables they think they should eat every day to stay healthy. The Enhanced Nutrition Education within the NFVPP did not result in a significant difference in participants' knowledge of fruits and vegetables compared to participants in the control group who did not receive the NFVPP (16). During the intervention, the Enhanced Nutrition Education was not implemented fully, and He et al. (16) speculated this to be the cause of the insignificant change in nutrition knowledge.

The Freggie Friday Program was implemented to encourage Canadian children to eat the daily recommended fruit and vegetable servings, while helping them understand the benefits of making healthy choices (50). Each participating school received a tool kit intended to complement their school's healthy living initiatives and ministry health guidelines. Within the tool kit was a two-page educator's guide on the program, incentive prize materials (i.e., ballot boxes, certificates, and toys) for children who brought a fruit or vegetable to school on Fridays, a how-to video, access to annual draws for $1000, and

a “We are a Freggie Friday School” poster. The program was implemented by administrators and teachers who were to follow instructions from the project coordinator. The Freggie Friday Program was implemented over four months and did not result in a significant increase in nutritional knowledge. These insignificant findings may be due to limited implementation of the intervention, inadequate teacher training, and a simple tool kit (50).

Action Schools! BC – Healthy Eating was a program that integrated classroom learning, environmental change strategies, and a family/community component to promote the consumption of fruits and vegetables among grades four and five children (14). To promote higher fruit and vegetable consumption, a menu of classroom activities and materials for implementation were provided to schools, along with 90 minutes of staff training. During the 12 weeks, teachers were asked to implement two weekly classroom activities and one monthly taste-testing activity. Schools were also asked to provide monthly newsletters, voluntary take-home activities, presentations to parent advisory committees, and the encouragement of parental involvement in schools’ Healthy Eating events. Activities outside the classroom, however, did not solely focus on fruits and vegetables. Knowledge of the importance of fruits and vegetables for disease prevention did not change over the course of the program. The absence of change in nutrition knowledge may be attributed to a lack of support from additional personnel, which negatively impacted the frequency and duration of lessons and taste testing experiences (14).

Based on comparisons of previous nutrition programs, nutritional knowledge may be influenced by the frequency and duration of lessons (14,16,21,23,24). When programs

defined a specific time for nutrition lessons each week, such as one 30-minute class (21), an increase in knowledge was observed (21,23,24), unlike when resources were just asked to be incorporated into the curriculum (14,16,50). Students also had greater knowledge at the end of the program when nutrition classes were 90 minutes in duration as opposed to 30 minutes or less (21,24). Lastly, when programs were implemented over a long period of time, such as seven months (23) as compared to five weeks (21), children were able to improve their knowledge more, as there were more opportunities for learning (23,24).

Attitudes Towards Fruits and Vegetables

Few studies have assessed the impact of a school nutrition program on children's attitudes (i.e., their thoughts or feelings) towards fruits and vegetables (14,16,24). Research has demonstrated that attitudes towards fruits and vegetables are positively associated with intention to increase consumption, and strategies to promote attitude changes are more successful in the early stages of the intervention (53-55).

As mentioned previously, Action Schools! BC – Healthy Eating was a program that created a menu of classroom activities and materials for implementation within participating schools to promote the consumption of fruits and vegetables among students in grades four and five (14). During the 12 weeks, teachers were asked to implement two weekly classroom activities and one monthly taste-testing activity. For the taste-testing activities, teachers purchased the fruits and vegetables using the $12.50 they received each month from the program coordinators. Efforts within the classroom to increase fruit and vegetable consumption were combined with strategies aimed at improving healthy

food choices within the school. Children's attitudes towards eating fruits and vegetables, however, did not change over the duration of the program (14).

The 21-week NFVPP offered students free fruit and vegetable snacks in addition to the Enhanced Nutrition Education (16). The snack component of the program offered students in kindergarten to grade eight with one serving of either a fruit or vegetable three times per week. A three-week menu rotation was created which included a total of nine items, including carrot sticks, broccoli florets, and whole pear fruit cups. Impact evaluation was completed on students in grades five to eight. To assess attitudes towards fruits and vegetables, students were asked to answer three statements on a scale ranging from fully disagree to fully agree. The statements included "eating fruits and vegetables every day makes me feel good", "eating more fruits and vegetables every day gives me more energy", and "eating fruits and vegetables could help prevent heart disease". Mean scores were high for attitudes towards fruits and vegetables, however, there was no significant difference in attitude scores between students who received the intervention and those who did not (16).

Both the Action Schools! BC and the NFVPP provided a resource that could be integrated into the curriculum and neither resulted in a significant difference in children's attitudes towards fruits and vegetables when comparing students receiving the interventions to those who did not (14,16). Given that the resources were just asked to be incorporated into the curriculum with no specific directions for duration of activities, and Day et al. (14) found that teachers only completed 64% of the required amount of two activities per week, it is possible that the resources were not provided frequently or long enough to instill changes in children's attitudes towards fruits and vegetables.

Providing nutrition education through positive experiences can cause significant changes in attitudes towards fruits and vegetables (24,56). The Little Cooks-Parental Networks program designed themed nutrition workshops with hands-on activities for the students and was the only nutrition program found to improve children's attitudes towards fruits and vegetables. Attitudes towards fruits and vegetables among grade five students was measured in two ways. First, attitude was measured by its perceived association between healthy eating and knowing how to cook. Second, attitude was measured by asking students whether they anticipated their peers to have a negative reaction to uncommon or new foods. There was a significant difference in attitudes towards fruits and vegetables between students who participated in the workshop compared to those who did not participate, with participants reporting to a higher degree that knowing how to cook was an important component of healthy eating (24). Creating a theme for each workshop, and having the kids participate in hands-on cooking activities, allowed for a more constructive atmosphere and an overall greater experience. This, in turn, promoted more positive attitudes towards fruits and vegetables. Furthermore, this program had consistent nutrition lessons for students, providing eight workshops throughout the year that were 90 minutes in duration, and this consistency may have also played a role in the observed improvement in attitudes towards fruits and vegetables among students (24).

Of the programs that targeted attitudes towards fruits and vegetables, only one program, the Little Cooks-Parental Networks program, resulted in an improvement in attitudes towards fruits and vegetables. This program incorporated hands-on activities that were consistently provided throughout the year and that were of a long duration,

suggesting that these components should be considered when designing a school nutrition program aimed at improving attitudes (24).

Preferences Towards and Willingness to Try Fruits and Vegetables

School nutrition programs which target changes in taste preferences towards fruits and vegetables may be most beneficial, as preferences for fruits and vegetables are a significant predictor of consumption (36,37,52). Children's preferences and willingness to try fruits and vegetables are strongly influenced by direct experience with those foods. Thus, how often a child is exposed to a fruit or vegetable, as well as the environment in which the food is tasted, will positively impact one's preferences (24,52). School nutrition programs which included scheduled taste-testings of fruits and vegetables over a longer duration, such as eight times over a period of one year, resulted in greater preferences towards fruits and vegetables, as well as an increase in the willingness to try new foods among children who participated (23-25). Conversely, when programs did not include a taste-testing component, the children experienced no change in their preference or willingness to try fruits and vegetables (16,50). This suggests that taste-testing, as well as how often the taste-testing is offered, is an important component of school nutrition programs if changes in preference or willingness to try fruits and vegetables are to be observed (23-25).

The eight annual nutrition workshops held by the Little Cooks-Parental Networks program included a recipe for food preparation based on the food item and nutrition theme of that workshop, as well as a tasting sample of what was prepared (24). Preferences and willingness to try fruits and vegetables was measured by a list of ten

food items most commonly disliked by children; students had to indicate whether they have tasted and like or dislike the item, or if they have not tasted the item but are willing or not willing to try it. The greater the number of food items that students indicated they liked or were willing to try indicated a more positive preference towards fruits and vegetables. At the end of the program, students in grade five indicated a greater readiness to taste new foods or to like a set of less typical foods when compared to grade six students who had not participated in the program (24).

The EarthBox Kids program took place from September 2010 to June 2011 and from September 2011 to June 2012 at the Kipohtakaw Education Centre in Alexander First Nation Alberta (23,25). The vegetables harvested from the EarthBoxes were sometimes used for classroom taste-testing activities, while the Healthy Snack Program offered students daily taste-testing of fruits and vegetables during the 2011-2012 school year. To test children's preferences towards fruits and vegetables, a 6-point Likert scale was used which ranged from "I will never eat it again" to "I really like it". Children were asked to taste and then rate how much they liked 17 raw fruits and vegetables from a list, including broccoli, green pepper, carrot, tomato, celery, cauliflower, cucumber, radish, mushroom, kiwi, pear, grape, orange, apple, cantaloupe, grapefruit, and banana. Of the 17 items on the questionnaire, only apple, pear, kiwi, broccoli, radish, mushroom, and grapefruit were not provided by the snack program or EarthBox. After each food item was tasted and rated, children were asked "Do you eat this food item at home?". These questions were completed at baseline when the EarthBoxes were first planted in November 2010, at the 7-month follow-up in June 2011, and at the 18-month follow-up in May 2012. From baseline to the 18-month follow-up, students in grades one to six had

a significant increase in their preferences towards fruits, including grapes and kiwi. Preferences for vegetables significantly increased at the 7-month follow-up, however, preferences decreased below baseline values at the 18-month follow-up. Children most preferred apples, bananas, oranges, and grapes, while preferring radishes, mushrooms, and grapefruit the least. Foods most preferred by participants were those most frequently consumed at home, while foods least preferred by participants were rarely consumed at home (23,25).

Despite Action Schools! BC – Healthy Eating incorporating a monthly taste-testing activity, no effect on willingness to try fruits and vegetables was observed post-intervention in grades four and five students (14). As there were only a maximum of three taste-testing activities during the program, this may not have been sufficient exposure to result in changes in preferences or willingness to try fruits and vegetables, as it has been found that exposures to a new food as many as 10 to 15 times is needed in order to enhance preferences towards it (14,37).

During the 21-week NFVPP, children were provided with one serving of either a fruit or vegetable three times per week (i.e., Free Fruit and Vegetable Snacks) and/or curriculum-based resources that focused on promoting fruits and vegetables (i.e., Enhanced Nutrition Education) (16). To assess changes in preferences towards fruits and vegetables among students in grades five to eight, participants were asked to score their preferences for 20 fruits and 23 vegetables. Preference scores for all fruits and vegetables were relatively low, while all three groups had a high willingness to try new fruits and vegetables. There was no significant difference between those who received the Free Fruit and Vegetable Snacks plus the Enhanced Nutrition Education, those who received

only the Free Fruit and Vegetable Snacks, and those who did not receive any intervention (16). The lack of a taste-testing component in the NFVPP, and snacks only offered three times per week, likely played a role in the low preferences found. The Freggie Friday Program additionally did not change preferences towards fruits and vegetables, likely attributable to the lack of a taste-testing component and shorter program (50).

When children engaged in hands-on activities, in addition to discussions of healthy eating, they developed higher preferences towards fruits and vegetables (20,23-25). For instance, the EarthBox Kids program consisted of a gardening activity and weekly snack program that incorporated the foods the children had grown into the snacks provided (23,25). By gardening, the children were provided with hands-on experience of how to grow, harvest, prepare, and eat healthy foods, while also increasing their exposure to the taste of new fruits and vegetables. Teachers also assimilated the food grown into their lessons, using them as examples of healthy food choices. These components of the program worked to create an environment conducive to changes in children's food preferences (25). The Sandy Lake Diabetes Prevention Intervention similarly allowed for hands-on activities through the children's video cooking club and radio show. These activities, in combination with the storytelling incorporated into the school curriculum, created a positive environment for students to learn and resulted in an increase in preferences towards fruits and vegetables (20).

Programs which offered taste-testing of fruits and vegetables were found to be successful at increasing preferences towards fruits and vegetables among children aged six to eleven (20,23-25). Though, how frequently the taste-testing occurs and the duration of the program are important factors in preference changes, with programs at least one-

year in length and provision of at least eight taste-testing activities being more successful (23-25). When designing a school nutrition program, hands-on activities should also be considered for incorporation due to their influence on preferences towards fruits and vegetables (20,23-25).

Fruit and Vegetable Consumption

School nutrition programs have been effective at increasing children's consumption of fruits and vegetables following the program (14-19). Peer influence plays a role in this observed effect, as evidenced by one program, Team Nutriathlon, that implemented a team approach to motivate students (18,19). For the program, grade five and six students from eight different schools were divided into teams of five to six students and encouraged to increase their consumption of fruits and vegetables in order to meet team requirements set by Team Nutriathlon. Team goals were based on the quantity and variety of food eaten; quantity was measured by the accumulated portions of fruits and vegetables team members consumed during the eight-week program. Students were also provided with individual goals, where they were challenged to reach their recommended CFG servings based on their age and sex. Students were asked to record their daily fruit and vegetable consumption for each meal from Monday to Friday. Every two weeks students were provided with a summary report of their consumption both individually and as a team, discussing the goals set and if students were meeting them. Using this data, teachers were able to motivate students and help them reflect on their behaviours, while students could create individual and team strategies in order to maintain or increase their consumption. Following the 8-week program, teachers were

provided with the results and administered individual and team awards to students based on their outcomes. At the end of the study, those who participated in the intervention consumed approximately five servings of fruits and vegetables, while participants who did not have the intervention consumed approximately three and a half servings of fruits and vegetables. When comparing the intervention group to the control group, there was a significant difference in their fruit and vegetable consumptions (18). Chamberland et al. (19) also implemented Team Nutriathlon with grade seven and eight students from three different schools, who were divided into teams of three to five students. The goals for individuals and teams remained the same during this study, however it was completed over six weeks instead of eight. At the end of the six weeks, students in the intervention group consumed approximately six servings of fruits and vegetables, while the control group consumed approximately three and a half servings of fruits and vegetables, rendering a significant difference between groups. Students stated that teachers also played a key role in the success of the program by providing encouragement, reminders for recording one's data, and tips to help increase consumption, demonstrating that the influence of the teacher and school environment are important factors associated with fruit and vegetable consumption (19).

Most school nutrition programs that found an increase in self-reported consumption of fruits and vegetables assessed consumption at baseline and immediately following the intervention (14-17). Only in the studies by Chamberland et al. (19) and Drapeau et al. (18) were students' consumption further evaluated ten weeks following the end of the Team Nutriathlon program. Drapeau et al. (18) found that children's consumption remained significantly higher ten weeks following the program when

compared to students who had not participated in the program. By contrast, Chamberland et al. (19) found that increased consumption of fruits and vegetables was only observed during the six-week nutrition intervention, as consumption of fruits and vegetables returned to baseline levels at the ten-week follow-up. This was likely the case because, without continuous support from their peers and teachers, students were no longer motivated to change their consumption habits. It is also noteworthy that in the study by Chamberland et al. (19), the Team Nutriathlon program was conducted over a six-week period compared to an eight-week period in the study by Drapeau et al. (18). The eight-week period was found to instil long-term changes amongst the children participating in the program, while the six-week program did not. This suggests that the length of the program can impact efficacy with regard to improving consumption of fruits and vegetables.

Successful programs also incorporated nutrition into the school curriculum throughout the intervention period, including the NFVPP and the Action Schools! BC – Healthy Eating program, indicating its importance in influencing fruit and vegetable consumption (14-16). The Alberta Project Promoting active Living and healthy Eating (APPLE) Schools was a three-year initiative aimed at providing healthy eating and active living strategies through contributions to the schools' health curriculum during both instructional and non-instructional school time. The program focused on the unique needs and barriers of each participating school, including parents, staff, and the community, in program plans. The APPLE Schools program provided classroom gardens, after-school cooking classes, and physical activity programs to make healthy living fun and engaging (15).

