University of Alberta

Promoting Healthy Eating and Active Living in Schools: A Pilot Study

by

Heidi Maria Bates

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Nutrition and Metabolism

Department of Agricultural, Life and Environmental Sciences

Spring 2010
Edmonton, Alberta

Examining Committee

Dr. Linda McCargar, Department of Agricultural, Food and Nutritional Science

Dr. Ronald Plotnikoff, Faculty of Physical Education and Recreation

Dr. Noreen Willows, Department of Agricultural, Food and Nutritional Science

ABSTRACT

Highly structured school-based interventions have shown promise in reducing risk factors for obesity in children. However, challenges exist with the sustainability of these kinds of programs and little is known about the potential for less structured interventions to effect change on behaviours that underpin overweight and obesity in children.

We utilized an experimental design to test the effects of a semi-structured intervention on the lifestyle behaviours of grade 4 to 6 students at four schools. We also assessed stakeholder satisfaction with the intervention.

ANOVA found no significant differences in vegetable and fruit intake or steps taken per day between conditions (control versus intervention); suggesting that impact of the intervention on these behaviours was inconsequential. Narrative accounts provided by the stakeholders expressed satisfaction with the intervention.

This pilot study contributes to our understanding of the types of strategies likely to be efficacious in reducing the prevalence of childhood overweight and obesity.

ACKNOWLEDGEMENTS

I would like first to acknowledge the loving support of my husband, Kerry, and my daughters, Hallie and Jenny. Thank you for allowing me the freedom to pursue my studies and for being my tireless cheerleaders.

A very sincere note of thanks to my supervisor, Dr. Linda McCargar. I feel so lucky to have had the chance worked with you. Thank you for your advice, patience and consistent encouragement. You are truly a role model for all that a graduate supervisor should be.

To Drs. Ron Plotnikoff and Noreen Willows, my committee members – thanks! It has been a pleasure to have had the opportunity to learn from you. In addition, I would like to acknowledge the contributions of Dr. Shawn Fraser who graciously shared his expertise and advice regarding the statistical analysis of my data.

To the members of the McCargar lab: Laura Forbes (Kennedy), Carla Prado, Kate Storey (Calengor), Diane Drummond, Shauna Downs and Stephanie Thomas – you have made this journey incredibly fun and I will take with me life long memories of our friendship!

Finally, I would like to acknowledge the support of Maureen McKay, Coordinator, University of Alberta Integrated Dietetic Internship. Maureen, your ongoing encouragement has allowed me to soar to new heights.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PROMOTING HEALTHY EATING AND ACTIVE LIVING IN SCHOOLS: A PILOT STUDY

CHAPTER ONE

INTRODUCTION

1.1 RATIONALE

Research suggests an increasing trend towards overweight and obesity in Canadian children and youth, with the prevalence escalating dramatically over the past two decades (Tremblay & Willms, 2000). This trend is troubling in that failing to maintain a healthy body weight during childhood and adolescence has serious and enduring consequences. Overweight and obesity in children and youth is correlated with an increased risk for chronic disease and mental health concerns. In addition, childhood overweight or obesity are independent risk factors for adult obesity (Guo & Chumlea , 1999).

Body weight is influenced by multiple behavioural, environmental, social and physiological factors. However, changes in energy intake and physical activity levels (energy expenditure) are, either directly or indirectly, causally linked to unhealthy body weights in children.

The physical environment in which children and youth live is increasingly being recognized as a determinant of eating habits and physical activity levels (Duncan, Duncan, Strycker, & Chaumeton , 2002; Fein, Plotnikoff, Wilde & Spence, 2004; Spence and Lee, 2004; Kahn, Ramsey, Brownson, Heath, Howze, Powell, Stone, Rajab & Corso, 2002;

Krahnstoever-Davison and Law, 2006; Sallis, Prochaska & Taylor, 2000 and McMillan, 2005). Schools are a key environment in which to target children and youth with interventions that promote healthy eating and active living given the significant amount of time young people send in school and the fact a majority of children and youth attend school on a daily basis.

Highly structured, multi-level interventions have shown promise with respect to positively impacting eating habits and physical activity levels (Veugelers and Fitzgerald, 2005; Franks, Kelder, Dino, Horn, Gortmaker, Wiecha & Simoes, 2007; Summerbell, Waters, Edmunds, Kelly, Brown & Campbell, 2005). However, challenges exist with respect to the long-term sustainability of large scale, school-based lifestyle interventions (Franks et al, 2007).

Less structured interventions are appealing alternatives to more elaborate and costly approaches to increasing physical activity levels and promoting healthy eating in schools. However, relatively little is known about the potential for semi-structured interventions to effect change on these lifestyle behaviours and the outcomes of healthy eating and physical activity interventions in schools that are by design smaller in scale and simply structured have not been extensively studied.

1.2 PURPOSE

The primary purpose of this study is to implement a semi-structured, health promotion intervention, known as the One Step at a Time Pilot Project (OSTPP), in two elementary schools over a 5-month period of time with the goal of increasing the vegetable and fruit consumption and physical activity levels of children in grades 4 to 6. Figure 1-1 illustrates the components of the OSTPP intervention. The ability of the OSTPP to achieve these goals will be assessed through pre and post test measurements of dietary intake, physical activity and anthropometrics (e.g. weight and height). Two control schools will be assessed using the same measures at the same time points for comparison.

A secondary purpose of this study is to describe participant satisfaction with the OSTPP intervention. Study participants, school staff, and parents from the intervention schools will be invited to provide narrative accounts (e.g. written comments, letters, notes, team member journal entries and cards) of their experience and satisfaction with both the overall intervention and its individual components. In addition, members of the research team will be asked to describe their experiences in implementing elements of the OSTPP using team member journals.

Understanding if a semi-structured, health promotion intervention can effect positive changes to healthy eating and active living behaviours in children will help to inform the development of future school-based programs targeted at the reducing the risk of overweight and obesity.

Figure 1-1: Components of the OSTPP

Tracking Diaries
Everyone (students and staff) at each of the intervention schools was provided with a tracking journal to record the number of steps taken per day and the number of servings of vegetables and fruits consumed per day over the 5-month implementation period. Only data from consenting participants were included in the project data set.

Pedometers
Everyone (students and staff) at each of the intervention schools was provided with a pedometer to track steps taken per day.

Newsletter Content
On a monthly basis, each of the intervention schools was provided with content, related to the project that could be inserted into their school newsletter. The content included a brief update on project activities plus practical strategies for increasing vegetable and fruit intake and steps per day.

Enhanced Activities
Three times per week (Monday, Wednesday, and Friday) project volunteers led nutrition and physical activity games, experiences, and education during the lunch-hour at each intervention school. In addition, at the request of school staff, project volunteers also led classroom based nutrition education and cooking demonstrations.

1.3 RESEARCH QUESTIONS

This study explored two primary research questions. In addition, three secondary research questions were also considered.

1.3.1 Primary Research Questions

1. Can a semi-structured health promotion intervention (the One Step at a Time Pilot Project or OSTPP), delivered in schools, increase vegetable and fruit consumption and physical activity levels of grade 4 to 6 students?
2. Do participants (students, school staff, parents and research team members) consider a semi-structured, school-based intervention (OSTPPP) to be a practical and acceptable approach to increasing the vegetable and fruit intake and physical activity levels of grade 4 to 6 students?

1.3.2 Secondary Research Questions

1. How does the vegetable and fruit intake of grade 4 to 6 students who participated in this study compare to the recommendations of *Canada's Food Guide to Healthy Eating*?
2. What is the prevalence of physical inactivity in the grade 4 to 6 students who participated in this study and how does this level of prevalence compare to published estimates?
3. What is the prevalence of obesity and overweight in the grade 4 to 6 students who participated in this study and how does this level of prevalence compare to published estimates?

1.4 HYPOTHESES

This study had two hypotheses:

1. Implementation of a semi-structured, school-based intervention (One Step at a Time Pilot Project or OSTPP) will significantly increase vegetable and fruit intake and physical activity levels in grade 4 to 6 students compared to similar students attending the control schools. Specifically:
    a. Grade 4 to 6 students from the intervention schools will significantly increase their vegetable and fruit intake (servings/day from 24 hour dietary recall) compared to grade 4 to 6 students from the control schools.
    b. Grade 4 to 6 students from the intervention schools will significantly increase their physical activity levels (PAQ-C score) compared to grade 4 to 6 students from the control schools.
2. Implementation of a semi-structured, school-based intervention (OSTPP) is a practical and acceptable approach to increasing the vegetable and fruit intake and physical activity levels of grade 4 to 6 students based on written narrative accounts provided by study participants, school staff, parents and members of the research team.

1.5 OBJECTIVES

The objectives of the present study were:

Objective 1:

To describe the vegetable and fruit intake of the study participants by condition (intervention or non-intervention), and grade level using 24 hour dietary recall records and 3 day, self-reported records of vegetable and fruit intake collected from the participants pre and post intervention.

Objective 2:

To describe the physical activity level of the study participants by condition (intervention or non-intervention), and grade level using a guided, self-administered Physical Activity Questionnaire for Older Children (PAQ-C) and 3 day, self-reported pedometer records collected from the participants pre and post intervention.

Objective 3:

To assess the satisfaction of study participants, school staff, parents and members of the research team with the implementation of a semi-structured, school-based intervention (the One Step at a Time Pilot Project or OSTPP) to increase vegetable and fruit consumption and physical activity levels in grade 4 to 6 students through written narrative accounts offered in a variety of forms (e.g. written comments, letters, notes, team member journal entries and cards).

Objective 4:

To compare the reported vegetable and fruit intake of the children who participated in this study with the recommendations of Canada's *Food Guide to Healthy Eating* using 24 hour dietary recall records collected from the participants at baseline and post intervention.

Objective 6

To assess the prevalence of physical inactivity in the children who participated in this study by comparing overall physical activity scores derived from the Physical Activity Questionnaire for Older Children (PAQ-C) collected at baseline and post test to standard cut offs for physical inactivity (e.g. overall PAC-Q score of <3.0).

Objective 7

To determine prevalence of overweight and obesity among the study participants as compared to published reports of the prevalence of overweight and obesity in children using anthropometric data – measured weight (kg), and height (cm) – collected from the participants pre and post intervention.

CHAPTER TWO:
LITERATURE REVIEW

Overweight and obesity are growing public health concerns affecting significant numbers of young people in Canada and around the world. Despite the increasing prevalence of these problems in children, there is a paucity of data describing best practices to prevent these conditions and promote the achievement of healthy body weights.

This literature review discusses issues related to overweight and obesity in school-age children and explores the impact of school-based nutrition and active living interventions in promoting the achievement of healthy body weights.

2.1 OVERWEIGHT AND OBESITY IN CHILDREN

2.1.1 Defining Overweight and Obesity in Children

In adults, Body Mass Index (BMI) is recognized worldwide as the standard for assessing body weight (World Health Organization, 1995). BMI, which is based on correlations of weight and height and their relationship to morbidity and mortality, is a non-invasive measure that is inexpensive to administer, relatively simple to calculate, and supported by epidemiological data (World Health Organization, 1995). Adults with a BMI that exceeds 25 kg/m^2 are considered to be overweight, while those with a BMI greater than 30 kg/m^2 are considered to be obese (World Health Organization, 1995).

Defining specific, universally accepted criteria or cut points that are indicative of overweight or obesity in children has proven to be a challenge. Growth in height and weight gain is healthy and expected during childhood. However, these changes mean that BMI changes substantially between birth and adulthood. For BMI to serve as a valid and reliable indicator of overweight and obesity in children, these changes must be considered. Specifically, BMI must be correlated to not only morbidity and mortality, but also age and gender to provide an accurate assessment of body weight in young people.

Consensus is lacking with respect to where the definitional cut points for overweight and obesity should be established when using BMI to assess body weight in children. While many studies examining children have used BMI to delineate underweight, healthy weight, overweight and obese from one another the cut points used have varied. The United States Centers for Disease Control and Prevention (CDC) have established age and gender based standards for using BMI to assess body weights in children and youth from birth to 20 years of age (Kuczmarski, Ogden, Guo, Grummer-Strawn, Flegal, Mei, Wei, Curtin, Roche, & Johnson, 2000). Using the CDC method, BMI is calculated from weight and height data using the same formula used to calculate BMI in adults [e.g. BMI = Weight (Kg)/Height (m^2)]. BMI is then plotted on gender specific BMI-for-age growth charts to obtain a percentile ranking. Finally, the percentile ranking is compared to established cut points that categorize body weight status into one of four categories.

The CDC BMI-for-age method is not the only BMI-based approach to assessing body weight status in children. The CDC's percentile ranges are based on survey data collected in the U.S. and are principally intended for use with American children and youth (Flegal, Ogden, Wei, Kuczmarski & Johnson, 2001). Recognizing that the data that underpins the CDC method may not be internationally representative, other researchers have developed alternative approaches to classifying body weight and defining overweight and obesity in children.

In 2000, Cole and colleagues proposed definitional cut points for overweight and obesity in children based on longitudinal survey data collected in Brazil, Great Britain, Hong Kong, the Netherlands, Singapore and the U.S. (Cole, Bellizzi, Flegal, & Dietz, 2000). These cut points, which are known as the International Obesity Task Force (IOTF) cut offs, assess body weight using centile curves that relate adult BMI cut points to assessment of body weight in children. The cut points used to define overweight and obesity in children were identified by drawing centile curves that passed through the adult BMI cut points for overweight and obesity – 25 kg/m^2 and 30 kg/m^2 respectively – at 18 years of age. The resulting curves were then averaged to provide age and gender specific cut points for overweight and obesity for younger individuals aged 2 to 18 years. (Cole et al, 2000).

It is important to recognize that limitations exist with respect to direct comparisons of overweight and obesity prevalence data. These limitations are related to differences in the classification method used to estimate prevalence. As previously noted, the CDC and IOFT methods are under-pinned by data collected from different populations of children and youth. Practically this difference means that estimates of the prevalence of childhood overweight and obesity are, in part, a function of the classification method.

Research suggests that the IOTF method tends to provide a more conservative estimate of overweight and obesity prevalence compared to the CDC method (Ball GD and Willows ND, 2005; Flegal KM, Ogden CL, Wei R, Kuczmarski RL, and Johnson CL, 2001; Willows ND, Johnson M, and Ball GD, 2007; Edwards J, Evans J, and Brown AD, 2008). In addition, both the CDC and IOTF methods of assessing body weight in children have limitations. The fact that the CDC method is derived from data that is representative of only one population of children potentially limits its ability to reliably assess the body weights of children who live outside of the U.S. At the same time, both methods employ cut points that are based on arbitrary assumptions and data correlating precise cut points to health outcomes (positive or negative) in children is lacking (Flegal et al, 2001).

In 2004, Dietitians of Canada, the Canadian Paediatric Society, the College of Family Physicians of Canada, and the Community Health

Nurses Association of Canada issued a collaborative statement on, "The Use of Growth Charts for Assessing and Monitoring Growth in Canadian Children and Infants" (Dietitians of Canada, Canadian Paediatric Society, The College of Family Physicians of Canada, and Community Health Nurses Association of Canada, 2004). The statement, which is designed to guide Canadian practitioners, recommends, "For Canadian children, the CDC BMI-for-age charts are recommended for use in clinical and community settings. Use of international BMI chart is recommended when comparing prevalence data for BMI for international populations." (Dietitians of Canada et al, 2004, p. 172).

2.1.2 Prevalence of Overweight and Obesity in Canadian Children

Canada currently lacks a comprehensive surveillance system to monitor trends in overweight and obesity in children. Few Canadian studies have objectively assessed body weight, relying instead on self-reported data, which is subject to bias and reporting errors. The lack of consensus with respect to the definitions and measures used to assess and classify body weight, both in Canada and internationally, has also presented challenges in terms of assessing the true prevalence of these conditions.

Despite these confounding issues, recent reports suggest an increasing trend towards overweight and obesity in Canadian children with the prevalence escalating dramatically over the past two decades. Nationally representative studies of Canadian children indicate that since

1981 BMI values have increased at a rate of nearly 0.1 kg/m^2 per year for both genders at most ages (Tremblay & Willms, 2000). Tremblay and Willms found that the prevalence of overweight (defined as a BMI greater than the 85^{th} percentile for age and gender) among 7 to 13 year old boys increased from 15% in 1981 to 35.4% in 1996 and among girls of the same age from 15% to 29.2% (Tremblay & Willms, 2000). The prevalence of obesity (defined as a BMI greater than the 95^{th} age and gender specific percentile) in 7 to 13 year old children more than tripled during this same period, from 5% in 1981 to 16.6% for boys and 14.6% for girls in 1996 (Tremblay & Willms, 2000).

Data from the Canadian Community Health Survey (CCHS) (Statistics Canada, 2004), which employed direct measurements of weight and height in children, support the findings of Tremblay and Willms (2000). CCHS data indicate that 18% of Canadian children and youth aged 2 to 17 are overweight and 8% are obese for a combined rate of 26% (Statistics Canada, 2004). Compared to data collected from children of similar ages as part of the Canada Health Survey in 1978/79 this represents a 6% increase in the prevalence of overweight and a 5% increase in the prevalence of obesity in Canadian children and youth in the span of two and a half decades (Statistics Canada, 2004). Notably, the CCHS found that the combined prevalence of overweight and obesity amongst children and youth in Alberta was significantly below the national average (22% in Alberta versus 26% nationally) (Statistics Canada, 2004). This difference is attributed to a significantly lower prevalence of overweight only (Statistics Canada, 2004). The prevalence of obesity in Alberta children and youth was similar to the national rate (Statistics Canada, 2004).

The increasing trend towards overweight and obesity in children and youth is not unique to Canada. Evidence suggests that the prevalence of overweight and obesity in both young people and adults has increased and reached near epidemic levels in both Western industrialized nations and developing countries worldwide (World Health Organization, 2006)

2.1.3 Etiology of Overweight and Obesity in Children

On the surface, the origins of the current obesity pandemic are quite straightforward. Adiposity occurs when energy (or calorie) intake exceeds energy expenditure. However, this simplistic explanation defies the complexity of energy balance in the body, which, in reality, is mediated by multiple influences.

Genetic, physiological, psychological, social, ecological and familial factors are all thought to exert some influence on individual risk for overweight or obesity in children. In 1998, The International Obesity Task Force Public Health Approaches to the Prevention of Obesity (PHAPO) Working Group developed a Causal Web that describes the complex interrelationships that influence food intake, physical activity levels and body weight (Ritenbaugh, Kumanyika, Antipatis, Jeffery, & Morabia, 1999). The contribution(s) of each of the factors presented on the Causal Web to the risk for overweight and obesity has not been fully quantified and to date, no single factor has been identified as “the” cause of weight disturbances in children. However, there is recognition that factors, which may appear to be seemingly unrelated to body weight, exert influence far ‘upstream’ from the eating and activity behaviours that are ultimately responsible for weight status. For example, the physical environment in which a child lives and plays may be structured, by chance or intent, such that it either promotes or inhibits activity; a key influencer of body weight in children and youth.

On an individual level, genetic factors undoubtedly influence the propensity for overweight and obesity in some children, independent of environmental factors such as learned eating and physical activity behaviours. There is also recognition that obesity tracks through some families. For example, children with one obese parent have a three-fold increase in the odds ratio for developing adult obesity (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). The odds ratio increases markedly to more than ten if both parents are obese (Whitaker et al, 1997). However, it is important to recognize that genetics alone cannot be established as the driver of overweight and obesity in children with obese parents. Instead, the situation may also be influenced by environmental factors, such as shared eating and activity patterns.

The impact of genetics on body weight and composition, while influential, is not felt to be the only factor in the trend towards obesity and overweight in children and youth (Hebebrand & Hinney, 2008). The rapid rise in the prevalence of childhood obesity suggests that, while genetics likely plays a role in the etiology of this problem, environmental factors also exert significant effects. Specifically, a sustained positive shift in energy balance driven by excessive calorie intake and/or inadequate physical activity levels are believed to play a central role in the increasing trend towards childhood obesity (Anderson & Butcher, 2006).

2.1.4 Health Consequences of Overweight and Obesity in Children

Overweight and obesity increase, either directly or indirectly, the risk for a number of chronic diseases and mental health concerns.

Weight disturbances in children and youth pose long-term consequences and a persistent increase in the risk for chronic disease. Positive correlations exist between increased adiposity in children and youth and the development of dyslipidemias, hypertension, impaired glucose tolerance, type 2 diabetes mellitus, menstrual irregularities, asthma, orthopedic injuries and obstructive sleep apnea (American Academy of Pediatrics, 2002; Clarke, Woolson & Lauer, 1986; Dietz, Gross & Kirkpatrick, 1982; Freedman, Dietz, Srinivasan, & Berenson 1999; Gidding, Bao, Srinivasan, & Berenson, 1995; Must, Jacques, Dallal, Bajema, & Dietz, 1992; Richards, Cavallo, Meyer, Prince, Peters, Stuart, & Smith, 1985; Rodriguez, Winkleby, Ahn, Sundquist & Kraemer, 2002; Sinha, Fisch, Teague, Tamborlane, Banyas, Allen, Savoye, Rieger, Taksali, Barbetta, Sherwin, & Caprio, 2002). In addition, adolescent overweight has been shown to increase all cause morbidity and mortality from coronary heart disease (Must et al, 1992).

Being overweight or obese during childhood significant increases the risk for adult obesity and, as a result, an increased risk for chronic disease that often extends across the lifespan. Guo and Chumlea (1999) reported that the probability of childhood obesity persisting into adulthood increases from approximately 20% at 4 years of age to approximately 80% by adolescence. Furthermore, links have been made between adolescent obesity and an increased risk for health problems during adulthood. Particularly concerning is evidence indicating that overweight in adolescence is a more powerful predictor of lifetime health risk than overweight in adulthood (Must, 1992).

The negative effects of overweight and obesity are not limited to physical health. Overweight and obesity are independent risk factors for mental health concerns in young people and a growing body of literature suggests that these concerns challenge children to live fulfilling lives. . Work by Schwimmer and colleagues found that obese children and adolescents aged 5 to 18 years reported significantly lower health-related quality of life compared to healthy weight children (Schwimmer, Burwinkle & Varni, 2003). Overweight and obese youth in grades 7 to 12 are also more likely than their healthy weight peers to report suffering from peer directed social marginalization, verbal harassment, and bullying (Eisenberg, Neumark-Sztainer, & Story, 2003). Problems with depression and low self-esteem in children are also associated with weight disturbances, particularly if they persist into adolescence. (Must & Strauss, 1999, Strauss, 2000; Wang and Veugelers, 2008).

2.2 DIETARY INFLUENCES ON BODY WEIGHT IN CHILDREN

2.2.1. Dietary Intake Assessment in Children

Twenty-four hour dietary recalls are the most commonly used methodology to assess dietary intake (Buzzard, 1998). Twenty-four hour dietary recalls are relatively inexpensive to implement and are capable of capturing a sizable depth of information related to food intake (Dwyer, 1997). However, this methodology is limited by concerns relating to its ability to obtain valid information on eating habits, particularly in children.

The validity of the 24-hour recall methodology in children has been shown to be highly variable (McPherson, Hoelscher, Alexander, Scanlon, & Serdula, 2000) and based upon a number of factors including the age of the child, the types of foods consumed and the scope of the 24-hour recall (full day versus select meals or snacks only). Age is a key determinant of a child's ability to provide a valid dietary recall. Reynolds, Johnson, & Silverstein (1990) found that there was a global tendency for children to significantly underestimate their energy, carbohydrate and fat consumption compared to trained observers and that the magnitude of underestimation was related to age. Specifically, 7 to 8 year old children underestimated intake to a higher degree than children aged 11-12 years (Reynolds et al, 1990). Work by Emmons and Hayes (1973) support these findings.

Comparing recall ability in first, second, third and fourth grade children, Emmons and Hayes (1973) found that the ability to correctly recall a school lunch generally improved by grade with the percentage of food items recalled correctly across grades one through four to be 60.5, 52.4, 67.3, and 80.6 % respectively.

A variety of strategies can be used to enhance the validity of the 24 hour dietary recall methodology. Thorough training of interviewers who guide the data collection process can decrease the risk of reporting errors and thereby strengthen the validity of this methodology (Dwyer, 1997). In addition, implementing a phasic, or multiple pass approach to obtaining the recall can also help to decrease errors (Dwyer, 1997).

Despite the inherent limitations, 24 hour recalls are often used to assess dietary intake in children. Many large-scale dietary assessment surveys and health promotion interventions, including the 2004 Canadian Community Health Survey (CCHS), the third National Health and Nutrition Examination Survey (NHANES III), the Bogalusa Heart Study, the Child and Adolescent Trial for Cardiovascular Health (CATCH), and Continuing Survey of Food Intakes by Individuals have utilized this methodology and it continues to be a much used tool in both population health surveillance and community nutrition research. (Statistics Canada, 2006; Briefel, Sempos, McDowell, Chien S, & Alaimo, 1997; Nicklas, Webber, Srinivasan & Berenson, 1993; Luepker, Perry, McKinlay, Nader, Parcel, Stone, Webber, Elder, Feldman, Johnson, Kelder, & Wu, 1996; United States Department of Agriculture (USDA), 2001).

2.2.2 Energy Intake

Body weight is influenced by multiple factors. Ultimately, however, all of these factors contribute to energy balance or homeostasis, the key determinant of body weight in children (Troiano, Briefel, Carroll, & Bialostosky, 2000). When energy intake approximates energy expenditure, body weight remains stable. In contrast, when imbalances exist between energy intake and expenditure, weight will either increase or decrease.

It is often assumed that the increased prevalence of overweight and obesity in children is due to a concomitant increase in energy or calorie intake coupled with a decrease in energy output or expenditure. However, it is important to recognize that data describing energy intakes of Canadian children is limited. In addition, the data that are available do not provide unequivocal support for the belief that increased calorie intake, independent of other factors, is responsible for the relatively high levels of overweight and obesity currently observed in children.

The most recent Canadian information on the energy intakes of children comes from the 2004 CCHS (Statistics Canada, 2006). The CCHS represents the first national nutrition survey since the Nutrition Canada survey in 1970-1972 (Statistics Canada, 1973). The CCHS data were collected through face-to-face interviews done in the respondent's homes (Statistics Canada, 2006). Children aged 6 to 11 years were interviewed with their parents present to assist them in responding to the survey questions (Statistics Canada, 2006). The CCHS found that mean energy intakes for boys and girls aged 4 to 8 years was 1,895 kcal/day (Statistics Canada, 2006). For children aged 9 to 13 years of age, mean energy intake was 2,446 kcal/day for boys and 2,035 kcal/day for girls (Statistics Canada, 2006). These values, for both genders and age groups, are relatively close to the Estimated Energy Requirement (EER) for comparable age and gender groups based on an active physical activity level (PAL) and, as a result, would not be expected to produce the magnitude of weight gain observed in Canadian children (Institute of Medicine, 2005). Furthermore, the level of intake reported by the CCHS is actually below that reported by children of similar age and gender in the last major survey of Canadians' eating habits in the early 1970's (Statistics Canada, 2006) (Statistics Canada, 1973). These findings align with those of other recent Canadian studies in adolescents which suggest that the energy intake of Canadian youth is within the levels recommended by the Institute of Medicine (IOM) (Jacobs-Starkey, Johnson-Down &Gray-Donald, 2001; Hanning, Woodruff, Lambraki, Jessup, Driezen, & Murphy, 2007).

In the absence of Canadian research, American data serve as a proxy source of information on the current eating patterns in children and youth. As is the case in Canada, data describing the energy intakes of children in the United States is limited and does not clearly support the notion that excessive calorie intake is the primary contributor to the increased weights observed in many children. For example, data from the Nationwide Food Consumption Surveys (NFCS) show modest but significant increases in energy intake by children and youth aged 2 to 18 years between 1989 to 1991 and 1994 to 1996 (Nielsen et al, 2002). In contrast, using data from the Continuing Survey of Food Intakes by Individuals (CSFII) 1994-96, 1998; the CSFII 1989-91; and the Nationwide Food Consumption Survey 1977-78, Enns, Mickle, & Goldman (2002) found no significant changes in the energy intakes of 6 to 11 year olds between 1977-78 and 1994-96, 1998. In fact, their data suggest that energy intake by girls and boys has remained stable over this twenty year period of time at approximately 1800 kcal/day (girls) and 1950 kcal/day (boys)(Enns et al, 2002). Paradoxically, in the face of the trend towards pediatric overweight and obesity, Cavadini et al (2000) found that the energy intakes of American children and youth aged 11 to 18 years decreased by 17% between 1965 and 1996.

Despite the contradictory data collected thus far, the increased prevalence of overweight and obesity is believed to be rooted in disparities in energy balance (IOM, 2004). Reducing energy intake while increasing energy expenditure through physical activity remain cornerstones of obesity risk reduction and treatment programs for children (Lobstein, Bauer & Uauy, 2004; Wofford LG, 2008).

