

Sustainability of the Health Benefits of the APPLE Schools Comprehensive School Health  
Program

by

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## **ABSTRACT**

The global epidemic of chronic noncommunicable diseases has been largely associated with unhealthy environmental influences which impact on lifestyles. Whole school approaches to health promotion provide opportunity to build health promoting environments to support healthy lifestyles among young people. Whole school approaches such as the Comprehensive School Health (CSH) approach have demonstrated effectiveness in improving students' health behaviors and promoting healthy body weights, the sustainability of these benefits is yet to be established. This thesis research aimed to: i) evaluate the sustainability of the health benefits of APPLE Schools, a CSH initiative, in graduates of APPLE elementary schools, who are now in junior high/high school, and ii) explore factors that influence the practice of healthy behaviors among adolescents. Quantitative and qualitative methods were used to address the objectives. Data were collected in a 2015/16 Youth Health Survey among junior high and high school students (grades 7-12) in Northern Alberta, Canada. Participants included graduates from APPLE elementary schools (APPLE School graduates; n = 202) and comparison elementary schools (comparison school graduates; n = 338). Health-related knowledge, attitudes, self-efficacy, diet (24-hour dietary recall), physical activity (pedometer step count) and weight status were assessed. Baseline data on APPLE Schools and comparison schools accessed from the APPLE Schools survey and the Raising healthy Eating and Active Living Kids in Alberta (REAL Kids Alberta) survey carried out in 2008/09 were also utilized. Three interconnected papers were produced. The first paper assessed the long-term effects of participation in the APPLE Schools project on health-related knowledge, attitudes, self-efficacy, diet, physical activity and body weights of APPLE School graduates. Using mixed effects regression, differences in these outcomes between APPLE School graduates and comparison school graduates were assessed. Comparisons

between elementary school (2008/09) and junior high/high school (2015/16) on self-efficacy, physical activity and weight status were also determined. The results showed no significant differences between APPLE School graduates and comparison school graduates for the outcomes. However, APPLE School students in 2008 had started worse off with regards to healthy dietary habits in physical activity levels and obesity prevalence relative to other students but, within two years of the APPLE Schools program, were at par with students in comparison schools. Therefore, finding no significant differences between the two groups suggested one of two possibilities: 1) that the effects of APPLE Schools continued into junior high/high school, or 2) that the new school environment has an equalizing effect on students regardless of where they started. The second paper assessed whether there was a dose-response association between duration in APPLE elementary schools and the health outcomes (dietary intake, physical activity levels and body weight status) of APPLE School graduates. Mixed effects linear/logistic regression models were employed to examine this association. The results showed no dose-response association between duration in the APPLE Schools project and the outcomes. This finding further supported the possibility that the new school environment (junior high/high school) could have had an impact on behaviors of the students, and possibly masked the program effects. The third paper explored adolescents' perspectives on factors influencing their practice of healthy behaviours within the junior high/high school environment. In-depth interviews were conducted in a qualitative descriptive study with 22 junior high and high school students who participated in the 2015/16 Youth Health Survey. The data were analyzed using content analysis. Findings revealed three themes: 1) knowledge, 2) contextual factors (home environment and school environment) and 3) individual factors (self-motivation and personal responsibility). Overall, the students were knowledgeable about what it takes to be healthy. The home

environment and school environment were highlighted as contextual factors perceived to influence the practice of health behaviors in the junior high/high school environment by providing the right kind of knowledge, structure and opportunities to cultivate and maintain a healthy lifestyle. Students identified self-motivation and personal responsibility as individual factors influencing the practice of their health behaviors. This thesis supports the need for continuity in life-stage appropriate initiatives that promote and support healthy lifestyles among young people. Such programs can provide the needed consolidation and reinforcement of messages and learned behaviors to encourage sustainability into adulthood.

## **PREFACE**

This thesis is an original work by Nicole Naadu Ofosu. The research project, of which this thesis is a part, received research ethics approval from the University of Alberta Research Ethics Board for the Youth Health Survey, Project Name “CRIO 1.2: Maintenance of healthy lifestyle behaviors developed during childhood as a result of school health programs in adolescence”, Pro00054459, approved February 17, 2015, last renewed, April 11, 2018. The qualitative study also received ethics approval from the University of Alberta Research ethics Board, Project Name “CRIO 1.2b: Maintenance of healthy eating and active living among adolescents, following a change in school environment”, No. Pro00060175, approved June 23, 2016, last renewed January 22, 2018.

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composition. PJV was the supervisory author who conceived and designed the study. NNO, KAB, KS and SAL contributed to the design of the study and the acquisition of data. PJV, NNO, JPE and KAB conceived and designed the analysis. PV, JPE, KAB, KS and JCS assisted in interpreting the data and critically revised the manuscript.

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## **GLOSSARY OF TERMS**

APPLE Schools – A Project Promoting healthy Living for Everyone in Schools

CSH – Comprehensive school health

HPS – Health Promoting Schools

ICC- Intraclass Correlation Coefficient

PA – Physical activity

ROI4Kids – Return on investment for kids' health

YHS – Youth health survey

## **CHAPTER 1: INTRODUCTION**

### **1.0 Overview**

In the wake of the global epidemic of chronic noncommunicable diseases, largely associated with unhealthy lifestyle behaviours, pursuing healthy lifestyles at an early stage in life is essential. Although schools are not the only setting in which young people's development can be influenced, they are widely recognized as critical to the public health agenda for young people. Evaluations of comprehensive school-based health promotion initiatives have shown significant health benefits to students, however, there is a dearth of evidence on the sustainability of these benefits beyond the limits of the program. Such information is needed to evaluate and enhance the relevance and impact of such programs. This thesis presents an assessment of the sustainability of the benefits of a school-based health promotion initiative known as APPLE Schools - A Project Promoting healthy Living for Everyone in Schools, based in Alberta, Canada. In the subsequent sections of the introduction (chapter 1), the context, rationale and objectives of the thesis are outlined. Chapters 2 to 4 presents individual studies related to the thesis objectives. A general discussion and conclusion on the work presented in this thesis are contained in chapters 5 and 6.