The APPLE Schools Program and the Children's Lifestyle and School-Performance Study (CLASS) incorporated components of the Annapolis Valley Health Promoting Schools (AVHPS) program which was designed "to make the healthy choice the easy choice". Based on the AVHPS program, each program implemented school policies and practices designed to increase the physical activity of students and offer healthier menu alternatives. Both the APPLE and CLASS studies resulted in a significant increase in the consumption of fruits and vegetables among grade five students, suggesting that school nutritional policies and healthy menu alternatives provided at school may play an important role in improving fruit and vegetable consumption (15,17).

The EarthBox Kids program included a four-month snack program during the 2010 to 2011 school year and the 2011 to 2012 school year (23,25). From February 2011 to May 2011 students were provided with seven vegetables and seven fruits, including carrots, celery, cucumbers, cauliflower, peas, tomatoes, peppers, grapes, bananas, oranges, cantaloupe, strawberries, watermelon, and apricots. During the 2011 to 2012 school year, additional produce was provided such as mini-carrots, celery, cucumber, cauliflower, peas, tomato, broccoli, corn, peppers, and beans. When assessing consumption of fruits and vegetables at home, the EarthBox Kids program did not result in an increase in home consumption of fruits and vegetables among students. Although children received a variety of fruits and vegetables during the program and had an increase in their preferences towards them, the food provided was not available outside of school (23,25). Parents are primarily responsible for purchasing and preparing the meals provided within the home, thus influencing a child's food preferences (38). However, financial barriers and access to healthy foods further impact the food available for a child.

As the program was implemented on First Nations reserves, there was limited access to nutritious foods, and any fresh food available was of high cost (57). Thus, parents could not provide their children with the same variety and quantity of fruits and vegetables as the snack program, which affected the children's consumption of fruits and vegetables when at home. As consumption of fruits and vegetables at school was not reported by Hanbazaza et al. (23) or Traidor et al. (25), it is unclear whether the quantity and type of fruits and vegetables provided through the program impacted the consumption of fruits and vegetables during the school day.

The NFVPP was the only program among the studies assessing fruit and vegetable consumption that incorporated a snack program and was successful at improving fruit and vegetable intake (16). Students who received the snack program as well as the Enhanced Nutrition Education mentioned previously, and those who solely received the snack program, had higher total fruit and vegetable intake following the program when compared to the control group (i.e., students who did not receive the NFVPP). Particularly, a higher intake of fruits and vegetables was seen in students at school, where students who received the Enhanced Nutrition Education and snack program consumed approximately 1.9 (SD=0.1) servings of fruits and vegetables; those who only received the snack program consumed approximately 1.8 (SD=0.2) servings of fruits and vegetables; and the control group consumed approximately 1.4 (SD=0.2) servings of fruits and vegetables. This change may be attributed to the snack program received by both intervention groups, as no significant difference in intake was found between the two intervention groups (16).

Several school nutrition programs have been effective at increasing children's consumption of fruits and vegetables following the program (14-19). Peer and teacher influence play a role in consumption of fruits and vegetables, as evidenced by one program, Team Nutriathlon (18,19). The length of the program can further impact efficacy with regard to improving consumption of fruits and vegetables (18,19). Successful programs incorporated nutrition into the school curriculum (14-16), or school nutritional policies (15,17), indicating their importance in influencing fruit and vegetable consumption (14-17). Lastly, the inclusion of a snack program offering fruits and vegetables may positively influence consumption of fruits and vegetables at school (16,23,25).

Fruit and Vegetable Variety

The variety of fruits and vegetables consumed is also important when addressing healthy food choices, as diversifying the intake of fruits and vegetables allows for a greater consumption of nutrients found to be protective against chronic diseases (58). Only two studies assessed the influence of school nutrition programs on fruit and vegetable variety; the Action Schools! BC nutrition program and Team Nuriathlon. Following the 12-week Action Schools! BC program, the five intervention schools had a significant increase in fruit and vegetable variety when compared to the five schools that did not receive the intervention. This significant increase may be attributed to the classroom activities and taste-testing activities incorporated into the program, which allowed children to positively learn about healthy eating and become exposed to a wider variety of fruits and vegetables (14).

Team Nutriathlon, implemented over eight weeks with grade five and six students, encouraged consumption of a variety of fruits and vegetables through the formulation of team goals. These team goals were based on the quantity and variety of food eaten; variety was based on equal distribution of the six categories of foods. Fruits, vegetables, and milk and alternatives were organized into coloured groups based on their nutritional content. The green category consisted of vegetables rich in folic acid; orange represented fruits and vegetables rich in beta-carotene; purple consisted of vegetables rich in potassium and folic acid; yellow comprised fruits rich in vitamin C; red consisted of fruits rich in potassium and vitamin C; and blue included milk and alternatives rich in calcium and vitamin D. To motivate students, teachers provided students with awards if their team goals were met. Over the eight-week program, the blue category (i.e., milk and alternatives) increased at the fastest rate, followed by the red category which included fruits and vegetables such as apples, bananas, grapes, and fruit juices. The green category consisting of asparagus, broccoli, brussels sprouts, and spinach, and the orange category consisting of carrots, pumpkins, and mangoes, were consumed the least, increasing at the slowest rate over the eight weeks. Although the Team Nutriathlon program encouraged consumption of a variety of fruits and vegetables, no increase in variety was measured. This could be due to the lack of fruits and vegetables provided by this program, as well as limiting exposures to fruits and vegetables, thus affecting children's willingness to try new foods (18).

Limited studies have assessed the influence of school nutrition programs on the variety of fruit and vegetables consumed in youth. Classroom activities that promoted the consumption of fruits and vegetables, as well as taste-testing activities, were found to

result in positive changes in fruit and vegetable variety, whereas incentive materials provided through Team Nutriathlon did not result in significant changes in variety (18). This suggests that children require more knowledge of, and exposure to, fruits and vegetables if changes in fruit and vegetable variety are to occur.

Milk and Alternative Consumption

One in three children in Canada are not consuming the recommended amount of milk and alternatives (10). Milk and alternatives are essential in one's diet, as they provide protein and a number of nutrients necessary for healthy growth and development, particularly for the development of healthy bones and teeth. Through the essential nutrients found in milk and alternatives, including vitamin A, vitamin D, and vitamin B12, milk and alternatives can also provide protective effects for several chronic diseases such as cardiovascular disease, diabetes, osteoporosis, and some cancers (59). Due to the many associated health benefits, improving the consumption of milk and alternatives is an important focus of school nutrition programs (18,19,21,22). Research has shown that nutrition programs that administered (21,22) or promoted consumption of milk and alternatives (18,19) resulted in an increased consumption of milk and alternatives amongst children participating in the program (18,19,22).

A pilot snack program was initiated in Kashechewan, and an existing snack program was supplemented in Attawapiskat, to provide at least one serving of milk and alternatives each day to students in grades six to eight (22). Following the eight-month program, students attending the J.R. Nakogee School in Attawapist had a significant increase in their consumption of milk and alternatives, from 1.7 (*SD*=1.7) servings at

baseline to 2.1 (*SD*=1.4; *p*=0.03) servings one-week post-program. Students attending the St. Andrew's School in Kashechewan also had an increase in their consumption of milk and alternatives, from 2.2 (*SD*=1.9) servings at baseline to 2.8 (*SD*=2.0) servings at follow-up, although this difference was not statistically significant (*p*=0.07). Consumption of milk and alternatives among participants in Kaschechewan was further assessed at one-year follow-up, which showed a significant decrease in consumption of milk and alternatives when compared to the one-week post-program values, decreasing to 1.6 (*SD*=1.1) servings of milk and alternatives (*p*=0.02). Due to logistical and staffing issues, the snack program in Kaschechewan was provided intermittently, which may have influenced the results (22).

Team Nutriathlon also assessed consumption of milk and alternatives, utilizing individual and team goals to encourage children to increase their consumption of milk and alternatives (18,19). Drapeau et al. (18) implemented Team Nutriathlon over eight weeks with grade five and six students, finding that at the end of the program those who had received the intervention consumed approximately three servings of milk and alternatives, while the control group consumed approximately two servings of milk and alternatives. There was a statistically significant difference between the control and intervention groups, and this difference persisted at the ten-week follow-up (18). Chamberland et al. (19) implemented Team Nutriathlon over six weeks with grade seven and eight students. Students who had received the program consumed approximately three and a half servings of milk and alternatives at the end of the program, which was significantly higher than the one and a half servings of milk and alternatives consumed by the control group. However, this significant difference did not persist when participants

were assessed at the ten-week follow-up, finding that the intervention group's consumption of milk and alternatives decreased to two servings (19).

The decrease in the consumption of milk and alternatives found post-program in the studies by Gates et al. (22) and Chamberland et al. (19) may be attributed to the cessation of the program, the surrounding community where milk and alternatives are no longer readily available for consumption (22), and a decrease in peer-modelling that had occurred during the program (19).

A school nutrition program was implemented over the 2009 to 2010 school year in Fort Albany that included policy, education, food provision, family and community involvement, and program evaluation components (21). The nutrition education component of the program consisted of the "Power4Bones" program, goal setting, and peer-modeling. To influence the home environment, an informational handout was created for each class and provided to parents. The program further incorporated a community feast that was planned by the students to emphasize healthy foods and influence the community environment. Healthy breakfasts and snacks consisting of vegetables, fruits, whole grains, protein sources, and milk or milk and alternatives, were provided to students each day (21). Despite these attributes, the program had a very small sample size, consisting of only ten students for their dietary analysis. Although participants increased their servings of milk and alternatives from 1.8 servings (SD=1.1) to 2.1 servings (SD=3.0) post-program, the difference was not statistically significant (p=0.21), as the small number of participants impacted statistical power (21).

Studies that have assessed the influence of school nutrition programs on milk and alternative consumption have shown that provision (21,22) and promotion of milk and

alternatives (18,19) can positively influence consumption of milk and alternatives amongst children participating in the programs (18,19,22). Inadequate statistical power in the study by Gates et al. (21), however, impacted the ability to make definitive conclusions regarding the efficacy of nutrition education, parental and community involvement, and school policies, at influencing milk and alternative consumption (21).

School Policies and Diet Quality

Schools in Ontario must abide by four food and nutrition policies and guidelines: (i) Bill 8 – Healthy Food for Healthy Schools Act; (ii) Trans Fats Standards; (iii) Policy/Program Memorandum No. 135: Healthy Foods and Beverages in Elementary School Vending Machines; and (iv) the School Food and Beverage Policy (30,60). Bill 8 gives power to the Minister of Education to create policies, guidelines, and regulations surrounding nutrition standards, while also regulating the trans-fat content of all food and beverages sold in school cafeterias. The Trans Fat Standards determines the maximum amount of trans fat, as well as the ingredients used in the preparation of food and beverages, that can be sold to students in schools. The Policy/Program Memorandum No. 135 is a voluntary provincial policy outlining the recommended nutrition standards, selection criteria, and recommended servings sizes, for foods and beverages offered in school vending machines (30). The School Food and Beverage Policy states that all food and beverages sold in school cafeterias, vending machines, tuck shops/canteens, catered lunch programs, bakes sales, and sports events, must comply with set nutrition standards. Nutrition criteria are based on three categories: “sell most”, “sell less”, and “not permitted for sale”. Products in the “sell most” category must make up at least 80% of

food and beverages offered at school and are considered the healthiest options. They have higher levels of essential nutrients and lower levels of fat, sugar, and/or sodium. Products in the "sell less" category must make up a maximum of 20% of all food and beverages offered at school and are items with higher amounts of fat, sugar, and/or sodium. Products in the "not permitted for sale" category must not be sold in schools, such as fried foods and confectionary, as they contain few or no essential nutrients and/or contain high amounts of fat, sugar and/or sodium. The Minister of Education has the authority to ensure the School Food and Beverage Policy is implemented and that all school boards are compliant (60). School boards/districts are responsible for implementing each policy, while working with students, parents, school staff, community members, public health staff, and food service providers to ensure all the appropriate steps are set for proper implementation (30,60). Both the school boards and principals of each school are required to monitor each school's compliance with the policies. Monitoring should consist of outlining the school board's implementation plan and expectations to school principals, regular communication with the superintendent, and discussions of current status and next steps at principal meetings (60).

Programs wherein polices were implemented that banned high-fat, high-sugar snack foods in schools and/or offered healthy menu alternatives, witnessed an improvement in diet quality among children participating in the program (17,20). In other words, with greater access to healthy foods, children are less likely to eat foods high in fat and sugar. In fact, during the programs, higher purchases of foods lower in fat, lower in sugar, and higher in fibre were seen at home, indicating that these policy

implementations not only affected the school environment but the home environment as well (20).

Incorporating heathy eating and active living strategies into the curriculum also contributed to an overall improvement in diet quality (15,17,20). Both the CLASS (17) and APPLE Schools (15) programs used components from the AVHPSP program that focuses on the unique needs and barriers of each participating school, including parents, staff, and the community, when designing program plans. Specific focus was given to providing healthy eating and active living strategies within the curriculum (15,17). The APPLE Schools program also provided classroom gardens, after-school cooking classes, and physical activity programs to make healthy living fun and engaging (15). Grade five students from both the CLASS and APPLE Schools programs were found to have higher consumptions of fruits and vegetables, lower caloric intakes, and overall higher diet quality index scores (15,17). Similarly, the Sandy Lake Diabetes Prevention Curriculum incorporated health education lessons surrounding healthy eating, physical activity, and diabetes education, using storytelling as a way to develop knowledge and skills in students in grades three to five. By incorporating these topics into the curriculum, children were able to improve their knowledge of foods low in fat and had greater self-efficacy, increasing the likelihood of changing one's diet (20). Consequently, children who participated in curriculum-based programs had an observed decrease in overall energy consumption (15).

Improvements in diet quality among children participating in programs were witnessed wherein polices banning high-fat, high-sugar snack foods in schools were implemented and/or healthy menu alternatives were offered (17,20), as well as when

programs incorporated heathy eating and active living strategies into the curriculum (15,17,20).

Limitations of Current Studies on School Nutrition Programs in Canada

Although most studies assessing school nutrition programs implemented within Canada have yielded positive results, there are several limitations that impacted their overall success.

Sample Size

A large limitation in several of these studies was their small sample sizes (n=6/13). The sample sizes of the studies assessed ranged from 5,200 participants (17) to as low as 10 participants (21). He et al. (16) included a sample size calculation within their paper, showing that 437 students were needed in each group to detect an intervention effect of 0.4 servings of fruits and vegetables. Their two intervention groups consisted of 400 and 470 participants, while the control group consisted of 407 participants. As He et al. (16) did not reach their desired sample size for each group, they did not have sufficient statistical power for analysis (16). A majority of the studies which analyzed school nutrition programs did not provide a formal sample size calculation to show the number of participants needed to detect a significant difference (n=12/13). As many studies had 10 (21), 24 (22), 66 (23), 76 (25) or 122 (20) participants, it is possible they did not have sufficient participants to achieve statistical power. With inadequate statistical power, these programs had a lower chance of detecting a true effect (16,20-23,25).

Monetary and Personnel Support

Several of the studies examined lacked the monetary and personnel support required to operate the program at its full potential (n=6/13) (14,16,19-22). Decreased access to funding and personnel impacted the ability of the programs to purchase and deliver enough fruits and vegetables, affecting how much fruits and vegetables were provided to the children for the duration of the program, and thus affecting post-program consumption values (16,21,22). As well, teachers participating in the program required training, regular support, and resources for sustained operation, which requires an increased number of personnel. Without the support from additional personnel, lessons and taste testing experiences were negatively impacted (14). Monetary support also impacted the ability to include a process evaluation for each study, which is essential in monitoring how the program is carried out in comparison to a theoretical model (19).