2.2.3. Macronutrient Intake and Diet Quality

Macronutrient intake has been identified as a potential factor in childhood obesity. In particular, diets which are high in fat and simple carbohydrate, and low in complex carbohydrate have been associated with the development of childhood adiposity (Birch and Fischer, 1998).

According to the IOM (2002), diets for children aged 4 to 18 years of age should be composed of 45 to 65 percent carbohydrate, 10 to 30 percent protein, and 25 to 35 percent fat. The available data suggest that macronutrient distribution within the diets of children, while still within these ranges, has shifted over the past two decades, particularly where fat and carbohydrates are concerned. Enns et al. (2002) found that for children between the ages of 6 and 11 years of age the percentage of energy intake from carbohydrate increased by 7.61% to 54.9% for girls and by 8.0% to 54.8% for boys aged, between 1977 and 1996. During the same time period, the percentage of energy intake from protein intake decreased by 1.6% for both genders to 13.9 % of total energy for girls and 14.0% of total energy for boys. Fat intake also decreased for both genders from 1977 to 1996 (Enns et al, 2002). The percentage of energy intake from total fat has decreased from 38% to 32% for girls and boys, while the percentage of energy from saturated fat has decreased from 16% to 11% (Enns et al, 2002). These levels of intake are consistent with those observed in recent studies of Canadian children (Statistics Canada, 2006).

The changes in the macronutrient distribution of children's diets are reflective of overall trends in the types of foods currently favoured by North Americans. Both Canadian and US studies undertaken since the early 1990's suggest a trend towards decreasing consumption of milk, vegetables, soups, whole grain breads, and eggs, while during the same time period, intake of higher fat snack foods, fruit and fruit juices, carbonated beverages, poultry, and cheeses have increased (Hanning et al, 2007; Enns et al, 2002; Statistics Canada, 2006).

Data from the CCHS (Statistics Canada, 2006) indicate that school-age children obtain almost one quarter (22%) of their energy intake from less nutritious foods such as fats and oils (butter, margarine, cooking oils); foods that are mostly sugar (jam, candy, honey, syrup); higher fat and/or higher salt snack foods (potato chips, taco chips, cheese puffs); beverages (soft drinks – including fruit beverages, sport drinks and pop; water; coffee and tea); and condiments (pickles, mustard, ketchup, salt, pepper, herbs and spices). Similar findings were reported by Hanning et al (2007) for children and youth in grades 6, 7 and 8.

Concerns surrounding typical dietary patterns in Canadian children extend beyond the recognition that the contribution of less nutritious foods to overall intake is high. Evidence suggests that many children do not meet recommended intakes for vegetables and fruit; a habit that may indirectly increase the risk for overweight and obesity (Statistics Canada, 2006; Burrows, Warren, Colyvas, Garg & Collins, 2009).

2.2.4. Vegetable and Fruit Intake

CCHS data (Statistics Canada, 2006) indicate that a majority of children aged 9 to 13 years do not meet the recommendations of *Canada's Food Guide to Healthy Eating* with respect to vegetable and fruit intake (Health Canada, 1992). The *Food Guide* recommends that Canadians over the age of 2 consume 5 to 10 servings of vegetables and fruits each day (Health Canada, 1992). In reality, the evidence indicates that seven out of 10 children aged 4 to 8 years do not meet this recommended level of intake and that at ages 9 to 13 years, 62% of girls and 68% of boys report dietary intakes that are inadequate in vegetables and fruit (Statistics Canada, 2006). Similar findings have been observed in a number of other recent Canadian studies of school age children (Action Schools! BC, 2005; Veugelers, Fitzgerald & Johnston, 2005)

Inadequate vegetable and fruit intake is positively correlated with overweight and obesity risk in children and youth (MMWR, 2007; Ball, Lenk, Barbarich, Plotnikoff, Fishburne, Mackenize, & Willows, 2008; Burrows et al, 2009). Conversely, diets that provide relatively high numbers of servings of vegetables and fruits are associated with a reduced risk for multiple chronic diseases and conditions including certain types of cancer and cardiovascular disease (Ness & Fowles, 1997; Block, Patterson, & Sobar, 1992). While the specific mechanisms that lead to these health outcomes are not fully understood, it is generally accepted that the benefits of consuming vegetables and fruits are linked to their low energy density, and high nutrient and fibre content.

The energy density of vegetables and fruits is thought to contribute to contribute to a reduced risk for overweight and obesity. Energy density is the term used to describe the relationship between the amounts of calories found in a food compared to its weight (in grams). Foods with high energy density provide a large number of calories (4 to 9 calories/gram) compared to their weight (Centers for Disease Control and Prevention (CDC), 2005). To achieve this level of energy density, foods in this category contain relatively lower levels of water as compared to other constituents (CDC, 2005). Foods with medium energy density provide a moderate number of calories (1.5 to 4 calories/gram), while foods with low energy density provide relatively few calories (<1.5 calories/gram) (CDC, 2005). Foods with low energy density contain significantly more water than other constituents (CDC, 2005). With few exceptions, vegetables and fruits are low energy density foods, providing between 0.1 to 05 calories/gram (Drewnowski, 2003).

Short-term studies suggest that feelings of fullness, more so than calorie intake, influence cessation of eating in humans (Duncan, Bacon, & Weinsier 1983; Rolls, Bell, & Waugh, 2000; Bell, Castellanos, Pelkman, Thorwart & Rolls, 1998). For example, a 1983 study by Duncan et al. demonstrated that on a low energy density diet both obese and non-obese subjects expressed subjective feelings of fullness at an intake of approximately 1600 calories (Duncan et al, 1983). In contrast, when challenged with a high energy density diet the same subjects required almost double the calories (3000 kcal) to feel full (Duncan et al, 1983). These findings offer support for the notion that choosing a diet rich in low energy density foods, such as vegetables and fruit, plays a key role in satiety and overall energy balance.

Food preferences (or palatability) are inversely related to satiety (or feelings of fullness). Drewnoski (1998) found that while both children and adults demonstrated a preference for higher fat, higher sugar, energy dense foods, these foods produced relatively low levels of satiety.

It is theorized that the inverse relationship between palatability and satiety is a key influencer of current dietary patterns and the increasing trend towards overweight and obesity in children. Consuming foods that are energy dense but unlikely to promote satiety produces a situation where in overeating is promoted. This relationship is supported by an emerging body of evidence indicating that high-energy density diets are predictive of the risk for overweight and obesity, particularly among children with other risk factors for these conditions such as physical inactivity or a family history of adiposity (Kral, Stunkard, Berkowitz, Stallings, Brown & Faith, 2007; Johnson, Mander, Jones, Emmett& Jebb, 2007).

Recognition of the influence that low energy density foods like vegetables and fruit have on obesity risk in children, coupled with the knowledge that a majority of Canadian children do not take in adequate amounts of these foods, supports the relevance of offering targeted interventions aimed at changing these behaviours.

2.3. INFLUENCE OF PHYSICAL ACTIVITY ON BODY WEIGHT IN CHILDREN

2.3.1 __Methods for Assessing Physical Activity Levels in Children__

Accurately assessing physical activity levels of children is a challenging process. Unlike adults, children demonstrate high intra-day and inter-day variations in physical activity patterns, which makes it very difficult to draw meaningful conclusions from data collected over short periods of time (Sirard & Pate, 2001). In addition, assessment instruments that focus largely on quantifying structured leisure time activities may not capture the play-based, random movement that is characteristic of physical activity in children (Sirard & Pate, 2001).

A number of different measurement techniques have been developed to specifically assess physical activity levels in children and youth, each offering some advantages and some limitations. These measures can be grouped into two categories, according to the type of information they provide: 1) objective measure or instruments, and 2) subjective (self-report) measures or instruments

2.3.1.1. __Objective Measures of Physical Activity in Children__

Objective measures of physical activity quantify the level, and with some devices, the duration, intensity and patterning of daily physical activity in children in ways that are not influenced by recall ability, ethnicity, culture, or socioeconomic status. As a result, objective measures can provide important insights into the true activity levels of young people.

A number of different instruments exist to objectively measure physical activity but not all are appropriate for use in large, population-based studies. For example, while highly accurate energy expenditure data can be gleaned from doubly labelled water studies, indirect calorimetry or direct observation, the cost and inconvenience associated with using these instruments render them impractical for use in surveillance research (Sirard & Pate, 2001; Kohl, Fulton, & Caspersen, 2000). Other measures, such as pedometers, accelerometers and heart rate monitoring, while not as accurate, cost less to implement and may be better suited for use with large groups of children. There is often a need to make what Welk, Corbin and Dale (2000) have termed an "accuracy-practicality trade-off," when selecting objective instruments for assessing physical activity in children.

2.3.1.1. a. ***Pedometers to Assess Physical Activity in Children***

Pedometers or step counters are a type of motion sensor. These lightweight devices are typically worn at the hip and provide a measure of activity by "counting" the number of times a spring suspended lever arm moves up and down in response to ambulation (e.g., walking, running) (Tudor-Locke, 2002). This information is recorded and displayed as steps taken.

Tudor-Locke and colleges (2004) have developed optimal age- and sex-specific standards for steps/day related to international BMI cut off points for normal-weight and overweight/obese children. These recommendations were derived from a secondary analysis of pedometer and BMI data for a sample of 6 to 12 year old children from the United States, Australia, and Sweden which found that the cutoff point that separated normal weight children from overweight and obese children was 12,000 steps/day for girls and 15,000 steps/day for boys (Tudor-Locke, Pangrazi, Corbin, Rutherford, Vincent, Raustorp, Tomson, & Cuddihy, 2004).

The available evidence suggests that pedometer data provides a valid and reliable measure of physical activity in children. To assess validity, pedometers must be compared to established criterion standards for the objective assessment of physical activity in children such as direct observation (Sirard & Pate, 2001). Using this methodology, laboratory and field validation studies of pedometer use by children have yielded relatively high correlations between pedometer data and primary criterion standards such as direct observation (r = 0.80 to 0.97) (Kilanowski, Consalvi, & Epstein, 1999).

The reliability of pedometers as a measure of physical activity in adults is well established. However, relatively few studies have explored the reliability of pedometer data collected from children. Notwithstanding the paucity of data in this area, the studies that have been conducted support the belief that pedometers are a reliable measure of physical activity in children based on strong intra-class correlations between different bouts of physical activity (Jago, Watson, Baranowski, Zakeri, Baranowski & Conry, 2008; Louis, Eston, Rowlands,Tong, Ingledew & Fu, 1999).

The ability of children to reliably self-report pedometer data bears careful consideration by researchers wishing to use these devices to assess the physical activity level of young people. While the reliability of self-reported pedometer data is well established in adults and older youth, reports qualifying the specific age at which children are able to provide reliable self-reports of steps taken per day as measured by a pedometer are lacking. However, research conducted in other areas of study indicate that, in general, children as young as age 8 are capable of reliably reporting a range of both qualitative and quantitative information over short to intermediate periods of time (Micheal, KDM and Merrell KW, 1998; Henriksen L and Jackson C, 2009; Varnie JW, Limbers CA, Burwinkle TM, 2009).

While they are considered to be valid and reliable measures of physical activity in children, pedometers are not without limitations. By design, pedometers cannot assess intensity, frequency, type or duration of activity. Pedometers are also limited in their ability to measure certain types of activity. For example, pedometers cannot reliably detect motion that is limited to the upper body. Pedometers are also not sound measures of activity that occurs while seated. In addition, pedometers cannot be worn in water; which renders them ineffective in assessing activities such as swimming, diving or water play. There is also evidence to suggest that that pedometers may not be able to reliably detect steps taken during very slow walking (< 60 m/min) or in individuals with gait abnormalities (Bassett DR Jr, & Strath SJ , 2002; Wilcox, Tudor-Locke & Ainsworth, 2002). Finally, extra body fat, particularly in the abdominal region, may also impact a pedometer's ability to detect steps in that it can interfere with correct placement of a pedometer on the hip (Shepherd, Tolza, McClung & Schmalzried T, 1999).

A practical, but relevant drawback of pedometer use is the issue of tampering. Pedometers readings can be increased by simply holding the device in the hand and shaking it. In addition, the wearer can also delete the step count displayed on the device's read-out screen by pushing an easily identified button. These features of pedometers, which are not seen in other objective measures of physical activity, can significantly influence data collection and the reliability of any data that are collected.

Despite these limitations, the literature supports the use of pedometers in physical activity research focused on children. Relatively inexpensive, valid, reliable and non-invasive, pedometers can make a valuable contribution to studies aimed at assessing activity in school-age children.

2.3.1.2 Subjective (Self-Report) Measures of Physical Activity in Children

Subjective (self-report) measures of physical activity in children draw conclusions based on recalls of past experiences. They can be either self-administered, or the respondent can be guided through the data collection process by an interviewer. Because they are easy to implement with large groups of children at a relatively low cost, these types of measures are widely used.

Despite their popularity, the available evidence suggests that self report measures often overestimate physical activity levels in children compared to objective methods (Active Healthy Kids Canada, 2009). As a result, the validity and reliability of this approach to assessing physical activity levels is a concern.

The age of the children being studied is known to significantly impact the reliability of self-report measures to assess physical activity. A review by Kohl and colleagues (2002) found that test-retest reliability was lower in younger children (children < 9 years of age) compared to older children or youth. This is not surprising in the cognitive functions needed to support accurate recall of past behaviours develops with age.

Respondent age has also been shown to influence the validity of self-report measures of physical activity in children. Studies using self-report instruments with children younger than ten years of age have revealed insignificant validation coefficients, indicating that the instruments are not measuring what they are intended to measure in this population of children (Sallis, Buono, Roby, Micale, & Nelson, 1993).

Kohl and colleagues (2002) recommend that, “if assessment among children younger than 10 years of age is the goal, self-report recall methods should not be used.” This recommendation argues not for the abandonment of self-report measures, but for the need to consider the characteristics of the children being studied to ensure that they are old enough to provide accurate information on their physical activity behaviours (Kohl et al, 2002).

2.3.1.2. a. Validity and Reliability of the Physical Activity Questionnaire for Older Children (PAQ-C)

The Physical Activity Questionnaire for Older Children (PAQ-C) is a subjective, self-administered, recall questionnaire that is intended to assess habitual physical activity in children in grades four or higher (Kowalski, Crocker, & Faulkner, 1997). Based on a 7-day recall, the PAQ-C was designed to be implemented in school settings and to assess moderate to vigorous physical activity (MVPA) over specific seasons (fall, winter and spring) (Kowalski et al, 1997).

The reliability of the PAQ-C in children in grades 4 or greater has been established. Work by Crocker et al (1997), found acceptable test-retest reliability correlations of 0.75 (Males) and 0.82 (Females). Internal consistency is a measure of the degree to which different items on the same test that purport to measure the same general concept or construct offer agreement with each other. Crocker and colleagues (1997) demonstrated that the internal consistency of the PAQ-C ranged between 0.79 and 0.89, which indicates acceptable to good levels of reliability.

The validity of the PAQ-C in older school age children has also been established (Kowalski et al, 1997). Compared to other validated self-report instruments and to accelerometry, the PAQ-C has been shown to offer moderate validity in measuring MVPA in school-children aged 9 years of age and older (Kowalski et al, 1997). Using the Seven-Day Activity Recall, the Leisure Time Exercise Questionnaire and the Caltrac accelerometer as validation standards, Kowalski et al (1997) found moderate correlations between the PAQ-C and these other measures of physical activity in children.

The high reliability, moderate validity, and ease of administration make the PAQ-C an attractive tool to use when assessing large groups of children. It is capable of assessing the frequency of activity that occurs at school or outside of school, and reflects activities and settings that are typical for Canadian children. However, the PAQ-C is not without limitations. It does not, for example, explore the time spent on sedentary activities. The PAQ-C is also not capable of estimating energy expenditure, (Kowalski et al, 1997). Instead, it is designed to offer a general indication of physical activity levels in children (Kowalski et al, 1997). Finally, the reliability and validity of the PAQ-C with children under the age of 9 has not been established and, as a result, this tool would need to be employed with caution, if at all, in children younger than approximately grade four.

2.3.2 <u>Physical Activity Levels of Canadian Children</u>

Recent findings suggest that physical inactivity is common among Canadian children and youth. The Canadian Physical Activity Levels Among Youth (CAN PLAY) Survey has been objectively tracking physical activity levels in Canadian children and youth between the ages of 5 and 19 for three years by measuring daily steps using pedometers (Canadian Fitness and Lifestyle Research Institute, 2008). Data from the CAN PLAY Survey (2008) indicates that 6% of 5 to 10 year old girls and 16% of similarly aged boys accumulate enough steps per day to meet the recommendations of *Canada's Physical Activity Guide for Children and Youth* (Public Health Agency of Canada, 2002). These findings are consistent with other recent studies which indicate that a majority of school-age children in Canada are not active enough to meet guidelines for optimal growth and development (Canadian Fitness and Lifestyle Research Institute, 2008)

The trend toward inactivity in children appears to have gone largely unnoticed by parents and caregivers. An Environics survey conducted for the Canadian Paediatric Society (2002) found that a majority (60%) of Canadian adults with children between 6 and 14 years of age believed that their children had adequate levels of physical activity. In addition, 66% of those with children in the home agreed that their children had enough time and opportunity to be physically active while at school (Canadian Paediatric Society/Environics Research Group, 2002). The media attention given to childhood obesity since reports of these studies may have increased parents' awareness of the importance of physical activity. Nonetheless these findings bear consideration given that parental support and modelling of positive behaviours are key factors influencing physical activity of children and youth (Statistics Canada, 2000; Bois, Sarrazin, Brustad, Trouilloud &Curry, 2005).

2.3.3 Physical Activity and Obesity Risk in Children

Physical activity patterns of children and youth have been linked to the development of obesity (Ball et al, 2008; Janssen, Katzmarzyk, Boyce, King, & Pickett, 2004; Levin, Lowry, Brown, & Dietz, 2003; Yu, Sung, So, Lam, Nelson, Li, Yuan, & Lam, 2002). Work by Janssen et al (2004) suggests that physical inactivity and sedentary behaviours, such as television viewing, are strongly related to obesity in 11 to 16 year old Canadian children and youth. Other data indicate that 6 to 17 year old children who report relatively low levels of physical activity are significantly more likely to be overweight or obese than more active children of similar age and gender (Levin et al, 2003; Yu et al, 2002). Obese children and youth are also more likely to engage in sedentary activities than healthy weight children (Janssen et al, 2004). Conversely, participation in both organized and unorganized sport and consistently maintaining relatively high levels of physical activity appears to offer 7 to 11 year old children a measure of protection against obesity (Tremblay and Wilms, 2003). Based on these findings, it would seem prudent to encourage children to be as physically active as reasonably possible.

2.4. SCHOOL-BASED NUTRITION AND PHYSICAL ACTIVITY INTERVENTIONS TO REDUCE OBESITY RISK

2.4.1. ***Rationale for Intervening in the School Environment***

The environment in which an individual lives is increasingly being recognized as a mediator of eating habits, physical activity levels, and other behaviours related to obesity risk in children (Maziak, Ward & Stockton, 2008). Specifically, intervening on multiple levels on the characteristics of the environment which support excessive energy intakes and physical inactivity has been identified as a means to reducing obesity risk (Swinburn, 2009).

Schools are a key environment in which to target children with obesity risk reduction interventions for several reasons:

- Children spend significant amounts of time in the school environment.
- Schools serve the majority of children, making them an appealing venue for population health initiatives.
- Teachers, coaches and other school staff have the potential to exert considerable influence on physical activity and eating habits in children (Kahn et al, 2002).
- Schools offer access to facilities and equipment that support nutrition education and physical activity.

2.4.2 ***<u>Efficacy of School-Based Nutrition and Physical Activity Interventions for Obesity Risk Reduction</u>***

In an attempt to understand how best to combat the increasing trend towards overweight and obesity in children large numbers of school-based obesity risk reduction interventions have been launched over the past decade. These interventions have taken a variety of forms. Some have targeted dietary intake or physical activity levels alone while others have looked at the effect of targeting these behaviours in combination.

Assessing the efficacy of school-based nutrition education and physical activity interventions to reduce the risk of obesity in children has proven challenging. A lack of uniformity in the duration, design, and measures employed in the work undertaken to date has made comparisons difficult.

School-based nutrition and physical activity interventions appear to have modest impacts on the eating habits and activity patterns of children. A 2005 systematic review by Summerbell, Waters, Edmunds, Kelly, Brown and Campbell found that nearly all of the twenty-two long and short term studies they considered resulted in improvements in dietary intake or physical activity levels.

The ability of school-based interventions to positively influence vegetable and fruit intake in children appears to be modest and, at present, the level or “dose” needed to elicit sizable changes in food selection by children is not well understood (French & Stables, 2003).

Large scale, comprehensive or “whole school” interventions which act on multiple components of the school environment have been shown to positively influence vegetable and fruit intake (French & Stables, 2003). These types of interventions which in many cases have been used to target large groups of children at several schools are typically broad-based, theoretically framed and include a mixture of staff training, curricular education, policy implementation, and collaboration with school foodservices (French & Stables, 2003). Despite this level of intervention on large group of children (where even small changes can be readily detected), the effects have been modest (French & Stables, 2003). A meta and pooling analysis of seven such interventions to increase vegetable and fruit intake by Howerton, Bell, Dodd, Berrigan, Stolzenberg-Solomon, & Nebeling. (2007) suggests that while vegetable and fruit intake can be positively influenced using these highly structured and comprehensive approaches, the effects are relatively modest. For example, six of the seven studies reviewed by Howerton et al (2007) reported statistically significant differences in vegetable and fruit intake between the intervention and control groups (Auld, Romaniello, Heimendinger, Hambidge & Hambidge,1998; Auld, Romaniello, Heimendinger, Hambidge, & Hambidge, 1999; Foerster, Gregson, Beall, et al, 1998; Nicklas, Johnson, Myers, Farris, & Cunningham, 1998; Perry, Sellers, Johnson, Pedersen, Bachman, Parcel, Stone, Luepker, Wu, Nader & Cook, 1998a; Perry, Bishop, Taylor Murray, Mays, Dudovitz, Smyth & Story, 1998b; Reynolds, Franklin, Binkley Raczynski, Harrington, Kirk & Person, 2000). The pooled data reported by Howerton et al found statistically significant effects of the interventions they considered versus the controls at a level of+ 0.45 servings of vegetables and fruit per day. While seemingly a very small increase, the authors concluded that the effect on health could be sizable if these behaviours could be sustained (Howerton et al, 2007). Similar findings have been observed in reports of recently implemented Canadian interventions such as the Annapolis Valley Health Promoting Schools Project (AVHPSP) (Veugelers and Fitzgerald, 2005).

Smaller scale interventions in schools have been shown to be effective in increasing vegetable and fruit consumption in children at the same modest levels described by more elaborate interventions (Stables et al, 2005). However, like their larger scale counterparts, the success of smaller interventions appears to be predicated on elements such as staff training, family and community support and resource allocation, albeit at a much lower level (Stables et al, 2005).

The results of school-based physical activity interventions have been mixed. Some have shown short-term increases in physical activity levels of children; however, very few have demonstrated a sustained effect post-intervention (McKenzie, Nader, Strikmiller, Yang, Stone, Perry, Taylor, Epping, Feldman, Luepker & Kelder, 1996; Tell & Vellar , 1998). These findings do not suggest that school-based physical activity programs are not effective, but rather that issues with research design, measurement and evaluation have made it challenging to draw conclusions from the small amount of data that exists.

Although the data are limited, several researchers have conducted meta-analyses of relevant studies, including:

- Stone, McKenzie, Welk & Booth's (1998) review of 12 Kindergarten to Grade 12 school-based interventions, including many that combined multiple components,
- Kahn et al's (2002) review of 13 recent studies examining the impact of school-based physical education on both physical activity and physical fitness levels in children, and
- Matson-Koffman and colleagues' (2005) review of literature from 1970 to 2003 related to the impact of policy and environmental interventions on physical activity levels and nutritional status in children and youth.

Key findings from these reviews and other relevant literature include the following.

- Most interventions resulted in some improvements in knowledge and attitudes related to physical activity (Stone et al, 1998).
- The impact of interventions on physical activity levels varies. Many of the studies, particularly those focused on elementary school age children, reported mild success in increasing activity levels through modified physical education classes. Some, but not all, of the

studies also showed increases in out-of-school physical activity (Kahn et al, 2002).

- School-based fitness—versus physical activity—programs increase students' levels of fitness (McKenzie et al, 1996)
- School-based physical education appears to be effective in increasing levels of physical activity and improving physical fitness (Matson-Koffman et al, 2005).
- School-based interventions that target physical education classes can positively impact physical activity levels in children (Matson-Koffman et al, 2005).
- Interventions that involve trained PE teachers and those that increase the length of time that students are able to be physically active provide the strongest evidence of influencing these behaviours (Matson-Koffman et al, 2005).
- Parent involvement is a marker of success for interventions targeting healthy eating and physical activity. In Lister-Sharp et al's review (1999), all of the studies of interventions involving parents showed a positive impact on at least one outcome.

Although these findings are useful, Stone et al (1998) and Lister-Sharp et al (1999) both caution that their findings are largely based on self-report measures that may be subject to bias and problems with recall. Stone et al (1998) also note that the collection of school studies is limited for several age groups and that special attention is needed with respect to programming targeted at girls in particular.

The positive outcomes in dietary intake and/or physical activity levels that have been observed in some school-based interventions have not necessarily translated into measurable reductions in obesity risk as assessed by BMI. The degree to which school-based interventions effect positive changes on the BMI of children is equivocal. Findings of some studies support the efficacy of these kinds of interventions in achieving healthy weights in school-age children, while others do not. For example, a systematic review of 64 published works describing 19 distinct interventions conducted by Katz (2009) clearly demonstrated that school-based interventions had significant positive effects on body weight in children ranging in age from 3 to 18 years. This finding is echoed by the work of Veugelers and Fitzgerald (2005) whose study of a sample of 5200 grade 5 students in Nova Scotia found that those who participated in a comprehensive, school-based program exhibited significantly lower rates of overweight and obesity, had healthier diets, and reported more physical activities than students from schools without nutrition programs. Similarly, a review conducted by the American Dietetic Association (2006) found that there is fair evidence to support a role for multiple component (e.g. those that intervene on both eating habits and physical activity levels), school-based programs in producing positive changes in weight status/adiposity in elementary and secondary school students. Moreover, a systematic review conducted by Brown and Summerbell (2009) concluded that although the findings of the 38 studies they considered were inconsistent the overall evidence indicates that combined diet and physical activity school-based interventions may help prevent children becoming overweight in the long term.

In contrast to these findings, a systematic review of twenty studies of school-based interventions to enhance both diet and physical activity levels of children between the ages of 5 and 18 years conducted by Brown, Kelly and Summerbell in 2007 found that less than half (n = 9) produced measurable improvements in BMI over their term. Despite this, these authors concluded that school-based physical activity interventions (physical activity promotion and reduced television viewing) may help children maintain a healthy weight. In a previous review of 22 reports of school-based obesity risk reduction interventions published in 2005, Summerbell et al concluded that community, school or clinic-based interventions which focused on combining dietary and physical activity approaches did not significantly improve BMI in children less than 18 years of age.

The sizeable variation in the design and metrics used to evaluate the efficacy of school-based nutrition and physical activity programs to reduce obesity risk in children has confounded the identification of best practices. Weaknesses in methodology and measurement have contributed to the variability in findings and have made assessing the efficacy of school-based obesity risk reduction interventions challenging. Summerbell et al (2005) note that the studies considered in their review were of limited duration and were largely underpowered and/or poorly designed. Katz (2009) found that the small number of published studies and a marked variation in measures, methods and the populations of the different studies made drawing representative conclusions challenging. Similarly, Kropski, Keckley and Jensen (2008) concluded that at present, there is insufficient evidence to provide strong guidance as to the benefits of school-based obesity risk reduction programs due to the limited number of published studies as well as methodological concerns that limit the validity of and comparability between those identified.

To better understand the outcomes of school-based interventions to reduce obesity risk in children, additional, targeted research is needed. Specifically, Kropski et al (2008) recommend that future work consider the assessment of longer duration (e.g. > 12 months), multidisciplinary interventions which include environmental, physical activity, and educational components and are developmentally appropriate for the sample of children being studied. These authors also argue for the need for better design; enhanced power and control of covariates such as age, gender and socio-economic status; and the use of multiple outcome measures to detect positive effects of the intervention (e.g. BMI plus triceps skin fold measures, waist circumference, % body fat, overweight prevalence, incidence and remissions). In addition, there is also a critical need to assess the long-term sustainability of all school-based interventions that promote changes in eating habits and physical activity levels. No intervention is likely to render practical results unless sustainable over time with the limited resources available to the school and health care systems in Canada.

2.4.3 Theoretical Frameworks in School-Based Obesity Risk Reduction Interventions

Historically, health education in schools has been predicated on the belief that enhancing knowledge about health issues and practices is an effective means to drive people towards positive health behaviours. While a long-standing strategy, research suggests that knowledge acquisition alone has limited impacts on health behaviours and outcomes (Bandura, 1986). According to Bandura (2004), while knowledge of health risks and benefits is a prerequisite for change, psychological or self-influences are also necessary for people to practice new lifestyle behaviours.