### **1.1 Context: Environments, Lifestyles and Health**

Good health is an important dimension of quality of life, which is essential to personal, social and economic development <sup>1</sup>. Multiple levels of influence determine an individual's health behaviours and health <sup>2</sup>. Food choices for instance are influenced <sup>2</sup> by several factors, including the individual's biologically determined predispositions, past experiences with food, personal and social norms (e.g. values, knowledge and skills), and environmental factors (e.g. cost of food, its physical availability, and the degree of information – including advertising, education

and media surrounding food in the individual's context) <sup>3,4</sup>. Factors affecting the individual's choice about engaging in physical activity include demographic characteristics (e.g. gender, age, and ethnic background), attitudes, preferences, motivation and skills related to the behavior; and socioeconomic characteristics (e.g. education and income level) and the social environment <sup>5</sup>.

Environmental factors (e.g. social, physical, political) are widely recognized as key influences on behaviours and outcomes of behaviours as they provide the context within which behavior choices are made. The role of the environment as an influence on health behaviours and health is largely highlighted in the literature <sup>6-8</sup>. Studies on social determinants of health have shown how the contextual conditions in which people are born, grow, live, work and age are shaped by families, communities, power, the availability and distribution of resources, and policy choices <sup>8,9</sup>. Chronic disease studies for instance, strongly suggest that environmental factors are largely responsible for the dramatic increase in obesity and associated chronic conditions in the past few decades <sup>10,11</sup>. Significant environmental changes that contribute to the obesity epidemic include changes in the food systems to support the production of an ever-increasing number of energy dense foods, packaged in large portions, conveniently at low cost <sup>3,10</sup>. This contrasts with the relatively limited availability and access to fresh fruits and vegetables and other whole foods in many low-income families <sup>11</sup>. Environmental changes that impact physical activity behaviours include modern technologies allow people to be less active in their daily activities; communities designed to support more vehicle traffic, with inadequate or unsafe facilities for routine physical activities (e.g. walking); and an increase in passive entertainment avenues such as television and computer games. Given that most of human behavior is cued by environmental stimuli <sup>6</sup>, it is no surprise that in line with the environmental changes poor health conditions that are associated with unhealthy lifestyles have become increasingly common.

Chronic noncommunicable diseases are currently the leading cause of death in most industrialized nations and many developing countries<sup>12</sup>, accounting for almost 70% of all deaths worldwide<sup>13</sup>. And behavioural risk factors like smoking, unhealthy diets, physical inactivity, sedentary lifestyles and harmful use of alcohol have been shown to be strongly associated with chronic noncommunicable diseases such as obesity, type 2 diabetes, cardiovascular disease and some types of cancers<sup>13</sup>. The situation of unhealthy lifestyle behaviours is troubling because its effects are seen not only in adults, but also in children, as they are vulnerable to some of the major risk factors contributing to chronic diseases (i.e. unhealthy diets, physical inactivity)<sup>13</sup>. Consequently, increasing childhood and adolescent obesity rates<sup>14</sup> have coincided with the increase in appearances of adult diseases among children and adolescents. An example is type 2 diabetes, a metabolic complication of obesity<sup>14</sup>, formerly referred to as adult onset diabetes<sup>15,16</sup>, but renamed to reflect that it is now occurring in youth populations.

In Canada, a significant public health and economic burden is attributed to chronic diseases that are largely preventable by adopting healthy lifestyles<sup>17,18</sup>. By decreasing behavioral risk factors such as physical inactivity, poor nutrition, smoking and alcohol consumption, many chronic diseases can be prevented<sup>19</sup>. Nonetheless, Canada continues to face considerable public health challenges in preventing chronic diseases<sup>1</sup>, specifically, cardiovascular diseases, cancer, chronic respiratory diseases and diabetes, which are the cause of 65% of all deaths in Canada each year<sup>1</sup>. However, although people bear personal responsibility for their health, the environmental influences can significantly support or undermine their ability to act in healthful ways<sup>20,21</sup>. There is therefore the need to build supportive environments that can help promote healthy behaviours and practices.



### ***1.1.1 Addressing the chronic disease epidemic***

Prevention is the only realistic solution to addressing the chronic disease epidemic<sup>22</sup>. Managing or treating chronic conditions such as obesity in adults is difficult and often unsuccessful, however, prevention and reversing excess weight gain in childhood and adolescence holds more promise and reward for addressing the situation<sup>23,24</sup>. Areas of action in relation to young people include building healthy school communities, addressing marketing of unhealthy foods to children, and empowering families to provide adequate support for healthy lifestyles in the home environment. It is important to help children and adolescents to develop and maintain healthy lifestyle practices such as eating nutritious meals, getting plenty of exercise and adequate sleep daily. These positive health habits will help them to grow strong, stay healthy and decrease the risk of chronic disease<sup>25</sup> and further contribute to building healthy societies that will impact positively on national development.

This view is echoed in the World Health Organization's 2016 Ending Childhood Obesity report in which six recommendations for childhood obesity prevention were made<sup>26</sup>. Four of the six recommendations are in areas that fall within the capacity of school-based health promotion.

Namely: 1) Promote intake of healthy foods through comprehensive programs that promote the intake of healthy foods and reduce the intake of unhealthy foods and sugar-sweetened beverages by children and adolescents; 2) Promote physical activity through comprehensive programs that promote physical activity and reduce sedentary behaviours in children and adolescents; 3) Initiate early childhood healthy diet and physical activity by providing guidance on, and support for, diet, sleep and physical activity in early childhood to ensure children grow appropriately and develop healthy habits; and 4) Ensure health, nutrition and physical activity for school-age children through comprehensive programs that promote healthy school environments, health and

nutrition literacy and physical activity among school-age children and adolescents <sup>26</sup>. There is therefore growing evidence to support interventions for children and adolescents in school settings as a health promotion strategy <sup>27,28</sup>. Schools provide a setting in which to deliver health information directly to students, and indirectly to the home and community <sup>29-31</sup>. Therefore, school-based health initiatives are essential to public health as they have great potential to contribute to improving child health in the short term and, chronic disease prevention in the long term.