Program Duration

Studies often implemented school nutrition programs for a short duration, and during only one season (n=5/13) (14,18,19,23,25). Clearly, the season will impact which fruits and vegetables are grown, and thus which fruits and vegetables can be offered to the students. By not accounting for seasonality, when the program was implemented would have impacted the variety of fruits and vegetables administered, likely affecting children's preferences and diet quality. For instance, the EarthBox Kids program provided students with the fruits and vegetables they had grown in their gardens as snacks. The season would have impacted which foods were able to be planted, as well as their successful growth, thus affecting which foods were served to the children (23,25).

Dietary Intake Tool

Studies often administered FFQs to calculate food consumption over a period of months (n=5/13) (14,15,17, 21). This is not an ideal method of data collection in this population, as children have difficulty recalling past events (26). Additionally, no studies directly measured children's dietary intake, instead using self-report methods (14-25). Self-reporting in children can be problematic, as there may be over-reporting, particularly when using 24-hour recalls and FFQs (26). Misreporting of dietary intake among youth is largely due to their lower literacy levels, limited cognitive abilities, and difficulties in estimating portion sizes. More specifically, children under the age of eight cannot accurately recall foods, estimate portion sizes, or calculate frequency of food consumption (61,62). While the average age of participants in the studies reviewed was approximately 11 years of age (14-25,50), a child's ability to self-report his/her food intake improves with age and further cognitive development, and it is not until approximately 12 years of age that a child can more accurately report their dietary intake (62,63).

Control Group

A number of studies did not use a control group (n=5/13) (20-23,25). A control group is essential in studies assessing the effectiveness of an intervention, as an inappropriate comparator, or no comparator at all, may invalidate the results of the study. Researchers are able to minimize bias and ease interpretation of results by incorporating a control group that is composed of individuals with characteristics similar to individuals in the intervention group, controlling for potential confounding variables that may impact

the desired outcome (64). Without a control group, it cannot be determined whether the changes observed were due to the intervention or other factors, such as age, gender, or external influences (23). The utilization of a control group, and the reduction in bias, increases the statistical power of the study, as the control group can be used as a baseline comparison to the intervention group and can show that the results found are in fact due to the intervention (65). Comparisons of the intervention group to the control group can further determine the magnitude to which the results found are due to the intervention, more commonly known as the effect size (66).

Conclusion

School nutrition programs are an ideal strategy for promoting and improving healthy eating practices in youth. However, the studies on school nutrition programs implemented to date have limitations, including inadequate monetary and personal support, small sample sizes, short program durations, failing to account for seasonality, using FFQs and self-report methods for dietary intake, and not including a control group. To address such limitations, a two-year pilot cluster randomized controlled trial was implemented within the Thames Valley region in Southwestern Ontario to assess how a CPSFP influences students' consumption and instances of fruits and vegetables compared to the TSNP. The CPSFP was designed with previous limitations in mind.

CHAPTER 3

METHODS

Study Design

A two-year pilot cluster randomized controlled trial was implemented to assess how a CPSFP influences students' consumption and instances of fruits and vegetables compared to the TSNP. Participating schools were randomly selected from schools within the Thames Valley region in Southwestern Ontario that are under the Thames Valley District School Board and the London District Catholic School Board.

The CPSFP served as the intervention and was implemented over a ten-week period in the designated intervention schools. The food offered through the CPSFP was secured from local farmers and/or food hubs and was based off a ten-week menu designed by OSNP. At the beginning of each week, a large shipment of food products was delivered in the morning to the schools, and could include mass quantities of whole fruits or vegetables, different variations of cheese, yogurt, cereal, crackers, hummus, eggs, etc. The food received was enough for the schools to provide snacks for each day of the week. Every week schools received a different variety of food, with little repetition of fruits or vegetables over the ten-weeks. Approximately 20% of the food delivered each week was required to be seasonal and local, so that at least two days per week the snacks were guaranteed local. If extra food was available at the end of the week, it was often carried over into the next week. When the food was delivered to the schools, parent volunteers, employees, teachers, and/or educational assistants received and prepared the food. Intervention schools continued to receive funding from OSNP for their snack programs and were encouraged to use that funding to purchase items for preparing and

serving the food, including reusable containers, plastics baggies, and plastic cutlery. The time at which the snack programs were provided depended on the school; however, they usually occurred during the first recess break. Snacks were typically cut-up into bite size pieces and could be presented on a big table, trolley carts, or trays for children to take as they desired. Some schools provided extra snacks in bins within the school office for kids if they were still hungry.

To account for seasonality, the CPSFP was implemented over a ten-week period at three different time points in the Spring or Fall. Phase 1 was implemented from February-May 2017; Phase 2 from October-December 2017; and Phase 3 from February-May 2018.

Control schools included schools that already had a school snack program with OSNP and that continued with their current program for the duration of the study. The programs in each school varied, as volunteers within the schools purchased and prepared the snacks.

This study was approved by the Research and Assessment Services at the Thames Valley District School Board (See Appendix A for Thames Valley District School Board Ethics Approval Letter) and the Western University Non-Medical Research Ethics Board (See Appendix B for Western University Ethics Approval Letter).

Sample Size Calculation and Participant Recruitment

The required sample size was calculated using a cluster randomized trial design to account for variation between clusters (schools) in addition to the standard variation among individuals within the cluster. The standard sample size calculation for two group

means was multiplied by a design effect formula that includes the intracluster correlation coefficient (ICC), which considers both the between-cluster variation and the within-cluster variation. He et al. (16) conducted an intervention in Ontario schools and utilized an ICC of 0.03 and a standard deviation (SD) of 4.5 for fruit and vegetable servings. A change of one serving in fruits or vegetables between the two groups was determined to be a practically important change. These values were used in the sample size calculation (See Appendix C for full sample size calculation).

The sample size calculation indicated that a total of 60 schools were needed, and thus 60 schools were randomly selected from 160 schools that currently had a TSNP with OSNP-SW. Recruitment of schools was completed by OSNP representatives. Intervention schools were randomly selected from the list provided by OSNP representatives and contacted to determine if they had the capacity to extend their snack program to five days per week with 100% of students receiving the program. If they were willing, they were asked to participate in the study. Control schools were selected based on school socioeconomic status (SES), and the type of program the school offered, to maximize the chances that the control and intervention schools were a match. Both the intervention and control group consisted of 30 schools. The intervention group consisted of those receiving the CPSFP, while the control group continued to receive the TSNP. Different schools were selected for each phase to ensure our desired sample size was reached.

Children between the ages of 9 and 13 who attended one of the selected schools were invited to participate, as they were cognitively able to complete the surveys. Volunteers from the Human Environments Analysis Laboratory (HEAL) in the

department of Geography at Western University visited each of the selected schools to complete an in-class presentation for the students, using the child assent as a script (See Appendix D for Child Letter of Information and Assent), informing students on the process of the study and the information they would be asked to provide. Following the presentation, teachers were provided with the Parental Letter of Information and Consent (See Appendix E for Parental Letter of Information and Consent) so that students could bring them home to their parents. Parents of children in grades five to eight were asked to provide consent for their child/children to participate in the study. Children were then asked to return these documents back to their teacher, upon which teachers sealed all consents in an envelope. A week following presentations, volunteers returned to each school to pick up the envelopes. Child assent was then reviewed with children who had parental consent so that the process and requirements of the study were understood, and all questions were answered. Children were asked to sign the assent form if they wished to participate and were enrolled in the study.

Following recruitment, each student was assigned a unique identification code, so their name would not appear on any materials or data files, except for the consent form and the Pupils-Eating-At-School (PEAS) survey. All information collected in this study was kept confidential. Names were required on follow-up PEAS surveys to ensure the surveys were matched correctly with the students' identification numbers. After the team collected the PEAS surveys, the cover page with the identifying information was removed and shredded so that no identifying information and data were stored together. Furthermore, materials and data files were only viewed by members of the research team,

stored in a locked filing cabinet, and transferred onto a password protected computer in a secure facility at the University of Western Ontario.

Data Collection: The PEAS Survey

Although valid and reliable methods exist for measuring children's food intake during the school day using direct observations by trained observers (67), such methods are not feasible for large multi-centered population studies. Therefore, a new tool was developed by the research team called the Pupils-Eating-At-School (PEAS) Survey to more efficiently capture children's food intake during the school day. This data collection method used components from a previously validated tool called the Day in the Life Questionnaire (DILQ) - a graphic write-and-draw 24-hour recall that is used to measure instances of fruits and vegetables in children ages seven to ten (68,69). Each PEAS survey was five pages in length. As students are unlikely to know standard servings sizes, the first page had examples of words that students would typically use for quantifying their food, such as one container when describing yogurt. The subsequent three pages consisted of blank charts which prompted students to record what and how much they ate or drank during specific time points that day. If the student was in a school with a BSD schedule, there were three blank charts asking what they ate for nutrition break one, nutrition break two, and at any other time point during the school day. If the student was in a school with a TSD schedule, there were three blank charts asking what they had for recess one, lunch, and recess two. Each survey encouraged students to organize the food they consumed into categories based on CFG, drinks, or "other" foods. The final page of the PEAS survey depicted a hunger scale, where students were asked on a scale from 0 to

10 to indicate how hungry they felt while completing the survey, with 0 being very hungry and 10 being very full (See Appendix F for PEAS Survey).

Data Collection: The Youth Survey

The Youth survey was administered in conjunction with the PEAS survey and included questions regarding individual- and family-level characteristics, nutrition knowledge, and fruit and vegetable preferences. Questions involving individual- and family-level characteristics included age, sex, ethnicity, and family structure. Food knowledge questions were adapted from surveys previously validated for evaluating the nutritional knowledge of students in grades four to eight (70,71), and surrounded fruit and vegetable consumption, healthy choices, estimated recommended servings, and categorization of food items. Fruit and vegetable preference questions asked children how much they like each type of fruit and vegetable offered in the program, as well as those not offered.

Data Collection Procedures

Data were collected on one day during two different time periods within each season: prior to the intervention, and at the ninth or tenth week of the ten-week intervention. All PEAS and Youth surveys were administered following the last recess/nutrition break within the school day. On survey days at the selected schools, participating students were asked to congregate in one large room, either the gym or library, to complete the survey. Prior to commencing the survey, instructions were provided to the students on how to complete the PEAS survey, and more specifically,

each table. Students were asked to write down anything they ate or drank for each time point and to be as specific as possible. If they did not have anything to eat or drink, they were asked to write "None" in the box. Volunteers were present to assist with any questions. After each student completed the survey, it was checked over before final collection to ensure it was filled out as instructed. Once all surveys were collected, they were transferred to the HEAL lab by a Master's student and filed.

Data Input

Information received from the PEAS surveys was used to calculate the daily number of CFG servings for each student, as well as the daily servings of 100% fruit juice, sugar-sweetened beverages, and snacks. All information was inputted into an Excel spreadsheet, with servings for fruits and vegetables being calculated separately. PEAS surveys were also used to calculate instances of fruits and vegetables; that is, how many times throughout the school day a child ate a fruit or vegetable. For example, if a student wrote that he/she had a vegetable for a nutrition break, this was classified as one instance of vegetables.

Consensus was achieved amongst the research team on classification of serving sizes for foods not listed in CFG (See Appendix G for all PEAS coding assumptions). Measurements and weights were collected to determine the number of food items equivalent to one CFG serving size (1/2 cup). Observation data were also used to further assist in making assumptions of foods listed within the PEAS surveys. For instance, if a student noted a certain quantity of fruit but did not specify the type of fruit, it was assumed to be one medium apple. If a student did not specify the vegetable consumed,

baby carrots were assumed. If no quantity was provided for a vegetable or fruit, 0.5 CFG vegetable servings, and 0.75 CFG fruit servings were assumed. If a student stated "Cheese" but not the type or quantity, it was assumed to be 50g and one CFG serving. If a student stated that they ate cheese and provided a quantity, but not what type of cheese, it was assumed that they consumed slices of cheese, equal to 0.5 CFG servings each. If a student stated "Turkey", "Ham", or "Salami" but no amount, it was assumed to be 1 slice of deli meat. If a participant stated that they ate a sandwich but did not specify what type, it was assumed that the sandwich consisted of two slices of bread, one slice of deli meat, one slice of cheese, and one leaf of lettuce. A serving of sugar-sweetened beverage was assumed to be 125mL/ half a cup, similar to CFG's serving for 100% fruit juice. Apple juice and orange juice were classified as 100% fruit juice. Based on reference amounts established by Health Canada (72) and typical packaging sizes of commons snacks, a snack serving was classified as 25-30g, with 27g being used as the average when calculating the number of servings. For all food items, if a child wrote "a container" it was calculated as half a cup. If a child stated "a little" it was regarded as a quarter cup; "a lot" was counted as one cup. If a child wrote "a handful" it was classified as a quarter cup.

The Food Processor Nutrition and Fitness Software version 11.3.285 by ESHA Research was used to analyze the nutrient content of foods not listed within CFG. If the nutrient content of the specified food was comparable to that of other fruits or vegetables, then it was classified as such. For instance, pickles are not currently listed within CFG but were found to have a similar nutrient content to cucumbers and were recorded the same. ESHA was also used to determine weights for food items provided within the

survey; however, when brand names were provided, nutrition facts tables for those items were used to gather weights.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 22. Categorical variables were reported using percentages. The mean and standard deviation summarized normally distributed continuous variables, whereas the median and interquartile range was used for skewed continuous variables. For ease of interpretation, however, the mean and standard deviation was also reported for skewed continuous variables. The chi-square test compared differences in proportions for categorical outcomes between the intervention and control group, and the independent samples t-test was used to compare mean differences in continuous variables between groups. If the continuous outcomes were skewed, the independent samples Mann-Whitney U test compared differences in medians between groups. In order to assess the impact of pre-consumption values and clusters (i.e., schools) on consumption values for fruits and vegetables during the intervention, a multiple linear regression was used and the mean change in CFG servings for each school within the intervention group was calculated. Sub-analyses were also performed using the Spearman rank correlation coefficient to determine the strength and direction of the relationship between age and consumption of each food group, as well as instances of fruit and vegetables. The independent samples Kruskal-Wallis test was used to compare differences in median changes in CFG servings and instances of fruits and vegetables and gender. A p-value <0.05 was considered statistically significant.

CHAPTER 4

RESULTS

A total of 2,422 students, and 60 schools, participated in the study (n=1,331 students and 30 schools in the intervention group; n=1,091 students and 30 schools in the control group). Within the selected schools, 9,522 students were eligible to participate, and as the total sample size equalled 2,422 students, this rendered a participation rate of 25.4%. The average age of participants was 11.1 years (*SD*=1.2) in the intervention group and 11.4 years (*SD*=1.3) in the control group ($p<0.001$). The intervention group was comprised of 58.2% females, compared to 57.7% females in the control group ($p=0.97$). The intervention group had a significantly higher proportion of schools with a BSD schedule than the control group (75.0% vs. 44.1%, respectively, $p<0.001$).

Comparisons of Food Groups between the Intervention and Control Participants

Baseline Consumption Values for each Food Group

Table 1 compares baseline consumption for each of the food groups in the intervention and control groups. The average consumption of vegetables was 0.6 servings (*SD*=0.9) in the intervention group and 0.5 servings (*SD*=0.8) in the control group ($p=0.58$). The average consumption of fruit at baseline was 1.1 servings (*SD*=1.2) in the intervention group and 1.1 servings (*SD*=1.2) in the control group ($p=0.94$). The average consumption of milk and alternatives was 1.0 serving (*SD*=1.1) in the intervention group and 1.0 serving (*SD*=1.2) in the control group ($p=0.24$). There was no significant difference between the intervention and control group in consumption values for any of

the aforementioned and remaining food groups (i.e., grains, meat and alternatives, 100% fruit juice, sugar-sweetened beverages, and snacks).