Theoretical frameworks provide a means to better understand the relationship between psychology and health behaviours. By acting on the psycho-social determinants of health theory based interventions are more likely to produce desired health outcomes (Glanz, Rimer & Lewis, 2002). By identifying the factors that drive behaviour under specific conditions, researchers and health promotion practitioners can predict and promote desired health behaviours and develop targeted interventions (Glanz et al, 2002). Theory-based health promotion practice also allows for a logical, coherent approach to evaluation and assessment of the outcomes of an intervention (Glanz et al, 2002).

The available data support the implementation of theory-based interventions to reduce the risk of obesity in children. Beckman, Hawley & Bishop, 2006; Daniels, Arnett, Eckel; Gidding, Hayman, Kumanyika, Robinson, Scott, St. Jeor & Williams, 2005; Cole, Waldrop, D'Auria & Garner, 2006; Sharma, 2007). There is a sizeable body of evidence showing that theory-based interventions which act on multiple elements of the school environment can effect positive changes in the eating habits and physical activity patterns of children and youth (Daniels et al, 2005). There is also evidence which directly links theory-based interventions with obesity risk reduction in children. For example, a 2006 systematic review conducted by Cole, Waldrop, D'Auria and Garner (2006) identified 10 recent reports of theory-driven, school-based nutrition and physical activity interventions with demonstrated benefits in terms of weight loss or BMI reduction in children between 4 and 14 years of age.

A number of different theories have been developed to explain the complex psychology which underpins health behaviours. Social Cognitive Theory (SCT) is an example of one such theory that has been widely used in school-based nutrition and physical activity interventions.

SCT is a conceptual model that describes how humans acquire the behaviours they demonstrate. It proposes that individuals learn and adapt their own behaviours largely by observing the behaviours of others and considering the outcomes of these behaviours within a specific environment or situation (Baranowski T, Perry CL, Parcel GS, 2002). According to Bandura (1986) behaviour is the product of an ongoing and reciprocal interplay between the individual and the environment. How an individual interprets the results of their own behaviour informs and alters the environments in which they exist. The environment affects the personal factors the individual possesses which, in turn, inform and alter subsequent behaviours.

Bandura (2004) has identified 10 constructs that mediate the reciprocal relationship between personal factors, behaviour and the environment. These constructs and their meanings are described in Table 2-1.

The construct of self-efficacy, in particular, is a key element of SCT. Self efficacy is the term used to describe an individual's assessment of their ability to successful perform a particular behavior under a given set of environmental conditions and is understood to play a central role in the specific health behaviours that people exhibit (Baranowski, Perry, & Parcel, 2002).

Table 2-1: Constructs of Social Cognitive Theory and their meaning

Construct	Meaning
Environment	Factors physically external to the individual that influence behaviour.
Situation	The individual's unique perception of the environment.
Behavioural capability	The knowledge or skill needed to successfully perform a specific behaviour.
Expectations	The outcome the individual expects to result from demonstrating a specific behaviour. Negative expectations would tend to inhibit an individual from adopting a new behaviour.
Expectancies	The value the individual places on the outcome of a specific behaviour. Positive expectancies tend to promote demonstration of behaviour.
Self-control	Personal regulation of goal-directed behavior or performance
Observational learning	The acquisition of new behaviours that results from observing or watching others.
Reinforcements	Environmental responses to an individual's behaviour. Reinforcements influence the likelihood that a behaviour will be practiced again in the future.
Self-efficacy	The person's confidence in their ability to successfully perform a behaviour, skill or task.
Emotional coping responses	Strategies or tactics that are used by a person to deal with emotional stimuli in their environment associated with behaviour change.

To promote behaviour change, interventions framed on SCT are designed such that specific components of the program act on or operationalize one or more of the constructs of the theory. For example, an intervention which strives to increase vegetable and fruit intake in teens might focus on operationalizing the construct of expectation to promote the desired changes in eating behaviours. Using advertisements which show popular or famous teen age role models enjoying vegetables and fruits to create the expectation that this desirable behaviour.

The relatively large numbers of constructs and the practical challenges associated with operationalizing all of them simultaneously limits the utility of SCT as a framework for health promotion interventions. As a result, many interventions which use this theory as a framework are designed to operationalize a selection of the constructs of SCT only.

Compounding the practical limitations of operationalizing all of the constructs of SCT are issues related to measurement and assessment of reliability. The reliability of SCT's constructs to predict behaviour is predicated on the measures used to assess changes in behaviour. If the measures employed are invalid or weak, the reliability of the SCT construct(s) will be low. Thus, it is essential for practitioners to give careful consideration to choosing measures that are valid and reliable for the SCT construct being challenged.

SCT has been used as the framework for multiple nutrition, physical activity and obesity prevention interventions in schools. For example, a review by Sharma (2006) focusing on school-based interventions designed to prevent childhood and adolescent obesity found that of the eleven studies identified, more than half were based on SCT. Many of the constructs of SCT have also been shown to be significant predictors of vegetable and fruit intake, and physical activity in school-age children (Sharma, 2006; Resnicow, Davis-Hearn, Smith, Baranowski, Lin, Baranawski, Doyle& Wang DT, 1997; Trost, 1997; Barnett, O'Loughlin & Paradis, 2002). These finding argue for the use of SCT as a framework upon which to base nutrition and physical activity interventions targeted at children in schools.

2.5 CONCLUSION

The trend towards overweight and obesity in children poses serious consequences on both an individual and societal level. Left unchecked, the pandemic of childhood obesity has the potential to further increase the already staggering prevalence of type 2 diabetes, heart disease and other chronic diseases. The treatment costs related to addressing these concerns is considered to be significant to the Canadian health care system (Katzmarzyk and Janssen, 2004). Furthermore, predictions of leading experts suggest that "unless effective population-level interventions to reduce obesity are developed, the steady rise in life expectancy observed in the modern era may soon come to an end and the youth of today may, on average, live less healthy and possibly even shorter lives than their parents” (Olshansky, Passaro, Hershow, Layden, Carnes, Brody, Hayflick, Butler, Allison, & Ludwig, 2005).

School-based nutrition and physical activity interventions offer promise in terms of limiting the prevalence of overweight and obesity in children. Children spend significant amounts of time in the school environment and schools offer the infrastructure needed to support health promotion interventions.

Data on the outcomes of small-scale, school-based nutrition and physical activity interventions are limited. However, the data that are available suggest that even relatively modest interventions can influence these behaviours (Stables, Young, Howerton, Yaroch, Kuester, Solera Cobb & Nebeling, 2005).

Finally, there is a dire need for additional research describing best practices in school-based interventions to reduce the risk of obesity in children. To obtain this information, future work must be well designed and structured such that the true efficacy of the intervention(s) can be measured and compared.

CHAPTER THREE:
DESIGN AND METHODOLOGY

3.1 ETHICIAL APPROVAL

Ethical approval for this study was received from the Human Research Ethics Board, Faculty of Agriculture, Forestry and Home Economics, at the University of Alberta (Appendix 1). The study was subsequently approved by the Cooperative Activities Program (CAP) at the Faculty of Education, University of Alberta; the Edmonton Public School Board and the principals at the participating schools.

3.2 DESIGN

This pilot study used a cluster randomized controlled trial (RCT) design to assess the impact of a semi-structured, school-based intervention on the vegetable and fruit intake and physical activity levels of a convenience sample of grade 4 to 6 students at four public schools (Glenora, Abbott, Crestwood and Overlanders) in Edmonton, Alberta between January and May, 2005. These specific schools were chosen based on the willingness of school administrators to participate and on the socio-economic status (SES) of the neighborhood in which they were located.

Neighborhood SES was assessed using data from the 2001 Statistics Canada Federal Census (Statistics Canada, 2002). Specifically, the two schools (Glenora and Crestwood) located in neighborhoods where the average household income exceeded the average household income for the City of Edmonton ($57,360.00) were considered to be the high SES schools. The two schools (Abbott and Overlanders) located in neighborhoods where the average household income was below the average for the City of Edmonton were considered low SES schools.

Students in grades 4 to 6 at the participating schools were eligible to take part in this study. This cohort of students was selected from the broader school population based on evidence from the literature suggesting that children younger than age 9 (approximately grade 4) are unlikely to provide reliable and valid information about their dietary habits and physical activity levels due to age-related limitations in recall and comprehension (McPherson, Hoelscher, Alexander, Scanlon, Serdula, 2000; Reynolds, Johnson, and Silverstein J, 1990). The researchers provided all eligible students at each of the schools with project information sheets and consent forms to take home for their parent(s) or guardian(s) to consider (Appendix 2). Students whose parent(s) or guardian(s) provided written consent were subsequently provided with an age appropriate, written description of the project and an assent form (Appendix 3). To be included in the study, students had to provide written assent and have received written consent from their parent or guardian.

The participating schools were randomized such that two [Glenora School (School #1) and Abbott School (School #2)] received the study intervention, while the remaining two schools [Crestwood School (School #3) and Overlanders School (School #4)] served as controls. The control schools received the intervention the following school year (September to December, 2006) in appreciation for their participation.

The intervention consisted of 3 components:

1. **Pedometers and Tracking Diaries*:*** Pedometers (or step counters) were a key element of the intervention and served two distinct purposes. Primarily, the pedometers were used as a tool to increase participant awareness of the importance of daily physical activity and their own, unique level of activity. The secondary role of the pedometers was as a tool to capture data related to the physical activity levels of the intervention group. To reinforce the established unity and a sense of community, all students, administrative staff and teachers in the intervention schools received pedometers (step counters) to count the number of steps they took each day during the intervention. However, only data collected from eligible participants was subsequently analyzed and reported in the study results. Tracking diaries (Appendix 4) were provided to everyone at the intervention schools and were used to create a written record of each participant's daily step count. The tracking diaries were also used to record daily vegetable and fruit intake. The researchers provided the students, administrative staff and teachers with training on the use of pedometers and the tracking diaries. Participants were advised to record both the number of steps they took and the number of vegetable and fruit

servings they consumed on a daily basis for the duration of the study. Supplemental information on how to use a pedometer as well as guidelines for recording daily steps and vegetable and fruit intake was provided in the tracking diaries.

2. **School Newsletter Content**: To promote self-efficacy for vegetable and fruit intake and physical activity, the researchers provided the schools with relevant content for inclusion in their monthly newsletters (Appendix 5). The content that was provided focused on simple, practical strategies to promote vegetable and fruit intake and physical activity in school-age children. The content also provided parents, guardians and others with information on the study itself.
3. **Enhanced activities*.*** Three days per week (Monday, Wednesday and Friday), during the schools' lunch period, senior undergraduate students and graduate students from the Faculty of Agriculture, Forestry and Home Economics and the Faculty of Physical Education led 30 minute nutrition and physical activity games, experiences, and education. The students, who volunteered their time to the project, were all knowledgeable about nutrition and/or physical education. The activities selected for use in the program included loosely structured, common Canadian playground games (e.g. tag, dodge ball, and soccer) and informal nutrition education.

Insomuch as possible, the enhanced activities reinforced the school newsletter content provided by the researchers.

Prior to the start of the intervention, all research staff was provided with an orientation to the study and its methodology, information on their respective responsibilities, and strategies for managing large groups of elementary school students. Principals from the intervention schools also provided guidance on interacting with elementary school children. The information provided during training was reinforced through regular meetings of the research team.

3.3 METHODOLOGY

To measure the impact of the intervention on vegetable and fruit intake and physical activity levels of grade 4 to 6 students, data were collected a two points in time (pre-test and post-test). Specifically, data describing the vegetable and fruit intake, physical activity levels, and anthropometric characteristics of the participants were collected at both the intervention and the control schools prior to the start of the intervention. Similar data were collected five months later at the end of the end of the intervention. Once collected, data was entered into Microsoft Excel 2000 (Microsoft Corporation, Redmond, WA, 2000).

Satisfaction with the implementation of this semi-structured, school-based intervention (OSAATP) to increase vegetable and fruit intake and physical activity levels in grade 4 to 6 students was assessed through narrative descriptions or accounts collected in a variety of forms (e.g. written comments, letters, notes, team member journal entries and cards).

3.3.1. <u>Assessment of Vegetable and Fruit Intake</u>

Two methods were used to assess vegetable and fruit intake: 1) Twenty-four hour dietary recall and, 2) Three day, self-report of vegetable and fruit intake.

3.3.1. a. <u>Twenty Four Hour Dietary Recall</u>

One standard 24-hour dietary recall for a weekday was obtained from each participant at both pre and post-testing. Each participant was interviewed on a one-on-one basis by a trained interviewer. The interviewer explained the purpose and process of the 24-hour recall to the participant prior to starting the recall. The participants were advised that there they were to provide a detailed recall of what they ate on the preceding day. They were assured that there were no “right or wrong” responses and that any information that they provided would be kept confidential.

A logical, sequential process was used by the interviewers to guide the recall process. The participants were asked to recall what they had eaten on the previous day starting with breakfast. Three dimensional, life-like food models were used by the interviewers to cue the participants to more accurately recall the types of foods that they consumed and the relative portions that they consumed. Where possible, food brand and/or restaurant names were obtained from the participants. In addition, the interviewers probed the participants about where they were when eating and who they shared the food with (e.g. friend, family member, team-mate). Multiple passes were used to obtain the greatest depth of information possible. Prior to closing the interview, the interviewer reviewed the recall with the participant to ensure that nothing was omitted.

Data obtained from the 24-hour dietary recalls were analyzed by a well trained, highly experienced Registered Dietitian (HMB) familiar with the eating habits and patterns of children. The Dietitian reviewed each recall and using the portion sizes described by *Canada's Food Guide to Healthy Eating* (1992) manually calculated the number of servings of vegetables and fruit consumed by the participant.

3.3.1. b. <u>Three Day Self –Report of Vegetable and Fruit Intake</u>

To assess average (mean) daily intake of vegetables and fruit, participants were asked to complete a 3 day, written, self-report. Three consecutive days, including 1 weekend day, were assessed at each point. The participants were provided with detailed instruction describing the amount of food that constitutes a serving of vegetables and fruit using practical examples. Written information on recording vegetable and fruit intake was also provided to parent(s) and guardian(s). Participants recorded their intake using either a 3 day tracking sheet provided to the participants by the researchers or in their tracking diary. Data reported on the 3 day tracking sheet or in the participant's tracking diary was reviewed by an experienced Registered Dietitian (HMB) to ensure that the reported number of servings of vegetables and fruit had been accurately tallied.

3.3.2 ***Assessment of Physical Activity Level***

Two methods were used to assess the physical activity levels of the study participants: 1) Physical Activity Questionnaire for Children (PAQ-C) and, 2) Three Day Self Report of Steps Taken per Day.

3.3.2. a ***Physical Activity Questionnaire for Children (PAQ-C)***

The study participant's leisure-time physical activity was determined using the Physical Activity Questionnaire for Children (PAQ-C). The PAQ-C is a seven day self-report questionnaire designed to assess daily activity in the moderate to vigorous range. Overall or composite physical activity scores were calculated as an average physical activity score (PA score) in a continuous range from 1 (low active) to 5 (high active). Participants scoring less than 3 were considered to be inactive.

Using the methodology described by Kowalski, Crocker and Faulkner (1997), the PAQ-C was self-administered by the study participants. A trained dietetic intern provided the participants with an explanation of the purpose and process of completing the PAQ-C before asking them to begin. The intern was available to answer questions and generally assist the participants as they completed the PAQ-C. PAQ-C responses were numerically coded by question and an overall PAQ-C score was calculated for each participant.

3.3.2. b ***Three Day Self Report of Steps Taken per Day***

Data were collected to assess the average (mean) number of steps per day taken by each participant. The Yamex Digi-Walker DW-200 pedometer (Tokyo, Japan) was used to measure steps. The participants were provided with detailed instruction on the use, positioning and care of the pedometer. They were subsequently asked to track and record the number of steps they took per day over a 3 day period using either a 3 day tracking sheet provided by the researchers or in their tracking diary. The importance of accurately recording the pedometer data during the recording periods was reinforced by the research team. Using a similar approach to that employed to assess vegetable and fruit intake, 3 consecutive days, including 1 weekend day, were assessed at each point. During the self-report period, the participants recorded the number of steps that they took daily between rising in the morning and retiring at night.

Self-reported step count records were returned and revised by a research team member (HMB) prior to statistical analysis.

3.3.3 Anthropometric Measures

Pre-test and post-test measurements of height, weight and Body Mass Index (BMI) were obtained from the study participants. The participants were weighed in a private room or screened area within the testing site. They were in minimal indoor clothing without shoes.

Weight was measured using a portable medical scale (SECA, Hanover, MD) and recorded to the nearest kilogram (kg).

Height was measured to the nearest 0.1 centimetre (cm) using a set square placed against a fixed wall.

BMI was manually calculated from the child's height and weight using the following formula:

$$\text{BMI} = \text{weight (kg)}/\text{height (m}^2\text{)}$$

BMI values were rounded to the nearest 0.1 $kg \cdot m^2$.

Estimates of the prevalence of overweight and obesity were calculated using the CDC method. Specifically, calculated BMI values were classified using the CDC BMI-for-age weight status categories and percentile ranges (Kuczmarski et al, 2000).

3.3.4 Narrative Accounts of the Intervention Experience

Qualitative data about satisfaction with this pilot of a semi-structured, school-based intervention to increase vegetable and fruit intake and physical activity level were collected over the five month term of the project (January to May 2005). As a result, the findings are based on an analysis of data collected at different junctures over the pilot period and do not reflect a pre/post assessment of satisfaction.

The assessment of satisfaction with the intervention focused on identifying the elements of the intervention's design that were perceived by the stakeholders (study participants, school staff, parents and the research team) as positive supports for increases in vegetable and fruit intake and physical activity in grade 4 to 6 students in order to inform future school-based programming.

Data were collected from multiple sources to promote data triangulation. Denzin (1978) defines triangulation as the use of a variety of sources of data in a study to combine strengths and correct the deficiencies inherent in using any one source of data. Assessing narrative accounts from all of the intervention's stakeholders allowed for triangulation thereby increasing the validity and credibility of the findings.

Data related to perceived satisfaction with the intervention was both informally and formally solicited throughout the duration of the intervention.

Research on the use of qualitative methods in evaluation supports the value of allowing study participants to share their experiences in their own vernacular and in forms that reflect typical communication (Patton, 1987). Recognizing this, study participants, school staff, and parents were informally but consistently encouraged to share written accounts of their experiences, in any form deemed acceptable to them including letters, notes, cards, posters, and E-mail messages. These submissions were voluntarily supplied by these stakeholders and were in no way a requirement related to participation in the intervention. To best capture the true essence of the accounts, submissions in the normal language of the contributor, grammatically correct or not, were welcomed.

The experiences of research team members were more formally documented in field journals. Training on the use of the field diary was provided to team members prior to the start of the Intervention. Specifically, team members were asked to describe, in detail, their daily interactions with the study participants as well as their perceptions on the functionality of the intervention's design in the school setting using a structured field diary.

3.4 DATA ANALYSIS

Quantitative data were analyzed using the Statistical Package for the Social Sciences (SPSS) (Version 17.0, SPSS Inc, Chicago, IL, 2008). All data were transferred to SPSS files from a Microsoft Excel 2000 (Microsoft Corporation, Redmond, WA, 2000).

Descriptive statistics (e.g. means, standard deviations, frequencies, skewness and kurtosis) were computed for all variables both pre and post-test in order to describe the characteristics of the study population, understand the nature of the data, and to ensure that the distributions met the assumptions of the statistical tests being used.

One way analysis of variance (ANOVA) was used to determine if there were significant differences between conditions (control and intervention) at pre versus post-test. Repeated measures analysis of variance (RM-ANOVA) was used to determine if there were significant main and interaction effects on the variables between conditions over time. Chi-square tests for independence were used to assess differences in categorical variables. Differences were considered significant at $p<0.05$.

Thematic analysis of qualitative data such as narrative accounts can take several forms (Riley and Hawe, 2005). In this pilot study qualitative data collected in the narrative accounts were reviewed by one member of the research team (HMB) who, using an iterative process identified reoccurring themes (Glaser, 1992). Specifically, rather than relying on pre-conceived themes or categories, HMB reviewed the data to identify recurrent themes or issues. In this way, relevant themes were allowed to emerge.

Categorization of the data was based on the overall impression and the reading and re-reading of the narrative accounts and field journals to identify semantic relationships and emerging themes. Data about both the positive and negative aspects of the intervention were included. Consistency of responses and the context of similar statements in each group and across groups were noted. Codes were subsequently assigned to each idea, comment or response in order to allow for categorization of the data by theme. Where possible, code assignment was verified through discussion with the respondent (e.g. accounts with names attached to them obtained from research team members and school staff)

The relative importance of each theme was assessed by translating the qualitative responses into quantifiable terms. Themes identified through the qualitative data analysis process were ranked by frequency of report. The number of responses related to any one theme was compared to the overall number of responses to create a percentage. Final rankings of the themes were based on this percentage value.

CHAPTER FOUR:
RESULTS

4.1 PARTICIPANT RECRUITMENT AND SAMPLE CHARACTERISTICS

All students (n=356) in grades 4 to 6 at the four schools (2 intervention; 2 controls) were eligible to participate in the study. Consent and assent forms were returned for 225 students; 136 from the two intervention schools plus 89 from the two control schools giving an overall participation rate of 63% for all of the four schools. Students from the intervention and control schools comprised 60.5% and 39.5 % of the total sample respectively.

Student absenteeism, the movement of students from the schools during the duration of the study, and non-compliance in record keeping created an imbalance within the study design. Unbalanced designs introduce confounding factors into the ANOVA which, in turn, make assessment of effects challenging. The tests of main effects and interactions are no longer orthogonal and, as a result, are not independent of each other, therein violating the assumptions of the ANOVA calculations.

The lack of balance observed within this study was addressed by removing unbalanced data prior to the ANOVA analysis. Specifically, data from students who did not complete the 24 hour dietary recalls, the 3 day record of vegetable and fruit intake, the PAQ-C, or the 3 day record of steps/day at both pre and post test, were removed from the respective samples for these analyses.

Figure 4-1 summarizes the number of students who participated in each measure (both pre and post-test) as well as the number of responses that were ultimately included in the data analysis.

Of the 225 students enrolled in the study, 17 (10 from the intervention group, 7 controls) dropped out due to movement out of the schools or absenteeism on the testing dates, thereby reducing the sample able to contribute both pre and post test measures to 208 children.

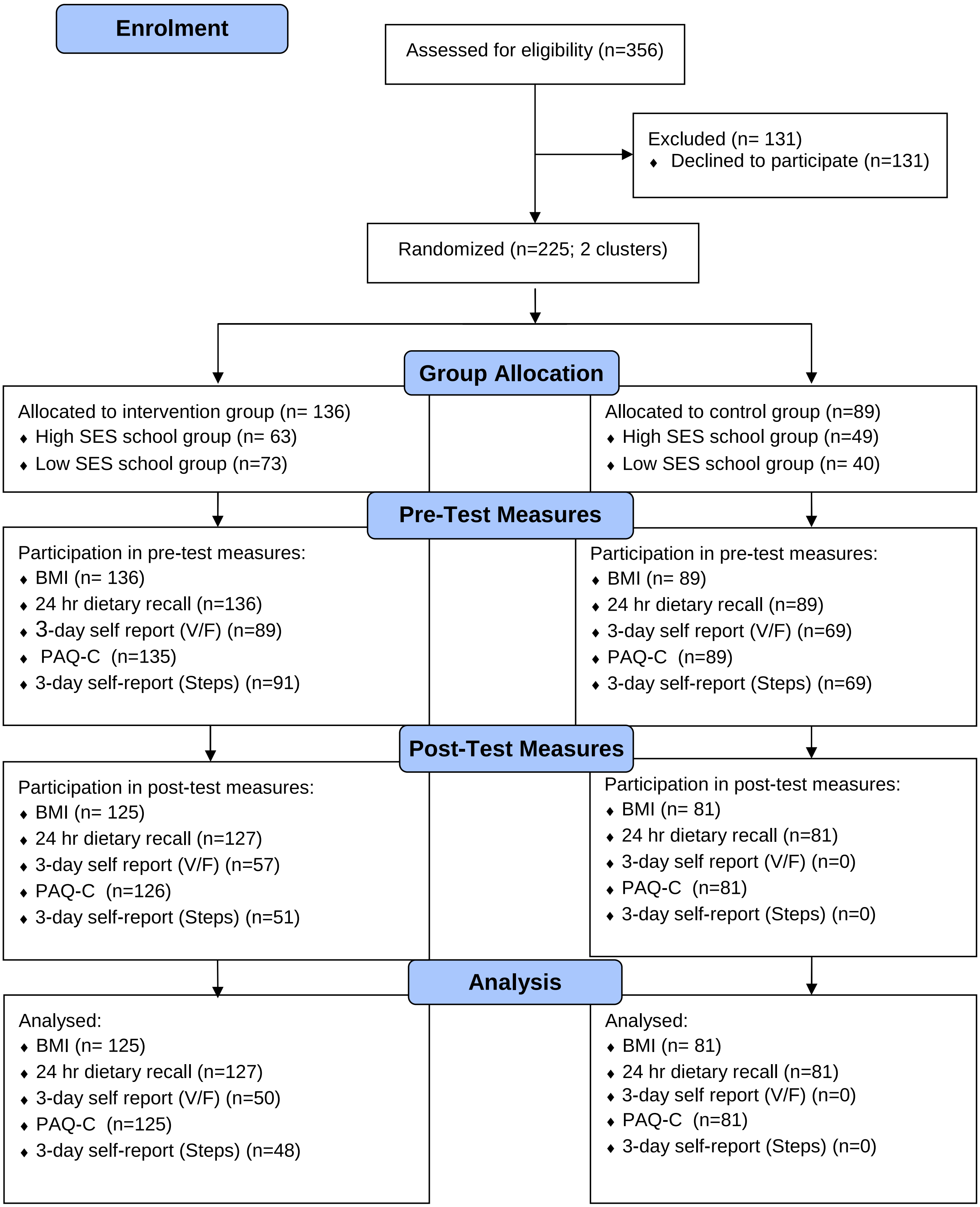
Incomplete anthropometric data necessary to calculate BMI was collected from 2 students are post-test. These data were subsequently removed from the analysis of BMI.

Twenty-four hour dietary recall records were collected from all 208 students who remained in the sample at post-test and all were included in the statistical analysis of this measure.

Data from a total of 206 students was considered in the analysis of the PAQ-C scores. While 207 post-test PAQ-C records were received, 1 was removed from the data analysis as the student has not provided corresponding pre-test data.

Three day, self-reports of vegetable and fruit intake and steps taken per day were received from a total of 158 and 160 students respectively at pre-test. Of the vegetable and fruit intake records, 47 came from students at the intervention schools, and 20 from students at

Figure 4-1: Flow diagram of participant involvement in the OSTPP



the control schools. Self-reports of the number of steps taken per day over the 3-day recording period were received from 45 students at the intervention school and 20 at the control school. It is important to note that similar records were not collected from the control schools at post test. As a result, between group comparisons on these measures were not undertaken and only the within subjects effects over time were analyzed and reported.

Fifty-seven students provided 3 day, self-reported records of vegetable and fruit intake both pre and post intervention. However, 7 of these records were found to be incomplete and were subsequently removed from the data set which ultimately consisted of a total of 50 records.

Fifty-one students provided 3 day, self-reports of the number of steps they took. As was the case with the self-reports of vegetable and fruit intake, several of the records were found to be incomplete and were removed from the data set. In total, 48, 3-day self reports of steps/day were considered in the statistical analysis.

4.2 PARTICIPANT CHARACTERISTICS

Participant characteristics at baseline are described in Table 4-1. A one-way between groups ANOVA was conducted to assess any differences in the students by condition prior to the launch of the intervention. Statistically significant differences at the $p < 0.05$ level in age

Table 4-1: Participant characteristics measured at Baseline (T1)

	Intervention	**Control**
n	136	89
Female	69 (51%)	51 (57%)
Male	67 (49%)	38 (43%)
Age (years)	9.8 ± 0.9	10.2 ± 1.0[*a]
BMI (kg·m^2)	19.5 ± 4.3	18.8 ± 4.0

[*a] intervention<control (F: 9.024, $p<0.003$)

[F (1,223) = 9.024, p=0.003] and height [F (1,223) = 6.922, p=0.009] were observed between the two groups, with the control group being older and taller. The groups were similar with respect to weight and BMI.

4.3 ASSESSMENT OF VEGETABLE AND FRUIT INTAKE

4.3.1 24 Hour Dietary Recall

There was no significant interaction between condition (control versus intervention) and time [Wilks' Lambda = 1.00, F (1,206) = 0.05, p=0.82, partial eta squared = <0.001] (Table 4-2).