### ***1.1.2 Promoting healthy lifestyles through school-based health promotion***

Health behaviours leading to poor health outcomes are often developed in childhood and adolescence and sustained throughout the life-course <sup>30,32-34</sup>. Consequently, shaping environments to better support healthful decisions is key to effective health promotion for young people <sup>35,36</sup> and for laying the foundations for future adult health and economic well-being <sup>30</sup>. School health programs play an important role in this regard as they can improve young people's knowledge, attitudes and skills <sup>37,38</sup> and, health behaviours and outcomes <sup>22,39-41</sup>.

Although schools are not the only setting in which young people's development can be influenced, schools are widely recognized as critical to the public health agenda for young people for several reasons. Key among these is the interdependence between health and education, whereby healthy students are better learners, and better-educated individuals are healthier <sup>29,42</sup>. Consequently, health promotion in schools has mutual benefits both for education and health as it links health and education issues and systems, and incorporates health into all aspects of school and learning <sup>29</sup>. Additionally, from a public health perspective, schools provide a platform to reach a large proportion of students of diverse socioeconomic status or backgrounds within the same setting <sup>22,39</sup>. This is important for initiating primary prevention

measures to lay a good foundation for health at a population level. The school setting is also naturally tailored to provide and support learning<sup>7,40</sup> and students have an intensive and prolonged contact with the school learning environment throughout childhood and adolescence as they spend the majority of their weekday waking hours in schools<sup>28</sup>. Therefore, health promotion can be initiated at an early age to build good health habits. Furthermore, the organizational, communication and social structure of schools provide an efficient means of reaching students with health promotion initiatives, since the school setting is tailored to enhance learning<sup>22</sup>.

School-based health promotion programs vary in many ways, including program design, theoretical basis and content, duration and delivery, community involvement and financial support available<sup>43</sup>. However, globally, there is a shift from traditional health promotion approaches that focus solely on teaching health education and delivering short-term health related interventions in school, as well as focusing on individual behavioural change<sup>44,45</sup>. Although such approaches (usually delivered through the school curriculum) aim to improve knowledge and skills, and modify norms, they have often had disappointing results<sup>32</sup> because of issues such as the low priority health education tends to have in schools, and the lack of teacher training in health education pedagogy to adequately handle the field<sup>46</sup>. Generally, people bear personal responsibility for their health behaviours and related outcomes, however, environmental factors can support or undermine people's ability to make healthful choices<sup>20</sup>. Therefore, the interaction between the environment and the individual needs to be considered in health promotion initiatives. Consequently, school-based health promotion is moving towards making the broader school environment a health promoting school environment<sup>28,44</sup>, which can support healthful choices. This requires a whole school approach whereby all school stakeholders

(student, parents, teachers, policy makers, etc.) are actively and collectively involved in identifying and addressing students' health needs<sup>28,47,48</sup>.

## **1.2 The whole school approach to health promotion**

The World Health Organization's Ottawa Charter for Health Promotion (1986) provides a framework for an internationally recognized whole school approach to health promotion, known as health promoting schools. It involves a contextual or socio-ecological approach to health which focuses on the social determinants of health in addition to health factors related to individual lifestyles<sup>47,49</sup>. Key components or areas of action in this approach are the school curriculum, ethos and/or environment, and families and/or communities<sup>30</sup>. Through the school curriculum, health education topics can be incorporated into the formal class activities. The ethos and/or environment addresses how the values, and attitudes supported by the school (i.e. the school culture), and how the physical environment and setting of the school can be used to support good health practices. Finally, in recognition of the importance of external spheres of influence on young people's health, families and the wider community should also be engaged in the health promotion process<sup>30,47</sup>. Synonymous with the term Health Promoting Schools are the terms Comprehensive School Health (CSH) and Coordinated School Health (now referred to in some areas as Whole School, Whole Community, Whole Child), which are terms used in other jurisdictions and all have underlying concepts based on the World Health Organization's (WHO) Ottawa Charter for Health Promotion (1986).

In Canada, CSH is the more common whole school approach to health promotion that is utilized<sup>44</sup>. It is defined as “*an internationally recognized approach to supporting improvements in students' educational outcomes while addressing school health in a planned, integrated and holistic way*”<sup>29</sup>. It therefore meets the purpose of health promotion in schools, which is to

address health issues within an educational framework <sup>50</sup>. CSH recognizes and emphasizes the reciprocal relationship between health and education <sup>30</sup> in that, health and education are interrelated; good health is important for learning as healthy children achieve better education outcomes, which is associated with improved health later in life <sup>42</sup>. Benefits of this approach include the fact that it recognizes the potential of schools to directly influence students' health and behaviours; it incorporates health into all aspects of school and learning; and it links health and education issues and systems <sup>29</sup>. Additionally, CSH facilitates improved academic achievement and can lead to fewer behavioural problems in the classroom, It also helps students develop the skills they need to be physically and emotionally healthy for life<sup>29</sup>.

CSH promotes health and educational achievement among students by providing supportive social and physical environments through multiple spheres of influence, including the school setting, policies and programs, families, the community, and other stakeholders <sup>31</sup>. The Pan-Canadian Joint Consortium for School Health (JCSH) provides support for CSH implementation <sup>44</sup>. The JCSH identifies four separate but interconnected components or action areas that address school health in a planned, integrated and holistic way <sup>29</sup>. These are: 1) teaching and learning; 2) social and physical environment; 3) partnerships and services; and 4) policy. The goal is that, when the CSH approach is applied to a school, the actions in all four components are integrated to provide the needed skills and support for students. However, there are variations in the implementation of CSH since the four components serve mainly to provide a structure or guideline upon which CSH interventions can be tailored to the needs of individual school communities.

### ***1.2.1 APPLE Schools - A Project Promoting healthy Living for Everyone in Schools***

APPLE Schools is a school-based health promotion project that uses the CSH approach to create healthy school communities <sup>51</sup>. Based originally in Alberta, it was formerly known as Alberta Project Promoting healthy Eating and Active Living in Schools (APPLE Schools). It is currently expanding to reach other provinces in Canada, hence the new name, A Project Promoting healthy Living for Everyone in Schools.