The mean instances of vegetables at baseline was 0.7 (*SD*=0.7) in the intervention group and 0.7 (*SD*=0.7) in the control group (*p*=0.66). The mean instances of fruit was 1.0 (*SD*=0.8) in the intervention group and 1.0 (*SD*=0.8) in the control group (*p*=0.62).

Changes in Consumption of each Food Group from Baseline to Follow-up

Table 2 compares changes in consumption for each food group between the intervention and control groups from baseline to follow-up. Consumption of vegetables did not change in the intervention group (mean=0.0; *SD*=1.0) or the control group (mean=0.0; *SD*=1.0) from baseline to follow-up (*p*=0.94). Fruit consumption did not change in the intervention group (mean=0.0; *SD*=1.4) and decreased by 0.1 servings (*SD*=1.4) in the control group (*p*=0.06). Consumption of milk and alternatives increased by 0.1 servings (*SD*=1.5) in the intervention group and decreased by 0.1 servings (*SD*=1.5) in the control group, and this difference was statistically significant (*p*=0.01). There were no other statistically significant changes in consumption for the other food groups between the intervention and control groups.

Instances of vegetables did not change from baseline to follow-up in the intervention group (mean=0.0; *SD*=0.9) or control group (mean=0.0; *SD*=0.9; *p*=0.75). Instances of fruit did not change in the intervention group (mean=0.0; *SD*=0.91) and decreased by 0.1 (*SD*=1.0) in the control group (*p*=0.10).

Comparisons between the Intervention and Control Groups within BSD Schools

As there was a significant difference in school schedules between the intervention and control groups (i.e., with the intervention group predominantly comprised of schools with a BSD schedule), further analyses were conducted to compare the effects of the intervention versus control on consumption changes within each school schedule. Table 3 compares changes in consumption for each of the food groups in the intervention and control groups within BSD schools. Vegetable consumption from baseline to follow-up did not change in the intervention group (mean=0.0; *SD*=1.0) or the control group (mean=0.0; *SD*=1.0; *p*=0.94). Fruit consumption did not change in the intervention group (mean=0.0; *SD*=1.3) and decreased by 0.1 servings (*SD*=1.4) in the control group (*p*=0.50). The intervention group had an increase of 0.2 servings (*SD*=1.5) of milk and alternatives from baseline to follow-up, while the control group had a decrease of 0.1 servings (*SD*=1.5), and this difference was statistically significant between groups (*p*=0.01). There was no significant difference between the two groups in changes in consumption of vegetables, fruit, grains, meat and alternatives, 100% fruit juice, sugar-sweetened beverages, or snacks.

Instances of vegetables did not change from baseline to follow-up within the intervention group (mean=0.0; *SD*=0.9) or the control group (mean=0.0; *SD*=0.9; *p*=0.85). Similarly, instances of fruit did not change in the intervention group (mean=0.0; *SD*=0.9) or the control group (mean=0.0; *SD*=0.9) from baseline to follow-up (*p*=0.83).

Comparisons between the Intervention and Control Groups within TSD Schools

Table 4 compares changes in consumption for each of the food groups in the intervention and control groups within TSD schools. Vegetable consumption increased by an average of 0.1 servings (*SD*=1.1) in the intervention group, while vegetable consumption did not change in the control group (mean=0.0; *SD*=0.9; *p*=0.98). Consumption of fruit increased by 0.1 servings (*SD*=1.6) in the intervention group and decreased by 0.2 servings (*SD*=1.4) in the control group (*p*=0.07). Consumption of snacks increased by 0.1 servings (*SD*=1.8) in the intervention group and decreased by 0.2 servings (*SD*=1.8) in the control group, and this difference was statistically significant (*p*=0.01). There was no significant difference in changes in consumption for the remaining food groups between the intervention and control groups.

Instances of vegetables did not change from baseline to follow-up within the intervention group (mean=0.0; *SD*=0.9) or the control group (mean=0.0; *SD*=0.9; *p*=0.52). Instances of fruit did not change in the intervention group (mean=0.0; *SD*=1.0) and decreased by 0.2 (*SD*=1.0) in the control group (*p*=0.05).

Moderation Effects of Clusters within the Intervention Group

The mean change in consumption and instances of fruits and vegetables was calculated for each cluster (school) within the intervention group. Amongst the 30 intervention schools, the mean change in consumption of vegetables ranged from a decrease of 0.4 servings to an increase of 0.4 servings. The mean change in consumption of fruit ranged from a decrease of 0.6 servings to an increase of 0.9 servings. The mean

change in instances of vegetables ranged from a decrease of 0.6 to an increase of 0.4, while instances of fruit ranged from a decrease of 0.5 to an increase of 0.9.

A multiple regression was used to assess the impact of pre-consumption values and clusters (schools) on consumption values for fruits and vegetables during the intervention. Clusters (schools) had no significant impact on consumption of vegetables during the intervention (ß=0.04, p=0.20). Pre-consumption of vegetables was significantly and positively associated with consumption of vegetables during the intervention (ß=0.39, p<0.001). Clusters (schools) and pre-consumption of vegetables accounted for 14.8% of vegetable consumption during the intervention (R^2=1.50, F(2,1026)=90.31, p<0.001).

Clusters (schools) had no significant impact on consumption of fruit during the intervention (ß=0.001, p=0.98). Pre-consumption of fruit was significantly and positively associated with consumption of fruit during the intervention (ß=0.28, p<0.001). Clusters (schools) and pre-consumption of fruit accounted for 7.8% of fruit consumption during the intervention (R^2=0.08, F(2,1027)=44.80, p<0.001).

Clusters (schools) had no significant impact on instances of vegetables during the intervention (ß=0.06, p=0.06). Baseline instances of vegetables was significantly and positively associated with instances of vegetables during the intervention (ß=0.33, p<0.001). Clusters (schools) and baseline instances of vegetables accounted for 11.0% of instances of vegetables during the intervention (R^2=0.11, F(2,1021)=64.26, p<0.001).

Clusters (schools) had no significant impact on instances of fruit during the intervention (ß=0.01, p=0.72). Baseline instances of fruit was significantly and positively associated with instances of fruit during the intervention (ß=0.30, p<0.001). Clusters

(schools) and baseline instances of vegetables accounted for 8.8% of instances of vegetables during the intervention (R^2=0.09, F(2,1019)=50.11, p<0.001).

Changes in Consumption of each Food Group Regardless of Intervention or Control

The Relationship between Age and Changes in Food Group Consumption

The Spearman rank correlation coefficient was used to assess the association between age and changes in consumption of each food group, as well as instances of fruit and vegetables. There were no meaningful or statistically significant correlations between age and consumption of vegetables, grains, milk and alternatives, meat and alternatives, 100% fruit juice, sugar-sweetened beverages, snacks, instances of vegetables, or instances of fruit (with *r* values ranging from -0.04 to 0.01). There was, however, a statistically significant but very weak inverse correlation between age and consumption of fruit (r= -0.05; p=0.04).

The Relationship between Gender and Changes in Food Group Consumption

Changes in consumption of each food group from baseline to follow-up were calculated within each gender. Neither consumption of vegetables (p=0.58) nor fruit (p=0.78) varied by gender. There was also no significant change in grain consumption (p=0.86), milk and alternatives (p=0.71), meat and alternatives (p=0.37), 100% fruit juice (p=0.17), or sugar-sweetened beverages (p=0.09) by gender. Consumption of snacks decreased by 0.1 servings (SD=2.0) in females, 0.2 servings (SD=1.9) in males, and 0.9 servings (SD=1.1) in others (p=0.04); however, there were only 7 participants who did not classify themselves as male or female (data not shown). There was no significant

change in instances of vegetables (p=0.29) or fruits (p=0.98) from baseline to follow-up by gender.

Table 1. Baseline Consumption Values for each Food Group in the Intervention and Control Groups

Baseline Food Group	Intervention		Control		p-value
	Mean (SD)	*Median (IQR)*	*Mean (SD)*	*Median (IQR)*	
Vegetable	0.6 (SD=0.9)	0.3 (IQR=1.0)	0.5 (SD=0.8)	0.3 (IQR=0.8)	0.58
Fruit	1.1 (SD=1.2)	1.0 (IQR=1.8)	1.1 (SD=1.2)	1.0 (IQR=1.8)	0.94
Grains	1.9 (SD=1.7)	2.0 (IQR=2.0)	1.9 (SD=1.6)	2.0 (IQR=1.5)	0.90
Milk and Alternatives	1.0 (SD=1.1)	0.5 (IQR=1.5)	1.0 (SD=1.2)	0.5 (IQR=1.5)	0.24
Meat and Alternatives	0.6 (SD=0.8)	0.5 (IQR=1.0)	0.6 (SD=0.9)	0.5 (IQR=1.0)	0.25
100% Fruit Juice	0.2 (SD=0.7)	0.0 (IQR=0.0)	0.3 (SD=0.8)	0.0 (IQR=0.0)	0.29
Sugar-Sweetened Beverages	0.7 (SD=1.4)	0.0 (IQR=1.5)	0.8 (SD=1.5)	0.0 (IQR=1.5)	0.07
Snacks	1.4 (SD=1.5)	1.0 (IQR=2.0)	1.4 (SD=1.6)	1.0 (IQR=2.0)	0.77
Instances of Vegetables	0.7 (SD=0.7)	1.0 (IQR=1.0)	0.7 (SD=0.7)	1.0 (IQR=1.0)	0.66
Instances of Fruit	1.0 (SD=0.8)	1.0 (IQR=1.0)	1.0 (SD=0.8)	1.0 (IQR=1.0)	0.62

The independent samples Mann-Whitney U Test compared median differences in baseline food group consumption between groups.
SD=Standard Deviation
IQR=Interquartile Range

Table 2. Changes in Consumption of each Food Group in the Intervention and Control Group

Changes in Food Group (Delta)	Intervention		Control		p-value
	Mean (SD)	*Median (IQR)*	*Mean (SD)*	*Median (IQR)*	
Vegetable	0.0 (SD=1.0)	0.0 (IQR=0.5)	0.0 (SD=1.0)	0.0 (IQR=0.5)	0.94
Fruit	0.0 (SD=1.4)	0.0 (IQR=1.5)	-0.1 (SD=1.4)	0.0 (IQR=1.5)	0.06
Grains	0.0 (SD=2.2)	0.0 (IQR=2.0)	0.0 (SD=2.0)	0.0 (IQR=2.0)	0.50
Milk and Alternatives	0.1 (SD=1.5)	0.0 (IQR=1.5)	-0.1 (SD=1.5)	0.0 (IQR=1.0)	**0.01**
Meat and Alternatives	0.0 (SD=1.1)	0.0 (IQR=1.0)	-0.1 (SD=1.1)	0.0 (IQR=1.0)	0.58
100% Fruit Juice	0.0 (SD=0.9)	0.0 (IQR=0.0)	0.0 (SD=1.1)	0.0 (IQR=0.0)	0.38
Sugar-Sweetened Beverages	0.0 (SD=1.6)	0.0 (IQR=0.0)	-0.1 (SD=1.7)	0.0 (IQR=0.0)	0.43
Snacks	-0.1 (SD=1.9)	0.0 (IQR=1.8)	-0.2 (SD=2.0)	0.0 (IQR=1.8)	0.13
Instances of Vegetables	0.0 (SD=0.9)	0.0 (IQR=1.0)	0.0 (SD=0.9)	0.0 (IQR=0.0)	0.75
Instance of Fruit	0.0 (SD=0.9)	0.0 (IQR=2.0)	-0.1 (SD=1.0)	0.0 (IQR=2.0)	0.10

The independent samples Mann-Whitney U Test compared median differences in changes of food group consumption between groups.
SD=Standard Deviation
IQR=Interquartile Range

Table 3. Changes in Consumption of each Food Group in the Intervention and Control Groups within BSD Schools

Changes in Food Group (Delta)	Intervention		Control		p-value
	Mean (SD)	*Median (IQR)*	*Mean (SD)*	*Median (IQR)*	
Vegetable	0.0 (SD=1.0)	0.0 (IQR=0.5)	0.0 (SD=1.0)	0.0 (IQR=0.5)	0.94
Fruit	0.0 (SD=1.3)	0.0 (IQR=1.5)	-0.1 (SD=1.4)	0.0 (IQR=1.3)	0.50
Grains	-0.1 (SD=2.3)	0.0 (IQR=2.0)	0.0 (SD=2.0)	0.0 (IQR=2.0)	0.43
Milk and Alternatives	0.2 (SD=1.5)	0.0 (IQR=1.5)	-0.1 (SD=1.5)	0.0 (IQR=1.0)	**0.01**
Meat and Alternatives	-0.1 (SD=1.1)	0.0 (IQR=0.8)	-0.1 (SD=1.2)	0.0 (IQR=0.9)	0.44
100% Fruit Juice	0.0 (SD=0.9)	0.0 (IQR=0.0)	0.0 (SD=1.0)	0.0 (IQR=0.0)	0.61
Sugar-Sweetened Beverages	0.0 (SD=1.7)	0.0 (IQR=0.0)	-0.1 (SD=1.7)	0.0 (IQR=0.0)	0.74
Snacks	-0.1 (SD=1.9)	0.0 (IQR=1.8)	-0.2 (SD=2.2)	0.0 (IQR=1.8)	0.73
Instances of Vegetables	0.0 (SD=0.9)	0.0 (IQR=0.0)	0.0 (SD=0.9)	0.0 (IQR=0.0)	0.85
Instance of Fruit	0.0 (SD=0.9)	0.0 (IQR=1.0)	0.0 (SD=0.9)	0.0 (IQR=1.0)	0.83

The independent samples Mann-Whitney U Test compared median differences in changes of food group consumption between groups.
SD=Standard Deviation
IQR=Interquartile Range

Table 4. Changes in Consumption of each Food Group in the Intervention and Control Groups within TSD Schools

Changes in Food Group (Delta)	Intervention		Control		p-value
	Mean (SD)	*Median (IQR)*	*Mean (SD)*	*Median (IQR)*	
Vegetable	0.1 (SD=1.1)	0.0 (IQR=1.0)	0.0 (SD=0.9)	0.0 (IQR=0.5)	0.98
Fruit	0.1 (SD=1.6)	0.0 (IQR=1.9)	-0.2 (SD=1.4)	0.0 (IQR=1.5)	0.07
Grains	0.1 (SD=1.9)	0.0 (IQR=2.1)	0.0 (SD=2.0)	0.0 (IQR=2.0)	0.60
Milk and Alternatives	0.1 (SD=1.5)	0.0 (IQR=1.0)	0.0 (SD=1.5)	0.0 (IQR=1.0)	0.88
Meat and Alternatives	0.1 (SD=1.0)	0.0 (IQR=1.0)	0.0 (SD=1.0)	0.0 (IQR=1.0)	0.40
100% Fruit Juice	-0.1 (SD=0.9)	0.0 (IQR=0.0)	0.0 (SD=1.0)	0.0 (IQR=0.0)	0.52
Sugar-Sweetened Beverages	0.0 (SD=1.3)	0.0 (IQR=0.0)	-0.1 (SD=1.6)	0.0 (IQR=0.0)	0.41
Snacks	0.1 (SD=1.8)	0.0 (IQR=1.5)	-0.2 (SD=1.8)	0.0 (IQR=1.8)	**0.01**
Instances of Vegetables	0.0 (SD=0.9)	0.0 (IQR=2.0)	0.0 (SD=0.9)	0.0 (IQR=1.0)	0.52
Instance of Fruit	0.0 (SD=1.0)	0.0 (IQR=2.0)	-0.2 (SD=1.0)	0.0 (IQR=1.0)	0.05

The independent samples Mann-Whitney U Test compared median differences in changes of food group consumption between groups.
SD=Standard Deviation
IQR=Interquartile Range

CHAPTER 5

DISCUSSION

A two-year pilot cluster randomized controlled trial was implemented to investigate how a ten-week centrally-procured school food program intervention influences consumption and instances of fruits and vegetables among children ages 9-13 years compared to a traditional school nutrition program. The CPSFP did not result in a significant change in consumption or instances of fruits and vegetables, although it did result in a small, but statistically significant increase in consumption of milk and alternatives. Further analysis of the CPSFP separately within schools on balanced school day and traditional school day schedules also revealed that it had no impact on consumption and instances of fruits and vegetables. Schools with a BSD schedule did, however, have a small, statistically significant difference in changes in consumption of milk and alternatives between groups, while schools with a TSD schedule had a weak, statistically significant difference in changes in snack consumption between groups.