No significant main effect of time was observed although vegetable and fruit intakes did increase marginally in the entire sample of students over the course of the study [Wilks' Lambda = 1.00; F (1,206) = 0.85, p=0.36, partial eta squared = 0.004].

The main effect comparing the two conditions (control versus intervention) was not significant [F (1,206) = 1.11, p=.294, partial eta squared = 0.01], suggesting that the conditions produced similar effects on vegetable and fruit intake.

4.3.2 Three Day Self –Report of Vegetable and Fruit Intake

A one-way repeated measures ANOVA was conducted to compare 3 day self-reports of vegetable and fruit intake (for the overall sample) at pre-test (T1) and post-test (T2) (Table 4-2). The means and standard deviations are presented in Table 4-2. The data suggest that statistically significant changes in vegetable and fruit intake occurred between T1 and

Table 4-2: Effects for vegetable and fruit intake measured by 24 hour dietary recall and 3 day self report

Dependent Variable	Condition	Baseline (T1) (Mean ± SD)	Post-Test (T2) (Mean ± SD)	Change	Effect
24 hour dietary recall of vegetable and fruit intake (Servings/day)[a]	Intervention (N = 127)	4.4 ± 2.8	4.6 ± 3.2	+0.2	Time[b]
	Control (N=81)	4.0 ± 2.7	4.3 ± 3.6	+0.3	Time[b]
3 day self report of vegetable and fruit intake (Servings/day)[a]	Intervention Only (N = 50)	4.3 ± 2.0	5.1 ± 2.1	+0.8	Time[c]

[a] Serving sizes as described by *Canada's Food Guide to Healthy Eating*
[b] Significant main effect for time for both conditions (F (1,206) = 540.171, p=<0.001)
[c] Significant effect for time (F (1, 49) = 8.53, p=0.005)

T2 [Wilks' Lambda = .0.85; F (1, 49) = 8.53, p=0.005, partial eta squared =0.148].

4.3.3 ***Congruence Between Reported Vegetable and Fruit Intake and the Recommendations of Canada's Food Guide to Healthy Eating***

Canada's Food Guide to Healthy Eating (1992) recommends that children between the ages of 6 and 12 years should consume between 5 to 10 servings of vegetables and fruit each day. Twenty-four hour recall data for the overall sample of children (control + intervention) who participated in the OSAATPP found that vegetable and fruit intake at pre-test averaged 4.3 servings/day (SD = ±2.8), while reported post-test vegetable and fruit intakes averaged 4.5 servings/day (SD = ± 3.3) (Table 4-2). Median vegetable and fruit intake across the entire sample of children at both baseline and post-test was 4.0 servings/day.

4.4 ASSESSMENT OF PHYSICAL ACTIVITY LEVELS

4.4.1 ***Physical Activity Questionnaire for Older Children (PAQ-C)***

No significant interaction was observed between condition (control versus intervention) and time [Wilks' Lambda = 0.99, F (1,200) = 1.79, p=.183, partial eta squared = 0.009] or between grade level and time [Wilks' Lambda = 0.98, F (1,200) = 2.54, p=0.82, partial eta squared = 0.25) (Table 4-3).

There was a substantial main effect for time [Wilks' Lambda = 0.80, F (1,200) = 47.84, p=<0.001, partial eta squared = 0.20], with both groups

Table 4-3: Effects for physical activity levels measured by overall PAQ-C scores and 3 day self report of steps taken per day

Dependent Variable	**Condition**	**Baseline (T1) (Mean ± SD)**	**Post-Test (T2) (Mean ± SD)**	**Change**	**Effect**
Overall PAQ-C Score	Intervention (N = 81)	3.05 ± 0.71	3.47 ± 0.77	+0.42	Time[a]
	Control (N = 125)	3.18 ± 0.68	3.48 ± 0.77	+0.30	Time[a]
3 day self report of steps taken per day	Intervention Only (N = 48)	12066 ± 4624	17300 ± 8969	+5324	Time[b]

[a] Significant main effect for time (F (1,204) = 51.42, p=<0.001)
[b] Significant effect for time (F (1, 47) = 17.02, p=<0.001)

(control and intervention) showing an increase in reported physical activity levels across the duration of the study. This effect appeared to be driven by significant differences in post-test PAC-Q scores observed in the grade 5 students. One-way ANOVA of between group effects of PAQ-C scores by grade level were significant [F (2,204) = 6.917, p=0.001, partial eta squared = 0.64]. Post-hoc multiple comparisons found that mean post-test PAQ-C scores for grade 5 students [M = 3.73, SD = 0.71] were significantly different from the grade 4 students [M= 3.25, SD = 0.85]. Post-test PAQ-C scores for grade 6 students [M = 3.44, SD = 0.65] did not differ significantly from those of students at either of the other grade levels. The main effect comparing the influence of the two conditions (control versus intervention) on physical activity levels was not significant [F (1,204) = 0.59, p=0.44, partial eta squared = 0.003].

*4.4.2 **Three Day Self-Report of Steps Taken per Day***

A one-way repeated measures ANOVA was conducted to compare 3 day self-reports of steps taken per day (as measured by the Yamex Digi-Walker Pedometer) at pre-test (T1) and post-test (T2). The means and standard deviations are presented in Table 4-3. A significant effect for time was observed, with reported steps taken per day increasing over the course of the study [Wilks' Lambda = .0.73; F (1, 47) = 17.02, p=<0.001, multivariate partial eta squared = 0.266].

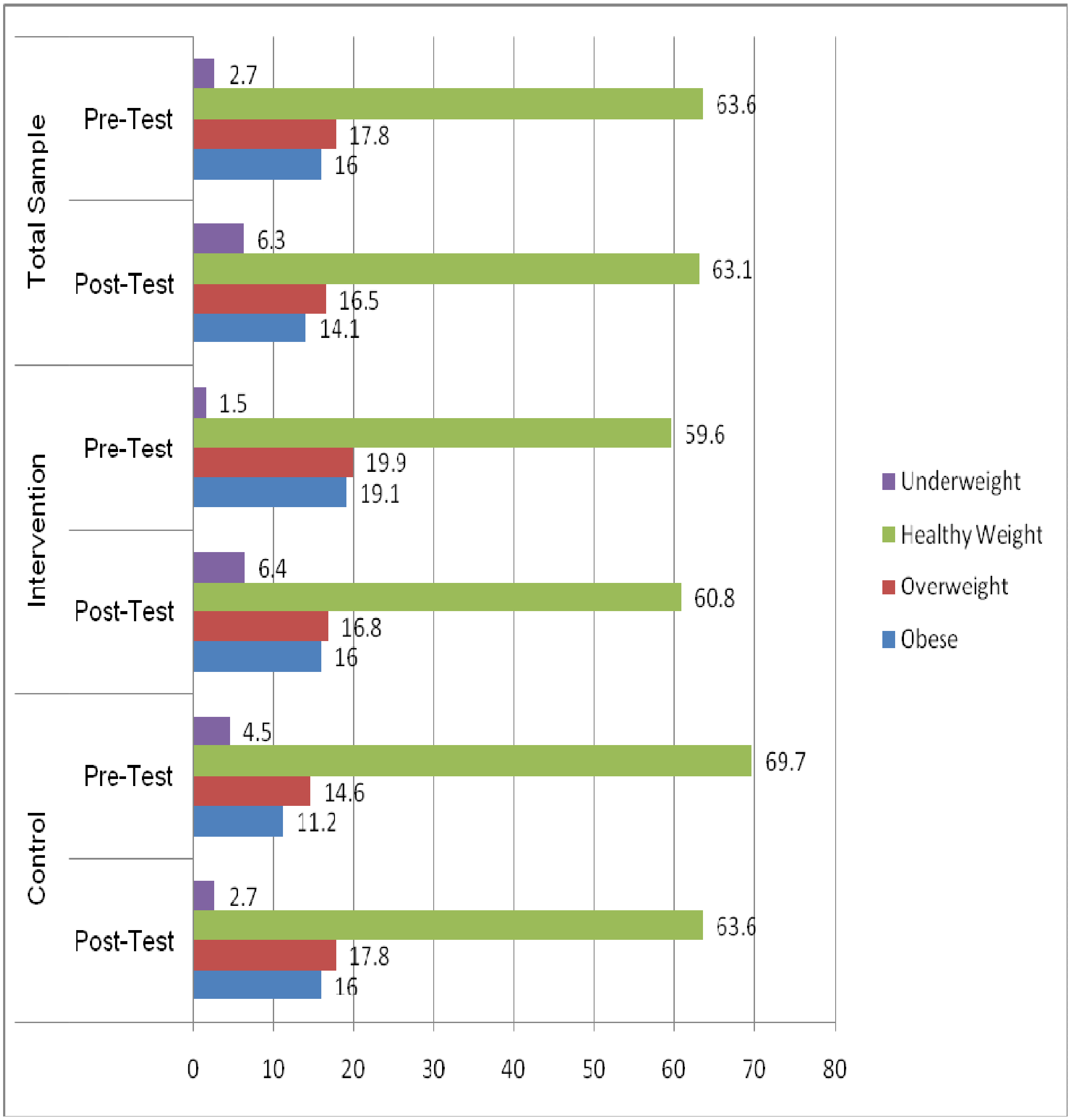
4.3.3 ***Prevalence of Physical Inactivity Based on Overall PAC-Q Score***

Overall PAQ-C scores serve as a measure of the physical activity levels of children. Scores of < 3.0 are considered to be indicative of physical inactivity. Mean overall PAQ-C scores for the entire sample of students who participated in this pilot study at pre and post test were 3.10 ± 0.70 and 3.48 ± 0.77 respectively (Table 4-3). The median overall PAQ-C score across the entire sample of children at baseline was 3.1, while at post-test the median overall PAQ-C score was 3.6.

4.5 PREVALANCE OF OVERWEIGHT AND OBESITY

BMI data are presented in Figure 4-2. Using the CDC method to classify BMI, 17.8% (n=40) of the overall sample of students (n=225) were classified as overweight (age and gender specific BMI from the 85th but less than the 95th percentile) while 16.0% (n=36) were classified as being obese (age and gender specific BMI equal to or greater than the 95th percentile) at pre-test. Post-test, the overall prevalence of overweight (intervention + controls) was 16.5% (n=34/206) while the overall prevalence of obesity was 14.1% (n=29/206). A Chi-square test for independence indicated no significant association between groups (control versus intervention) and the prevalence of overweight and obesity at either baseline or post-test.

Figure 4-1: Prevalence of overweight and obesity (%) by BMI for age and gender[1] at pre and post test



[1] BMI classified using the CDC method

4.6 NARRATIVE ACCOUNTS OF THE INTERVENTION EXPERIENCE

4.6.1 ***Team Member Field Journals***

The contribution of the research team to the implementation of this intervention was sizable. Relatively large numbers of undergraduate and graduate students were needed to support the delivery of the program's Enhanced Activity Sessions. Table 4-5 provides an overview of the volunteer contribution (in hours) to the delivery of the Enhanced Activities by school on a day-to-day basis. In total, undergraduate and graduate students contributed a total of 840 hours of time to the delivery of this element of the project.

Seven members from the two research teams based at the intervention schools provided field journals containing narrative accounts of their experiences.

4.6.1.a ***Participation in Enhanced Activities***

Estimates from the research team members suggest that an average of 31± 10 children at each of two intervention schools participated in the Enhanced Activity Sessions offered during the lunch hour break, 3 times each week (Table 4-4). Based on a total of 136 children in intervention group (at both schools combined) this gives a participation rate of approximately 46%. Significant variation in the number of children

Table 4-4: Contribution (in hours) of the research team volunteers to the delivery of the Enhanced Activity Sessions

	School #1	School #2
Student participation (per day) ($\bar{x}$)	22	38
Research team member participation (per day) ($\bar{x}$)	3 (Range: 2-4)	4 (Range 3-6)
Total Time Contributed by Research Team Volunteers (hours) ($\bar{x}$)[1]	360	480

[1] Time contribution is based on an average contribution of 2 hours/day X 3 days/week X 20 weeks.

participating in the Enhanced Activity Sessions was observed in both intervention schools, ranging from a low of 13 students to a high of 56 students between grades 1 to 6.

4.6.1.b <u>Themes Arising from the Field Journals</u>

Five themes were identified through the analysis of the student narratives. A summary of the key themes arising from the student narratives can be found in Table 4-5:

The influence of the weather on the intervention. Forty two observations related to the influence of weather conditions on participation in and/or the perceived success of the Enhanced Activities in the Field Journals. Cold or wet weather was identified as a deterrent to participation by the students. In addition, the team members found leading activities challenging when the weather conditions were poor as both they and the children struggled to stay clean, warm and dry. As one team member observed, "*It was a really warm, but windy day out. The warm weather made the field really bad to play on; there were pools of water, slushy snow and a lot of mud. It made it very hard to play."*

Behaviour management challenges. *"The most difficult part of leading the games is when the kids fight about cheating and cry!"* Thirty five

Table 4-5: Summary – Themes arising from the field experience journals[a]

Field Experience Journals		
Theme	**Number of occurrences**	**Illustrative comment/quote**
Influence of the weather	42	*"The weather was awful today. It was huge snowflakes that melted when they touched you so everyone got really wet. This was probably why we had such a small group today."*
Behaviour management challenges	35	*"Unfortunately, the girl that was closest to winning cried when the bell rang and wanted the kids to keep playing until she won. However, all the kids started to head back inside. She started to cry and was really upset"*
Implement simple games with simple rules	29	*"The kids had lots of energy today. Toilet tag was a great game to play because it involves a lot of running!"*
Divide to multiply the fun	14	*"We should have split up the kids at the beginning; it was really confusing for the kids. Elbow tag did not go well with the younger kids. I think this game was too fast-paced for this age group and about half the group cheated."*
Managing "come and go " play	11	*"Many children come to join us after they get back from going home to lunch. This is too bad because we are in the middle of the game and they come back at different times and it becomes difficult to get late joining children the rules of the game that we are playing."*
Anticipating safety issues	7	*"The hand hockey was a little rough only because the boys would slide and then because they were on the ground they would get stepped on or hit accidently."*
Working with the facility	7	*"The gym is very small and therefore, we were limited as to what games could be played with the amount of kids that participated."*
Show and tell with food	2	*"Lots of the kids had never seen a mango before. It was really interesting to watch them touch and smell the fruit we brought."*

[a] Based on 7 field experience journals submitted by research team members

observations were made by the research team members concerning the challenges encountered in managing the student's behaviour during game play. Reports of the students arguing about game rules; cheating; crying or ignoring instructions were voiced in multiple ways from all of the team members. In these accounts the team members expressed frustration with their inability to effectively manage these childhood behaviours.

Implement simple games with simple rules. Simple games with simple rules, that a majority of school-age children are familiar with was identified as the key to the success of the Enhanced Activity Sessions in 29 observations. The journals indicated that while initially novel or elaborate games were planned by the teams, over time these plans were set aside in favour of games that took less time to explain. As one team member noted, *"it was a lot easier as we played games that they already knew and didn't have to hold their attention while explaining the games."* Examples of games deemed to be easily implemented include: Skittles (a game similar to lawn bowling), tag (with multiple variations), dodge ball, skipping (for girls), soccer, and Capture the Flag (a team-based game which involves "stealing" a flag or marker from the opposing side).

Divide to multiply the fun. Fourteen observations spoke to the importance of dividing the younger (grades 1-3) and older (grades 4-6) students into two groups in order to make the Enhanced Activity Sessions enjoyable by all. The physical size and condition of the older students, coupled with a greater understanding of a larger variety of games relative to the younger students made leading activities for the whole group of students difficult to manage. Team member observations also identified differences in game preference between the two groups, with older students preferring more rule-governed, structured games such as soccer and younger students gravitating towards more simplistic games like tag.

Dividing the children into two groups by age for discussions around nutrition education was also identified as a means to increase participation, understanding and enjoyment. One team member observed, *"we may have to alter the way we teach the nutrition discussions depending on the type of group we have."*

Managing "come and go" play. The Enhanced Activity Sessions were not mandatory and, as a result, student participation was dynamic, both on a daily basis and within the sessions themselves. Eleven observations described the challenges of managing "come and go" play where students initially joined in the game and then left as their interest waned or, conversely, students arrived to join in a game that was already in progress. This presented challenges in terms of organizing the games, particularly if structured rules or team play was involved. As one observer commented, "*Once again many children came to join us after they came back from eating at home. Makes it difficult for continuous play because we had to stop the game and make new teams."*

Anticipating safety issues. Seven observations from team members expressed concerns related to the safe implementation of some activities.

Games such as dodge ball and hockey that were well accepted by the students and perceived as offering physical activity benefits were also identified as being of concern in terms of their safety. *"The hand hockey was a little rough only because the boys would slide and then because they were on the ground they would get stepped on or hit accidently."* Several observations described minor injuries to students during the course of game play. These situations were of concern to the team members who expressed discomfort with their inability to proactively anticipate safely issues.

Working with the facility. Throughout the intervention, the team members utilized the school facilities (e.g. playground areas and gymnasium) and equipment (e.g. cones, balls, hoops, nets). Seven observations identified challenges related to lack of space for safe and fun play, or lack of appropriate equipment. During inclement weather when the Enhanced Activity Sessions were held in the school gymnasiums, these sessions were identified as being particularly problematic due to a lack of space for free movement. In describing this kind of situation, one team member wrote, *"It was a little too small of a gym to have that many energetic kids!"* Similarly, lack of equipment was also voiced as a concern by team members. "*One major problem is that the school only has one large skipping rope, more would be better."*

***Show and Tell with Food*.** The use of real foods as props and/or food samples during discussions around vegetables and fruits was identified as a key strategy for increasing the interest of the children in the informal nutrition education sessions in six observations.   Team members' accounts also suggested that providing the children with factual information about the origins and uses of the vegetable or fruits being discussed also enhanced their interest.

4.6.2 <u>Student Narratives</u>

A total of 61 narrative accounts in the form of letters, cards and notes were received from students at the two intervention schools. Some of these accounts were undertaken as classroom projects where teachers encouraged the students to write a narrative in their own words to the team members. Others reflected individual submissions offered to team members over the course of the intervention.

4.6.2.a <u>Themes Arising from the Student Narratives</u>

Five themes were identified through the analysis of the student narratives. A summary of the key themes arising from the student narratives can be found in Table 4-6:

We had fun! More than half of the student observations (n=33) expressed their enjoyment with the intervention's Enhanced Activity Sessions. In the words of one student, *"Our lunch time used to be boring because there was nothing to do, but now it is very, very fun!"* Many of the students described their interest in continuing to participate in the kinds of games lead by the research team because they were fun, a construct related to physical activity that seemed to challenge their existing beliefs.

Table 4-6: Summary – Themes arising from the student narratives[a]

Field Experience Journals		
Theme	**Number of occurrences**	**Illustrative comment/quote**
We had fun!	33	*"We had a blast when you guys were here!"*
Increased awareness of healthy lifestyle benefits	20	*"When I did this [the Enhanced Activity Sessions] I looked better, felt better and I think better too."*
Value for the camaraderie that developed with the research team	12	*"We will miss you a lot. I really liked the jumping jacks. Please come back. Can we do the jumping jacks again?"*
Enjoyment of vegetables and fruit	11	*"I told my mom I want to have strawberries like at school!"*
The merits of pedometers	7	*"I love my pedometer. I wear it every day!"*

[a] Based on 61 narrative accounts received from students

As one student wrote, *"This project helps us kids get in shape. We haven't thought like this befor [sic]. We had a blast when you guys were here!"*

Increased awareness of healthy lifestyle strategies. Twenty student observations described a positive impact of the intervention on their awareness and/or adoption of healthy lifestyle strategies including physical activity and vegetable and fruit consumption. *"It was so healthy for your body I did not now [sic] so I am eating fruit and vegetables."* These impacts were described in both general *(e.g. "You helped us learn to be more healthy*.") and specific terms *(e.g. "Thank you for tracking our steps and the exercise games. It's really good for my diabetes.").* Several students identified health benefits outside of physical health, including cognitive performance. As one student noted, *"When I did this [the Enhanced Activity Sessions] I looked better, felt better and I think better too."*

Value for the Camaraderie that Developed with the Research Team. The relationship that developed between the Research Team members and the students was positively described in 12 observations made by students. The students expressed feelings of gratitude for the contributions made to them by the Team Members ("It was really cool that you helped us in everything!"). Several observations also described feelings of sadness that the "*activity ladies*" were leaving and hope that the Team would return in the future. *"We will miss you a lot. I really liked the* *jumping jacks. Please come back. Can we do the jumping jacks again?"* Similarly, a 6 year old who faithfully attended every activity session commented*, "Do you know why I keep coming back? Because your games are the most awesomest [sic]. You guys are so much fun and so cool!"*

Enjoyment of Vegetables and Fruit. Eleven student observations described their enjoyment of the vegetables and fruits served by the Team on occasion as snacks or taste samples. Strawberries were mentioned by name as being particularly well accepted in half of these accounts (n = 6). Taste enjoyment and the informal nutrition education provided by the Team were cited by some of the students as having a positive influence on their plans to choose vegetables and fruit into the future. "*You inspired me to eat more fruit and vegetables more often. Especially the activity ladies and how they told us vitamins we need in our bodies."*

The Merits of Pedometers. The pedometers provided to the students at the start of the intervention were viewed positively by those who submitted narrative accounts. While virtually all of the student accounts mentioned the pedometers, 7 spoke specifically to the value of devices in terms of their ability to promote active living. In the words of one student*, "I love my pedometer. I wear it every day!"* The loss or destruction of pedometers by the students was a second recurring sub-theme. Approximately 10% (n=7) of the students who provided narrative accounts indicated that they had either lost or broken their pedometer during the course of the intervention. The losses or damages occurred through varying means and many of the students expressed remorse and sadness at having to go without the device. *"Thank you for the pedometer, but it broke. This is how it broke. I went to my friends [sic] house and it Fell [sic] off on the street. Now I am vrey [sic] said that is broke."*

4.6.2.b Preferred Games

The student narratives identified several games by name as being preferred. These games included:

- Capture the Flag
- Hornets and Wasps (a variant of tag)
- Fresh (a variant of tag)
- Basketball/bucket ball

4.6.3 School Administrator Accounts

Brief narrative accounts were provided by email by the principals at both of the intervention schools. Both noted that the intervention was easy to implement within their school settings due to the involvement of the volunteers leading the Enhanced Activity Sessions. This was seen as a benefit to the schools where limited resources are available to support non-curricular initiatives. As one of the principals wrote, *"This was painless for us to do."* Both principals expressed an interest in continuing the type of programming afforded by the intervention in the future.

CHAPTER FIVE:
DISCUSSION

Recent reports suggest a trend towards overweight and obesity in Canadian children and youth, with the prevalence escalating dramatically over the past two decades (Tremblay & Willms, 2000). Overweight and obesity increase, either directly or indirectly, the risk for a number of health problems and medical conditions and, as a result, research is ongoing worldwide to identify effective strategies and best practices to promote healthy weights in young people. The findings of this thesis contribute to these efforts by describing the effects of a semi-structured, school-based intervention on lifestyle factors associated with the achievement of healthy body weights: vegetable and fruit intake and physical activity.

5.1 MAIN FINDINGS

This study provides evidence that the semi-structured approach used by the One Step at a Time Pilot Project (OSTPP) is not effective in increasing vegetable and fruit intake and physical activity levels of grade 4 to 6 students in the short term (5 months). No significant differences in either of these parameters between conditions (control versus intervention) were observed; suggesting that over the time period we considered the impact of the intervention on these lifestyle behaviours was inconsequential. Significant effects of time were observed for 3 day self-reported vegetable and fruit intake and physical activity levels measured by PAQ-C score and 3 day self-reports of the number of steps taken per day. However, these effects occurred across both groups of children (control and intervention) and were not attributable to the intervention itself. Rather, it appears that other factors, unrelated to the OSTPP, acted to produce increases in these behaviours between baseline and post-test.

A second main finding of this research was that a majority of the children at both baseline (59%) and post-test (59%) did not achieve the recommendation of *Canada's Food Guide to Healthy Eating* to choose at least 5 servings of vegetables and fruit each day. This finding is consistent with other recent research which also suggests that Canadian children do not take in adequate amounts of vegetables and fruit (Statistics Canada, 2006). Particularly troubling was our finding that 5% of the children at baseline and 11% at post-test reported consuming <1 serving of vegetables and fruit each day.

A majority of the children who participated in the OSTPP exceeded the cutoff point defining physical inactivity (e.g. PAQ-C scores <3.0). We found that at baseline 59% of the children exceeded this cut-off point, while 77% had PAQ-C scores of 3.0 or greater at post-test. This finding suggests that the children in our sample were achieving a minimum acceptable level of activity on a daily basis. This reflects a higher level of physical activity (as measured by PAQ-C) than found in comparable Canadian studies of school-age children (Reed, Warburton, Macdonald, Naylor & McKay, 2008)

Using the CDC method of classifying BMI, the prevalence of overweight and obesity in this sample of grade 4 to 6 children was found to be 18% and 16% respectively at baseline and 17% and 14% at post-test. Our findings are consistent with other studies of Canadian children in terms of the prevalence of overweight we observed. The prevalence of obesity in our sample was considerably higher than other published reports. For example, data from the 2004 Canadian Community Health Survey (CCHS) place the prevalence of overweight and obesity in children between the ages of 6 and 11 at 18% and 8% respectively. It is important to recognize that the CCHS used the IOTF method rather than the CDC method to estimate the prevalence of overweight and obesity in their sample of children. The IOTF method has been shown to provide a more conservative estimate of the prevalence of childhood obesity as compared to the CDC method (Willows, Johnson and Ball, 2007; Edwards, Evans, and Brown, 2008). As a result, it possible that prevalence found in the OSTPP sample is more robust than this comparison suggests.

Study participants, school staff, and members of the research team expressed satisfaction with the implementation of the OSTPP. While the research team described challenges in implementing some of the pilot project's components, these challenges did not detract from the participant's or school staff member's satisfaction with the intervention.

Overall, these results suggest that although the approach used by the OSTPP was not efficacious in producing short-term increases in vegetable and fruit intake and physical activity levels in grade 4 to 6 children, the nature of the intervention itself was well accepted by the children and school administrators alike. Like other samples of school-age children described in the literature, the grade 4 to 6 students who participated in this study exhibited a relatively high prevalence of overweight and obesity and inadequate intakes of vegetables and fruit, findings that lend additional support for the need to intervene on these health behaviours in order to promote optimum health.

5.2 GENERAL DISCUSSION

Several research questions for this study were identified *a priori:*

1. Can a semi-structured health promotion intervention (the One Step at a Time Pilot Project or OSTPP), delivered in schools, increase vegetable and fruit consumption and physical activity levels of grade 4 to 6 students?
2. Do participants (students, school staff, parents and research team members) consider a semi-structured, school-based intervention (OSTPP) to be a practical and acceptable approach to increasing the vegetable and fruit intake and physical activity levels of grade 4 to 6 students?
3. How does the vegetable and fruit intake of grade 4 to 6 students who participated in this study compare to the recommendations of *Canada's Food Guide to Healthy Eating*?

4. What is the prevalence of physical inactivity in the grade 4 to 6 students who participated in this study and how does this level of prevalence compare to published estimates?
5. What is the prevalence of obesity and overweight in the grade 4 to 6 students who participated in this study and how does this level of prevalence compare to published estimates?

Considering the results within the context of these questions and the related literature provides insights into how the findings might be used to inform the development of school-based interventions focused on healthy eating and active living in the future.

For logic and flow, the outcomes of the study's research questions are best discussed by grouping them into categories: 1) vegetable and fruit intake, 2) physical activity levels, 3) stakeholder satisfaction with the OSTPP, and 4) prevalence of overweight and obesity.

5.2.1 Vegetable and Fruit Intake

Our results indicate that the semi-structured approach used by the OSTPP had no significant effect on the vegetable and fruit intake of the grade 4 to 6 students who participated in the study. Although vegetable and fruit intake increased over time, this effect could not be attributed to the intervention per se. Instead, it is speculated that the time effect that was observed was the result of seasonal changes in dietary intake where vegetable and fruit intake increased between baseline and post-test due to the greater variety of lower-priced produce available in late spring versus winter.

This null finding for an effect of the OSTPP is not entirely inconsistent with the published literature in the area which, although mixed, has found the affects of school-based interventions to increase vegetable and fruit intake to be modest at best; with many interventions proving to be ineffective in producing any measurable changes in these behaviours. For example, French and Stables' 2003 review of 16, multi-component school-based interventions to increase both vegetable and fruit intake and physical activity levels found that while these interventions produced significant results the absolute increases in vegetable and fruit intake observed were very small, ranging from 0.2 to 0.6 servings day.