APPLE Schools began in 2008 in ten elementary schools located in socio-economically disadvantaged neighborhoods and currently reaches seventy schools in Northern Alberta (regardless of socio-economic status) <sup>51</sup>. The mission of APPLE Schools is to inspire and empower school communities to lead, choose, and be healthy by recommending and supporting measurable and sustainable changes <sup>51</sup>. APPLE Schools aim to effect change in the school, home and community by promoting healthy eating, physical activity and good mental health. Each school is provided with dedicated staff time in the form of a school health facilitator trained in nutrition, physical activity, and community development, who works with students, parents, school staff and community members to develop school action plans specific to the needs of each school <sup>51</sup>. School action plans include, but are not limited to, student-led activities that are designed to make healthy living fun and engaging, such as planting classroom gardens, after-school cooking classes and physical activity programs <sup>51</sup>.

Annual evaluation surveys were conducted since APPLE Schools' inception in 2008 <sup>51</sup>. The survey collected data on health, nutrition, physical activity, lifestyle factors and measured height and weight among grade 5 students, and data on the school and home environment among their parents and school administrators. Identical survey tools were also used in a biennial large population-based survey that evaluates the impact of the provincial government's initiatives to

promote healthy weights among children and youth – The Raising healthy Eating and Active Living Kids in Alberta (REAL Kids Alberta) survey<sup>51,52</sup>. Comparisons were subsequently made between APPLE Schools and participating schools from the REAL Kids survey (comparison school students). Given that there are other school-based health promotion programs in the Alberta school system, the comparison school students were most likely beneficiaries of other school-based health promotion programs, albeit low dose interventions relative to the intensity of the APPLE Schools program. These on-going low dose programs could also impact on behaviours of students from the comparison schools. Thus, all referral to comparison schools or students in this thesis are not referrals to schools or students that had no school-based health promotion program exposure, but rather schools that most likely had some programs, but likely lower program doses compared to APPLE Schools program dose. Baseline evaluations in 2008 showed that students in schools selected to be part of APPLE Schools had higher dietary energy intake, lower fruit and vegetable intake, lower physical activity levels and a higher prevalence of obesity compared to other students in Alberta<sup>51</sup>. Subsequent evaluations have established the effectiveness of APPLE Schools in improving diets, increasing physical activity and reducing the prevalence of childhood obesity<sup>51-53</sup>.

### **1.3 Evaluations of school-based health promotion interventions**

Given the diversity in program approaches and implementation strategies, the evidence supporting the effectiveness of school-based health promotion has not been consistent across board. However, a strong belief in the potential of school-based health promotion to impact positively on children's health and health behaviours persists. The sub-sections below provide a summary on evaluations of school-based programs including strengths and limitations and the gaps in knowledge.

### *1.3.1 Evidence of effectiveness*

The effectiveness of different types of school-based interventions in impacting positively on young people's health behaviours and health within the program environment has been shown in a number of systematic reviews <sup>7,28,30,54</sup>. The UK Health Technology Assessment Program produced two systematic reviews evaluating the effectiveness of school-based interventions in promoting health and preventing risk behaviours in children <sup>28</sup>. The first was a review of primary studies of the WHO's Health Promoting Schools approach <sup>28</sup>. Twelve studies were identified in which the effectiveness of Health Promoting Schools in improving health-related behaviour (e.g. dietary intake) and health (e.g. fitness) were demonstrated. The results also showed that the Health Promoting Schools approach can impact positively on aspects of mental and social well-being such as self-esteem and bullying. Although these interventions were based on the WHO's Health Promoting Schools approach, none of the schools involved in the studies had been able to implement all the components of the approach. This contributed to variations in the methodological rigorousness of the studies assessed, thereby creating challenges in the effectiveness evaluation process. A more thorough implementation of the Health Promoting Schools approach may have produced stronger intervention effects in the evaluations.

The second part of the work was a review of reviews of health promotion in schools <sup>28</sup>. Thirty-two systematic reviews met the study criteria and they spanned the areas of nutrition, physical activity, safety, psychological aspects of health, sexual health, substance use and personal hygiene. All the reviews found that there was improved health knowledge because of the school-based health promotion. They also found that interventions to promote healthy eating, physical activity, prevent injuries and abuse and promote mental health were the most likely to be



effective. However, interventions to prevent substance abuse, promote safe sex and oral hygiene were the least effective. Results on impact of the interventions on attitudes were not reliable.

Langford, Bonell, Jones, Poulidou, Murphy, Waters, Komro, Gibbs, Magnus, Campbell<sup>30</sup> also assessed the effectiveness of the Health Promoting Schools' framework for improving health and well-being of students and academic achievement in a systematic review and meta-analyses involving 67 eligible studies. The studies showed positive average intervention effects for body mass index, physical activity, fruit and vegetable intake, tobacco use and bullying. Little to no evidence was found for impact on the outcomes fat intake, alcohol use, drug use and violence. Academic achievement was assessed by some studies in terms of impact on academic attainment or school attendance. The effect on academic achievement was not strong, ranging from no significant intervention effects to positive intervention effects. Overall, the authors found that the Health Promoting Schools framework is effective in improving some aspects of students' health. The methodological limitations identified in the studies included reliance on self-reported data, lack of long-term follow-up, and high attrition rates.

Driessen, Cameron, Thornton, Lai, Barnett<sup>54</sup> conducted a systematic review on the effect of changes to the school food environment on eating behaviours (purchase, consumption) and body weight of children. Of the 18 studies included in their review, 17 reported a positive outcome on either body mass index or healthfulness of food sold or consumed. Overall, they found that modifications of the school food environment (including policy changes at state or national level) could have a positive impact on eating behaviors. As with the previous review (Lister-Sharp, Chapman, Stewart-Brown, Sowden<sup>28</sup>), the authors also found issue with the methodological rigorousness of some of the included studies, in that the lack of high quality study designs tempered the strength of some of the findings.