As there may have been some variation in how clusters (schools) executed the intervention, as well as neighborhood SES, further analysis was needed to determine the impact of clusters on consumption values during the intervention. Guidelines for analysis of cluster randomized trials were followed (73), where the mean change in consumption and instances of fruits and vegetables was calculated for each cluster to create one data point for each cluster. Each cluster mean and baseline values for consumption and instances of fruits and vegetables were then included in a multiple regression to assess their effect on consumption values during the intervention. Clusters (schools) did not

significantly influence consumption values during the intervention. Baseline consumption values, alternately, were a significant predictor of consumption and instances of fruits and vegetables during the intervention.

Research has shown that school nutrition programs aimed at providing high-quality nutrient-dense foods are effective at increasing consumption of fruits and vegetables in children (14-19), with programs of a longer duration having a more significant impact (19). Although these programs were successful at achieving their objectives, such studies contained weaknesses in their methodological designs (14,16,18-23, 25). The CPSFP was created with such limitations in mind, obtaining sufficient monetary and personnel support to conduct a ten-week intervention with 2,422 students, whereby locally-sourced fruits and vegetables were provided during three different seasons. The present analysis of the CPSFP incorporated an experimental study design that was an improvement over previous studies of programs deemed to be successful. However, even with the improved methodology, the CPSFP did not result in a larger increase in consumption of fruits and vegetables compared to the TSNP. There are several plausible explanations for our null findings.

Nutrition Knowledge and Literacy

A difference between previous nutrition programs and the CPSFP is that the latter did not incorporate nutrition lessons into the intervention design. Although this was not the aim of the CPSFP, nutrition lessons may prove important in observing diet changes, as knowledge is a key factor involved in behaviour change (51). Improvements in nutrition knowledge were observed in school nutrition programs that incorporated

nutrition into the school curriculum (21,23,24), while programs which provided classrooms with activities promoting fruits and vegetables did not prompt such change (14,16).

The CPSFP did provide schools with a nutrition booklet to distribute to students following their baseline PEAS survey that included information on local fruits and vegetables; however, follow-up surveys revealed that most of the participants in the intervention group had not used the nutrition booklets. It is likely that students who did not review the nutrition booklet were unable to gain the nutrition knowledge needed to elicit a change in diet. Additionally, for students who had used the nutrition booklet, there was no way to determine how much of the book they had read, which may have also impacted their nutrition knowledge.

The effectiveness of the booklet at improving children's nutritional knowledge will be further investigated in a separate thesis, but it is possible that the lack or inconsistency in the distribution and/or use of the nutrition booklet played a key role at influencing children's changes in consumption of fruits and vegetables. Programs with nutrition lessons allow for more structured learning, as some previous programs included nutrition lessons each week (21,23,24), had classes of a longer duration (21,24), and were implemented over a long period of time (23,24), providing more opportunities for learning and enabling children to improve their knowledge to a greater extent. Resources, on the other hand, leave the learning up to the student, as the student chooses how frequently, and how much, they wish to review the nutrition resource. It is possible that the nutrition booklet provided through the CPSFP was insufficient to advance nutritional knowledge and motivate students to change their eating behaviours.

Parental Influence

Parents are responsible for purchasing and preparing the meals provided within the home, influencing a child's food preferences (35,38). Therefore, parents play a key role in children's consumption habits, as preferences for fruits and vegetables are a significant predictor of consumption (36,37). What is consumed most often and least often within the home has been found to directly correlate with foods most liked and disliked by children. For example, studies have found children to prefer apples, bananas, grapes, kiwis, oranges, pears, celery, and carrots the most, while liking tomatoes, mushrooms, radishes, and grapefruit the least (23,25). The CPSFP provided a wide variety of fruits and vegetables, including possible foods the children were unfamiliar with, did not like, or were less willing to try. As children are more inclined to choose foods that they are served regularly (39), any unfamiliar foods offered may have been left uneaten, influencing their follow-up fruit and vegetable consumption.

Similarly, if parents continued to pack their child's lunch, children would likely prefer to eat their packed lunch over the school's snacks, becoming less hungry and/or un-interested in consuming the snacks offered through the school. Alternately, after being informed of the changes to the snack program, it is possible that the parents began packing fewer and smaller amounts of fruits and vegetables in their child's lunch since the snack program would be providing more. With less fruits and vegetables in their lunches, consuming fruits and vegetables in the snack program would only replace the ones they would have had in their lunch, thus resulting in no significant changes in fruit and vegetable consumption.

Peer Influence

Consumption habits observed among youth are heavily influenced by their peers; what an individual sees his/her peers consuming directly influences what is consumed (42-44). As adolescents have been found to perceive healthy eating as 'uncool', leaving those who partake in such behaviours to peer ridicule, it is suggested that individuals fear that eating differently than their peers will result in being laughed at or excluded from a group (42). Therefore, it is possible that students did not utilize the snack program often due to the frequency of which they saw their peers eating the snacks offered. Additionally, how students thought their peers perceived the snack program could have impacted students' willingness to try the snacks provided. These perceptions would have influenced the quantity of fruits and vegetables consumed through the program and subsequently the changes in consumption observed at follow-up.

It is also possible that the students influenced how others filled out their survey, as students sat in groups and talked while completing their surveys. Some students may have not taken the survey seriously, either under-reporting and/or mis-reporting what they ate that day.

School Schedule

Neilson et al. (12) assessed the influence of school schedule on students' intake by comparing the home-packed lunches of students attending schools with TSD and BSD schedules. Students who attended schools with a BSD schedule had significantly more servings of milk and alternatives, snacks, and sugar-sweetened beverages in their lunches than students attending schools with a TSD schedule (12). As the intervention group for

the current study had a significantly higher proportion of schools with a BSD schedule than the control group, it is possible that school schedule may have played a role in the results that were found. Specifically, when comparing the changes in consumption of milk and alternatives among all schools, BSD schools only, and TSD schools only, significant changes in consumption of milk and alternatives were found overall and within BSD schools, but not within TSD schools. These findings, in addition to the study by Neilson et al. (12), suggest that having a significantly higher proportion of intervention schools with a BSD schedule may have influenced the results to show a significant difference in consumption of milk and alternatives with the CPSFP, when it may not have shown significance if there was an equal distribution of school schedules in the sample. More importantly, when looking exclusively at schools with a TSD schedule, the differences in consumption and instances of fruits between groups were close to significance. While there was no change in consumption or instances of fruit within the intervention group, there is a chance that if the sample included an equal distribution of schools with a TSD or BSD schedule, the larger samples of students in TSD schools may have positively impacted the change in consumption and instances of fruit and a significant difference in consumption and/or instances of fruit may have been found.

Duration of the Program

Previous programs that improved children's consumption of fruits and vegetables ranged from six weeks to three years in length (14-19), with programs of a longer duration having a greater influence on long-term consumption habits (19). As the CPSFP was only ten weeks, it was shorter in duration than most of the previous nutrition

programs. The duration of the program would have influenced which locally-sourced fruits and vegetables were available during that time period and how often different types of fruits and vegetables would be available. The frequency of exposure, as well as direct experience with the food, strongly influence children's preferences and willingness to try fruits and vegetables (24). With a shorter timeframe, children may not have been exposed to the fruits and vegetables long enough to impact their preferences or attitudes towards them, thus influencing their consumption.

Measurement Method

The PEAS survey was originally intended to be used to measure dietary intake for students during three school days at baseline and three school days at the end of the intervention; however, due to school requests to limit the number of visits to each school and disruptions to classes, it was deemed that the PEAS survey would be conducted for one day at baseline and one day at the end of the intervention. It is possible that the PEAS survey may have been inadequate in measuring children's consumption values, as research has shown that a three-day food record provides a better representation of dietary intake, as it has a lower proportion of missed foods or phantom foods (i.e., foods that were reported but not observed) when compared to FFQs and 24-hour recalls in both youth and adults (74-76). By only capturing dietary intake on one day, the PEAS survey may not have provided a good representation of the students' intakes due to variation in their weekly schedules, and the higher likelihood of misreporting. For instance, despite extensive planning to ensure all students participating were not on any field trips, some students had gone on a field trip the morning of their survey day, which would have

impacted what food was reported on the PEAS survey that afternoon. This may have resulted in an atypical eating day for some students, as they may have packed their lunch differently for the field trip or bought food while away from school. The field trip may have also interfered with the kids' opportunities to utilize the snack program, and thus the survey would have not provided a good snapshot of the program's effectiveness. Additionally, some schools had a pizza day on the day of the survey, which would have also impacted what food was packed in the children's lunches and subsequently their report of their usual daily intake.

Children have difficulty recalling past events (26), and while the PEAS survey did not require as much recall as an FFQ, participants may have struggled to recall what they consumed earlier that day. Depending on their activities on the day of survey completion, students may have been too distracted to correctly remember what they had consumed during each snack break, as studies have shown distracted eating influences memory of that meal (77,78). Accordingly, impaired memory of foods consumed may have resulted in under- or over-reporting on the PEAS surveys, misrepresenting changes in consumption and instances of fruits and vegetables.

During data input, it was found that a majority of students were not specific in their surveys. For example, students may have provided the food item they consumed with no amount or written that they had a sandwich but not what kind. As a result, several assumptions had to be made during coding. This may have influenced the consumption values for fruits and vegetables, as we were not always able to capture an accurate quantity of what was consumed.

Errors in the completion of some of the PEAS surveys suggests that some students did not have sufficient knowledge to effectively quantify the food they consumed. It is possible that students disregarded the examples provided within the PEAS survey and, as the oral instructions were brief, the students did not have an adequate understanding of appropriate ways to report food items and quantities. Thus, it may have been more beneficial to go over more examples with the students during the oral introduction of the survey to ensure greater understanding. It is also possible that students did read the examples provided within the PEAS survey, but they were not detailed enough to provide clear comprehension of the instructions.

Errors in the completion of some of the PEAS surveys may also be a result of inconsistencies among data collection days. Prior to commencing the survey, a Master's student, whom was acting as team lead for that data collection day, was to provide instructions to the students on how to complete the PEAS survey. Several Master's students assisted in the data collection process, with different members going to each school. Due to this, it is possible that slightly different instructions were provided to students in each school, with participants either receiving very detailed or very brief instructions. The level of detail of instructions provided could have influenced how participants filled out the PEAS survey and subsequently how accurate the reports of students' fruit and vegetable consumption were. Additionally, a group of volunteers was present to assist with any questions and check over each survey to ensure it was filled out as instructed. However, some team leads may not have been diligent in getting their volunteers to check over the surveys, or volunteers may have been lenient in how students filled out the surveys. As a result, errors within the PEAS surveys may have

been missed or overlooked, thus requiring more assumptions to be made during data input and influencing the consumption values for fruits and vegetables.

The Intervention

While the CPSFP provided a wider variety of fruits and vegetables than the TSNP, it is possible there may not have been any substantial increase in fruits and vegetables offered through the snack program. Snack programs were found to base their options off students' likes and dislikes. These preferences were likely based on behaviours observed during the TSNP that the intervention schools had prior to the CPSFP. When the intervention began, it is possible that the schools aimed to provide snacks of similar serving sizes as in the old snack program, and thus children would not have been consuming substantially more servings or amounts of fruits and vegetables than the control schools, just a different variety of fruits and vegetables.

The school snack program offered the snacks once per day. When the snack was administered may have influenced the possible changes in instances in fruits and vegetables consumed. Children prefer to consume fatty and sugary foods over vegetables (79), with research showing that when vegetables, snacks, and sugar-sweetened beverages are packed in the child's lunch, the vegetables are more likely to be left uneaten (12). So, it is likely that if the snacks from the CPSFP were offered during the first nutrition break, students were more likely to consume their packed snacks and sugar-sweetened beverages instead. If the CPSFP was run in the afternoons, the students may have already consumed their packaged snacks and sugar-sweetened beverages during the morning nutrition breaks and may have selected fruits and vegetables from the snack

program in replacement of the fruits or vegetables packed in their lunches. As produce from the CPSFP may have been replacing the fruits and vegetables students would have already been consuming at that time, their instances of fruit or vegetable each day would have remained the same.

Study Strengths

Although we did not receive the outcome we expected, the OSNP study still had several strengths. This study was the first to study the effectiveness of a Canadian school snack program on a large scale, including 60 schools and 2,422 participants. This large sample size enabled the study to detect a true effect.

The randomized controlled trial (RCT) design was a major strength of this study. RCTs are considered the gold standard for determining the effect of an intervention, as the randomization within the design reduces bias and any confounding factors that may influence the results (80-82). Participating schools within this study were randomized into the intervention or control group so that both groups were comparable in regard to confounding factors such as age, gender, and SES. Biases are further controlled within an RCT through the use of blinding (82). Participants in this study were unaware of which snack program they were being provided with, and thus which group they were in, to minimize any perceptions of each program that could influence the results.

Examining the impact of clusters (schools) on consumption and instances of fruits and vegetables was an additional strength of this study. Many cluster randomized trials fail to consider the clustering effects in their analyses (73), including several studies that previously assessed the effectiveness of school nutrition programs (14,24,50). Failing to

account for cluster effects can increase the chances of fictitious significant findings, resulting in inaccurate, and potentially misleading, findings (73).

Access to sufficient funding and personnel further supported the execution of the program, with volunteers playing a key role in the recruitment of participants and the administration of surveys.

The intervention was also a strength, as it allowed for a more consistent snack program within schools, providing equal access of healthy foods to all students. The provision of locally-sourced fruits and vegetables exposed students to a wider variety of fruits and vegetables and completing the study over three different seasons expanded the variety of food offered.

Study Limitations

An important limitation of this study was the students' inability to correctly fill out the PEAS surveys. Inadequate detail provided, or information reported on only one page, limited the ability to correctly quantify children's consumption, as well as instances, of fruits and vegetables. This in turn could have impacted the overall accuracy of the results found.

In the original study design, the PEAS surveys were to be administered over three days. While a three-day food record may be the most ideal method for measuring dietary intake in youth, it is not necessarily the most feasible, as it requires a larger time commitment from both participants and the research team. Personnel played a large role in the recruitment of participants, successfully enrolling a large sample within the study; however, personnel were also a limitation since volunteers were unable to commit large

amounts of time each week for survey administration. Likewise, schools and teachers wanted minimal burden and the least amount of disruption of class time as possible. As a result, time constraints, and both teachers and volunteers unable to provide support for the extra survey days, resulted in the PEAS surveys being administered on only one day.

Having students fill out the PEAS survey only once at baseline and follow-up was another limitation of this study. Reporting food intake on a single day may not have provided a good representation of each child's dietary habits compared to if the children were asked to report intake for three days. Studies which have used 24-hour recalls to assess the effectiveness of school nutrition programs at improving children's dietary habits have found mixed results, either finding significant changes in diet following the program (16,20) or finding no significant improvements (21,22). As a result, the data reported from the PEAS surveys may not have been sufficient to detect the true effectiveness of the CPSFP.

The location that the surveys were administered was an additional limitation, as all students had to gather in one large room, and students were often distracted by their peers during survey completion. Conversations with peers could have caused an unfavourable testing environment, as they could have influenced one another's answers and affected students' ability to follow instructions.