A lack of uniformity in the duration, design, and measures employed in the school-based interventions to increase vegetable and fruit intake reported in the literature makes comparisons difficult. However, it appears that a "dose-response" relationship may exist that is integral to promoting changes to dietary intake in school-age children. A 2003 review of school-based interventions to increase vegetable and fruit consumption among children and youth suggests that those which positively affect this aspect of diet share some commonalities (French & Stables, 2003). First, the successful interventions described in the literature tend to provide what could be described as intense "doses," of information and skill-building activities designed to increase vegetable and fruit intake. Their design involves sweeping and intense actions; simultaneously acting on multiple components of the school environment including teacher training; curriculum and classroom instruction; foodservices, and policy (French & Stables, 2003). Second, measurable improvements in vegetable and fruit intake appear to be accrued chronically over many months or even years rather than in an acute fashion over the short-term (French & Stables, 2003).

The design of the OSTPP was dissimilar from that which has shown promise in terms of increasing vegetable and fruit intakes in school-age children. First, it is conceivable that the semi-structured design employed by the OSTPP does not provide the relatively intense “dose” needed to affect measurable changes in vegetable and fruit intake in school-age children. The dedication of sizeable amounts of time to nutrition education is a defining characteristic of those interventions which have demonstrated change in behaviours related to vegetable and fruit intake (French & Stables, 2003). In these interventions, nutrition education focused on increasing vegetable and fruit intake typically ranged from 40-45 minutes per week and was generally delivered as part of the classroom curriculum (French & Stables, 2003). In addition, successful interventions have tended to provide training to classroom teachers to allow them to deliver the prescribed nutrition education activities with confidence and fidelity to the intervention (French & Stables, 2003). .

Our approach varied greatly from that used in interventions which have demonstrated significant increase in vegetable and fruit intake. We did not provide a prescribed “dose” of time each week that was specifically dedicated to the delivery of nutrition education. Instead, the bulk of the nutrition education provided to the children was in brief “doses” of no more than 15 minutes prior the start of one of the Enhanced Activity Sessions. Classroom experiences in food preparation were also offered upon request of the teacher and not all of the children who participated in this study took part. In addition, the OSTPP did not act on teacher training or health curriculum content; other factors which are elements of interventions which have been shown to be efficacious in increasing vegetable and fruit intake (French & Stables, 2003).

The lack of results we observed may also be due to measurement issues. Our study ran for a relatively short period of time (5 months). This is contrary to the characteristics of interventions that have shown efficacy where nutrition education activities were implemented over several years not weeks. Recognizing this, it may be that we did not see results because the term of our intervention was not long enough.

While we did not show a significant effect of the OSTPP on vegetable and fruit intake our data add to the literature describing food behaviours in school-age children. The median vegetable and fruit intakes of the children in our sample (4 servings/day at both baseline and post-test) fell below the minimum 5 servings a day recommended by *Canada’s*

Food Guide to Healthy Eating. This finding is consistent with other published reports of Canadian children indicating that inadequate intakes of vegetables and fruits are common (Statistics Canada, 2006). .

The sub-optimal vegetable and fruit intakes observed in our sample is troubling given research linking vegetable and fruit intake to overweight and obesity in children (Statistics Canada, 2006). Data from the Canadian Community Health Survey (CCHS) (2006) suggest a protective effect of vegetable and fruit intake on the risk for overweight and obesity in children. In the CCHS sample, children and youth (ages 2 to 17 years of age) who consumed 5 or more servings of vegetables and fruit were significantly less likely to be overweight or obese that those whose intakes fell below this threshold (Statistics Canada, 2006). This effect has also been observed in several other reports in the literature (Action Schools! BC, 2005; Veugelers, Fitzgerald & Johnston, 2005, Jacobs-Starkey et al., 2001)

Concerns about the sub-optimal vegetable and fruit intakes observed in Canadian children are warranted given the data suggesting that this trend may be predictor of risk for overweight and obesity. Data collected from overweight and obese 8 to 17 year old children admitted to the Pediatric Centre for Weight and Health at the University of Alberta Hospital in Edmonton, Alberta show that almost ¾ of the children admitted to this weight management program did not meet the *Food Guide's* recommendations for vegetable and fruit intake. Similarly, Burrows et al

(2009) found that overweight and obese children took in fewer servings of vegetables and fruit and had lower levels of serum carotenoids, and cryptoxanthin, and lycopene (objective bio-markers of vegetable and fruit intake), than healthy weight children.

The concerns related to inadequate levels of vegetable and fruit intake observed in the children who participated in the OSTPP are not limited to the risk for overweight and obesity. Because vegetables and fruits provide a wide range of essential nutrients, the inadequate intakes we observed suggest a risk for malnutrition which, in turn, presents negative consequences in terms of growth, development and lifelong health. Vegetables and fruits are primary sources of vitamins, minerals, and dietary fibre which appear to offer protective effects against chronic diseases including cardiovascular disease, type 2 diabetes, hypertension, certain types of cancer, and metabolic syndrome (Lock K, Pomerleau J, Causer L, Altmann DR, McKee M, 2005; World Health Organization, 2003; Maynard M, Gunnell, D, Emmett, P M, Frankel, S, Davey Smith, G.. 2003). Failing to achieve the recommendations of *Canada's Food Guide* puts children at risk for the development of these conditions and, as a result, warrants immediate and ongoing attention from nutrition and health promotion practitioners.

*5.2.3 **Physical Activity Levels***

Our findings indicate that implementation of the OSTPP over a 5 month period did not produce significant increases in the physical activity levels of the grade 4 to 6 students who participated. As was the case with the analysis of vegetable and fruit intake, physical activity levels tended to increase between baseline and post-test. However, this effect was not related to the intervention. We speculate that the increase we observed was the result of seasonal improvements in weather conditions which made outdoor play and recreation opportunities more accessible to the children in our sample.

The OSTPP used a relatively simple approach to promote physical activity. Enhanced Activity Sessions lasting approximately 40 minutes and involving outdoor games were offered on a voluntary basis to the children during their lunch hour, 3 times each week. While these sessions encouraged the children who participated to be active, there is no evidence that the contribution produced a significant increase in overall physical activity level over the short-term (4 months) we considered.

Data that strongly supports the efficacy of school-based interventions in promoting physical activity in children between the ages of 6 and 11 is lacking (Van Sluijs, McMinn & Griffin, 2007). While some studies have produced increases in activity levels, others have had no effect whatsoever (Van Sluijs, McMinn & Griffin, 2007). For example, a recent meta-analysis of 19 studies of school-based interventions for children conducted by Van Sluijs, McMinn & Griffin (2007) found inconclusive evidence to support the effectiveness of effect for multi-component interventions, like the OSTPP, which involve the promotion of both physical activity and nutrition. In general, those studies that have produced positive results have offered multiple opportunities for the children to be active (e.g. physical education classes, after school programs, class-room based activity "breaks."), strong supports for physical education and active living programs (e.g. trained physical education specialists as leaders, parental and community engagement) and relatively intense doses (e.g. minimum 150 minutes per week derived from a combination of physical education classes, organized school-based extracurricular activities, and 0pportunities for active play). Two such programs have been implemented in Canadian schools in recent years and both have demonstrated success in increasing physical activity levels.

Action Schools! BC is a multi-component intervention targeting physical activity and vegetable and fruit intake in elementary schools (Reed et al, 2008). The intervention seeks to actively involve families, teachers, principals and school administrator in creating and implementing comprehensive changes to the school environment to promote healthy eating and active living (Reed et al, 2008). The goal of Action Schools! BC is to have children reach an activity "dose" of no less than 150 minutes each week that is acquired through traditional physical education classes, organized activity sessions held at both recess and lunch, and extracurricular games (Reed et al, 2008). A randomized controlled trial of the Action Schools! BC intervention suggests it is an efficacious approach to enhancing physical activity in schools (Reed et al, 2008). Over a 10 month period, the intervention was able to elicit a 20% improvement in cardiovascular fitness compared to controls. In addition, children in the intervention schools of were found to have higher overall PAQ=C scores than children in the control schools (2.61±0.42 versus 2.55±0.37) (Reed et al, 2008).

The Annapolis Valley Health Promoting Schools Project (AVHPSP) is multi-component, nutrition and physical activity intervention. Originally implemented in a total of 8 elementary and middle schools over a 3 year period, the intervention in now used in schools across the province of Nova Scotia (Veugelers & Fitzgerald, 2005). In addition to nutrition education, the project involves enhancements to physical education curricula, implementation of physical activity sessions outside of physical education classes, after school access to school facilities such as the gymnasium and broad-scale community engagement (Veugelers & Fitzgerald, 2005). Evaluation of phase 1 of the AVHPSP found that children in the intervention schools were higher levels of participation in physical activities and less participation in sedentary activities. In addition, students who took part in the AVHPSP were less likely to be overweight or obese, and had higher intakes of vegetables and fruit.

The OSTPP did not share the characteristics of interventions which have shown promise in terms of increasing the physical activity levels of children which may have been a factor in the null findings for this intervention. In light of the evidence showing that increases in physical activity are associated with relatively intense interventions that are carried out over lengthy periods of time, it is conceivable that the informal and entirely voluntary approach we used did not provide a “dose” of physical activity that was intensive enough to promote measurable change.

The OSTPP, independent of school-based physical education classes, Alberta’s Daily Physical Activity initiative and extracurricular programs, provided the children with approximately 120 minutes (3 X 40 minutes/week) of physical activity programming per week. With the inclusion of these other opportunities for activity in the school, it is likely that the children in our sample reached the “dose” or levels of physical activity provided by successful interventions such as Action Schools! BC. However, it is important to recognize that participation in the Enhanced Activity Sessions offered by the OSTPP was voluntary. Unlike more structured interventions, children at the intervention schools in our study had the choice as to whether or not they participated. Those who did choose to participate (approximately 46% of the total intervention sample) were also able to decide the duration of their participation. Data collected by the research team indicate that the duration of participation was variable, with children taking part and then leaving the Sessions. This lack of fidelity to the planned intervention may, in part, explain the lack of effect for physical activity we observed. In addition, the OSTPP did not act on other components of the school environment that have been associated with increases in physical activity levels which may have impacted our findings. Specifically, our intervention did not involve changes to curriculum, teacher training, or community supports.

The duration of the OSTPP may also have limited the results. Physical activity levels in our project were assessed after one, 5 month period. The literature indicates that interventions which have demonstrated significant improvements in the physical activity levels of children were implemented consistently over lengthy (e.g. >12 months) periods of time (Van Sluijs, McMinn & Griffin, 2007). Recognizing this, it is possible that, given more time our intervention may have elicited significant changes to the activity levels of the children we studied.

5.2.4 ***Stakeholder Satisfaction with the OSTPP***

Ethnography is the study of direct, first-hand observation of daily behaviour and participation (Denzin, 1997). This was not a true ethnographic study. However, we employed elements of ethnographic methodology, including the collection of narrative accounts describing the satisfaction of the project's stakeholders (study participants, school staff, parents and the research team) with the methods employed.

The accounts provided by the research team members, the study participants and school staff overall lend support to the methods used by the OSTPP to increase vegetable and fruit intake and physical activity levels of school children. While challenges were identified, the perspectives of the stakeholders were generally positive and do not identify any significant practical limitations to implementing this type of intervention on a broader scale.

Accounts from the research team primarily describe the practical realities associated with the implementation of health promotion interventions of in schools. In particular, the research team admittedly struggled with managing the behaviour of the children during game play and anticipating safety concerns. Their accounts suggest that their lack of effectiveness in this area troubled them and potentially detracted from their satisfaction with the intervention.   Similar challenges have previously been associated with school-based health promotion interventions and research involving children and should be considered by those planning these kinds of projects (U.S. Department of Health and Human Services,1996; Martin & Conklin, 1999; Christensen & James, 2000; Canadian Fitness and Lifestyle Research Institute and ParticipACTION, 2009).   Training to promote a greater awareness of safe practices in game play as well as skill development to increase self-efficacy in managing common childhood behaviours such as frustration, anger, and a lack of desire to follow rules could potentially over-come these challenge and thereby enhance the satisfaction levels of those leading the intervention's Enhanced Activity Sessions.

The narrative accounts received from the children who took part in the OSTPP were universally positive. The children fondly described their experiences with the research team members, whom they appeared to view as role-models. The intervention's activities also appeared to increase awareness of the benefits of healthy eating and physical activity. The over-riding perception of the intervention by the children who provided accounts was that it was fun, a factor which appeared to increase their interest in engaging in the project's activities. Enjoyment has been identified as a key determinant of physical activity behaviour in children and youth and, as a result, this perception on the part of the children lends support to further exploration of the approach employed in this pilot intervention (President's Council on Physical Fitness and Sports, 2000).

Gittleshon et al use the term "school climate" to define the set of characteristics that distinguish one school from another and that affect the behaviour of people within the school (Gittleshon, Merkle, Story, Stone, Steckler, Noel, Davis, Martin, Ethelbah, 2003). It is understood that schools are open, organizational systems that are dynamic rather than static in nature (Gittleshon et al, 2003). School climate changes over time depending on the perceptions of its members, and is influenced by a school's organization, staff stability and morale, leadership and administrative support, and resources (human and financial) (Gittleshon et al, 2003). These factors impact the implementation and sustainability of all programs introduced into the school environment, a reality that school-based researchers must appreciate (Gregory, Henry, Schoeny, 2007; Gittleshon et al, 2003; Cullen, Baranowski, Baranowski, Herbert, deMoor, Hearn, 1999).

School administrators (principals) have been shown to exert influence over the collective experience of the school climate by the teaching staff which, in turn, alters their implementation of school health interventions (Gregory, Henry, Schoeny, 2007). Specifically, teachers who view the school administration (principal) as being open, collaborative and supportive of a school-health intervention are more likely to engage in its implementation than those who hold less positive perceptions. Gregory, Henry and Schoen (2007) have theorized that clear demonstrations of support for a school health intervention on the part of the school administrator (principal), coupled with a willingness to engage teachers in the implementation process builds a level of trust and motivation among school staff that, in turn, enhances their desire to participate.

The principals at both of the OSTPP expressed extremely positive perceptions of the intervention as well as a willingness to participate in similar school health projects in the future. Ease in implementing the OSTPP was specifically identified as a factor that influenced the perceptions of these school administrators. This characteristic is also likely to be of relevance to others in leadership roles in schools, where the demands for time, personalized attention to problems, and delivery of academic outcomes are juxtaposed with limited budgets, staff resources and facilities. In particular, interventions that are perceived by school administrators and teachers to be the cause of extra work or work that is not a priority may struggle to be fully implemented due to lack of support (Kallestad & Olweus, 2003). The fact that the OSTPP was viewed by the principals as something that offered benefits without adding to their workload suggests its potential for acceptance by other school administrators.

5.2.5 Prevalence of Overweight and Obesity

This study adds to the growing body of literature describing the prevalence of overweight and obesity in children and youth. Our results indicate that more than 1 in 3 children in our sample were either overweight or obese. At baseline, the observed prevalence of overweight in our entire sample of children was 17.8%, while 16% were found to be obese. Post-test, 16.5% of the children were overweight, and 14.1% were obese.

The prevalence of overweight in our sample at both baseline and post-test approximates that reported elsewhere in the literature for Canadian children (Statistics Canada, 2004). Using data from the 2004 Canadian Community Health Survey (CCHS), Shields found that 18% of children between the ages of 6-11 years were overweight; a level similar to that seen in our sample at both pre and post test (17.8 and 16.5% respectively). In contrast, the prevalence of obesity in the children who participated in the OSTPP (approximately 15%) was higher than that observed by Shields (2004) and others (Tremblay & Willms, 2000).

It is possible that the differing levels of prevalence of obesity are the result of varying methodological approaches to classifying BMI. As previously noted, the CCHS data were classified using the IOTF method, while the OSTPP relied on the CDC method. Given that the IOTF method tends to be a more conservative estimate of the prevalence of childhood obesity it is possible that the high prevalence we observed relative to the CCHS data was, in part, a function of the method used.

The relatively high prevalence of obesity observed in our sample may also be the result of sampling bias. Our study utilized a convenience sample of children from four schools in the Edmonton, Alberta area. Two of the schools, accounting for 50% of the children in the study, were located in communities with low SES. Low SES is a known predictor of obesity risk in children (Gordon-Larsen, Adair, and Popkin, 2003; Willms, Tremblay, and Katzmarzyk, 2003; Oliver and Hays, 2005). For example, an analysis of data from the 1996 National Longitudinal Survey of Children and Youth (NLSCY) and the 1981 Canada Fitness Survey (CFS) by Willms, Tremblay and Katzmarzyk (2003) found a dramatic inverse relationship between the prevalence of overweight and SES in all parts of Canada. Similarly, analysis of data from the first wave (1994) of the (NLSCY) conducted by Tremblay and Willms found that both overweight and obesity were significantly related to SES. Recognizing this, it may be that our sampling methodology we used produced results that tend to over-estimate the prevalence of obesity when compared to the general population of children. The available evidence suggests that this was the case. For example, at pre-test the prevalence of obesity and overweight in the low SES schools was 25.6% and 20.4% respectively compared to 6.3% and 15.2% respectively at the high SES schools. At post-test the differences in the relative prevalence of obesity and overweight between the two SES strata persisted. At post-test the prevalence of obesity and overweight in the low SES schools was 21.4% and 21.4% respectively, while prevalence at the high SES schools was 7.4% and 12.0% respectively.

The prevalence of obesity in the OSTPP closely approximately that of other studies conducted on samples with high or exclusive populations of low SES children. Oliver and Hayes (2005), in looking at samples of children stratified by SES and using the IOTF classification method, found that the prevalence of obesity among children living in low SES communities was 16%. While our classification method differed from that used by these authors, the level of prevalence they observed is comparable to that seen in the OSTPP (15%).

The fact that relatively large numbers of children in our sample were either overweight or obese is concerning. As previously noted, overweight and obesity increase the risk for a number of chronic diseases including type II diabetes (American Academy of Pediatrics, 2002; Clarke, Woolson & Lauer, 1986; Dietz, Gross & Kirkpatrick, 1982; Freedman, Dietz, Srinivasan, & Berenson 1999; Gidding, Bao, Srinivasan, & Berenson, 1995; Must, Jacques, Dallal, Bajema, & Dietz, 1992; Richards, Cavallo, Meyer, Prince, Peters, Stuart, & Smith, 1985; Rodriguez, Winkleby, Ahn, Sundquist & Kraemer, 2002; Sinha, Fisch, Teague, Tamborlane, Banyas, Allen, Savoye, Rieger, Taksali, Barbetta, Sherwin, & Caprio, 2002). Our findings augment the existing evidence in support of child health interventions focused on helping children achieve and maintain healthy body weights.

5.3 STRENGTHS AND LIMITATIONS OF THE STUDY

5.3.1 Strengths

The OSTPP used a cluster, randomized controlled trial design where the study participants were randomized at the level of the school into two groups: Intervention and control. The presence of the control group increased our ability to eliminate or account for confounding variables; thereby increasing the reliability of our findings.

A second strength of this study is the use of objective measures of weight, height, and physical activity (steps taken/day). Our ability to obtain measured weights and heights from a relatively large group of children provides a level of rigour not associated with self-reports of the same data and thereby adds to the validity of our findings. Similarly, the use of pedometers to track the number of steps taken each day by the children allowed us to objectively assess physical activity levels and compile comparable data. Objective instruments like pedometers quantify levels of physical activity, producing data that are not influenced by recall ability, ethnicity, culture or socio-economic status. They are also relatively simple to use and are reliable and valid measures of physical activity in children.

This study also benefited from the skilled personnel who formed the research team. For example, all 24 hour dietary recalls were explained and conducted by registered dietitians, dietetic interns and senior level nutrition students familiar with the methodology. This decreased the variability of the diet records which, in turn, increased the reliability of our findings.

Finally, this study was well supported by the schools in which it occurred. School administrators (principals) and teaching staff welcomed the presence of the research team and offered the logistical support needed to ensure the intervention was implemented with fidelity.

5.3.2 Limitations

The results of this study should be viewed in light of several limitations. First, our intervention was tested on a convenience sample of children. Consequently, the extent to which our finding can be generalized to a broader population of children is not known.

As previously noted, this study was a cluster randomized controlled trial (C-RCT), a design which presents issues with respect to statistical analysis.

Cluster randomized controlled trials are a variant of a randomized, controlled trial (RCT) design. Unlike a RCT where individuals are randomly assigned to either intervention or control groups, g*roups of individuals* are randomized to one of the two conditions. C-RCT are considered a viable and practical method for evaluating community based interventions like the OSTPP where randomization at the individual level would be difficult and there is a need to recognize a population health focus (Campbell and Grimshaw, 1998).

Several advantages of using the C-RCT design have been identified (Grimshaw, Campbell, Eccles and Steen, 2000). These advantages include:

1. Reduced threat of "contamination." Contamination occurs when individuals in the intervention group influence the conduct or response of others in the same group.
2. The C-RCT design meshes more naturally with the intervention being studied. Some interventions are, by their nature, designed to be offered to groups of people rather than to individuals. In these kinds of studies, the C-RCT may more closely align with the intervention than the traditional RCT approach.
3. Practicality. Delivering a multi-faceted intervention like the OSTPP to only a select group of students in a school (e.g. those randomized to the intervention group) would be practically difficult to manage.

Off-setting the potential advantages of the C-RCT design are a number of issues which can make measurement of effects challenging. Many statistical tests are based on the assumption that the subjects involved in the study are independent of one another and that any changes observed are, therefore, a result of the intervention. In the C-RCT design individuals are clustered together based on some shared factor such as place of residence, membership in an organization, or, as is the case with the OSTPP, designated school. This shared factor or factors means that the sample effectively contains individuals who are more similar to each other than would be expected in a truly random sample of individuals. This, in turn, violates the assumption of independence and creates co-variance that standard statistical analyses cannot effectively assess. Ultimately, this is reflected as a loss of statistical power relative to similar analyses conducted on individually randomized group which can produce Type II errors (e.g. a conclusion that there is no effect when one exists).

A number of strategies can be used to off-set the loss of power created by cluster randomization. First, a C-RCT will always require a larger sample size than that of a traditional RCT to mathematically compensate for the correlation that exists within a cluster of people (Puffer, Torgerson, and Watson, 2003). This correlation, which is known as the intracluster correlation coefficient or ICC, can be mitigated by increasing the size of the sample (Puffer, Torgenson and Watson, 2005).

Work by Puffer et al (2003) suggests the necessary increase in sample size can be substantial; ranging from 50-100% more participants than would be required in a comparable individually randomized trial.

Careful consideration must be given to the statistical tests used to analyze C-RCT. Standard test statistics, such as Chi-squared, *t* and *F* tests tend to produce P-values that are too small and confidence intervals that are too narrow if the clustering of the subjects is not taken into account (Bland, 2004).

Our use of ANOVA and RM-ANOVA to assess the outcomes of the OSTPP may have misrepresented the full impact of the intervention. Data collected from C-RCT designs like ours have been found to have correlated observations or clustering that may arise when repeated measurements are conducted on the same subject (Li F, Maddalozzo GF, Hammer P, and Duncan TE, 1998). RM-ANOVA methods do not inherently address this issue because they assume that observations are independent of one another and, as a result, may not accurately assess treatment effects (Huck SW and McLean RA, 1975). Ultimately this may mean that the true impact of the independent variables being measured may not be fully realized (e.g. Type II error). Further analysis of our data using multi-level modeling techniques, such as Generalized Estimating Equation (GEE) would address this issue and add strength to our conclusions. Generalized Estimating Equation analysis has the capacity to account for co-variance, and clustering of effects, which, in turn, can enhance power (Twish, Smidt, de Vente, 2004).

Over the course of this pilot project several students left the study due to movements out of the school or school absences. Data collected from these students was subsequently removed from the data set to give to balance required for the RM-ANOVA. By not considering these responses it is possible that we created biased comparisons between the two groups (intervention and control) and, therefore, did not gain a reliable assessment of the intervention. Intention to Treat (ITT) analyses, which considers all subjects allocated to the study in the results – including so-called “drop-outs,” - could be used to address this issue (Jo, Asparouhov, and Muthén, 2004)

The nature of the intervention also presented some limitations. We did not define nor implement a specific “dose” of nutrition education. Instead, the research team members working in the field were given general instructions to provide nutrition education as part of the Enhanced Activity Sessions and in other situations if the opportunity was presented. As a result, we were not able to definitively quantify the amount of instruction provided to the children. The lack of a defined level of nutrition education also prevented us from assessing fidelity to the approach being tested.

The methods we used to engage the support of family members and the broader school community are also a limitation of this study. Our primary method of communication with these stakeholders was through content posted in the school newsletters. Our approach was passive in nature. We did not act to ensure that the newsletter information was received by parents nor did we evaluate the outcome of this element of the intervention.

The process we used to collect narrative accounts was very informal and, as a result, may not reflect the perceptions of all of the intervention's stakeholders. With the exception of the accounts provided by the Research Team, narrative accounts were not solicited. As a result, it is possible that those that were submitted reflect only the views of those who enjoyed their experience with the intervention. In addition, because no formal structures were used to guarantee the anonymity of responses it is possible that the submission of negative or critical comments was limited.

Finally, it must be recognized that the duration of this intervention was relatively short (5 months). Eating and physical activity behaviours are complex and take time, knowledge and skill development to change. It is possible that we did not sustain the intervention long enough to see a measurable effect.

CHAPTER SIX:
CONCLUSION

6.1 CONCLUSIONS

The trend towards overweight and obesity in Canadian children and youth poses a significant threat to the health and warrants the concern of parents, caregivers, governments, and researchers. Left unchecked, this situation presents significant ramifications to both individual children and to Canadian society. For children, obesity represents a powerful threat to both short and long term health. In addition, childhood obesity and co-morbidities such as diabetes have the potential to devastate Canada's universal health care system through the cumulative direct and indirect costs incurred during treatment (Katzmarzyk & Janssen, 2004).

Schools are a logical environment for health promotion interventions to reduce the risk for overweight and obesity in children. Children spend significant amounts of time in school and schools offer the infrastructure, human resources, and peer involvement to support health-related programming and education. This pilot study of a semi-structured, school-based intervention contributes to our understanding of the types of strategies that are likely to be efficacious in terms of increasing vegetable and fruit intake and physical activity in children.

First, this study provides evidence that short term, a semi-structured intervention like the OSTPP is not efficacious in promoting increases in vegetable and fruit intake nor physical activity levels. At the same time, school stakeholders (students, principals, research team members) expressed high levels of satisfaction with the intervention, suggesting that the flexible, responsive nature of this pilot project bears further examination as a method for engaging schools and children in activities to promote health.

Finally, the OSTPP adds to the understanding of the lifestyle habits and physical condition of school-age children in Canada. This data provides additional evidence to support the belief that school-age children are not consuming adequate amounts of vegetables and fruit. In addition, given that 1 out of every 3 children in our sample was either overweight or obese, this study supports the idea that ongoing action to promote the achievement of healthy body weights is needed.

6.2 FUTURE RECOMMENDATIONS

The results of this study present a range of questions and issues that must be addressed through future research in order to fully realize the potential of the school environment in promoting healthy eating and active living. Specifically, it is recommended that future research, dialogue and stakeholder action focus on the following questions:

1. What is the minimum “dose” of physical activity programming and nutrition education needed to promote significant changes in behaviour?

2. Can the methods used by a semi-structured intervention like the OSTPP engage parents, care-givers, and community members at the level needed to promote changes to physical activity and eating behaviours in children?
3. What amount and type of training is needed to support volunteers in leading the type of intervention piloted here?
4. What can and is being done to address the methodological and design weaknesses that currently limit our understanding of best practices in school-based health promotion research?

This was a pilot study that was primarily designed to test the feasibility and logistics of implementing a larger scale, more comprehensive study of the OSTPP intervention in the future. The preliminary work undertaken here identified the following issues which should be addressed in order to ensure the quality and efficiency of further trials of the intervention:

1. ***Sampling and statistical issues.*** The C-RCT design employed in this pilot study is appropriate for use in a larger study of the OSTPP intervention. However, during the early planning stages the cluster design must be taken into account. Specifically, in keeping with the 2004 CONSORT Statement on the presentation of results from clustered trials, attention must be paid to estimating the necessary sample size needed to mitigate the loss of statistical power created by the C-RCT design (Campbell MK, Elbourne DR, Altman DG and the CONSORT Group, 2004). In addition, *a priori* consideration

must be given to the use of multi-level modelling, such as GEE and ITT analysis, in order to ensure the reliability of results and conclusions.

2. ***Standardization of the elements of the intervention***. The OSTPP intervention is intentionally informal and semi-structured. While this characteristic of the intervention makes it easy to implement, it does not permit easy assessment of fidelity to the intervention and outcome evaluation. Recognizing this, future trials of the intervention would benefit from standardization of key elements such as time spent on and learning objectives related to nutrition education.
3. ***Increased Training for Enhanced Activity Facilitators***. The research team volunteers who led the Enhanced Activity Sessions consistently described challenges in terms of managing the behaviour of the children. These challenges appear to have been a source of stress for the volunteers. Targeted training to build skills related to teaching and leading children would address this issue and promote sustainable involvement by the project's volunteers.