Morton, Atkin, Corder, Suhrcke, van Sluijs <sup>7</sup> assessed the effects of school environmental characteristics (physical and social environment) on adolescent physical activity and sedentary behavior in a systematic review. They found that improvements to the school environment such as activity settings for physical activity, and a physical activity ‘culture’ within the school had positive impacts on student physical activity and sedentary behaviors. Teaching behaviors such as role-modeling that support a positive climate for physical activity in the school also had positive impacts.

In summary, school-based interventions that recognize the significance of multiple levels of influence on student health (e.g. policy, physical and social environment) were more likely to have meaningful impact on student behaviors.

### ***1.3.2 Evidence of sustainability of school-based health promotion program effects***

It is generally recognized that childhood experiences, attitudes and behaviors can impact on adolescent behaviors and potentially extend into adulthood. This is demonstrated in a study by Kelder, Perry, Klepp, Lytle <sup>55</sup>, in which the authors conducted an annual tracking of adolescent smoking, physical activity and food choice behaviors starting from grade 6 for seven years. They found that students who began experimenting with smoking were more likely to either begin to be or remain regular smokers. Furthermore, students identified at baseline as measuring high in physical activity and healthy dietary habits were more likely to remain high while those measuring low remained low. Despite the acknowledgment of the potential for behaviors and habits to persist past childhood, few studies have assessed the sustainability of school-based health promotion benefits. This gap in knowledge reflects the difficulties associated with such long-term evaluations, which include losses to follow-up in the transition from one school environment to another or life stage to another, and difficulty acquiring adequate sample sizes

<sup>56,57</sup>. The subsequent paragraphs present a summary on assessments of the sustainability of school-based intervention effects in the long-term. Of the studies available on long-term effect evaluations, most tend to focus on physical activity outcomes.

Trudeau, Laurencelle, Tremblay, Rajic, Shephard <sup>58</sup> conducted a follow-up of participants from the Trois-Rivières Growth and Development Study, twenty years after their initial involvement in the program. The program was conducted between 1970 – 1977 and it involved a quasi-experimental study of elementary school children. The experimental group received 5 hour per week physical education taught by professional physical educators throughout their six years of elementary school. The control group received only the standard provincial physical education program of maximum 40 minutes per week supervised by their homeroom teacher. Twenty years later, the researchers reported that with the exception of expected gender effects, there was overall no significant differences in the practice of physical activity between the two groups. More women in the experimental group exercised or engaged in strenuous labour three times or more per week than women in the control group. Also, women in the experimental group had lower relative risk of back problems. Participants in the experimental group were more likely to perceive their health as ranging from very good to excellent. The control group generally felt less psychological dependency on exercise. No inter-group differences were found in attitudes toward and beliefs about physical activity. A limitation of this study was the use of self-reported measures, which are prone to bias and may produce socially desirable responses <sup>59</sup>, particularly among participants from the experimental group. As such, objective physical activity assessment methods (pedometers, accelerators) are preferred over subjective measures as it limits incidences of recall bias that may produce an overestimation or underestimation of the measures of interest

<sup>60,61</sup>.

In more recent studies, Lai, Costigan, Morgan, Lubans, Stodden, Salmon, Barnett <sup>57</sup> systematically reviewed various school-based interventions that focus on physical activity to assess whether they produced a sustained impact in children and adolescents. ‘Follow-up assessment’ was defined as data collection at least six months after post-intervention testing. They included studies that had intervention duration of four weeks or more. Of the fourteen studies identified, ten studies measured and reported a sustained impact on physical activity. However, some studies reported a sustained impact only for boys or only for girls, and nine studies used self-reported methods of assessment. They also found that no study met four key methodological criteria that have been shown to influence results, i.e., clarity on the randomization process, assessor blinding, analyzing participants in their original groups, and retaining sufficient participants through the entire study. Thus the authors were not definite in their conclusions, mentioning that there was some likelihood that physical activity was a sustainable outcome. They also found that interventions that were of longer duration (greater than one year) that utilized a theoretical model or framework were more effective in producing a sustained impact. Tarro, Llauro, Morina, Sola, Giralt <sup>56</sup> and Nader, Stone, Lytle, Perry, Osganian, Kelder, Webber, Elder, Montgomery, Feldman, Wu, Johnson, Parcel, Lucpker <sup>62</sup> also reported sustained effects on PA, two and three years respectively after the cessation of the school-based intervention. These findings too were based on self-reported physical activity assessments. Tarro, Llauro, Morina, Sola, Giralt <sup>56</sup> additionally found that there was a reduced obesity prevalence.

In contrast, Meyer, Schindler, Zahner, Ernst, Hebestreit, van Mechelen, Brunner-La Rocca, Probst-Hensch, Puder, Kriemler <sup>63</sup>, objectively measured physical activity, three years after the cessation of an intervention in elementary schools. They found that apart from aerobic fitness,

previously observed beneficial effects on physical activity (accelerometer measurements) and body fat after one year were not sustained in the intervention arm. The relatively short duration of the intervention (nine months) may have impacted the sustainability of the intervention. Similarly, in the WAVES study – a cluster randomized controlled trial <sup>64</sup>, after a 12-month intervention to promote healthy eating and physical activity, among elementary school students, through schools and families, no meaningful effect on adiposity, dietary intake or physical activity at 15 months and 30 months follow-up was found. Although this was a theoretically informed, skill- based intervention, the long-term uptake by the students was not as expected. The intervention duration and delivery may not have allowed for adequate time for the children to be rooted in the behaviors being taught.