The low participation rate of 25.4% could also be a limitation, as students who participated in the baseline and/or follow-up surveys may have had different consumption habits than their peers who chose not to participate in the study. Consequently, if more students participated in the study, and a higher participation rate was achieved, there may

have been a more diverse sample size with varying consumption habits, influencing the results found.

Lastly, the length of the study could have affected the findings, as the intervention was only executed over ten-weeks, while previous nutrition programs were often longer in duration, such as three years (15). The length of the intervention may not have been long enough to instill long-term changes in children's consumption habits.

Future Research

More research is needed to assess the extent to which school nutrition programs influence children's consumption habits. Particularly, it would be beneficial to implement a CPSFP that is of a longer duration, such as one full school year, to determine how program length influences children's consumption of fruits and vegetables. Additionally, implementing a nutrition curriculum along with the snack program that focuses on locally grown foods, the importance of healthy eating, and healthy eating options, could showcase the importance of nutrition knowledge in initiating behaviour changes. As the CPSFP was found to provide a wider variety of fruits and vegetables compared to the TSNP, future research could incorporate taste-testing activities into the snack program to further expose children to the varying foods available and entice changes in their preferences towards fruits and vegetables. Creating a new tool for measuring intake would also be valuable, as children struggled to use the PEAS survey to effectively quantify the food they ate. Developing an online tool with pictures of common serving sizes that children can select and complete at home, while also asking for a three-day food record, may better capture the effectiveness of a school nutrition program. Future

research could also utilize the new Canada's Food Guide recommendations to determine whether students are meeting their nutritional requirements by assessing what proportion of their meals at school nutrition breaks is each food group in comparison to the new plate method (83).

Conclusion

With a significant number of children failing to meet their recommended CFG servings for fruits and vegetables each day, it is increasingly important to establish strategies that can aid in improving diets early in life. School nutrition programs have been successful at increasing consumption of healthier foods, and so a CPSFP was designed to further improve upon previous nutrition programs. The CPSFP obtained a greater proportion of the food for the program from local farmers, distributing a wider variety of fruits and vegetables to students, and improving the nutritional quality of the food provided compared to the TSNP. In the TSNP, schools independently ran the program and had volunteers purchase and prepare the snacks, resulting in many schools providing mostly grain products. Although differences were present between the TSNP and the CPSFP, the CPSFP did not result in a significant change in consumption or instances of fruits and vegetables. Despite these results, school nutrition programs still serve as a promising intervention for changing consumption habits in youth, as children spend most of their day at school, and the school environment plays a large role in a child's eating habits. More research is needed to examine the influence of school nutrition programs on children's consumption habits. Particularly, it would be beneficial to implement a CPSFP that is of a longer duration, incorporates a nutrition curriculum

along with the snack program, and incorporates taste-testing activities to further expose children to the varying foods available. Future research focused on determining the ideal nutrition program design will provide a framework for which to create a standardized school nutrition program within Canada, providing an opportunity for schools to influence children's consumption habits early in life.

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APPENDIX A – THAMES VALLEY DISTRICT SCHOOL BOARD ETHICS APPROVAL LETTER

9 Feb 2017

Dear Dr. Clark:

Your project, entitled "Evaluating the impacts of an innovative centrally-procured school food program on student nutrition and the local food economy" has been approved by Research and Assessment Services at the Thames Valley District School Board. Please ensure that all members of your research team who will be assisting with data collection involving students have an up-to-date criminal record check. You may contact the schools that have been identified.

The continued willingness of our families and staff to participate in research studies is greatly enhanced by pertinent feedback of findings. It is suggested that direct feedback be provided to the school(s), staff, students, and/or families involved in the study. Please find attached the Thames Valley District School Board Study Completion Form. Once you have completed your research in our board, please complete this form and submit it to Research and Assessment Services. This form should be submitted within two years of receiving approval. If the study is not completed within two years of the date on this letter, please submit a study extension request to Dr. Sarah Folino.

All the best with your research. Please feel free to contact me if I can be of further assistance.

Sincerely,

Sarah Folino, Ph.D.
Research and Assessment Services
Thames Valley District School Board

APPENDIX B – WESTERN UNIVERSITY ETHICS APPROVAL LETTER

Western Research

Research Ethics

Western University Non-Medical Research Ethics Board
NMREB Delegated Initial Approval Notice

Principal Investigator: Dr. Jason Gilliland
Department & Institution: Social Science\Geography,Western University

NMREB File Number: 108549
Study Title: Evaluating the impacts of an innovative centrally-procured school food program on student nutrition and the local food economy

NMREB Initial Approval Date: November 29, 2016
NMREB Expiry Date: November 29, 2017

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Instruments	PEAS Questionnaire - Balanced School Day	2016/11/29
Instruments	PEAS Questionnaire - Traditional School Day	2016/11/29
Western University Protocol	Received November 29, 2016	
Recruitment Items	Facebook Announcement	2016/11/29
Letter of Information & Consent	Facilitator - Focus Group/Interview (Written)	2016/11/29
Letter of Information & Consent	Facilitator - Interview (Verbal)	2016/11/29
Letter of Information & Consent	Parents - No Observation	2016/11/28
Letter of Information & Consent	Parents - Observation	2016/11/29
Assent	No Observation	2016/09/27
Assent	Observation	2016/09/27
Data Collection Form/Case Report Form	Observational Data - Received September 28, 2016	
Instruments	Parent Survey	2016/08/30
Instruments	Facilitator Focus Group Guide	2016/09/27
Instruments	Youth Focus Group Guide - Received September 28, 2016	
Instruments	Youth Survey	2016/11/03

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the NMREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 0000094l.

Ethics Officer, on behalf of Dr. Riley Hinson, NMREB Chair or delegated board member

Ethics Officer: Erika Basile ___ Nicole Kaniki ___ Grace Kelly ___ Katelyn Harris ✓ Vikki Tran ___ Karen Gopaul ___

APPENDIX C – SAMPLE SIZE CALCULATION

Step 1 - Base sample size calculation:

$$\frac{n = 2SD2\ (Z1 - \pm\beta + Z1 - \ \alpha/2)2}{(\text{Mean2} - \ \text{Mean1})^2}$$

Where Z1-β = 0.84, if β = 0.20 (power = 80%) and Z1-α/2 = 1.96, if α = 0.05.

Rationale for estimates:

- SD: Previously published data suggests that the SD of the outcome measure, servings of fruit and vegetable consumption is **4.5** (He et al., 2009).
- $Mean_2 - Mean_1$: The difference that would be considered meaningful to detect is set at **1 serving**.

$$\frac{n = 2(4.5)2\ (0.84 + 1.96)2}{(1)^2}$$

= 318 students per group (not taking into account the design effect or loss to follow-up)

Step 2 - Design effect:

The design effect formula for a cluster, where students are nested in schools (clusters) is:

D = 1 + (m-1) x ICC

Where, m = cluster size and ICC is the intracluster correlation coefficient of the outcome measure. He et al. (2009) conducted an intervention in Ontario schools and utilized an ICC of 0.03.

With approximately 250 children per school, and an estimate of 125 children in grades 4 to 8 (i.e., 25 students per class), we will recruit **75** students per school, assuming that 60% of eligible students will participate (sources). The **cluster size** will be assumed to be: 25 students x 0.6 = 15 students per class.

D = 1 + [(m-1) x ICC] = 1 + [(15 – 1) x 0.03]
= 1.42

The sample size in each group (CPSFP and control) would be:

Cluster sample size = n x D
= 318 x 1.42
= 452 students per arm or 904 students total
Thus, if each cluster (school) has 15 students (as defined):

452 students / (15 students / school) = 30 schools per group

Therefore, sample size will be 30 schools in the CPSFP and 30 control group schools for a total of **60 schools**.

APPENDIX D – CHILD LETTER OF INFORMATION AND ASSENT

Child Assent: Ontario Student Nutrition Program

Principal Investigator: Dr. Jason Gilliland, Department of Geography, University of Western Ontario

Western

Hello! We are researchers from Western University and we are doing a study in your school. We need students in Grades 5-8, like you, to help us learn about how your school's snack program changes your eating habits.

What are we going to study? We'd like to know what you eat and drink during the school day, as well as understand what fruits and vegetables you like. We are also interested in learning what you know about fruits and vegetables!

What we are asking you to do? If you agree to participate, we'd like you to complete three steps:

1) Fill out two short ***surveys*** (one today and one in a few months) on what you eat during the school day, your food preferences, and what you know about vegetables and fruits. You will fill these out at school with your classmates and each survey takes 25-30 minutes to finish but you can take as much time as you need.
2) Have a Western Researcher watch what you eat for 1 day while you are at school.
3) At the end of our project, you could also join in a ***group discussion*** with some of your classmates to talk to us about your school's snack program. You do not have to join in this group activity. This will take place at your school during lunch. We would like to audio record our talk. All group discussions are audio-recorded and transcribed word for word. Therefore, if you do not wish to be audio-recorded you will not be able to participate in the discussions. We cannot guarantee what is said in the group discussion won't be shared by your classmates, but we always remind all students not to share what they have heard. We will also be using the things you say from our discussion in our writing, but we will make sure no one can tell that it is you who said it.

Do you have to join this project? No – you only join if you want to. You can also decide at any time that you would like to stop. We will never share your information with anyone else, even your parents, but you can ask to see it at any time. You can ALWAYS talk to your teacher or the researchers if you have any questions or worries.

☐ Check this box, if you want **to participate in this study!**

AND do you want to participate in the audio recorded group discussion:

☐ Yes, I want to participate in the audio recorded group discussion.

☐ No, I do not want to participate in the group discussion.

_____
Print your first & last name

_____ _____
Sign your name ***Today's Date***

_____ _____
Researcher's Signature ***Today's Date***

APPENDIX E – PARENT LETTER OF INFORMATION AND CONSENT

Research Project: Ontario Student Nutrition Program Evaluation

***Principal Investigator**: Dr. Jason Gilliland, PhD Department of Geography, University of Western*

Western

Dear parent or guardian,

Dr. Jason Gilliland and his research team from Western University invite you and your child to participate in a study aimed at understanding how the Ontario Student Nutrition Program (OSNP) may impact your child's eating habits at school. The study involves students from **grades 5 through** 8 at participating elementary schools in London-Middlesex, Elgin-St. Thomas, and Oxford.

What is being studied?

Our team is studying how the OSNP snack program influences your child's eating habits and knowledge. By participating in this study, you and your child can help inform the OSNP on what can improve the program overall, and more specifically, in your child's school.

What will happen in this study?

If you agree to allow your child to participate in our project, **your child** will be asked to:

- **Complete 2 *surveys***. Children are invited to participate in one survey now and an identical follow-up survey in 9 to 10-weeks. Both surveys ask children about themselves (e.g., gender, age, household status), the food they eat during the school day, and knowledge about vegetables and fruit. Each survey will take place during school hours and usually takes about 25-30 minutes to complete (Note: Students not filling out the survey will be given quiet activities to do at their desks).
- ***Food intake observation***. Your child's food intake at school **may** be observed and recorded during one of the days that the survey is being completed. Observers will be located at least 6-feet from the lunch table and will not interact with the children directly.
- **Participate in a group discussion.** Children will also be invited to participate in a group discussion to talk about their snack program and to help clarify how the program benefited them. The 30 to 60-minute group discussion will involve 4-6 youth and will take place at school during lunch. Participation in the group discussion is completely voluntary; a child can decide not to participate and still be allowed to participate in the rest of the study. All discussions are audio-recorded and transcribed verbatim. Anonymous direct quotes from the group discussions may be used by the research team in publications. We as researchers cannot guarantee what is said in the group discussion won't be shared by classmates, but we always remind students not to share what they have heard.

If you would like your child to participate, **parents** are asked to:

- **Complete and return the *attached consent form* in the envelope provided to school.**
- **Complete the attached *survey***. The survey asks questions about your household and what you and your family eat and drink. It usually takes about 10-15 minutes to fill out. The Parent Survey is completely voluntary – your child can still join the study themselves even if you decide not to fill out the Parent Survey; however, as the survey gives us critical information from the point of view of parents, we would really appreciate your participation.

Do we have to participate in this study?

Your participation in this study is completely voluntary. You and your child do not have to participate. You can each refuse to answer any survey questions, and can choose to leave the study at any time. If you or

your child decides to leave the study at any time (even up to 30 days AFTER the study has been completed), any data collected from you or your child will be immediately destroyed and excluded from the analysis.

What are the benefits and risks if my child participates?

By participating in this research, students and parents will help us evaluate the effectiveness of how providing a nutrition snack program improves children's eating patterns and knowledge about healthy eating. By better understanding this relationship, the OSNP can develop a model that can be used for snack programs across Canada. This will help students can gain the maximum health benefit when receiving snacks at school.

There is little risk to your child if he/she participates in this study, but there is a slight chance that you or your child may be uncomfortable sharing details of your family, such as economic status, eating patterns. We are also asking for your postal code in the parent survey to provide us an approximation of where you live, so that we can have a better understanding of your neighbourhood (e.g., proximity to grocery stores, fast food outlets, variety stores, neighbourhood level income). We are minimizing the risks you may feel as follows:

- All information collected in this study is kept strictly confidential.
- You or your child will not be personally identified or identifiable by name in any of the documents related to the study, except for the consent form and the daily school food journal. This will be accomplished by assigning a unique identification code. Until the unique identification code is recorded your consent and parent survey will be stored together to ensure the connection between surveys is maintained.
- Materials and data files will ONLY be viewed by members of the research team and will be stored in a locked filing cabinet until transferred onto a password protected computer in a secure facility at the University of Western Ontario.
- To minimize children being uncomfortable while they are eating and being observed, observers will be located at least 6 feet from the lunch table and will not interact with the children directly.

Representatives of The University of Western Ontario's Non-Medical Research Ethics Board may require access to your study-related records to monitor the conduct of the research. Data will be kept until the conclusion of data analysis and publications from this study are completed. The results of this study will only be presented for groups so that children will never be individually identifiable. While we do our best to protect your information there is no guarantee that we will be able to do so. If data is collected during the project which may be required to report by law, we have a duty to report. You do not waive any of the legal rights you would otherwise have as a participant in a research study.

Who do I contact if I have any other questions?

Should you have any questions or concerns about participating in this project, you can contact the lead researcher (Dr. Jason Gilliland) at the University of Western Ontario by phone or email . If you have any further questions regarding your rights as a study participant, please contact the Office of Human Research Ethics by phone or email .

This letter is for you to keep. Please complete and return the attached consent form to your child's school if you would like him/her to participate in this study.

Research Project: Ontario Student Nutrition Program Evaluation

Parent / Guardian Consent Form (Grades 5-8)

Western

Principal Investigator: Dr. Jason Gilliland, PhD Department of Geography, University of Western Ontario

We ask that you allow your child in grades 5-8 to participate in this study during class time to help us understand how the Ontario Student Nutrition snack program impacts your child's eating habits at school. Please ensure you review the ***Letter of Information*** before providing your child's consent.

WE NEED YOUR PERMISSION TO HAVE YOUR CHILD PARTICIPATE IN THE STUDY

1. Study Participation:

☐ Yes, I would like my child to participate in this study.

2. Group Discussion:

☐ Yes, I would like my child to participate in the audio-recorded group discussion, where anonymous direct quotes from the group discussions may be used by the research team in publications.

OR

☐ No, I would not like my child to participate in the group discussion.

I agree for my child _____ to participate in this study.
please clearly print your child's full name

_____ _____
Parent / Guardian's signature ***Date***

_____ _____
School name ***Teacher's name***

Completed consent forms should be returned to the school with the child who brought it home by

DATE.