6.3 FINAL COMMENT

Childhood overweight and obesity have been the focus of much media and research attention over the past decades. While strides have been made in terms of understanding how we might solve this problem, the number of children struggling with excessive body weights continues to increase (Robert Wood Johnson Foundation, 2009). For example, the prevalence of childhood obesity in some regions of North America now encompasses almost half (44%) of the population (U.S. Health Resources and Services Administration, Maternal and Child Health Bureau, 2007). This reality of modern society has and will likely continue to negatively shape the experiences of children (Schwimmer , Burwinkle & Varni, 2003; Eisenberg, Neumark-Sztainer, & Story, 2003; Strauss, 2000). It is entirely conceivable that coming generations of children will not experience childhood as a time to play, run, jump and have fun because the widespread prevalence of obesity will not permit it. To quote Yale University researcher, David Katz, "*Childhood obesity and its consequences constitute a bona fide health crisis. We simply cannot afford to wait for the world to change but rather must trust in both the evidence we have to date and informed judgment to intervene in schools with the urgency a crisis demands."* (Katz, 2009).

LITERATURE CITED

Action Schools! BC. *Phase 1 (pilot) Evaluation report and recommendations. A report to the Ministry of Health Services*. November 2005. On-line [Available]: http://www.health.gov.bc.ca/library/publications/year/2004/actionschoolsreport.pdf . Retrieved: June 21, 2009.

Active Healthy Kids Canada. Active Kids are Fit to Learn. *Canada's Report Card on Physical Activity for Children & Youth 2009*. Active Healthy Kids Canada: Toronto, ON; 2009.

American Academy of Pediatrics, Section on Pediatric Pulmonology, Subcommittee on Obstructive Sleep Apnea Syndrome. Clinical practice guideline: diagnosis and management of childhood obstructive sleep apnea syndrome. **Pediatrics** 2002; 109: 704-712.

American Dietetic Association. Position of the American Dietetic Association: individual-, family-, school-, and community-based interventions for pediatric overweight. **Journal of the American Dietetic Association** 2006; 106:925–45.

Anderson PM & Butcher KF. Childhood obesity: Trends and potential causes. **The Future of Children** 2006; 16(1): 19-46.

Auld GW, Romaniello C, Heimendinger J, Hambidge C & Hambidge M. Outcomes from a school-based nutrition education program using resource teachers and cross-disciplinary models. **Journal of Nutrition Education** 1998; 30:268-280.

Auld GW, Romaniello C, Heimendinger J, Hambidge C & Hambidge M. Outcomes from a school-based nutrition education program alternating special resource teachers and classroom teachers. **Journal of School Health** 1999; 69:403-408.

Ball GD and Willows ND. Definitions of pediatric obesity. [Comment] **Canadian Medical Association Journal** 2005; 172(3):309-10; author reply 310-11.

Ball GDC, Lenk JM, Plotnikoff RC, Fishburne GJ, Mackenzie KA, & Willows ND. Overweight children and adolescents referred for weight management: are they meeting lifestyle behaviour recommendations? **Applied Physiology, Nutrition and Metabolism** 2008; 33(5): 936-945.

Bandura A. *Social foundation of thought and action: a social cognitive theory*. Prentice Hall: Englewood Cliffs, NJ; 1986.

Bandura, A. Health promotion by social cognitive means. **Health Education and Behavior** *2004; 31* (2): 143-164.

Barnett TA, O'Loughlin J, & Paradis G. One- and Two-Year Predictors of Decline in Physical Activity Among Inner-City School Children. **American Journal of Preventive Medicine** 2002*; 23*(2): 121-128.

Baranowski T, Perry CL, and Parcel GS. How individuals, environments, and health behaviour interact. In: K Glanz, BK Rimer, FM Lews (Eds.), *Health Behaviour and Health Education: Theory, Research and Practice (3rd Ed.)* San Francisco: Jossey-Bass. 2002.

Bassett DR Jr, & Strath SJ. Use of Pedometers to Assess Physical Activity. In: Welk GJ., editor. *Physical Activity Assessments for Health Related Research.* Human Kinetics Champlain, IL: 2002.

Beckman H, Hawley S & Bishop T. Application of theory-based health behaviour change techniques to the prevention of obesity in children. **Journal of Pediatric Nursing** 2006; 21(4): 266-275.

Bell EA, Castellanos VH, Pelkman CL, Thorwart ML, & Rolls BJ. Energy density of foods affects energy intake in normal-weight women. **American Journal of Clinical Nutrition** 1998; 67:412-20

Birch LL, & Fisher JO. Development of eating behaviors among children and adolescents. **Pediatrics** 1998 101: 539-549.

Bland JM. Cluster randomised trials in the medical literature: two bibliometric surveys. **BMC Medical Research Methodology** 2004; 4: 21.

Block G, Patterson B, & Subar A. Fruit, vegetables, and cancer prevention: a review of the epidemiological evidence. **Nutrition and Cancer** 1992; 18:1–29

Bois JE, Sarrazin PG, Brustad RJ, Trouilloud DO, & Curry F. Elementary schoolchildren's perceived competence and physical activity involvement: the influence of parents' role modelling behaviours and perceptions of their child's competence. **Psychology of Sport and Exercise** 2005; 6(4): 381-397.

Briefel RR, Sempos C, McDowell M, Chien S, & Alaimo K. Dietary methods research in the third National Health and Nutrition Examination Survey: underreporting of energy intake. **American Journal of Clinical Nutrition** 1997; 65 (Suppl), 1203S-1209S.

Brown T & Summerbell C. Systematic review of school-based interventions that focus on changing dietary intake and physical activity levels to prevent childhood obesity: an update to the obesity guidance produced by the National Institute for Health and Clinical Excellence. **Obesity Reviews** 2009; 10(1): 110-141.

Brown T, Kelly S & Summerbell C. Prevention of obesity: a review of interventions. **Obesity Reviews** 2007; 8 Suppl 1:127-3.

Burrows TL, Warren JM, Colyvas K, Garg ML, & Collins CE. Validation of overweight children's fruit and vegetable intake using plasma carotenoids. **Obesity** 2009 17(1): 162-168.

Buzzard, M. 24-hour dietary recall and food record methods. In: Willett W., editor. *Nutritional Epidemiology*. 2nd edition. Oxford University Press; New York, NY: 1998. p. 52.

Campbell MK, Elbourne DR, Altman DG and the CONSORT Group. CONSORT statement: Extension to cluster randomized controlled trials. British Medical Journal 2004; 328(7441):702-8.

Campbell MK and Grimshaw JM. Cluster randomised trials: time for improvement. The implications of adopting a cluster design are still largely being ignored. **British Medical Journal** 1998; 317(7167):1171-2.

Canadian Fitness and Lifestyle Research Institute. *Canadian Physical Acitivity Levels Amoung Youth (CAN PLAY) Bulletin No. 1.* Canadian Fitness and Lifestyle Research Institute; Ottawa, ON: 2008.

Canadian Fitness and Lifesty Research Institute and ParticipACTION. Research File: School based physical activity interventions. Canadian Fitness and Lifestyle Research Institute; Ottawa, ON: 2009.

Canadian Paediatric Society/Environics Research Group. *Physical Activity and Canadian Children: Final Report.* Environics Research Group: Ottawa, ON. 2002.

Cavadini C, Siega-Riz AM, Popkin BM. U.S.adolescent food intake trends from 1965 to 1996. **Archives of Disease in Childhood** 2000; 83**:**18-24 .

Centres for Disease Control and Prevention. (2005). Can eating vegetables and fruit help people manage their weight? *Research to Practice, Series 1.* On-line [Available]: http://www.cdc.gov/nccdphp/dnpa/nutrition/pdf/rtp_practitioner_10_07.pdf. Retrieved: June 25, 2009.

Christensen P. & James A. (2000). *Research with children: Perspectives andPractices*. London: Falmer Press.

Clarke WR, Woolson RF, & Lauer RM. Changes in ponderosity and blood pressure in childhood: the Muscatine Study. **American Journal of Epidemiology** 1986; 124:195-206.

Cole K, Waldrop J, D'Auria J, & Garner H. An integrative research review: School-based childhood overweight interventions. **Journal for Specialists in Pediatric Nursing** 2006; 11(3): 169-177.

Cole TJ, Bellizzi M, Flegal K, & Dietz W. Establishing a standard definition for child overweight and obesity worldwide: international survey. **British Medical Journal** 2000; 320, 1-6.

Cullen KW, Baranowski T, Baranowski J, Herbert D, deMoor C, Hearn MD & Resnicow K. Influence of school organizational characteristics on the outcomes of a school health promotion program. **Journal of School Health** 1999; 69(9): 376-380.

Cullen KW, & Watson K. The impact of the Texas public school nutrition policy on student food selection and sales in Texas. **American Journal of Public Health** 2009; 99(4):706-12.

Daniels SR, Arnett DK, Eckel RH; Gidding SS, Hayman LL, Kumanyika S, Robinson TN, Scott BJ, St. Jeor S, & Williams CL. American Heart Association scientific statement: Overweight in children and adolescents - pathophysiology, consequences, prevention, and treatment. **Circulation** 2005; 111:1999-2012.

Denzin NK. The logic of naturalistic inquiry. In NK Denzin (Ed.), *Sociological methods: A sourcebook*. New York: McGraw-Hill. 1978.

Dietitians of Canada; Canadian Paediatric Society; College of Family Physcians of Canada; Community Health Nurses Association of Canada. The use of growth charts for assessing and monitoring growth in Canadian infants and children [Position Statement]. **Canadian Journal of Dietetic Practice and Research** 2004; 65(1):22-32.

Dietz WH, Gross WL, & Kirkpatrick JA Jr. Blount disease (tibia vara): another skeletal disorder associated with childhood obesity. **Journal of Pediatrics** 1982; 101: 735-737.

Drewnowski, A. Energy Density, Palatability and Satiety: Implications for Weight Control. **Nutrition Reviews** 1998; 56:347–353.

Drewnowski A. The role of energy density. **Lipids** 2003; 38(2): 109-115.

Duncan KH, Bacon JA, & Weinsier RL. The effects of high and low energy density diets on satiety, energy intake, and eating time of obese and nonobese subjects. **American Journal of Clinical Nutrition** 1983;37:763-7.

Duncan SC, Duncan TE, Strycker LA, & Chaumeton NR. Neighborhood physical activity opportunity: a multilevel contextual model. **Research Quarterly for Exercise and Sport** 2002; 73(4):457-463.

Dwyer, J. T. Assessment of Dietary Intake. In M. Shils, J. A. Olson, M. Shike and A. C. Ross (Eds.), *Modern Nutrition in Health and Disease,* 8th ed., pp. 887–904. Baltimore: Williams and Wilkins, 1997.

Edwards J, Evans J and Brown AD. Using routine growth data to determine overweight and obesity prevalence estimates in preschool children in the Capital Health Region of Alberta. **Can J Pub Health** 2008; 99(2): 91-94.

Eisenberg ME, Neumark-Sztainer D, & Story M. Associations of weight-based teasing and emotional well-being among adolescents. **Archives of Pediatric and Adolescent Medicine** 2003; 157(8):733-8.

Emmons L, & Hayes M. Accuracy of 24-hr. recalls of young children. **Journal of the American Dietetic Association** 1973; 62:409–416.

Enns CW, Mickle SJ, & Goldman JD. Trends in food and nutrient intakes by children in the United States. **Family Economics and Nutrition Review** 2002*;* 14(2):56–68.

Fein AJ, Plotnikoff RC, Wilde TC & Spence JC. Perceived environment and physical activity in youth. **International Journal of Behavioural Medicine**. 2004; 11(3): 135-142.

Flegal KM, Ogden CL, Wei R, Kuczmarski RJ & Johnson, CL. Prevalence of overweight in US children: comparison of US growth charts from the Centers for Disease Control and Prevention with other reference values for body mass index. **American Journal of Clinical Nutrition** *2001;* 73(6):1086-1093.

Foerster SB, Gregson J, Beall DL, et al. The California Children's 5 a Day Power Play! Campaign: evaluation of a large-scale social marketing initiative. **Family and Community Health** 1998; 21:46-64.

Franks AL, Kelder SH, Dino GA, Horn KA, Gortmaker SL, Wiecha JL, & Simoes, EJ. School-based Programs: Lessons Learned from CATCH, Planet Health, and Not-On-Tobacco. **Preventing Chronic Disease** 2007; 4(2): A33.

Freedman DS, Dietz WH, Srinivasan SR, & Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa heart study. **Pediatrics** 1999; 103: 1175-1182.

French SA & Stables G. Environmental interventions to promote vegetable and fruit consumption among youth in school settings. **Preventive Medicine** 2003; Dec; 37(6 Pt 1):593-610.

Gidding SS, Bao W, Srinivasan SR, & Berenson GW. Effects of secular trends in obesity on coronary risk factors in children: the Bogalusa heart study. **Journal of Pediatrics** 1995; 127: 868 – 874.

Gittlesohn J, Merkle S, Story M, Stone EJ, Steckler A, Noel J, Davis S, Martin C, & Ethelbah, B. School climate and implementation of the Pathways study. **Preventive Medicine** 2003; 37:S97–S106.

Glanz K, Rimer BK & Lewis FM (eds). *Health Behaviour and Health Education: Theory, Research, and Health Education.* Jossy-Bass: San Franciso, CA. 2002.

Glaser B. *Basics of grounded theory analysis*. Mill Valley, CA: Sociology Press. 1992.

Gordon-Larsen P., Adair, LS, Popkin BM. The relationship of ethnicity, socioeconomic factors, and overweight in US adolescents. **Obesity Research** 2003; 11 (1), 121–129.

Gregory A, Henry DB & Schoeny ME. School Climate and Implementation of a Preventive Intervention. **American Journal of Community Psychology** 2007; 40:250–260.

Grimshaw JM, Campbell MK, Eccles M, Steen IN. Experimental and quasi-experimental designs for evaluating guideline implementation strategies. **Family Practice** 2000;17: S11-8.

Gue SS & Chumlea WC. Tracking of body mass index in children in relation to overweight in adulthood. **American Journal of Clinical Nutrition** 1999; 70(Suppl):S145-S148.

Hanning RM, Woodruff SJ, Lambraki I, Jessup L, Driezen P, & Murphy CC. Nutrient intakes and food consumption patterns among Ontario students in grades six, seven, and eight. **Canadian Journal of Public Health** 2007; 98(1), 12-6.

Health Canada. *Canada's Food Guide to Healthy Eating for People Four Years and Over.* Ottawa: Minister of Public Works and Government Services Canada. Catalogue No. H39-2521/1992E. 1992.

Hebebrand J & Hinney A. Environmental and genetic risk factors in obesity. **Child and Adolescent Psychiatric Clinics of North America** 2008; 18(1): 83-94.

Henriksen L and Jackson C. Reliability of children's self-reported cigarette smoking. **Addictions**, 1999; 42(2): 271-77.

Howerton MW, Bell BS, Dodd KW, Berrigan D, Stolzenberg-Solomon R, and Nebeling L. School-based nutrition programs produced a moderate increase in vegetable and fruit consumption: meta and pooling analyses from 7 studies. **Journal of Nutrition Education and Behaviour** 2007; 39(4): 186-96.

Huck SW and McLean RA. Using a repeated measures ANOVA to analyze the data from a pretest-posttest design: A potentially confusing task. **Psychology Bulletin** 1975; 82(4): 511-518.

Institute of Medicine. Fact Sheet: Childhood Obesity in the United States – Facts and Figures. Washington, DC. 2004. On-line [Available]: http://www.iom.edu/Object.File/Master/22/606/FINALfactsandfigures2.pdf Retrieved: June 17, 2009.

Institute of Medicine. *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids*. Washington DC: National Academy Press. 2005.

Jacobs-Starkey L, Johnson-Down L, & Gray-Donald K. Food habits of Canadians: comparison of intakes in adults and adolescents to *Canada's Food Guide to Healthy Eating*. **Canadian Journal of Dietetic Practice and Research** 2001; 62 :61-67.

Jago R, Watson K, Baranowski T, Zakeri I, Baranowski J & Conry K. Pedometer reliability, validity and daily activity targets among 10- to 15-year-old boys. **Journal of Sports Sciences** 2006; 24(3): 241-51.

Janssen I, Katzmarzyk PT, Boyce WF, King MA, & Pickett W. Overweight and obesity in Canadian adolescents and their associations with dietary habits and physical activity patterns. **Journal of Adolescent Health** 2004; 35(5):360-7.

Jo B, Asparouhov T and Muthén BO. Intention-to-treat analysis in cluster randomized trials with noncompliance. **Statistics in Medicine** 2008; 27:5565–5577.

Johnson L, Mander AP, Jones LR, Emmett PM, & Jebb SA. A prospective analysis of dietary energy density at age 5 and 7 years and fatness at 9 years among UK children. **International Journal of Obesity** 2007; Oct 2, 2007.

Kahn EB, Ramsey LT, Brownson RC, Heath GW, Howze EH, Powell KE, Stone EJ, Rajab MW, & Corso P.The effectiveness of interventions to increase physical activity. A systematic review. **American Journal of Preventative Medicine** 2002; 22(4)(Suppl): 73-107.

Kallestad JH & Olweus D. Predicting Teachers' and Schools' Implementation of the Olweus Bullying Prevention Program: A Multilevel Study. **Prevention & Treatment** 2003; 6(21)*:* posted October 1, 2003

Katzmarzyk PT & Janssen I. The economic costs associated with physical inactivity and obesity in Canada: an update. **Canadian Journal of Applied Physiology** 2004; 29(1):90-115.

Katz DL. School-Based Interventions for Health Promotion and Weight Control: Not Just Waiting on the World to Change. **Annual Review of Public Health** 2009; Vol. 30: 253-272.

Kilanowski CK, Consalvi AR, & Epstein LH. Validation of an electronic pedometer for measurement of physical activity in children. **Pediatric Exercise Science** 1999; 11:63-68.

Kohl HW, Fulton JE, & Caspersen CJ. Assessment of physical activity among children and adolescents: A review and synthesis. **Preventative Medicine** 2000; 31: S54-S76.

Kowalski KC, Crocker PRE, Faulkner RA. Validation of the physical activity questionnaire for older children. **Pediatric Exercise Science** 1997*;* 9(2): 174-86.

Krahnstoever-Davison K & Lawson CT. Do attributes in the physical environment influence children's physical activity? A review of the literature. **International Journal of Behavioural Nutrition and Physical Activity** 2006; Jul 27: 3-19.

Kral TV, Stunkard AJ, Berkowitz RI, Stallings VA, Brown DD, & Faith MS. Daily food intake in relation to dietary energy density in the free-living environment: a prospective analysis of children born at different risk of obesity. **American Journal of Clinical Nutrition** 2007; 86: 41-47**.**

Kropski JA, Keckley CH & Jensen CL. School-based obesity prevention programs: an evidence-based review. **Obesity** 2008; 16(5):1009-18.

Kuczmarski RJ, Ogden CL, Guo SS, Grummer-Strawn LM, Flegal KM, Mei Z, Wei R, Curtin LR, Roche AF, Johnson CL. 2000 CDC Growth Charts for the United States: methods and development. **Vital and Health Statistics. Series 11, Data from the National Health Survey** *2000;* 246: 1-190.

Levin S, Lowry R, Brown DR, & Dietz WH. Physical activity and body mass index among US adolescents: youth risk behavior survey, 1999. **Archives of Pediatric and Adolescent Medicine** 2003; 157(8): 816-20.

Li F, Maddalozzo GF, Hammer P, and Duncan TE. Analysis of longitudinal data of repeated observations using Generalized Estimating Equations methodology. **Measurement in Physical Education and Exercise Science** 1998; 2(2): 93-113.

Luepker RV, Perry CL, McKinlay SM, Nader PR, Parcel GS, Stone EF, Webber LS, Elder JP, Feldman HA, Johnson CC, Kelder SH, & Wu M. Outcomes of a field trial to improve children's dietary patterns and physical activity: The Child and Adolescent Trial for Cardiovascular Health (CATCH). **Journal of the American Medical Association** 1996; 275:768–776.

Lobstein T, Bauer L., & Uauy R. Obesity in children and young people: A crisis in public health. **Obesity Reviews** 2004; 5(Suppl. 1), 1−104.

Lock K, Pomerleau J, Causer L, Altmann DR, McKee M. The global burden of disease attributable to low consumption of fruit and vegetables: implications for the global strategy on diet. **Bulletin of the World Health Organization** 2005; 83(2):100-8.

Louis L, Eston RG, Rowlands AV, Tong KK, Ingledew DK & Fu FH. Validity of heart rate, pedometry and accelerometry for estimating the energy cost of activity in Hong Kong Chinese boys. **Pediatric Exercise Science** 1999; 11: 229-239.

Maynard M, Gunnell, D, Emmett, P M, Frankel, S, Davey Smith, G. Fruit, vegetables, and antioxidants in childhood and risk of adult cancer: the Boyd Orr cohort. *Journal of Epidemiology and Community Health* 2003;57(3):218-25.

Martin, J, Conklin, MT. eds. *Managing Child Nutrition Programs: Leadership for Excellence.* Gaithersburg, MD: Aspen Publishers, Inc., 1999.

Matson-Koffman DM, Brownstein JN, Neiner JA & Greaney ML. A site-specific literature review of policy and environmental interventions that promote physical activity and nutrition for cardiovascular health: what works? **American Journal of Health Promotion** 2005; 19(3): 167-93.

Maziak W, Ward KD, & Stockton MB. Childhood obesity: are we missing the big picture. **Obesity Reviews** 2008; 9(1):35-42.

McMillan TE. Urban form and a child's trip to school: The current literature and a framework for future research. **Journal of Planning Literature** *2005;* **19:** 440–456.

McKenzie TL, Nader PR, Strikmiller PK, Yang M, Stone EJ, Perry CL, Taylor WC, Epping JN, Feldman HA, Luepker RV & Kelder SH. School physical education: Effect of the Child and Adolescent Trial for Cardiovascular Health. **Preventive Medicine** 1996; 25: 423-31.

McPherson RS, Hoelscher DM, Alexander M, Scanlon KS, Serdula MK. Dietary assessment methods among school-aged children: validity and reliability. **Preventative Medicine** 2000; 31:S11–S33.

Michael KDM and Merrell KW. Reliability of children's self-reported internalizing symptoms over short to medium-length time intervals. **Journal of the American Academy of Child and Adolescent Psychiatry** 1998**;** 37(2): 194-201.

Must A, Jacques, PF, Dallal, GE, Bajema, CJ, & Dietz, WH. Long-term morbidity and mortality of overweight adolescents: A follow-up of the Harvard Growth Study of 1922 to 1935. **New England Journal of Medicine** 1992; 327: 1350-1355.

Must A &Strauss, RS. Risks and consequences of childhood and adolescent obesity. **International Journal of Obesity 1999;** 23: S2-S11.

Ness AR, & Fowles JW. Fruit and vegetables, and cardiovascular disease: a review. **International Journal of Epidemiology** 1997; 26:1–13.

Nielsen SJ, Siega-Riz AM, & Popkin BM. Trends in energy intake in U.S. between 1977 and 1996: Similar shifts seen across age groups. **Obesity Research** 2002; 10(5): 370-378.

Nicklas TA, Webber LS, Srinivasan SR, & Berenson GS. Secular trends in dietary intakes and cardiovascular risk factors of 10-y-old children: the Bogalusa Heart Study. **American Journal of Clinical Nutrition 1993;** 57(6):930–937.

Nicklas TA, Johnson CC, Myers L, Farris RP, & Cunningham A. Outcomes of a high school program to increase fruit and vegetable consumption: Gimme 5—A fresh nutrition concept for students. **Journal of School Health** 1998;68:248-253.

Oliver SN & Hayes MV. Neighbourhood Socio-economic Status and the Prevalence of Overweight Canadian Children and Youth. **Canadian Journal of Public Health** 2005; 96(6): 415-420.

Olshansky SJ, Passaro DJ, Hershow RC, Layden J, Carnes BA, Brody J, Hayflick L, Butler RN, Allison DB, & Ludwig DS. A potential decline in life expectancy in the United States in the 21st century. **New England Journal of Medicine** 2005; 352(11): 1138-45.

Patton MQ. *How to use qualitative methods in evaluation*. Newbury Park, CA: Sage Publications. 1987.

Perry CL, Sellers DE, Johnson C, Pedersen S, Bachman KJ, Parcel GS, Stone EJ, Luepker RV, Wu M, Nader PR & Cook K. Effects of the child and adolescent trial for cardiovascular health (CATCH) on fruit and vegetable intake. **Journal of Nutrition Education** 1998; 30:354-360.

Perry CL, Bishop DB, Taylor G, Murray DM, Mays RW, Dudovitz BS, Smyth M & Story M. Changing fruit and vegetable consumption among children: the 5-a-Day Power Plus program in St.Paul, Minnesota. **American Journal of Public Health** 1998;88:603-609.

President's Council on Physical Fitness and Sports. Motivating kids in physical activity. **Research Digest** 2000; 3(11).

Public Healthy Agency of Canada. *Canada's Physical Activity Guide for Children.* Ottawa: Minister of Public Works and Government Services Canada. Catalogue No. H39-646/2002-1EH39. 2002.

Puffer S, Torgerson DJ & Watson J. Evidence for risk of bias in cluster randomized controlled trials: A review of recent trials published in three general medical journals. **British Medical Journal** 2003; 327(7418):785-9.

Puffer S, Torgerson DJ & Watson J. Cluster randomized controlled trials. **Journal of Evaluation in Clinical Practice** 2005; 11(5): 479-483.

Reed KE, Warburton DER, Macdonald HM, Naylor PJ, McKay HA. Action Schools! BC: A school-based physical activity intervention designed to decrease cardiovascular disease risk factors in children. **Preventive Medicine** 2008, 46(6): 525-531.

Resnicow K, Davis-Hearn M, Smith M, Baranowski T, Lin LS, Baranawski J, Doyle C & Wang DT. Social-cognitive predictors of fruit and vegetable intake in children. **Health Psychology** 1997; 16(3): 272-276.

Reynolds KD, Franklin FA, Binkley D, Raczynski JM, Harrington KF, Kirk KA & Person S. Increasing the fruit and vegetable consumption of fourth-graders: results from the high 5 project. **Preventive Medicine** 2000; 30:309-319.

Reynolds LA, Johnson SB, & Silverstein J. Assessing daily diabetes management by 24-hour recall interview: The validity of children's reports. **Journal of Pediatric Psychology** 1990; 15(4):493–509.

Richards GE, Cavallo A, Meyer WJ III, Prince MJ, Peters EJ, Stuart CA, & Smith ER. Obesity, acanthosis nigricans, insulin resistance, and hyperandrogenemia: pediatric perspective and natural history. **Journal of Pediatrics** 1985; 107: 893-897.

Riley T and Hawe P. Researching practice: the methodological case for narrative inquiry. **Health Education Research** 2005; 20: 226-236.

Ritenbaugh C, Kumanyika S, Antipatis V, Jeffery R, Morabia A. Caught in the causal web: A new perspective on social factors affecting obesity. **Healthy Weight Journal** 1999; November/December 1999.

Robert Wood Johnson Foundation. <u>F as in Fat: How Obesity Policies are Failing in America</u>. Washington, DC: Robert Wood Johnson Foundation. 2009.

Rodriguez MA, Winkleby MA, Ahn D, Sundquist J, & Kraemer HC. Identification of population subgroups of children and adolescents with high asthma prevalence: finding from the Third National Health and Nutrition Examination Survey. **Archives of Pediatric and Adolescent Medicine** 2002; 156: 269-275.

Rolls BJ, Bell EA, & Waugh BA. Increasing the volume of a food by incorporating air affects satiety in men. **American Journal of Clinical Nutrition** 2000; 72:361-8.

Rowling L, & Jeffreys V. Capturing complexity: integrating health and education research to inform health promoting schools policy and practice. **Health Education Research, Theory and Practice** 2006; 25(5), 705-716.

Sallis JF, Buono MJ, Roby JJ, Micale FG, & Nelson JA. Seven-day recall and other physical activity self-reports in children and adolescents. **Medical Science in Sports and Exercise** 1993; 25:99-108.

Sallis J, Prochaska JJ, & Taylor WC. A review of correlates of physical activity of children and adolescents. **Medicine and Science in Sports and Exercise** 2000; 32**:** 963–975.

Schwimmer JB, Burwinkle TM, & Varni JW.Health-related quality of life of severely obese children and adolescents**. Journal of the American Medical Association** 2003; 289: 1813-1819.

Sharma M. School-based interventions for childhood and adolescent obesity. **Obesity Reviews** 2006; 7:261–269.

Shepherd EF, Tolza E, McClung CD & Schmalzried TP. Step activity monitor: Increased accuracy in quantifying ambulatory activity. **Journal of Orthopedic Research** 1999; 175(5): 703-708.

Sinha R, Fisch G, Teague B, Tamborlane WV, Banyas B, Allen K, Savoye M, Rieger V, Taksali, S, Barbetta G, Sherwin RS, & Caprio S. Prevalence of impaired glucose tolerance among children and adolescents with marked obesity. **New England Journal of Medicine** 2002; 346: 802-810.