Lobstein, Baur, Uauy, TaskForce <sup>22</sup> reviewed several reviews of school and community intervention trials. Most of the studies, which focused on improving nutrition and physical activity behaviors of children in the general population showed improvements in eating and/or exercise habits of children. However, the continued effects of the interventions into adulthood could not be assessed. They recommended the need to evaluate the cost-effectiveness and long-term impacts of school- and/or community-based health promotion interventions in youth. Lytle, Murray, Perry, Story, Birnbaum, Kubik, Varnell <sup>65</sup>'s evaluation of the Teens Eating for Energy and Nutrition at School (TEENS) study, a 2-year randomized control trial aimed at increasing students' intakes of vegetables and fruit and reducing intake of high fat foods, found positive interim results for students randomized to intervention schools. However, the positive effects in primary outcomes (such as vegetables and fruit consumption) were no longer evident by the end of the second year <sup>65</sup>. Dobbins, Husson, K, LaRocca <sup>66</sup> also conducted a systematic review of school-based physical activity programs for children and youth aged 6 to 18, with intervention

duration ranging from 12 weeks to 6 years. Most of the studies were randomized control trials. They found positive intervention effects for duration of physical activity, television viewing, VO<sub>2</sub> max and blood cholesterol. However, overall, they found that the school-based interventions had little effect on physical activity rates, systolic and diastolic blood pressure, body mass index (BMI), and pulse rate. The findings of an updated version of their systematic review did not significantly vary from these findings.

In summary, the evidence around sustained effects of school-based health promotion in the long-term, following a transition from the intervention environment into a non-intervention environment, or transition from one life-stage to the next is not conclusive. In most of these studies summarized above, the intervention students were most likely still in the same school environment in which they participated in the program. So, even though the intervention/program may have ended, being in the same program environment could account for some of the sustained behaviors reported. Additionally, some studies relied solely on self-reported data via questionnaires, which could potentially introduce response bias by participants reporting their activities not as actually happened but as is desirable. Furthermore, the use of physical activity questionnaires lends itself to limited reliability and validity particularly in assessing habitual physical activity and intensity of the activity<sup>67</sup>.

### ***1.3.3 Summary: Key points from evaluations of school-based health promotion initiatives***

Several points can be highlighted from the studies evaluating school-based health initiatives. First, school-based health programs vary in many ways, including program design, theoretical basis and content, duration and delivery, community involvement and financial support available<sup>43</sup>. As a result, the impact of the programs also varies. Interventions that use a whole school approach, involving the ethos and environment, with family and community involvement are

usually more effective, as they can shape the individual's environment to better support healthful decisions <sup>7,28,30</sup>. In addition, factors such as duration, frequency and intensity can influence the effectiveness of the programs <sup>57,66</sup>. As such, these factors should be considered when evaluating the effectiveness of such programs.

Second, there is no consensus on a standard procedure for program implementation, even under the same framework. This situation reflects the reality of differences in school contexts, needs and priorities when executing such programs. Schools differ in their objectives, leadership, enrolment criteria, curricular demands, socio-economic factors, physical structure and community support <sup>31</sup>. Additionally, various stakeholders (government, community, the school) may have different priorities. Consequently, a standard protocol for implementation of an approach (e.g. CSH) is therefore not feasible. As it stands, such implementation protocols tend to be generic, requiring that they should be tailored to the needs of the school. This therefore poses methodological challenges in systematic reviews of evaluation studies <sup>28</sup>. Systematic reviews could provide more useful information on effectiveness by grouping studies according to the approach or framework used. This will help the reader understand the degree of effectiveness of the types of school-based health promotion initiatives.

Third, regarding effectiveness, overall, small to average positive effects have been observed in school-based health promotion initiatives. This is due to the variations in programs types and execution process. However, these outcomes are still significant, particularly for addressing the world's urgent need for chronic disease control and prevention <sup>30</sup>. This is because, chronic diseases do not just occur among the small number of individuals at greatest risk, but amongst the much larger numbers of individuals at lower levels of absolute risk <sup>68</sup>. Therefore, achieving relatively small improvements in lifestyle across an entire population can produce greater overall

gains than focusing solely on the comparatively few people at high risk to achieve big lifestyle modifications<sup>69,70</sup>. Consequently, supporting young people to make healthy lifestyle choices through school-based health promotion initiatives has potentially positive future impact for the health and economic well-being of the individual and society.

Fourth, program effects while students remain within the program environment have been extensively evaluated. However, there is a dearth in studies assessing program effects in the long-term, particularly when students have left the program environment. Current gaps in the evidence of the impact of school-based health promotion programs include limited information on the sustainability of learned behaviors in the long-term, and cost-effectiveness of such programs. There is often an assumption of sustainability of learned behaviors. However, there is still the need for evidence from long-term evaluations of school-based health promotion programs beyond the intervention endpoint, and on a wider range of outcomes – dietary and physical activity behaviors, knowledge, self-efficacy, healthy weight status, etc. This will help to inform and improve current school-based interventions for optimum success.

#### **1.4 Rationale for this thesis**

School-based health promotion initiatives have been identified as ideal for health promotion among young people. Notable among these are those that use a whole school approach, such as CSH, whereby behaviors as well as environmental influences are addressed. Investments in such school-based health promotion programs assume that students benefit in terms of developing healthy lifestyle habits and attaining educational outcomes, which will be maintained throughout their lives. There are therefore high expectations for such initiatives to contribute to addressing the global chronic disease situation. These assumptions are yet to be substantiated, as the evidence for sustainability of program effects are limited.



Given this gap in the literature (and as discussed in the previous sections), it would be of added value to further assess whether the benefits of school-based health promotion programs are sustained in the long-term. Specifically, the sustainability of benefits of programs that have demonstrated effectiveness in the short term. Additionally, such an evaluation should focus on other outcomes in addition to physical activity outcomes, and with more rigorous assessment tools. Program duration and intensity should also be considered where possible, as it could have an impact on the outcomes.