APPENDIX F – EXAMPLE OF A COMPLETED PEAS SURVEY FOR A BSD SCHEDULE

Pupils Eating at School Questionnaire

Balanced Schedule

(1 Day)

First Name: _____

Last Name: _____

Date: _____

PEAS (Pupils Eating At School) Questionnaire – Balanced School Day

This form is about what you had to eat and drink today at school. **It is not a test** so there are no right or wrong answers. The important thing is that you try your hardest to remember what and how much you had to eat and drink. Here are two examples:

Example 1:

Did you have...	What did you have?	How much did you have?
Bread, pasta, or cereal?	Brown bread	2 slices
Milk, yogurt, or cheese?	Cheddar cheese on sandwich	1 slice
Meat, beans, eggs, or nuts?	Ham on sandwich	1 slice
Vegetables and fruit?	Lettuce on sandwich Apple	1 piece 1 medium
Drinks?	Orange juice box	1 box
Any other items?	Granola bar with chocolate chips	1 bar

Example 2:

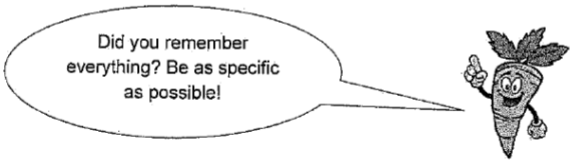
Did you have...	What did you have?	How much did you have?
Bread, pasta, or cereal?	Pasta with tomato sauce	3/4 thermos
Milk, yogurt, or cheese?	Yogurt tube	1/2 tube
Meat, beans, eggs, or nuts?	None	None
Vegetables and fruit?	Baby carrots Fruit cup	6 sticks 1 container
Drinks?	Sunny-D bottle	1 bottle
Any other items?	Salt & Vinegar chips	1 small bag

Your answers will be kept secret. Please do not talk to anyone else while filling out the form. If there is anything you do not understand or words you are not sure about, please ask your teacher.

Student ID Number: _____ **Date:** _____

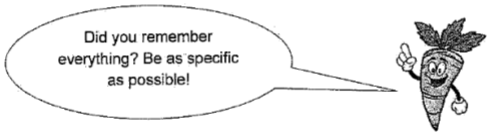
Did you have anything to eat or drink at school this morning at nutrition break 1? Please write down everything you ate or drank and be specific. If you did not have anything to eat or drink, write **None** in the box. Please print neatly.

Did you have...	What did you have?	How much did you have?
Bread, pasta, or cereal?	White Bread	Half a Sandwich
Milk, yogurt, or cheese?	Yogurt,	1 carton
Meat, beans, eggs, or nuts?	Meat	1 slice
Vegetables and fruit?	Raspberrys, Banana	about 10, 1
Drinks?	Water	1 cup
Any other items?	Pancake	1 Pancake



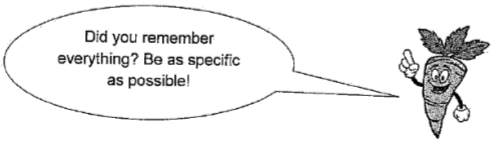
Did you have anything to eat or drink at school this afternoon at nutrition break 2? Please write down everything you ate or drank and be specific. If you did not have anything to eat or drink, write **None** in the box. Please print neatly.

Did you have...	What did you have?	How much did you have?
Bread, pasta, or cereal?	White Bread	1 half of a Sandwich
Milk, yogurt, or cheese?	Yogurt	1 cup
Meat, beans, eggs, or nuts?	Meat	1 slice
Vegetables and fruit?	Cucumber, Orange	6 Pieces, 1 orange
Drinks?	Water	1 cup
Any other items?	goldfish	35



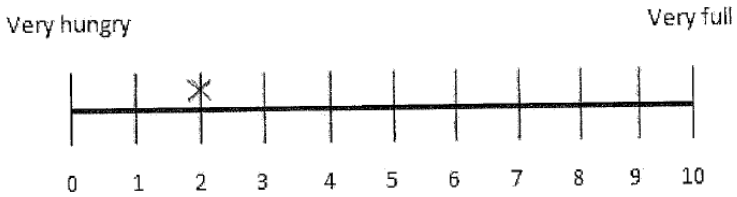
Did you have anything else to eat or drink at any other times during school? Please write down everything you ate or drank and be specific. If you did not have anything else to eat or drink, write **None** in the box. Please print neatly.

Did you have...	What did you have?	How much did you have?
Bread, pasta, or cereal?	none	
Milk, yogurt, or cheese?	none	
Meat, beans, eggs, or nuts?	none	
Vegetables and fruit?	none	
Drinks?	none	
Any other items?	Pancake, BlueBerry muffin	1 Pancake, 1 muffin



How hungry do you feel right now?

Please put an 'X' along the line that shows how hungry you are.



Thank you for completing this form. Please make sure you have answered all questions as best you can.

APPENDIX G - PEAS CODING ASSUMPTIONS

For All Items:

- "1 container" = ½ cup, unless it is for salad then assume 1 cup
- "A lot" = 1 cup
- "A little" = ¼ cup
- "A handful" = ¼ cup
- 1 Ziploc Snack Zipper Bag = ½ cup
- 1 spoonful = 1 Tbsp

Fruits and Vegetables

- If fruit not specified, assume 1 medium apple
- If vegetable not specified, assume baby carrots
- When no amount is given:
    - Assume 0.5 vegetable serving
    - Assume 0.75 fruit serving
- "Apple", "Orange", "Pear", or "Peach"
    - 6-8 slices per fruit
- "Applesauce"
    - 1 container = 111g (based on Mott's Fruitsation)
        - 1 CFG fruit serving
- "Broccoli", or "Cauliflower"
    - Assume 10 pieces per cup/ 5 pieces per ½ cup
- "Carrots"
    - If they write "1 carrot" assume 1 medium size carrot
        - 0.5 CFG vegetable serving
    - If they write "4" assume 4 baby carrots
    - Assume ~15 baby carrots per ½ cup
- "Ceasar Salad"
    - Assume 1 cup of lettuce is used
    - Assume 7g of croutons
- "Celery"
    - 1 celery stalk = 3 celery sticks
    - If they state "1" assume it is 1 medium celery stalk
        - 1 CFG vegetable serving
- "Clemintine"
    - Assume 1 clemintine is 0.5 CFG fruit serving
- "Cranberries"
    - ¼ cup = 40g
- "Cucumbers"
    - Assume ~ 10 cucumber slices per ½ cup

    - If they state "1" assume 1 small cucumber
    - If they state "1/2 cucumber" assume ½ of a regular cucumber
        - 2 CFG veg serving
- "Fruit Cup"
    - 1 cup/container = 113g
        - 1 CFG fruit serving
- "Green Beans"
    - Assume ~5 bean stalks per ½ cup
- "Hashbrown"
    - 1 prepared = 70g (1)
- "Olives"
    - Assume a vegetable
    - Approximately same weight as grapes based on ESHA, therefore assume 20 olives equals 1 CFG vegetable serving
    - If no amount is provided, assume 3 olives
- "Pepper"
    - Assume half a pepper/17 strips = ½ cup
- "Plum
    - Assume 6 slices per fruit
- "Raisins"
    - 1 snack box = 28g (1/8 cup)
        - 0.5 CFG fruit serving
- "Raspberries", "Blueberries"
    - Assume ~10 raspberries per ¼ cup
- "Salad"
    - Assume 0.75 cup of lettuce
    - Assume ¼ cup other vegetables
    - 1.25 CFG vegetable serving
- "Strawberries"
    - Assume ~8 per ½ cup
- "Smiles" (Potatoes)
    - 6 pieces = 85g
    - Assume ~10 per cup/ 5 per ½ cup
- "Smoothie"
    - Assume 1 cup if no amount given
    - Assume ¼ cup yogurt, ¼ cup milk, and ½ cup fruit
        - 1 CFG fruit serving and 0.5 CFG milk serving
- "Snap Peas"
    - Assume ~10 per ½ cup
- "Tomatoes"
    - Assume cherry tomatoes unless specified otherwise or it is obvious they are in a sandwich
    - Assume ~10 tomatoes per ½ cup
- "Watermelon"
    - If they state "1" assume it is 1 slice
        - 1 slice = 1 CFG fruit serving

    - If they say pieces, assume cubes
        - 5 medium-sized cubes = ½ cup

Milk and Alternatives

- "Babybel"
    - 1 babybel = 21g
        - 0.5 CFG milk serving
- "Cheese"
    - 1 cheese string = 21g (Based off Black Diamond Cheesestring)
        - 0.5 CFG milk serving
    - Cracker Barrel Single Serve, 1 package = 21g
        - 0.5 CFG milk serving
    - 1 block = 50g
        - 1 CFG milk serving
    - 1 slice = 20g
        - 0.5 CFG milk serving
        - Assume pieces are the same size, unless quantity is greater than 10 then assume ¼ CFG milk serving each
    - If no amount provided assume 50g
    - If type of cheese is not given then assume slices
    - ¼ cup shredded cheddar cheese = 28.25g = ~28g (ESHA)
    - 2 tbsp parmesan cheese = 15g
- "Cheese Whiz"
    - Do not count as a milk serving (too processed)
- "Laughing Cow
    - 1 wedge = 21g
        - 0.5 CFG milk serving
- "Milk"
    - Assume 1 cup if no amount is given
- "Sour Cream"
    - 1 Tbsp = 12g
- "Yogurt"
    - If they state "1" or "1 cup" assume it is a yogurt cup
        - 100g or 0.5 CFG milk serving
- "Yogurt Drink"
    - 1 yogurt drink = 200ml
        - 1 CFG milk serving
    - "Nano"
        - 1 drinkable container = 93ml
- "Yogurt tube"
    - 1 tube = 60g, 0.25 Milk serving

Meat and Alternatives

- "Almonds"
  - ~ 20 almonds per 1/8 cup
    - 0.5 CFG meat serving
- "Beans"
  - Brown beans/ baked beans
  - If no amount given assume ¾ cup of beans
- "Beef Jerky"
  - 1 piece = 20g
- "Chicken"
  - 1 breast = 1 CFG meat serving
  - 1 chicken nugget = 16g
    - Assume McDonald's Chicken Nugget
    - 4 pieces = 64g
  - "Chicken Wings"
    - 1 = 34g (ESHA)
  - "Chicken Drumstick"
    - 1 each = 71g
- "Eggs"
  - If no amount given, assume 2 eggs
    - 1 CFG meat serving
  - Assume 4 eggs makes 1 cup of scrambled eggs
- "Hamburger"
  - Assume 1 regular white bun
    - 1 CFG grain serving
  - Assume regular-sized hamburger
    - 1 CFG meat serving
  - If the child writes "lettuce" and "tomato" but no quantity assume 1 slice of each
  - "Mini Burger"
    - Assume ½ of a regular burger
- "Hot Dog"
  - Assume 1 bun
    - 1 CFG grain serving
  - 1 75g hot dog
    - 1 CFG meat serving
- "Hot Rods"
  - 1 hot rod = 8g
- "Meatball"
  - 1 meatball = 28g (ESHA)
- "Pepperette"
  - 1 pepperette = 25g
- "Pepperoni"
  - 14 slices = 56g (ESHA)
  - 1 slice = 4g

- "Pogo"
  - 1 pogo = 75g
- "Sausages"
  - 1 sausage = 55g (1)
- "Mini sausages"
    - Assume breakfast sausage
      - 2 breakfast sausages = 63g
  - "Kielbasa"
    - Assume 6 pieces = 1 full sausage
- "Sausage Rolls"
  - 1 roll = 37.5g (meat and snack serving)
- "Summer Sausage"
  - 1 slice = 28g
- "Salami", "Ham", "Turkey"/ Other Deli Meats
  - 1 slice = 32g
    - 0.5 CFG meat serving
  - 2 slices = 63g
    - 0.75 CFG meat serving
  - If no amount given, assume 1 slice
- "Spam"
  - 1 piece = 56g
- "Taco Bites"
  - 1 container of Michelina's = 156g
    - Assume 1 CFG grain serving, 0.5 CFG meat serving, and 0.25 CFG milk serving

Grain Products

- "Bran Buds"
  - 1/3 cup =28g
- "Bread"
  - "1" equals one slice
  - "Half of white bread"
    - Assume half a slice
- "Breadcrumbs"
  - 1/3 cup = 30g
- "Bread stick"
  - 1 stick = 7.5g
  - 1 soft breadstick = 43g
- "Cereal"
  - 1 bowl or bag = 1 CFG grain serving
    - Assuming medium-sized Ziploc bag
  - If no amount given, assume 1 handful of cereal (1/4 cup)
    - 0.25 CFG grain serving
  - Do not assume that there is milk

    - If type not specified, assume Cheerios
        - 1 cup of Cheerios = 30g
    - "Corn pops"
        - 1 cup = 30g
    - "Rice Krispies"
        - 1 cup = 28g
    - "Cookie Crips"
        - ¾ cup = 28g
- "Cheese bun"
    - 1 bun = 1 CFG grain serving
- "Ciabatta bun"
    - 1 bun = 90g
- "Crouton"
    - ¼ cup = 7.5g
- "Granola"
    - 1/3 cup = 50g
- "Muffin"
    - Assume 1 muffin is 55g (1)
    - "Mini Muffin"
        - 1 mini muffin = 25g
- "Naan bread"
    - 1 piece = 106g
- "Oatmeal"
    - 1 pack of instant oatmeal = 43g
- "Perogie"
    - 3 each = 114g
- "Pizza"
    - Assume 55g for crust, 25g cheese, 30mL tomato sauce and 7g pepperoni if specified
- "Pizza Bread"
    - Assume mini pizzas on English muffin
- "Ravioli"
    - For 1 small can assume 1 cup total: ½ cup pasta, ½ cup meat, 60mL tomato sauce
- "Rice"
    - If no amount given, assume ½ cup
- "Sandwich"
    - Assume 2 slices are used
        - 2 CFG grain serving
    - Assume 1 slice of ham
        - 0.5 CFG meat serving
    - Assume 1 slice of cheese
        - 0.5 CFG milk serving
    - Assume 1 leaf of lettuce
        - 0.25 CFG veg serving
- "Spaghetti"/ Pasta

    - If no amount given, assume 1 cup pasta and 60mL sauce
- "Sushi"
    - 1 container holds 8 pieces
        - Assume cucumber sushi unless specified
        - Assume ¾ cup rice
            - 1.5 CFG grain serving
        - Assume ½ cup cucumber
            - Assume 1 CFG vegetable serving
- "Sub bun"
    - 1 6inch bun = 70g
- "Small Tortilla"
    - 1 tortilla = 16g
- "Waffle"
    - 2 waffles = 70g (Kelloggs Eggo Waggle Serving Size)
- "Wrap"
    - Assume 1 white tortilla
        - Assume 2 CFG grain serving
    - Assume 1 shredded romaine lettuce leaf
        - 0.25 CFG vegetable serving
    - Assume 1/4 cup cooked chicken strips (20g)
        - 0.5 CFG meat serving
    - Assume no other toppings unless specified

Beverages

- "Milk"
    - If milk is written under dairy section and drink section, assume it was repetition and only include as dairy serving
    - If no amount given assume 1 cup
- "Arizona"
    - 1 can = 680mL
- "Coca Cola"
    - 1 can = 355mL
    - 1 bottle = 591mL
- "Water"
    - 1 bottle = 375mL
    - 1 glass = 250mL
    - No amount given = 125mL
- "Sugar-Sweetened Beverage" (SSB)
    - Assume 125mL is 1 serving
- "Ice Cap"
    - 1 small = 380mL
- "Fruit Juice"
    - Assume SSB
    - 1 bottle = 300mL
    - 1 box = 200mL