Sirard JR, Pate RR. Physical Activity Assessment in Children and Adolescents. **Sports Medicine** 2001; 31(6): 439-454.

Spence JC & Lee RE. Toward a comprehensive model of physical activity. **Psychology of Sport and Exercise** 2004; 4(10): 7-24.

Stables GJ, Young EM, Howerton MW, Yaroch AL, Kuester S, Solera MK, Cobb K & Nebeling L. Small school-based effectiveness trials increase vegetable and fruit consumption among youth. **Journal of the American Dietetic Association** 2005; 105(2):252-256.
.
Statistics Canada. *Nutrition Canada: a national priority. A report by Nutrition Canada to the Department of National Health and Welfare.* Ottawa, Ontario: Information Canada. Catalogue no. H58-36/1973. 1973.

Statistics Canada. *A Family Affair: Children's Participation in Sports*. Canadian Social Trends. Ottawa, Ontario: Statistics Canada. Cat. No. 11-008. 2000.

Statistics Canada. A National Overview, Population and Dwelling Counts. Ottawa, ON: Statistics Canada, Census Operations Division, Geography Division. 2002.

Statistics Canada. *Nutrition: Findings from the Canadian Community Healthy Survey. Measured Obesity: Overweight Canadian Children and Adolescents by Margot Shields*. Cat. No. 82–620–MWE200501. 2004; On-line [Available]: http://www.statcan.ca/english/research/82-620-MIE/2005001/pdf/cobesity.pdf Retrieved June 17, 2009.

Statistics Canada. *Canadian Community Health Survey. Nutrition: Findings from the Canadian Community Health Survey. Overview of Canadians' Eating Habits 2004 by Didier Garriguet.* Cat. No. 82-620-MIE-No.2. 2006; On-line [Available]: http://www.statcan.ca/english/research/82-620-MIE/82-620-MIE2006002.pdf. Retrieved June 17, 2009.

Stone EJ, McKenzie TL, Welk GJ & Booth ML. Effects of physical activity interventions in youth: Review and synthesis. **American Journal of Preventive Medicine** 1998; 15(4): 298-314.

Strauss RS. Childhood obesity and self-esteem. **Pedatrics** 2000*;* 105(1): e15.

Summerbell CD, Waters E, Edmunds LD, Kelly S, Brown T, & Campbell KJ. Interventions for preventing obesity in children. **Cochrane Database of Systematic Reviews** 2005; Issue 3. Art. No.: CD001871. DOI: 10.1002/14651858.CD001871.pub2

Swinburn B. Obesity prevention in children and adolescents. **Child and Adolescent Psychiatrics Clinics of North America** 2009; 18(1):209-23.

Tell GS & Vellar OD. Physical activity and cardiovascular disease risk factors in adolescents: The Oslo Youth Study. **Preventive Medicine** 1988; 17: 12-24.

Toriana RP, Briefel RR, Carroll MD, & Bialostosky K. Energy and fat intakes of children and adolescents in the United States: data from the National Health and Nutrition Examination Surveys. **American Journal of Clinical Nutrition** 2000; 72(s): S22-S27.

Tremblay MS & Willms JD. Secular trends in the body mass index of Canadian children. **Canadian Medical Association Journal** 2000; 163(11): 1429-1433.

Tremblay MS, Willms JD. Is the Canadian childhood obesity epidemic related to physical inactivity. **International Journal of Obesity and Related Metabolic Disorders** 2003; 27(5) 1100-1105.

Trost SG, Pate RR,Saunders R,Ward DS, Dowda D, and Felton GA. Prospective Study of the Determinants of Physical Activity in Rural Fifth-Grade Children. **Preventive Medicine** 1997; 26(2):257-263.

Tudor-Locke C. Taking steps toward increased physical activity: Using pedometers to measure and motive. **Research Digest** 2002*;* 3(17): 1-8.

Tudor-Locke C, Pangrazi RP, Corbin CB, Rutherford WJ, Vincent SD, Raustorp A, Tomson LM, & Cuddihy TF. BMR-referenced standards for recommended pedometer-determined steps/day in children. **Preventative Medicine** 2004; 38(6): 857-64.

Twisk JWR, Smidt N, & de Vente W. Applied analysis of recurrent events: a practical overview. **Journal of Epidemiology in Community Health** 2005; 59: 706-710

U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation. Changes in Children's Diets: 1989-1991 to 1994-1996, CN-01-CD2. P Gleason & C Suitor (Eds.) Alexandria, VA: USDA. 2001.

United States Department of Health and Human Services. "Guidelines for School Health Programs to Promote Lifelong Healthy Eating," **Morbidity and Mortality Weekly Report Recommendations and Reports** 1996; 45: RR-9, June 14.

U.S. Health Resources and Services Administration, Maternal and Child Health Bureau. National Survey of Children's Health, 2007. Overweight and Physical Activity Among Children: A Portrait of States and the Nation 2009. Washington, DC: U.S. Health Resources and Services Administration.

van Sluijs EM, McMinn AM, & Griffin SJ. Effectiveness of interventions to promote physical activity in children and adolescents: systematic review of controlled trials. **British Medical Journal** 2007; 335 (7622): 703.

Varnie JW, Limbers CA, Burwinkle TM. How young can children reliably and validly self-report their health-related quality of life?: An analysis of 8,591 children across age subgroups with the PedsQL™ 4.0 Generic Core Scales. **Health and Quality of Life Outcomes** *2007; Jan 3:* 5(1).

Veugelers PJ & Fitzgerald AL. Effectiveness of school programs in preventing childhood obesity: a multilevel comparison. **American Journal of Public Health** 2005; 95(3): 432-435.

Veugelers PJ, Fitzgerald AL & Johnston E. Dietary intake and risk factors for poor diet quality among children in Nova Scotia. Canadian Journal of Public Health 2005; 96(3): 212.

Wang F and Veugelers PJ. Self-esteem and cognitive development in the era of the childhood obesity epidemic. **Obesity Reviews** 2008; 9(6):615-23.

Welk GJ, Corbin CB, & Dale D. Measurement issues in the assessment of physical activity in children. **Research Quarterly in Exercise and Sport** 2000; 71(2 Suppl): S59-73.

Whitaker RC, Wright JA, Pepe MS, Seidel KD, & Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. **New England Journal of Medicine** 1997*;* 337(13): 869-873.

Wilcox S, Tudor-Locke CE, & Ainsworth BE. Physical activity patterns, assessment and motivation in older adults. In: RJ Shepard (Ed), *Gender, Physical Activity and Aging.* CRC Press: Boca Raton, FL: 2002.

Willms JD, Tremblay MS, Katzmarzyk PT. Geographic and Demographic Variation in the Prevalence of Overweight Canadian Children. Obesity Research 2003; 11: 668-673.

Willows ND, Johnson M, Ball GDC. Prevalence estimates of overweight and obesity in Cree preschool children in northern Quebec according to international and U.S. reference criteria. **American Journal of Public Health** 2007; 97(2):311-16.

Wofford LG. Systematic review of childhood obesity prevention. **Journal of Pediatric Nursing** 2008; 23(1): 5-19.

World Health Organization. *Physical Status: The Use and Interpretation of Anthropometry. Report of the WHO Expert Committee*. Geneva: WHO Technical Report Series, (854): 1995.

World Health Organization. Diet, Nutrition and the prevention of Chronic Diseases. Report of a Joint WHO/FAO Expert consultation. Geneva: WHO Technical Report Series 916, 2003.

World Health Organization. Fact Sheet No. 311: Obesity and Overweight, 2006; On-line [Available]: http://www.who.int/mediacentre/factsheets/fs311/en/index.html. Retrieved June 17, 2009

Yu CW, Sung RY, So R, Lam K, Nelson EA, Li AM, Yuan Y, & Lam PK. Energy expenditure and physical activity of obese children: cross-sectional study. **Hong Kong Medical Journal** 2002; 8(5):313-7.

Appendix 1: Ethics Certificate

Faculty of Agriculture, Forestry, and Home Economics
Human Research Ethics Board
Approval

is hereby granted to:

Linda McCargar, Principal Investigator for

04-51 Promoting healthy eating and active living in schools: one step at a time

for a term of one year, provided there is no change in experimental procedures. Any changes in experimental procedures must be submitted in writing to the HREB.

Granted: October 26, 2004

for *Naomi Krogman, Chair, AFHE REB*

Appendix 2: Information Sheet and Consent Form

INFORMATION LETTER

Title of Research Project: Promoting Healthy Eating and Active Living in Schools: One Step at a Time

This information letter describes a project being conducted at your son or daughter's school by the University of Alberta in partnership with elementary schools in the Edmonton area. Dr. Linda McCargar from the Department of Agricultural, Food and Nutritional Sciences and Dr. Ron Plotnikoff from the Faculty of Physical Education and Recreation and the Centre for Health Promotion Studies are investigators on the project. We hope the information below will help you decide if your son or daughter should be a part of it.

Your school board and principal have given us permission to conduct this research. This study has received ethical approval from the Human Ethics Review Board in the Faculty of Agriculture, Forestry and Home Economics at the University of Alberta.

Why is the study being done?
The purpose of the study is to run a health promotion program in the schools based on two simple messages (walk more everyday; eat more fruits and vegetables every day). Activities and resources and university student facilitators will help support the schools to help students make healthy choices.

Who are we looking for?
All students in your son or daughters school are being invited to participate in the research. The study will include two elementary schools that will start the program now and two elementary schools that will receive the program and resources six months from now. Your school <u>will start the program right now</u>.

What does your son or daughter have to do?
Once we receive your returned consent form, your child will also be asked to consent to participate. If your son or daughter is in grade 3-6 then he or she will have measurements of:

- Height and weight,
- Diet and physical activity (assessed with questionnaires and interviews),
- Fitness (measured by a short run test),
- Walking behavior (measured by a pedometer or step-counter, which your child will receive), and they will be asked to record

steps/day in a daily diary. [For 3 consecutive days at the beginning of the study; and during the project}.

- Fruit and vegetable intake (measured by a fruit and vegetable checklist), and they will be asked to record servings/day in a daily diary. [For 3 consecutive days at the beginning of the study; and during the project}.

If your son or daughter is in grade K-2 then he or she will have measurements of:

- Walking behaviour (measured by a pedometer or step-counter, which your child will receive), and they will be asked to record steps/day in a daily diary. [For 3 consecutive days at the beginning of the study; and during the project}.
- Fruit and vegetable intake (measured by a fruit and vegetable checklist), and they will be asked to record servings/day in a daily diary. [For 3 consecutive days at the beginning of the study; and during the project}.

These measures will also be done again in 6 months at the end of the program. Also, at the end of the program, some students will be asked to volunteer to participate in a one hour discussion (focus groups) about what they thought of the project. These sessions will be audio taped. Once general comments are determined from the tapes, they will be destroyed. No names will be associated with any comments.

The health promotion program will include providing pedometers to the entire school to encourage more walking. School newsletters will include monthly healthy eating and active living suggestions. Lastly, university student facilitators from Nutrition and Physical Education Programs at the University of Alberta will be at the schools at lunch hour three times per week to assist in healthy eating and active living activities. This will be very flexible and students can join in when they want to. They may want to participate once per week or three times per week. It is their choice. An example of an activity may be something as simple as a group walk around the school yard or walking challenges between classrooms.

What will the information be used for?

The information from this study will increase our understanding of nutrition and physical activity habits of children in Grades K-6. As well, we will learn what health promotion strategies are useful to children and schools to increase healthy choices and healthy behaviors of children. All information obtained will only be reported as group results in any reports, such as a master’s thesis, conference presentations, or publications in an academic journal. Results will be compared between schools that receive the program and schools that do not.

What if I change my mind about participation?
Being involved in this research project is completely voluntary. Your son or daughter is free to withdraw at any time until June 30, 2005. If you agree to their participation now but change your mind later that is fine. Just let us know.

Where is the information kept?
Only researchers at the University of Alberta will have access to the information. Everything will be coded by an identification number, not by a student's name. Computer and paper files will be kept in locked cabinets and locked offices at the University of Alberta. All individual data will be kept strictly confidential.

Who is funding the project?
The research is funded by the Canadian Institutes for Health Research

How do I include my son/daughter in the project?
We must receive a signed consent form from you to proceed. Please have your son or daughter return the consent form to their teacher.

What if I have questions about the study?
Please contact us if you require further information.

Sincerely,

Dr. Linda McCargar, Professor
Dept. Agricultural, Food and Nutritional Science

410 Agriculture/Forestry Centre
University of Alberta
Phone: 492-9287
Email: linda.mccargar@ualberta.ca

Dr. Ron Plotnikoff, Professor
Faculty of Physical Education and Recreation, and Centre for Health Promotion Studies
5-10 University Extension Centre
University of Alberta
Phone: 492-1358
Email: ron.plotnikoff@ualberta.ca

CONSENT FORM

Please sign, date and return this to your son or daughter's teacher.

Title of Research Project: Promoting healthy eating and active living in schools: One step at a time.

Investigators:

Dr. Linda McCargar, Professor
Dept. Agricultural, Food and Nutritional Science

410 Agriculture/Forestry Centre
University of Alberta
Phone: 492-9287
Email: linda.mccargar@ualberta.ca

Dr. Ron Plotnikoff, Professor
Faculty of Physical Education and Recreation, and Centre for Health Promotion Studies
5-10 University Extension Centre
University of Alberta
Phone: 492-1358
Email: ron.plotnikoff@ualberta.ca

Consent: Please circle your answers:

Do you understand that you have been asked to include your son or daughter in a nutrition and physical activity research study?

Yes **No**

Have you received and read a copy of the attached Information Letter?

Yes **No**

Do you understand that there are no risks involved in including your son or daughter in this research study?

Yes **No**

Do you understand that your son or daughter can quit taking part in this study at any time? Neither you nor your child has to say why and it will not affect their normal activities at school in any way. Final withdrawal date is June 30th, 2005.

Yes **No**

Was confidentiality adequately explained to you in the Information Letter?

Yes **No**

If your son/daughter volunteers for the focus group discussions at the end of the study, may we audiotape the discussion?

Yes **No**

Do you understand who will be able to access the information collected from this study?

Yes **No**

Do you understand that group results from your school may be compared to group results from other schools?

Yes **No**

Do you understand that the data collected will only be used for the purpose of the study?

Yes **No**

Will you consent to have your son or daughter take part in this research study?

Yes **No**

Please sign and date below:

Date: ___________________________

Name of Parent/Guardian: __________________________

Signature of Parent/Guardian: _______________________________

Son or daughter's name: ____________________________

If you have any concerns, complaints or consequences regarding this research project, you may contact Georgie Jarvis, Administrative Support to the AFHE Research Ethics Board, 2-14 Ag/For Centre, U of A, Edmonton AB T6G 2P5, 780-492-4931, Fax 780-492-0097

Appendix 3: Child Assent Form

Information sheet/assent form for children

Hi there! We need your help. We want to see how healthy you are. We want information from you so we can learn what makes children healthy.

For you to help us, we will ask you some questions and get you to do a physical challenge. We will ask questions like, ***"what sports and games do you do?"*** and ***"what did you eat yesterday***?" We will give you a pedometer (or step counter) to wear every day. It counts every step you take.

You can stop doing this anytime you want. Just let us know you would rather not continue.

Write in the bottom part of this page to let us know if you want to join this research study.

Please check (√) one of the following choices:

I want to join this research study ___________

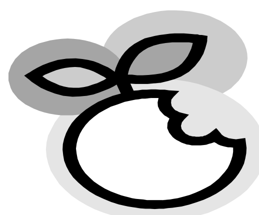
I don't want to join this research study ___________

My name is: ____

Oct 24/04

Appendix 4: Daily Tracking Journal

One Step, One Bite At a Time



Daily Tracker

4-10 Agriculture/Forestry Centre
University of Alberta
Edmonton, Alberta
Canada
T6G-2P5

One Bite, One Step at a Time and You

Welcome to *One Bite, One Step at a Time*, a pilot project of the University of Alberta that will assess physical activity levels and fruit and vegetables intake in school-age children.

The *One Bite, One Step at a Time Daily Tracker* is an essential component of the program. Student's involved in the program will use the *Daily Tracker* to:

- Record the number of steps they take each day (based on their pedometer readings)
- Record the number of servings of vegetables and fruits they take in each day
- Obtain basics facts about healthy eating and active living for children.

Getting Started - Using the Daily Tracker

Accurately recording steps and servings of vegetables and fruits is an essential part of the program. The process is fairly straightforward. Use the following information to help you accurately record items in your *Tracker*:

Tracking Servings of Vegetables and Fruit

Your *Daily Tracker* contains a special worksheet, called the *Vegetable and Fruit Tracker*, that you must use to record the number of vegetable and fruit servings you eat each day. There is a separate sheet for each month that the program will operate (January through May 2005).

Look at the *Vegetable and Fruit Tracker* and you will see a series of circles and squares in rows.

Di
d
yo

1. ○○○○○□□□□
2. ○○○○○□□□□
3. ○○○○○□□□□
4. ○○○○○□□□□
5. ○○○○○□□□□

Each row on the *Vegetable and Fruit Tracker* represents one day of the month. Be sure that you are in the correct row for the day that you are tracking when recording servings in your *Tracker*.

Each time you eat one serving of vegetables or fruit, place a check mark in one of the circles. Continue this process until you fill in all 5 circles.

If you eat more than 5 servings of vegetables and fruits in a day, continue the tracking process by placing a check mark in one of the squares. Do this until you have accurately recorded the number of servings of vegetables and fruits you ate that day.

Remember . . . only record servings of vegetables and fruits that you actually eat. Don't record foods that you do not finish or that you were served but did not eat.

What Counts as a Serving of Vegetables and Fruits?

One Bite, One Step at a Time uses the same servings sizes as *Canada's Food Guide to Healthy Eating* during the tracking process. One serving of vegetables and fruit is:

- 1 medium size piece of vegetable or fruit
  - E.g. 1 banana, 1 apple, 1 orange, 1 potato, 1 carrot
- 125 mL (1/2 cup) of vegetable or fruit pieces (raw or cooked)
  - E.g.125 mL of grapes, 125 mL of kernel corn, 125 mL of mashed potatoes or French Fries
- 125 mL (½ cup) of 100% vegetable or fruit juice
  - E.g. 125 mL of orange juice, 125 mL of vegetable cocktail, 125 mL pineapple juice
- 250 mL (1 cup) of salad greens or lettuce
  - E.g. 250 mL of tossed salad

Remember to record vegetables and fruits that are part of combination dishes or foods. Examples include:

- Tomato sauce
- Salsa
- Vegetables in stews or casseroles or on pizza
- Fruits blended into a smoothie
- Lettuce leaves and tomato slices on burgers or other sandwiches

If you are not sure what to record, please talk to your teacher who will pass your question along to the *One Bite, One Step at a Time Research Team* for an answer.

Foods That Don't Count as Servings of Vegetables and Fruits

Some foods can be difficult to classify. For example, cucumber pickles may seem like a vegetable because they come from cucumbers. However, not all foods that seem like vegetables and fruits really are. The following foods <u>do not</u> count as servings of vegetables and fruits and should **<u>not</u>** be recorded in your *Vegetable and Fruit Tracker*:

- Fruit jam or spread
- Fruit punches, beverages, or cocktails
- Fruit snacks or fruit roll-ups
- Dried fruit strips made from 100% fruit are different and should be counted

- Pickles
- Ketchup

If in doubt – find out! If you have questions, please talk to your teacher who will pass your question along to the *One Bite, One Step at a Time Research Team* for an answer.

Tracking Steps

Your *Daily Tracker* contains a special worksheet, called the *Step* T*racker*, that you must use to record the number of steps you take each day. There is a separate sheet for each month that the program will operate (January through May 2005).

Look at the *Step Tracker* and you will see a series of numbered rows.

1 ____________________ steps
2 ____________________ steps
3 ____________________ steps
4 ____________________ steps

Be sure that you are in the correct row for the day that you are tracking when recording steps in your *Tracker.*

Write down your number of steps before you go to bed. Remember to reset your pedometer to zero in the morning.

Noon-hour activity sessions are part of the *One Step, One Bite at a Time* program. Please fill in the box (see example – below) on your *Step Tracker* and let us know if you took part in these sessions.

Did you take part in the noon activity sessions? Let us know by circling your answer: I attended the noon activity sessions: YES NO How many noon activity sessions did you attend this month? ______________ (Keep track by making a check mark beside the days you attended)

Using Your Pedometer

Pedometers are small, plastic gadgets that track the number of steps a person takes. They are simple to use. Keep the following information in mind to make sure that your pedometer accurately records the number of steps you take each day.

How do I use the pedometer?

The pedometer should be worn on the left or right side of your body directly above the leg, on your waistband. **Wear the pedometer from the time you get up to the time you go to bed.**
After you put the pedometer on your waistband in the morning, reset it to zero by pushing on the yellow button. Close the pedometer and start moving….don't peek! At bedtime, open the pedometer and write down how many steps you have taken.

What If I Need to Take Off My Pedometer?

Don't take off your pedometer during the day unless it is absolutely necessary. You can do most activities while wearing your pedometers. However, there are a few situations where you may have to take your pedometer off for safety reasons or to keep the pedometer from becoming damaged. Examples of these kinds of situations include:

- Swimming
- Gymnastics
- Bathing or showering
- Some contact sports (e.g. hockey, football, rugby)

If you are not sure and don't know whether to remove your pedometer or not, talk to your parent(s) or caregiver, your teacher, or the coach leading the activity. They will be able to give you good advice.

If you do remove your pedometer, but are still active remember to estimate the number of steps you would have taken using this simple formula:

10 minutes of activity = 1000 steps

If you have questions about estimating the number of steps, please talk to you teacher who will pass your question along to the *One Step, One Bite Research Team* for an answer.

Are Pedometers Breakable?

YES!!! Pedometers are sturdy and designed to withstand some bumping and jumping. However, they are made out of plastic and will break if they are hit (hard) or if they are submerged in water. Be kind to your pedometer. . . you will be wearing it for several months.

Setting Goals and ***Track'n the Action***

At the end of each month you will be asked to fill in a *Track'n the Action* worksheet. This worksheet will ask you to think about how many vegetables and fruits you usually ate and how many steps you usually took during the previous month. Based on this information, you'll be asked to set a goal for the coming month.

Remember . . . your goal belongs to you and different children will have different goals each month.

January 2005

One Step, One Bite At a Time

Your vegetable and fruit goal for January is to:

- *Increase the number of vegetables and fruits you usually eat by* ***<u>one</u>*** *serving!*

- This means that if you normally eat 4 servings of vegetables and fruit each day, try to eat 5 servings, everyday during January.
- Use the results of the 3-day tracking process to help you decide how many servings of vegetables and fruit you usually eat.

- Remember, one serving is a very small amount of vegetables or fruit.

- Try adding 1 extra apple to your snacks or 125 mL (½-cup) more of your favorite veggies at dinner.

○ I normally eat ________________ servings of vegetables and fruit each day. ○ I will try to eat ____________servings of vegetables and fruit each day in January.

Vegetable and Fruit Tracker – January 2005

Make a check mark each time you eat one serving of vegetables or fruit.

1	○	○	○	○	○	☐	☐	☐	☐	☐
2	○	○	○	○	○	☐	☐	☐	☐	☐
3	○	○	○	○	○	☐	☐	☐	☐	☐
4	○	○	○	○	○	☐	☐	☐	☐	☐
5	○	○	○	○	○	☐	☐	☐	☐	☐
6	○	○	○	○	○	☐	☐	☐	☐	☐
7	○	○	○	○	○	☐	☐	☐	☐	☐
8	○	○	○	○	○	☐	☐	☐	☐	☐
9	○	○	○	○	○	☐	☐	☐	☐	☐
10	○	○	○	○	○	☐	☐	☐	☐	☐
11	○	○	○	○	○	☐	☐	☐	☐	☐
12	○	○	○	○	○	☐	☐	☐	☐	☐
13	○	○	○	○	○	☐	☐	☐	☐	☐
14	○	○	○	○	○	☐	☐	☐	☐	☐
15	○	○	○	○	○	☐	☐	☐	☐	☐
16	○	○	○	○	○	☐	☐	☐	☐	☐
17	○	○	○	○	○	☐	☐	☐	☐	☐
18	○	○	○	○	○	☐	☐	☐	☐	☐
19	○	○	○	○	○	☐	☐	☐	☐	☐
20	○	○	○	○	○	☐	☐	☐	☐	☐
21	○	○	○	○	○	☐	☐	☐	☐	☐
22	○	○	○	○	○	☐	☐	☐	☐	☐
23	○	○	○	○	○	☐	☐	☐	☐	☐
24	○	○	○	○	○	☐	☐	☐	☐	☐
25	○	○	○	○	○	☐	☐	☐	☐	☐
26	○	○	○	○	○	☐	☐	☐	☐	☐
27	○	○	○	○	○	☐	☐	☐	☐	☐
28	○	○	○	○	○	☐	☐	☐	☐	☐
29	○	○	○	○	○	☐	☐	☐	☐	☐
30	○	○	○	○	○	☐	☐	☐	☐	☐
31	○	○	○	○	○	☐	☐	☐	☐	☐

Goal: Eat at least 5 servings of vegetables and fruit each day.

← START HERE – Friday, January 14th

One Step, One Bite

At a Time

Your step goal for January is to:

- *Take an extra 2000 steps each day during the month of January!*

- This means that if you usually take 2000 steps each day, you need to try and take 4000 steps each day (in total) each day during January.
  - Use the results of the 3-day tracking process to help you decide how many steps you usually take.
- Remember, 1000 steps are equal to about 10 minutes of activity.

- Add a 20-minute session of walking your dog, or dancing, or playing tag to accumulate 2000 extra steps

I normally take ________________ steps each day.

I will try to take a total of _______________________ each day during January.

Step Tracking

January 2005

Write down your number of steps before you go to bed. Remember to reset your pedometer to zero in the morning.

Did you take part in the noon activity sessions? Let us know by circling your answer:

I attended the noon activity sessions:
YES NO

How many noon activity sessions did you attend this month? ______________
(Keep track by making a check mark beside the days you attended)

1	________________________	steps
2	________________________	steps
3	________________________	steps
4	________________________	steps
5	________________________	steps
6	________________________	steps
7	________________________	steps
8	________________________	steps
9	________________________	steps
10	________________________	steps
11	________________________	steps
12	________________________	steps
13	________________________	steps
14	________________________	steps ← **START HERE – Friday, January 14th**
15	________________________	steps
16	________________________	steps
17	________________________	steps
18	________________________	steps
19	________________________	steps
20	________________________	steps
21	________________________	steps
22	________________________	steps
23	________________________	steps
24	________________________	steps
25	________________________	steps
26	________________________	steps
27	________________________	steps
28	________________________	steps
29	________________________	steps
30	________________________	steps
31	________________________	steps

Track'n the Action

Take a minute and think about what you normally do and set a goal for the month ahead.

How many vegetables and fruit do you normally eat each day?

- If you normally:
  - Eat less than 5 servings of vegetables and fruit each day ➔ your goal is to eat at least one more serving of vegetables and fruit daily.

- If you normally:
  - Eat 5 - 10 servings of vegetables and fruit each day ➔ your goal is to keep doing what you're doing! You don't need to add any additional servings of vegetables and fruit. Aim to keep your total at 5 - 10 servings daily.

How many steps do you normally take each day?

- If you normally:
  - Take less than 12,000 steps each day ➔ your goal is to take 2000 more steps daily.

- If you normally:
  - Take 12,000 - 15,000 steps each day ➔ your goal is to keep doing what you're doing! You don't need to add any additional steps. Aim to keep your total number of steps at 12,000 - 15,000 steps daily.

My vegetable and fruit goal is to eat ________________________ servings each day this month.

My step goal is to take ________________________________ steps each day this month.

My Journal Page

Use this page to write down ideas that you brainstorm for increasing the number of steps that you take or the number of servings of vegetables and fruits you eat each day. Use your ideas to help you achieve your monthly goal.

February

2005

Beat the Cold

Vegetables and Fruit

- Vitamin C can help you from catching colds, and it keeps your teeth and gums healthy.
- Did you know that broccoli and green pepper are high in vitamin C?
- Did you know that 1 cup of kiwi is higher in vitamin C than 1 medium orange?
- Other vegetables and fruits that are high in vitamin C include: strawberries, grapefruit, orange juice and tomatoes!
- Try to choose vegetables and fruits that contain vitamin C each day.

Steps

February's activity sessions will also show you a variety of indoor and outdoor activities to stay warm for February!

- Walk around the school, play soccer, and shovel snow as activities to keep you warm when you are outside.
- Walk around the gym, dance, and skip rope as activities to keep you warm inside when it is too cold outside.

Vegetable and Fruit Tracker – February 2005

Make a check mark each time you eat one serving of vegetables or fruit.

Goal: Eat at least 5 servings of vegetables and fruit each day.