The APPLE Schools project provides an opportunity for such an evaluation. In the short term, it has demonstrated effectiveness in improving diets, increasing physical activity and reducing the prevalence of childhood obesity <sup>20,51,52</sup>. Beyond school hours, APPLE Schools students have shown increased physical activity after school hours and on weekends relative to comparison school students <sup>53,71</sup>. APPLE School students have also been observed to translate the knowledge gained in APPLE Schools into practice in the home <sup>72</sup>. An analysis of the associated potential impact of APPLE Schools, assuming the effects continue beyond the boundaries of the program, showed promising results <sup>73</sup>. Specifically, the life course prevalence of overweight and obesity would be less among students attending APPLE Schools relative to their peers attending control schools. Furthermore, if the APPLE Schools program were scaled up, the potential cost savings would be \$33 to \$82 million/year for the Alberta province and \$150 to \$330 million/year for Canada. Although this study by Tran, Ohinmaa, Kuhle, Johnson, Veugelers <sup>73</sup> provides evidence for potential economic impact assuming the intervention effects continue, there is still the need for actual assessments of sustained intervention effects over the life course, and subsequently, more accurate cost-effectiveness assessments. This will contribute to evaluating the full impact of such school-based health programs in terms of sustained health behaviors, chronic disease

prevention and avoidable health care costs, and to support improvements and broader implementation of such effective programs.

### **1.5 Objectives, research questions and their development**

The work produced in this thesis is situated within the larger Return on Investment for Kids' Health (ROI4Kids) research project (<https://www.ualberta.ca/public-health/research/groups-and-units/roi4kids>), which has the goal of investigating the return on investments from school-based health promotion programs and policies. Specifically, the project aims to evaluate the effectiveness of school health programs and policies; estimate program/policy costs and avoided healthcare costs; optimize the implementation of school health programs; and engage end-users in the research process to enhance the impact and uptake of findings. It is in line with the aims of the ROI4Kids research project that I developed the overarching aim of this thesis and the sub-objectives associated with it.

The ROI4Kids research team comprises of pan-Canadian experts in school-based health promotion, and knowledge translation and exchange. Throughout the ROI4Kids research development and progression of research objectives, key knowledge end-users have been engaged to ensure the research is relevant. These knowledge users will continue to inform the research project as it progresses, formally through stakeholder workshops and informally through ongoing consultation to maximize the uptake and impact of this research. Thus, the potential impact of the findings presented in this thesis will be translated to decision-makers, practitioners, and the public as part of the ROI4Kids project.

Having identified the knowledge gap in the sustainability of benefits of CSH initiatives, the ROI4Kids research team chose to evaluate the long-term impact of a CSH initiative. The APPLE

Schools project was selected as a model of CSH because it had demonstrated effectiveness in improving health behaviors – healthy eating and increasing physical activity, as well as reducing the prevalence of childhood obesity among students within the program<sup>52,53,74</sup>. APPLE Schools is also associated with an assumed potential for sustained learned behaviors and health dollar savings<sup>73</sup>. It therefore served as the ideal study for addressing my questions on: 1) whether the health benefits observed in the short-term were observed in the long-term when students graduate from APPLE elementary schools into junior high/high schools which were not APPLE Schools; 2) whether there is a dose-response association between the duration in APPLE elementary schools and the levels of health behaviors and health outcomes observed in APPLE School graduates who are now in junior high/high school (i.e. healthy eating, being physically active and healthy body weights); and 3) what factors enhance or inhibit healthy lifestyle practices among adolescents in junior high/high school. I used a quantitative approach for points 1) and 2) as this method was most suitable for meeting these objectives, given the survey data we had collected. For point 3), I choose to use a qualitative approach to gain personal insights from adolescents (both APPLE School graduates and non-APPLE School graduates). Although adolescence is an important life phase in which future patterns of adult health are established, the adolescent years are filled with competing interests that may interact with and impact on learned positive behaviors from childhood. I therefore chose to explore adolescents’ perspectives on factors influencing their health behaviors within the junior high/high school environment. I felt that this would complement my findings from the quantitative evaluations of the sustainability of school-based health program effects.

### ***1.5.1 Study objectives***

This thesis uses a multi-method approach, comprising quantitative and qualitative studies, by which it provides evidence of the successful fulfillment of the overarching aim of my research.

Namely:

**To examine the sustainability of the APPLE Schools CSH program benefits and to explore factors that influence the practice of healthy behaviors among adolescents in the junior high/high school environment.**

I developed the following specific objectives that build upon each other towards the aim of this thesis:

- **Objective 1:** To assess the effects of APPLE Schools on health-related knowledge, attitudes, self-efficacy, diet, physical activity, and weight status, seven years after the start of the project, when students have graduated into junior high/high schools.
  
- **Objective 2:** To assess whether there is a dose-response association between duration in APPLE elementary schools and the levels of health behaviors and health outcomes (i.e. healthy eating, being physically active and healthy body weights) observed in APPLE School graduates who are now in junior high/high school.
  
- **Objective 3:** To explore adolescents' perspectives on factors influencing their health behaviors within the junior high/high school environment.

To fulfill these objectives, I generated three research questions that comprise the subsequent three chapters and have been developed into scientific manuscripts. Where applicable, their citation and publication status are provided.

- **Research Question 1:** Do APPLE Schools graduates have better knowledge, attitude, self-efficacy, health behaviors (healthy eating, being physically activity) and healthy body weights compared to comparison school graduates? (Objective 1, Chapter 2)
  - Ofosu, N.N., Ekwaru, J.P., Bastian, K.A., Loehr, S., Spence, J.C., Storey, K., Veugelers, P.J. Long-term effects of comprehensive school health on health-related knowledge, attitudes, self-efficacy, health behaviors and weight status of adolescents. *BMC Public Health*, 2018: 18(1). Doi: 10.1186/s12889-018-5427-4
  
- **Research Question 2:** Is there a dose-response association between duration in APPLE elementary schools and levels of health behaviors and health outcomes observed in APPLE School graduates who are now in junior high/high school (i.e. healthy eating, being physically active and healthy body weights)? (Objective 2, Chapter 3)
  
- **Research Question 3:** From the adolescents' perspective, what factors influence their health behaviors in the junior high/high school environment? (Objective 3, Chapter 4)

### ***1.5.2 Data sets used in this thesis***

To address research questions 1 and 2, I used the following data sets: 1) ROI4Kids' Youth Health Survey; 2) APPLE Schools data; and 3) REAL Kids data. To address research question 3, I generated qualitative data from in-depth interviews with a convenience sample of Youth Health Survey participants.