    - If they say orange juice, assume it's 100% fruit juice
    - Assume apple juice is 100% fruit juice
    - If no amount given, assume 200mL
- "Fruitopia"
    - 1 can = 341mL
- "Gatorade"
    - 1 bottle = 20oz or 591mL
- "Koolaid"
    - Koolad Jammer = 177mL each
- "Powerade"
    - 1 bottle = 946mL
- "Rockstar Energy"
    - Assume 473mL

Snacks

- 25-30g = 1 serving
    - Use 27g for serving calculations
- "Animal Crackers"
    - 30g per snack pack
    - 1/3 cup = 14 animal crackers (30g)
- "Arrowroot/ Baby Cookies"
    - 1 cookie = 6.6g
- "After Eight"
    - 2 sticks = 9g
- "Air Head"
    - 1 pack = 16g
- "Apple Crisp"
    - ½ cup = 141g (ESHA)
- "Apple turnover"
    - 1 each = 82g
- "Bacon Dippers"
    - 9 crackers = 19g
- "Banana Bread"
    - 1 slice = 50g
- "Bear Paw"
    - 1 cookie = 28g
    - 1 pack (2 cookies) = 50g
    - "Minis"
        - 1 pouch = 35g
- "Beivita Bar"
    - 1 bar = 18g
- "Bits and Bites"
    - ¾ cup = 50g
- "Breton Cracker"

    - 4 crackers = 18g
    - "Breton bites"
        - 15 crackers = 20g
- "Brownie"
    - 1 brownie = 62g
    - "Two-bite brownie"
        - 2 brownies = 50g
- "Brookside Chocolate"
    - 1 mini pack = 19g
- "Cake"
    - 1 slice = 80g (1)
- "Cake Pop"
    - 1 each = 43g
- "Candy", "Gummies"
    - Piece of candy = 5g
    - Bag of candy = 20-25g
    - If no amount given for Candy, assume 1 snack pack of fuzzy peaches (13g)
    - If no amount given for Gummies, assume 1 welches snack pack
- "Candy Cane"
    - 1 regular size = 14g (ESHA)
    - 4 mini candy canes = 17g
    - If type not specified, assume 1 mini candy cane
- "Celebration cookies"
    - 2 cookies = 30g
    - 1 minis pouch = 26g
- "Cheese cake"
    - 1 slice = 80g
- "Cheetos"
    - 21 pieces = 28g
    - 1 crunchy snack pack = 28g
    - "Cheeto Puffs"
        - 1 small bag = 35g
- "Chips"
    - Small container = 21.2g
    - Ziploc bag = 10-15g
    - Handful = 5g
    - "Tostitos Chips/ Nacho Chips"
        - 40 chips = 50g
    - Single-serve bag = 28g
    - Lays chips; 36 = 50g
- "Chocolate bar"
    - Kit Kat, snack size = 13g
    - Standard Size chocolate bar = 45g
    - If no amount given, assume 1 mini chocolate bar
- "Chocolate chips"

    - 1 tbsp = 15g
- “Chocolate-covered raisins”
    - ¼ cup = 45g
- “Chocolate fingers”
    - 1 finger = 6g
- “Chocolate Heart”
    - 1 foil wrapped chocolate hear = ~8.3g
- “Chee cha puffs”
    - 2 cups = 20g
- “Cinnamon Bun”
    - 1 bun = 56g
    - Two-bite cinnamon rolls = 28g per roll
- “Coffee Crisp”
    - 1 mini bar = 12g
- “Cookie”
    - Assume chocolate chip cookie
        - 1 cookie = 16g
            - 1 serving = 2 cookies
    - “Arrowroot cookie”
        - 6 cookies = 30g
    - 1 bag of mini cookies = 28g
    - “Raspberry crème cookies”
        - 2 cookies = 30g
    - “Shortbread cookie”
        - 8 each = 30g
    - “Sugar cookie”
        - 2 each = 34g
- “Cosmic Brownie”
    - 1 package = 62g
- “Crackers” – Count as both snack and grain servings
    - 15-30g is serving size, reference is 20g (1)
    - 14 crackers = 30g
    - “Graham crackers”
        - 8 crackers = 31g
        - Assume snack serving only
    - “Melba Toast”
        - 4 crackers = 21g
        - 1 pack = 2 crackers
    - “Cracker and Cheese pack”
        - Total is 27g, assume 15g cheese and 12g cracker
            - 0.25 CFG milk serving and 0.5 CFG grain serving and 0.5 snack serving
    - “Ritz cracker”
        - 5 crackers = 16g
    - “Rice crackers”
        - 12 crackers = 20g

    - "Vegetable crackers/ Vegetable thins"
        - 13 crackers = 20g
    - "Swiss Cheese crackers"
        - 10 crackers = 19g
        - Count as snack only
- "Crispers"
    - 15 crispers = 20g
- "Crispy Minis"
    - 12 chips = 20g = 1 cup
- "Croissant"
    - 1 medium = 57g
    - 1 mini croissant = 30g
- "Cupcake"
    - 1 cupcake = 55g
        - 2 snack servings
    - 1 mini cupcake = 24g
- "Danish"
    - 1 regular size = 94g
- "Dunkaroos"
    - 1 container = 28g
- "Donut"
    - 1 each = 60g (ESHA)
    - "Powdered Donuts"
        - 4 donuts = ~53g
        - 1 donut = ~13g
- "Doritos"
    - 1 small bag = 28g
    - 21 chips = 50g
- "Emoji Cookie"
    - 1 snack pack = 30g
- "Fig Bar"
    - 1 bar = 57g
- "Flaky"
    - 1 Flaky Cake = 50g
- "Fries"
    - 10 each = 76g (ESHA)
- "Fruit Leather"
    - 1 Fruit to Go = 14g
- "Fruit Roll Up"
    - 1 fruit roll up = 14g
- "Fudge"
    - 1 piece = 17g (ESHA)
- "Fun Dip"
    - 1 pack = 12g
- "Fuzzy Peaches"

    - 1 snack pack = 13g
- "Granola Bar"
    - Assume chocolate chip, chewy, 24g
        - 1 CFG grain serving and 1 snack serving
    - "Made Good"
        - 1 each = 24g
    - "Nutrigrain Bar"
        - 1 bar = 37g
    - "Fibre 1 bar"
        - Assume 1 chewy oats and chocolate granola bar = 35g (1.25 snack serving and 1.25 grain serving)
    - "Lara Bar"
        - 1 each = 45g
        - Assume snack only
    - "Kashi Bar"
        - 2 bars/ 1 package = 40g
- "Goldfish"
    - 1 pack = 28g
    - 55 goldfish = 30g (ESHA)
    - 37 goldfish = ¼ cup = 20g
- "Gummy Bears"
    - 17 pieces = 39g
- "Gushers"
    - 1 pack = 25g
- "Hershey"
    - Hug/Kiss = 4g each
- "Hickory Sticks"
    - 1 bag = 47g
- "Honey Bun"
    - 1 bun/package = 66g
- "Ice Breakers"
    - 1 candy = 0.8g
- "Ice Cream"
    - ½ cup = 66g (ESHA)
    - If no amount given, assume ½ cup
- "Jell-o"
    - 1 serving = 21g
- "Jos Louis"
    - 1 cake = 54g
- "Kellogg's Pastry Crisp"
    - 1 pouch/ 2 crisps = 25g
- "Kinder Chocolate Bar"
    - 1 bar = 21g
- "K Kritters"
    - 12 cookies = 30g
- "Lindor Ball"

    - 1 ball = 13g
- “Lollipop”
    - 1 snack-size lollipop = 5g
- “1/2 Lune Moon”
    - 1 = 42g
- “Macaroons”
    - 2 each = 36g
- “Made Good Balls”
    - 1 snack pack = 24 (container 6 balls)
- “Maltesers”
    - 1 regular size pack = 37g
- “Maynards”
    - 1 snack pack = 12.5g
- “Marshmallow”
    - 1 = 7.5g
    - “Mini marshmallows”
        - 2/3 cup = 30g
            - Assume ~30 mini marshmallows
- “Mars bar”
    - 1 regular size = 53g
- “Mentos”
    - 1 piece = 2.7g
- “Mike and Ike’s”
    - 1 snack pack = 14g
- “Milk Chocolate Easter Egg”
    - 1 piece = 7g
- “M&M minis”
    - 1 tube = 50g
    - 1 medium-size bag of regular M&M’s = 48g
- “Nerds”
    - 1 medium box = 46.7g
- “Nibs”
    - 1 each = 1.30g
- “Oatmeal Cream Pie”
    - 1 cookie sandwich = 38g
- “Oreos”
    - 3 each = 34g
    - 9 mini oreos = 29g
    - 1 snack pack = 30g
- “Organic Cheddar Ducks”
    - 1 package = 28g
- “Peeps”
    - 4 peeps = 32g
- “Penguin Crackers”
    - 1 pack = 28g

- “Pie”
    - 1 slice = 110g
- “Pillsbury Crescent”
    - 1 roll = 28g
- “Pixie stick”
    - 1 stick = 12g
- “Pocky” (Chocolate-covered sticks)
    - 1 box = 40g
- “Popcorn”
    - Assume both grain and snack serving
    - 1 bag = 50g (1)
    - 8 cups = 50g
    - “Smart Popcorn”
        - 1 snack bag = 18g
- “Popsicle”
    - 1 = 45g
- “Poptart”
    - 1 pastry = 52g
- “Pudding”
    - 1 pudding cup = 96g
        - 1 snack serving
- “Pumpkin Delights”
    - 1 cookie = 35g
- “Pretzels”
    - 8 regular size pretzels = 28g (ESHA)
    - 20 mini pretzels = 30g
    - Bag of mini pretzels = 28g
    - 53 pretzel sticks = 28g
- “Preventia Cookies”
    - 1 snack pack = 30g
- “Pringles”
    - 1 Snack pack = 19g
    - 16 chips = 28g
- “Rice Krispie”
    - Kelloggs Rice Krispie Square Original Size = 22g
    - 1 mini = 11g
- “Rice Cake”
    - 1 cake = 9g
- “Ritz mini sandwiches”
    - 13 sandwiches = 31g
    - 1 snack pack = 30g
- “Rockets”
    - 1 pack = 7.5g
- “Seaweed”
    - 1 pack = 5g

- “Skittles”
  - Fun/snack size = 18g
- “Smarties”
  - 1 mini box = 10g
- “Snap pea Crisps”
  - Snack size bag = 21g
- “Sour Key”
  - 7 small pieces = 40g
- “Sour Patch Kids”
  - 16 pieces = 40g
- “Special K Bar”
  - 1 bar = 23g
  - 2 crisps = 25g
- “Starburst”
  - 8 pieces = 40g
- “Strudel”
  - 1 apple strudel = 71g
- “Swedish Fish”
  - 1 snack pack = 15g
- “Swiss Rolls”
  - 1 roll = 20g
- “Tangy Zangy”
  - 20 pieces = 40g
- “Tart”
  - 1 tart = 110g
- “Tea Biscuit”
  - 1 biscuit = 55g
- “Teddy Grahams”
  - 1 snack pack = 28g
- “Timbits”
  - 1 each = 19g
- “Tootsie Roll”
  - 6 midgee pieces = 40g
  - 4 junior (long rolls) = 40g
- “Twinkie”
  - 1 twinkie cake = 52g
- “Twix Bar”
  - 1 regular twix package = 50.7g
- “Twizzlers”
  - 1 stick = 11g
- “Veggie Sticks/ Straws”
  - 1 bag = 28g
- “Viva Puffs”
  - 2 cookies = 40g
- “Wafer Cookies”

    - 3 = 30g
- "Wagon Wheel"
    - 1 = 35g
- "Welches fruit snack"
    - 1 pack = 25g
- "Zebra Cake"
    - 1 cake = 37g
    - Package of 2 = 74g
- "Zookies Animal Crackers"
    - 1 package = 35g

Soup

- "Chicken Noodle Soup"
    - Assume in 1 cup of soup: ¼ cup meat, ½ cup pasta
- "Soup"
    - If type not provided, assume 1 cup of chicken noodle soup
- "Tomato Soup"
    - Assume ¼ CFG vegetable serving
- "Pea Soup"
    - Assume ¼ CFG vegetable serving and 1 CFG meat serving
- "Potato Soup"
    - Assume ¼ CFG vegetable serving

1. Government of Canada CFIA. Information within the Nutrition Facts Table [Internet]. 2015 [cited 2017 Jun 19]. Available from: http://www.inspection.gc.ca/food/labelling/food-labelling-for-industry/nutrition-labelling/informmuffination-within-the-nutrition-facts-table/eng/1389198568400/1389198597278?chap=5.

CURRICULUM VITAE

Kimberly Charbonneau

Education

Master of Science in Foods and Nutrition Thesis Stream
Western University, London, ON Sept 2017-Mar 2018

Bachelor of Science (Foods and Nutrition), Honours Specialization in Nutrition and Dietetics
Brescia University College, London, ON Sept 2012-May 2016

Publications

1. Dakkak H, Brown R, Twynstra J, **Charbonneau K**, Seabrook JA. The perception of pre- and post-natal marijuana exposure on health outcomes: A content analysis of Twitter messages. JNPM. *In Publication*.
2. **Charbonneau KD**, Seabrook JA. Adverse birth outcomes associated with types of eating disorders: A review. In Press: *Canadian Journal of Dietetic Practice and Research*.

Invited Presentations

1. **Charbonneau K**. Scale Development. Brescia University College, London, Ontario, November 5th, 2018.
   - Designed and presented a three-hour lecture on scale development in research to students in the Sociology 2205 Statistics class at Brescia University
2. **Charbonneau KD**, Smith A, Seabrook JA. Ethics in Research Using Human Subjects. Brescia University College, London, Ontario, March 7th, 2018.
   - Designed and presented a three-hour lecture on proper ethical protocols in research to students in the HE4411Research Methods class at Brescia University
3. **Charbonneau KD**. Pregnancy, Obstetric, and Perinatal Health Outcomes in Eating Disorders. Research Ready Seminar. Brescia University College, London, Ontario, January 15th, 2018.
   - Critically appraised the journal article "Pregnancy, Obstetric, and Perinatal Health Outcomes in Eating Disorders" by Linna et al. in a seminar series offered to undergraduate students at Brescia University, teaching students how to critically appraise and interpret the results of scientific articles
4. Dakkak H, Brown R, **Charbonneau K**, Seabrook J. The Effects of Perinatal Cannabis Exposure on Health Outcomes: A Content Analysis of Twitter messages. Child Health Symposium. May 26th, 2017.

Awards

Dean's Honour List
Brescia University College, London, ON 2013, 2015

Brescia University College Admissions Scholarship
Brescia University College, London, ON 2012-2014

Related Work Experience

Course Assistant for Sociology 2205 Statistics for Sociology
Brescia University College, London, ON Oct 2018-Dec 2018
- Acted as a liaison between the professor and students in order to address issues raised regarding exams and/or assignments

- Conduct individual meetings with students regarding their work to provide positive feedback and facilitate further learning
- Responsible for marking all exams

Course Assistant for Human Ecology 4411 Research Methods

Brescia University College, London, ON Oct 2017-Dec 2018

- Facilitated student discussion during lecture to promote further learning and critical thinking
- Acted as liaison between the professors and the 60+ students enrolled in the course
- Graded all assignments and exams in a timely manner - scheduled and held meetings with students upon request to further review and discuss assignment and exam outcomes
- Evaluated students' research proposals for thorough literature reviews, appropriate study designs, letter of information and consent forms, and accurate budget reports

School Age Educator and Dietary Assistant

YMCA of Western Ontario, London, ON Jan 2017-May 2017

- Designed weekly program plans for school age children consisting of interactive activities promoting learning and creativity
- Assisted in the planning and preparation of nutritional snacks for children with various dietary needs and restrictions
- Created reports for management documenting the development and successes of each child's progress within the program