1	○	○	○	○	○	□	□	□	□	□
2	○	○	○	○	○	□	□	□	□	□
3	○	○	○	○	○	□	□	□	□	□
4	○	○	○	○	○	□	□	□	□	□
5	○	○	○	○	○	□	□	□	□	□
6	○	○	○	○	○	□	□	□	□	□
7	○	○	○	○	○	□	□	□	□	□
8	○	○	○	○	○	□	□	□	□	□
9	○	○	○	○	○	□	□	□	□	□
10	○	○	○	○	○	□	□	□	□	□
11	○	○	○	○	○	□	□	□	□	□
12	○	○	○	○	○	□	□	□	□	□
13	○	○	○	○	○	□	□	□	□	□
14	○	○	○	○	○	□	□	□	□	□
15	○	○	○	○	○	□	□	□	□	□
16	○	○	○	○	○	□	□	□	□	□
17	○	○	○	○	○	□	□	□	□	□
18	○	○	○	○	○	□	□	□	□	□
19	○	○	○	○	○	□	□	□	□	□
20	○	○	○	○	○	□	□	□	□	□
21	○	○	○	○	○	□	□	□	□	□
22	○	○	○	○	○	□	□	□	□	□
23	○	○	○	○	○	□	□	□	□	□
24	○	○	○	○	○	□	□	□	□	□
25	○	○	○	○	○	□	□	□	□	□
26	○	○	○	○	○	□	□	□	□	□
27	○	○	○	○	○	□	□	□	□	□
28	○	○	○	○	○	□	□	□	□	□
29	○	○	○	○	○	□	□	□	□	□
30	○	○	○	○	○	□	□	□	□	□
31	○	○	○	○	○	□	□	□	□	□

Step Tracking

February 2005

Write down your number of steps before you go to bed. Remember to reset your pedometer to zero in the morning.

Did you take part in the noon activity sessions? Let us know by circling your answer:

I attended the noon activity sessions:

YES NO

How many noon activity sessions did you attend this month? ______________

(Keep track by making a check mark beside the days you attended)

1 ________________________ steps
2 ________________________ steps
3 ________________________ steps
4 ________________________ steps
5 ________________________ steps
6 ________________________ steps
7 ________________________ steps
8 ________________________ steps
9 ________________________ steps
10 ________________________ steps
11 ________________________ steps
12 ________________________ steps
13 ________________________ steps
14 ________________________ steps
15 ________________________ steps
16 ________________________ steps
17 ________________________ steps
18 ________________________ steps
19 ________________________ steps
20 ________________________ steps
21 ________________________ steps
22 ________________________ steps
23 ________________________ steps
24 ________________________ steps
25 ________________________ steps
26 ________________________ steps
27 ________________________ steps
28 ________________________ steps
29 ________________________ steps
30 ________________________ steps
31 ________________________ steps

Track'n the Action

Take a minute and think about what you normally do and set a goal for the month ahead.

How many vegetables and fruit do you normally eat each day?

- If you normally:
  - Eat less than 5 servings of vegetables and fruit each day ➔ your goal is to eat at least one more serving of vegetables and fruit daily.

- If you normally:
  - Eat 5 - 10 servings of vegetables and fruit each day ➔ your goal is to keep doing what you're doing! You don't need to add any additional servings of vegetables and fruit. Aim to keep your total at 5 - 10 servings daily.

How many steps do you normally take each day?

- If you normally:
  - Take less than 12,000 steps each day ➔ your goal is to take 2000 more steps daily.

- If you normally:
  - Take 12,000 - 15,000 steps each day ➔ your goal is to keep doing what you're doing! You don't need to add any additional steps. Aim to keep your total number of steps at 12,000 - 15,000 steps daily.

My vegetable and fruit goal is to eat ________________________ servings each day this month.

My step goal is to take ________________________________ steps each day this month.

My Journal Page

Use this page to write down ideas that you brainstorm for increasing the number of steps that you take or the number of servings of vegetables and fruits you eat each day. Use your ideas to help you achieve your monthly goal.

March

2005

Snack Attack

Vegetables and fruits

March's activity sessions will focus on using vegetables and fruits to make awesome snacks.

- Kids need snacks. Snacks help to fuel your body and your brain!
- Experiment with different vegetables and fruit. Add vegetables and fruits that you haven't tried before to your snacks in March!
- Vegetables and fruits to try as part of a snack include watermelon cubes, kiwi, star fruit, cucumber slices, carrot sticks, and cherry tomatoes!

Steps

March's activity sessions will provide you with ideas to increase steps in fun ways.

- Daily physical activity is essential for helping kids to grow and develop in a healthy way.
- Try adding steps in creative ways:
    - See if you can walk 2000 steps in 15 minutes.
    - Try speed walking for 10 minutes and then regular walking for another 10 minutes. How many steps did you take?
        - Speed walking is faster than a normal walk but slower than a run!

Vegetable and Fruit Tracker – March 2005

Make a check mark each time you eat one serving of vegetables or fruit.

1	○	○	○	○	○	□	□	□	□	□
2	○	○	○	○	○	□	□	□	□	□
3	○	○	○	○	○	□	□	□	□	□
4	○	○	○	○	○	□	□	□	□	□
5	○	○	○	○	○	□	□	□	□	□
6	○	○	○	○	○	□	□	□	□	□
7	○	○	○	○	○	□	□	□	□	□
8	○	○	○	○	○	□	□	□	□	□
9	○	○	○	○	○	□	□	□	□	□
10	○	○	○	○	○	□	□	□	□	□
11	○	○	○	○	○	□	□	□	□	□
12	○	○	○	○	○	□	□	□	□	□
13	○	○	○	○	○	□	□	□	□	□
14	○	○	○	○	○	□	□	□	□	□
15	○	○	○	○	○	□	□	□	□	□
16	○	○	○	○	○	□	□	□	□	□
17	○	○	○	○	○	□	□	□	□	□
18	○	○	○	○	○	□	□	□	□	□
19	○	○	○	○	○	□	□	□	□	□
20	○	○	○	○	○	□	□	□	□	□
21	○	○	○	○	○	□	□	□	□	□
22	○	○	○	○	○	□	□	□	□	□
23	○	○	○	○	○	□	□	□	□	□
24	○	○	○	○	○	□	□	□	□	□
25	○	○	○	○	○	□	□	□	□	□
26	○	○	○	○	○	□	□	□	□	□
27	○	○	○	○	○	□	□	□	□	□
28	○	○	○	○	○	□	□	□	□	□
29	○	○	○	○	○	□	□	□	□	□
30	○	○	○	○	○	□	□	□	□	□
31	○	○	○	○	○	□	□	□	□	□

Goal: Eat at least 5 servings of vegetables and fruit each day.

Step Tracking

March 2005

Write down your number of steps before you go to bed. Remember to reset your pedometer to zero in the morning.

1 ______________________ steps
2 ______________________ steps
3 ______________________ steps
4 ______________________ steps
5 ______________________ steps
6 ______________________ steps
7 ______________________ steps
8 ______________________ steps
9 ______________________ steps
10 ______________________ steps
11 ______________________ steps
12 ______________________ steps
13 ______________________ steps
14 ______________________ steps
15 ______________________ steps
16 ______________________ steps
17 ______________________ steps
18 ______________________ steps
19 ______________________ steps
20 ______________________ steps
21 ______________________ steps
22 ______________________ steps
23 ______________________ steps
24 ______________________ steps
25 ______________________ steps
26 ______________________ steps
27 ______________________ steps
28 ______________________ steps
29 ______________________ steps
30 ______________________ steps
31 ______________________ steps

Did you take part in the noon activity sessions? Let us know by circling your answer:

I attended the noon activity sessions:
YES NO

How many noon activity sessions did you attend this month? _____________
(Keep track by making a check mark beside the days you attended)

Track'n the Action

Take a minute and think about what you normally do and set a goal for the month ahead.

How many vegetables and fruit do you normally eat each day?

- If you normally:
  - Eat less than 5 servings of vegetables and fruit each day ➔ your goal is to eat at least one more serving of vegetables and fruit daily.

- If you normally:
  - Eat 5 - 10 servings of vegetables and fruit each day ➔ your goal is to keep doing what you're doing! You don't need to add any additional servings of vegetables and fruit. Aim to keep your total at 5 - 10 servings daily.

How many steps do you normally take each day?

- If you normally:
  - Take less than 12,000 steps each day ➔ your goal is to take 2000 more steps daily.

- If you normally:
  - Take 12,000 - 15,000 steps each day ➔ your goal is to keep doing what you're doing! You don't need to add any additional steps. Aim to keep your total number of steps at 12,000 - 15,000 steps daily.

My vegetable and fruit goal is to eat ________________________ servings each day this month.

My step goal is to take ________________________________ steps each day this month.

My Journal Page

Use this page to write down ideas that you brainstorm for increasing the number of steps that you take or the number of servings of vegetables and fruits you eat each day. Use your ideas to help you achieve your monthly goal.

April

2005

Bone-Up

Vegetables and Fruit

- Foods like milk, yogurt, cheese and fortified soy nutrients contain a nutrient called calcium that helps to keep your bones and teeth strong and healthy.

- Some fruits and veggies contain calcium too!

- Choose at least 3 servings of bone building foods each day. Examples include: 250 mL of milk or fortified soy beverage, 30 grams of cheese, 175 mL of yogurt.

- Add to your calcium count by eating vegetables and fruits such as kale, bok choy and broccoli!

Steps

Try something new this month:

- If it is warm out, you could go skating or skiing if you haven't been for a while!

- Have you ever tried snow-soccer? It's like soccer, except in the snow!

- Be creative!

Vegetable and Fruit Tracker – April 2005

Make a check mark each time you eat one serving of vegetables or fruit.

1	○	○	○	○	○	□	□	□	□	□
2	○	○	○	○	○	□	□	□	□	□
3	○	○	○	○	○	□	□	□	□	□
4	○	○	○	○	○	□	□	□	□	□
5	○	○	○	○	○	□	□	□	□	□
6	○	○	○	○	○	□	□	□	□	□
7	○	○	○	○	○	□	□	□	□	□
8	○	○	○	○	○	□	□	□	□	□
9	○	○	○	○	○	□	□	□	□	□
10	○	○	○	○	○	□	□	□	□	□
11	○	○	○	○	○	□	□	□	□	□
12	○	○	○	○	○	□	□	□	□	□
13	○	○	○	○	○	□	□	□	□	□
14	○	○	○	○	○	□	□	□	□	□
15	○	○	○	○	○	□	□	□	□	□
16	○	○	○	○	○	□	□	□	□	□
17	○	○	○	○	○	□	□	□	□	□
18	○	○	○	○	○	□	□	□	□	□
19	○	○	○	○	○	□	□	□	□	□
20	○	○	○	○	○	□	□	□	□	□
21	○	○	○	○	○	□	□	□	□	□
22	○	○	○	○	○	□	□	□	□	□
23	○	○	○	○	○	□	□	□	□	□
24	○	○	○	○	○	□	□	□	□	□
25	○	○	○	○	○	□	□	□	□	□
26	○	○	○	○	○	□	□	□	□	□
27	○	○	○	○	○	□	□	□	□	□
28	○	○	○	○	○	□	□	□	□	□
29	○	○	○	○	○	□	□	□	□	□
30	○	○	○	○	○	□	□	□	□	□
31	○	○	○	○	○	□	□	□	□	□

Goal: Eat <u>at least</u> 5 servings of vegetables and fruit each day.

Step Tracking

April 2005

Write down your number of steps before you go to bed. Remember to reset your pedometer to zero in the morning.

Did you take part in the noon activity sessions? Let us know by circling your answer:

I attended the noon activity sessions:

YES NO

How many noon activity sessions did you attend this month? ______________

(Keep track by making a check mark beside the days you attended)

1 _______________________ steps
2 _______________________ steps
3 _______________________ steps
4 _______________________ steps
5 _______________________ steps
6 _______________________ steps
7 _______________________ steps
8 _______________________ steps
9 _______________________ steps
10 _______________________ steps
11 _______________________ steps
12 _______________________ steps
13 _______________________ steps
14 _______________________ steps
15 _______________________ steps
16 _______________________ steps
17 _______________________ steps
18 _______________________ steps
19 _______________________ steps
20 _______________________ steps
21 _______________________ steps
22 _______________________ steps
23 _______________________ steps
24 _______________________ steps
25 _______________________ steps
26 _______________________ steps
27 _______________________ steps
28 _______________________ steps
29 _______________________ steps
30 _______________________ steps
31 _______________________ steps

Track'n the Action

Take a minute and think about what you normally do and set a goal for the month ahead.

How many vegetables and fruit do you normally eat each day?

- If you normally:
    - Eat less than 5 servings of vegetables and fruit each day ➔ your goal is to eat at least one more serving of vegetables and fruit daily.

- If you normally:
    - Eat 5 - 10 servings of vegetables and fruit each day ➔ your goal is to keep doing what you're doing! You don't need to add any additional servings of vegetables and fruit. Aim to keep your total at 5 - 10 servings daily.

How many steps do you normally take each day?

- If you normally:
    - Take less than 12,000 steps each day ➔ your goal is to take 2000 more steps daily.

- If you normally:
    - Take 12,000 - 15,000 steps each day ➔ your goal is to keep doing what you're doing! You don't need to add any additional steps. Aim to keep your total number of steps at 12,000 - 15,000 steps daily.

My vegetable and fruit goal is to eat ________________________ servings each day this month.

My step goal is to take _______________________________ steps each day this month.

My Journal Page

Use this page to write down ideas that you brainstorm for increasing the number of steps that you take or the number of servings of vegetables and fruits you eat each day. Use your ideas to help you achieve your monthly goal.

May

2005

Healthy Students Make Healthy Schools

Vegetables and Fruit

- School is an important place for kids. You'll spend almost 1,200 hours and eat almost 200 lunches at school each year! Help make your school a healthy place to be!
- Think about what you could do to make it easier to make healthy food choices at your school.
- Experiment. Be creative. Come up with ideas to make your school a place where healthy eating is easy!

Steps

Identify ways to add activity to your school day:

- Active ideas don't need to be expensive or take a lot of time. Keep it simple!
- Challenge yourself to move for one entire recess break!
- Figure out how many steps it would take you to walk from Edmonton to New York. Walk during lunch and recess and track your steps on a map.
- Organize a "walking school bus." Get a group of kids together (and a parent or two) and walk to school instead of getting a ride.

Vegetable and Fruit Tracker – May 2005

Make a check mark each time you eat one serving of vegetables or fruit.

1	○	○	○	○	○	☐	☐	☐	☐	☐
2	○	○	○	○	○	☐	☐	☐	☐	☐
3	○	○	○	○	○	☐	☐	☐	☐	☐
4	○	○	○	○	○	☐	☐	☐	☐	☐
5	○	○	○	○	○	☐	☐	☐	☐	☐
6	○	○	○	○	○	☐	☐	☐	☐	☐
7	○	○	○	○	○	☐	☐	☐	☐	☐
8	○	○	○	○	○	☐	☐	☐	☐	☐
9	○	○	○	○	○	☐	☐	☐	☐	☐
10	○	○	○	○	○	☐	☐	☐	☐	☐
11	○	○	○	○	○	☐	☐	☐	☐	☐
12	○	○	○	○	○	☐	☐	☐	☐	☐
13	○	○	○	○	○	☐	☐	☐	☐	☐
14	○	○	○	○	○	☐	☐	☐	☐	☐
15	○	○	○	○	○	☐	☐	☐	☐	☐
16	○	○	○	○	○	☐	☐	☐	☐	☐
17	○	○	○	○	○	☐	☐	☐	☐	☐
18	○	○	○	○	○	☐	☐	☐	☐	☐
19	○	○	○	○	○	☐	☐	☐	☐	☐
20	○	○	○	○	○	☐	☐	☐	☐	☐
21	○	○	○	○	○	☐	☐	☐	☐	☐
22	○	○	○	○	○	☐	☐	☐	☐	☐
23	○	○	○	○	○	☐	☐	☐	☐	☐
24	○	○	○	○	○	☐	☐	☐	☐	☐
25	○	○	○	○	○	☐	☐	☐	☐	☐
26	○	○	○	○	○	☐	☐	☐	☐	☐
27	○	○	○	○	○	☐	☐	☐	☐	☐
28	○	○	○	○	○	☐	☐	☐	☐	☐
29	○	○	○	○	○	☐	☐	☐	☐	☐
30	○	○	○	○	○	☐	☐	☐	☐	☐
31	○	○	○	○	○	☐	☐	☐	☐	☐

Goal: Eat <u>at least</u> 5 servings of vegetables and fruit each day.

Step Tracking

May 2005

Write down your number of steps before you go to bed. Remember to reset your pedometer to zero in the morning.

1 ________________________ steps
2 ________________________ steps
3 ________________________ steps
4 ________________________ steps
5 ________________________ steps
6 ________________________ steps
7 ________________________ steps
8 ________________________ steps
9 ________________________ steps
10 ________________________ steps
11 ________________________ steps
12 ________________________ steps
13 ________________________ steps
14 ________________________ steps
15 ________________________ steps
16 ________________________ steps
17 ________________________ steps
18 ________________________ steps
19 ________________________ steps
20 ________________________ steps
21 ________________________ steps
22 ________________________ steps
23 ________________________ steps
24 ________________________ steps
25 ________________________ steps
26 ________________________ steps
27 ________________________ steps
28 ________________________ steps
29 ________________________ steps
30 ________________________ steps
31 ________________________ steps

Did you take part in the noon activity sessions? Let us know by circling your answer:

I attended the noon activity sessions:
YES NO

How many noon activity sessions did you attend this month? ______________
(Keep track by making a check mark beside the days you attended)

Track'n the Action

Take a minute and think about what you normally do and set a goal for the month ahead.

How many vegetables and fruit do you normally eat each day?

- If you normally:
    - Eat less than 5 servings of vegetables and fruit each day ➔ your goal is to eat at least one more serving of vegetables and fruit daily.

- If you normally:
    - Eat 5 - 10 servings of vegetables and fruit each day ➔ your goal is to keep doing what you're doing! You don't need to add any additional servings of vegetables and fruit. Aim to keep your total at 5 - 10 servings daily.

How many steps do you normally take each day?

- If you normally:
    - Take less than 12,000 steps each day ➔ your goal is to take 2000 more steps daily.

- If you normally:
    - Take 12,000 - 15,000 steps each day ➔ your goal is to keep doing what you're doing! You don't need to add any additional steps. Aim to keep your total number of steps at 12,000 - 15,000 steps daily.

My vegetable and fruit goal is to eat ________________________ servings each day this month.

My step goal is to take _______________________________ steps each day this month.

My Journal Page

Use this page to write down ideas that you brainstorm for increasing the number of steps that you take or the number of servings of vegetables and fruits you eat each day. Use your ideas to help you achieve your monthly goal.

Congratulations!!!

You have completed the One Step, One Bite at a Time Project!!

Appendix 5: Newsletter Content

Newsletter #1

Dear Parents and Caregivers,

Greetings from the *Healthy Schools Project: One Step, One Bite At a Time*! We are delighted to be working with your children and would like to provide you with more information about the project and the work we will be doing with the children at Glenora and Abbott Schools over the next several months.

The Healthy Schools Project: One Step, One Bite at a Time is a research project of the University of Alberta. In December, you should have received an information letter describing the Project. Your child's school has volunteered to take part in this 5-month research project which is focused on promoting healthy eating and active living in school-age children. Specifically, the Project will work to increase the number of vegetables and fruits the children eat and the number of steps they take each day.

The Project will provide hands-on support to help the children at Glenora and Abbott enhance their eating habits and activity levels. Student facilitators from the University will be at your child's school during lunch break every Monday, Wednesday, and Friday leading activities that focus on the theme for that month. In January when the project was launched, the theme was an introduction to *One Step One Bite at a Time*. The activity was to try to increase daily steps by 2,000 and to increase daily fruit and vegetable servings per day by one. A pedometer to measure steps and a fruit and vegetable tracker was provided to every student whether they are in the research study or not.

February is just around the corner and the theme for the month is "*Beat the Cold.*" During February we will challenge the children to choose a variety of indoor and outdoor activities to stay warm and have fun! In addition, we'll be providing the children with information on vegetables and fruit that are good sources of vitamin C. Students will learn which vegetables and fruit are high in vitamin C. They will also be given practical ideas for incorporating these vegetables and fruits into their eating habits during the lunch break activities facilitated by the student teams from the University.

Parents and caregivers can be an essential part of the project. You can participate by helping your child accurately record their vegetable and fruit intake and the number of steps they take each day. You can also provide support for their learning by emphasizing the importance of foods high in vitamin C. Encourage physical activities and active play. If you are stuck for other ideas or more information, the Internet is a great place to get valuable information. A few websites you may want to visit are http://www.phac-aspc.gc.ca/pau-uap/paguide/child_youth/index.html and http://www.dole5aday.com/.

Did you know that children should eat a minimum of 5 servings of fruits and vegetables per day, and walk a minimum of 12,000 steps per day? This might sound like a lot, but when you think about it, it's not that *much. For example, one serving of vegetables and fruit is equal to: ½ cup of peas or 1 small apple. So, ½ cup of apple juice for breakfast, 1 small banana for a mid-morning snack, ½ cup of carrots for lunch, 1 cup of salad and ½ cup of corn for supper equals 5 servings. Accumulating steps is also easier than it may sound. For example, a child can accumulate 2,000 steps in about 20 minutes of walking.*

If you have questions about the Project, feel free to ask. Simply contact your child's teacher who can forward your questions to us for a response.

Newsletter #2

Dear Parents/Guardians,

February is upon us. This month the One Step One Bite at a Time Project will be focusing on vitamin C and activities that will keep everyone warm and moving both indoors and out!

Vitamin C is an essential nutrient that is found in many vegetables and fruits including:

- Oranges, grapefruit, tangerines and their juices;
- Sweet bell peppers;
- Broccoli;
- Tomatoes and tomato sauce
- Strawberries; and
- Kiwi fruit

Vitamin C helps promote the health of our gums and skin. In addition, vitamin C is has what nutritionists call “anti-oxidant properties.” In simple terms, this means that vitamin C helps to protect the cells of our bodies from the damage caused by daily living.

The vitamin C in foods can be destroyed by excessive heating or exposure to air or light. To preserve the vitamin C content of vegetables and fruit, eat them raw or cook them using methods such as steaming or microwaving. These methods “lock in” the nutrients and help you get the most for your food dollar.

Both children and adults need to eat foods that contain vitamin C every day. Our bodies cannot store large amounts of this nutrient, so we need a daily supply to stay healthy.

It can be tempting to slow down and crawl under a blanket when it is cold outside. However, we need to be active even when the temperatures plummet. Keep your family active this winter by trying one of these fun activities:

- Set up a simple obstacle course in your basement. Challenge family members to beat the clock and complete the course.
- Experiment with winter activities your family has not tried before. Examples may include snow-shoeing, cross country skiing or speed skating. Rental equipment for first-timers is available at many city facilities.
- Play with it! Enjoy the delights of childhood all over again. Help your children build a snowman; start a snowball fight or a game of snow tag. As long as you’re moving, anything goes.

Newsletter #3

Dear Parents/Guardians,

March is here and the smell of spring is in the air! Not only is March filled with warm winds and sunny skies, it's also the time for *Snack Attack*!

The University of Alberta student facilitators have been attending your child's school for approximately 2 months and have thoroughly enjoyed their time thus far. The lunch break activities have been an overwhelming success! Kudos to your children for their high energy levels and participation!

The message for March is *Snack Attack*. This theme and it's related activities are to focus on using vegetables and fruit to make awesome snacks and to find ways to increase *steps-per-day* in fun ways. Nutritious snacks are important to keep the body and brain fuelled throughout the day. Snacks are not just for kids; parents need snacks too! As we all know, children learn by example, therefore, if they see mom or dad eating healthy snacks, they will follow. The results may not be instant but if children see healthy snacks day-in and day-out, eventually the habit will form. Include different vegetables and fruit as this will allow your child to experience a wide variety of flavours and textures. Introducing a new vegetable or fruit every week or every other week will not overwhelm your child's taste buds. If your child doesn't like a certain food, don't force them to eat it. As well, bribing your child with a cookie to eat their vegetables will just make that vegetable look like a “bad” food. Instead, introduce that food again at a later date because their tastes may change as they get older.

Did you know that childhood obesity is becoming an epidemic? Lack of physical activity is believed to be part of the problem. Recent research shows that the average child spends more than 24 hours a week watching TV! Physical activity is important for a growing child as it strengthens bones, maintains a healthy weight, increases sleep quality, improves concentration, along with many other benefits. Take charge of your child’s health by becoming an advocate for active living. Remember, children learn by example. Spend the next few weeks of winter with your children outside enjoying the last of the snow. This will provide them with the opportunity to burn off any extra energy and allow for some fun family time together. Invite other families in your area for an outside activity night. This will teach your children valuable social skills with adults and peers, as well as, increase their confidence and self esteem.

Just remember that the healthy lifestyle habits that are created while your children are young will be maintained as your children become adolescents. Encourage healthy habits by practicing them along side your child. A few websites you may want to visit are http://www.dietitians.ca/english/index.html and http://kidshealth.org/index.html.

Did you know that the nutritional value of fresh, frozen, or canned vegetables and fruit are similar? Substitute these foods for other less nutritional prepackaged snacks. Parents, you have the greatest influence on your child's health……keep up the great work!!

Newsletter #4

Dear Parents/Guardians,

April is here and we are almost finished with the *Healthy Schools Project – One Step at a Time!* This month's important message is *Bone-Up*. The theme and its related activities are to focus on increasing calcium-rich foods and drinks, and performing bone-building physical activities every day.

Milk and dairy products contain high amounts of an important nutrient called calcium. Calcium is necessary for keeping bones and teeth strong and healthy. It is especially important for children and young adults because calcium accumulates in the bones until the late-twenties. Maximizing calcium storage in bone when your child is young decreases their risk of developing a condition called osteoporosis later in life. Osteoporosis is a debilitating condition that is influenced by both lifestyle habits and genetics. It causes bones to become very weak, very brittle and fracture very easily.

Taking in adequate amounts of calcium-rich foods throughout life can significantly reduce the risk that your child will develop osteoporosis later in life. The recommended dietary allowance (RDA) for calcium is 1300 mg/day for children ages 9 – 18 years. This can be achieved by having your child strive to meet the recommendations of 3 to 4 servings of milk and milk products everyday as set out in Canada's Food Guide. Vegetables and fruit also contain calcium, although generally in much smaller amounts than that found in milk products. Enjoying vegetables and fruit, such as kale, bok choy, or oranges can add to your child's daily calcium intake.

Physical activity helps the body use calcium to build healthy bones. Weight bearing activities such as walking, jogging, and push-ups are best for keeping your bones strong. Walking, jumping-jacks, bunny-hops, and "The Locomotion" are just a few ideas your child can do easily and at any time. Rope-jumping contests are a great way to have fun and build bones at the same time! There are a number of other creative ways to make weight bearing activities fun so your child will want to do them every day.

To learn more about calcium-rich foods and bone-building activities, visit http://albertamilk.com and http://canadian-health-network.ca.

Did you know that the calcium content in chocolate, skim, 1%, 2%, and whole milk is comparable?

Weight bearing means that your muscles and bones are working against gravity, therefore, physical activities such as swimming and bike riding are not considered weight bearing activities.

Don't forget:

1) Pedometers should be reset (press yellow button) every morning

2) Record steps-per-day and servings-per-day in the Daily Tracker

Newsletter #5

Dear Parents/Guardians,

Congratulations Everyone! The One Step at a Time Project has reached the "home stretch!" We haven't got much time left, but we still need your help! Please continue to track your vegetable and fruit intake and steps-per-day in your Daily Tracker until May 20th.

May 20th is the last day the University of Alberta student facilitators will be at your child's school. However, this does not mean that your child cannot continue tracking his or her progress with vegetable and fruit intake and steps-per-day. Encourage your child to eat well and be active. You can help your child create new tracking sheets modeled on the ones in the Daily Trackers. Use these new sheets to track intake of vegetables and fruits and foods from the other 3 food groups in Canada's Food Guide. Your child can also continue to track his or her progress for increasing physical activity and reducing "non-active" time spent watching TV and playing video games. Encouraging children to eat healthy and keep active will promote healthy growth and development.

We would like to thank you, your child, and Abbott/Glenora School Personnel for participating in this worthwhile project. The information on vegetable and fruit consumption and steps-per-day that your child is providing will help us to develop programs that promote healthy living and prevent childhood obesity. Again, thank you!

Two useful websites you may want to visit are http://www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/food_guide_rainbow_e.html and http://www.phac-aspc.gc.ca/pau-uap/paguide/. These sites provide access to Canada's Food Guide to Healthy Eating and Canada's Physical Activity Guide for Children and Youth.

We'll retrieve your child's Daily Tracker at the end of the project. Until then, please remember:

1) Pedometers should be reset (press yellow button) every morning

2) Record steps-per-day and servings-per-day in the Daily Tracker until the project formally ends on May 20th.