#### ***ROI4KIDS' Youth Health Survey***

Data for APPLE School graduates and comparison school graduates were derived from the Youth Health Survey. This survey was conducted as part of the Return on Investment for Kids' Health (ROI4Kids) project. ROI4Kids is a multidisciplinary research project funded by Alberta Innovates through the Collaborative Research and Innovation Opportunities (CRIO) Team Grant (<https://www.ualberta.ca/public-health/research/groups-and-units/roi4kids>). It aims to evaluate and improve school health programs and policies that promote healthy eating and active living. The Youth Health Survey (YHS) was conducted during the 2015/16 school year among students from junior high and high schools in Northern Alberta. It involved a home survey to be completed by parents at home, which provided socio-demographic information including parents' education and household income. And a student survey on knowledge, attitudes, self-efficacy and diet, and an objective assessment of students' physical activity, lifestyle factors, and measured height and weight which was conducted in the schools.

#### ***APPLE Schools data***

The APPLE Schools project was launched in 2008 and annual evaluation surveys have since been conducted to evaluate its effectiveness<sup>52</sup>. The project uses identical survey tools as the Raising healthy Eating and Active Living Kids in Alberta (Real Kids Alberta) evaluation. Data are collected on health, nutrition, physical activity, lifestyle factors, and measured height and

weight among grade 5 students, and data on the school and home environment among their parents and school administrators.

### ***REAL Kids data***

Data for the comparison schools were derived from the REAL Kids evaluation. This is a large population-based survey that collects data on health, nutrition, PA, lifestyle factors, and measured height and weight among grade five students, and data on the school and home environment among their parents and school administrators<sup>53</sup>. REAL Kids evaluates the impact of the provincial government's initiatives to promote healthy weights among children and youth<sup>52,75</sup>.

### ***1.5.3 Summary of my contributions to this thesis***

I assisted in data collection for the Youth Health Survey and in the process put together my research questions, having them reviewed by my supervisory committee. I personally conducted all the literature review and statistical analyses presented in this thesis. For the qualitative study, I identified schools and students, and connected with them (and parents) to organize the data collection. I personally conducted all the interviews for the data generated. I also carried out all the qualitative data analyses. The full drafts of the manuscripts presented in this thesis were prepared and written by myself and were reviewed by my supervisory committee.

### ***1.6 Structure of this thesis***

This thesis employs a “paper-based” format which includes an introduction, three chapters that align with the three objectives of this thesis, and a general discussion of overall findings. The subsequent three chapters comprise analyses of the three research questions developed to address the study objectives. Chapters 2, 3 and 4 are written in a scientific manuscript format for

consideration for publication in peer-reviewed journals. The final chapter is a discussion of overall findings from the thesis, methodological considerations, strengths and limitations, and final conclusions and recommendations.



## **CHAPTER 2: Long-term effects of comprehensive school health on health-related knowledge, attitudes, self-efficacy, health behaviors and weight status of adolescents**

Ofori, N.N., Ekwaru, J.P., Bastian, K.A., Loehr, S., Spence, J.C., Storey, K., Veugelers, P.J.

Long-term effects of comprehensive school health on health-related knowledge, attitudes, self-efficacy, health behaviors and weight status of adolescents. *BMC Public Health*, 2018: 18(1).

### **2.0 Abstract**

**Background:** APPLE Schools is a Comprehensive School Health (CSH) project, started in schools in socioeconomically disadvantaged areas where dietary habits are poor, physical activity levels are low, and obesity rates are high. Earlier research showed program effects whereby energy intake, physical activity and weight status of students in APPLE Schools had reached similar levels as that of students in other schools. However, it is unknown whether the effects of CSH are sustained when children grow into adolescents. Effects of APPLE Schools on health-related knowledge, attitudes, self-efficacy, diet, physical activity, and weight status, seven years after the start of the project, when students were in junior high and high school were assessed. We hypothesized that APPLE School graduates and comparison school graduates will remain at similar levels for these indicators.

**Methods:** In the 2015/16 school year, junior high and high school students (grades 7-12) in Northern Alberta, Canada participated in a Youth Health Survey. Participants included graduates from APPLE elementary schools (APPLE School graduates; n = 202) and comparison elementary schools (comparison school graduates; n = 338). Health-related knowledge, attitudes, self-efficacy, diet (24-hour dietary recall), physical activity (pedometer step count) and weight status were assessed. Mixed effects regression was employed to assess differences in these

outcomes between APPLE School graduates and comparison school graduates. Comparisons between elementary school (2008/09) and junior high/high school (2015/16) of self-efficacy, physical activity and weight status were also conducted.

**Results:** APPLE School graduates did not significantly differ from comparison school graduates on any outcomes (i.e. knowledge, attitudes, self-efficacy, diet, physical activity, and weight status). Additionally, no significant differences existed in the comparisons between 2008/09 and 2015/16.

**Conclusion:** Our findings of no difference between the APPLE School graduates and comparison school graduates suggest that the effects of APPLE Schools may continue into adolescence or the new school environment may have an equalizing effect on the students regardless of where they started. Since lifestyle practices are adopted throughout childhood and adolescence, and the school environment has an important influence on development, an extension of CSH initiatives into junior high/high schools should be considered. This will help to consolidate and support the continuance of healthy lifestyle messages and practices throughout childhood and adolescence.

## 2.2 Methods

### Study population

This research is part of the Return on Investment for Kids' Health (ROI4Kids) research project, which employs a multidisciplinary approach to evaluate and improve school health programs and policies that promote healthy eating and active living. Students from junior high and high schools in Northern Alberta participated in a Youth Health Survey (YHS) during the 2015/16 school year, seven years after the initial implementation of APPLE Schools in 2008. The sample size for this survey was estimated using a sample size calculator: <http://www.sample-size.net/means-sample-sizeclustered/>. The estimate was done for physical activity (pedometer steps per day) taking into account the design effect while using an intraclass correlation coefficient (ICC) of 0.018<sup>53</sup>, a power of 80%, a difference between the APPLE Schools program students and comparison students of 1,000 pedometer-measured steps per day, at a 0.05 significance level with adjustment for the expected response rate. Our calculations indicated that a sample size of 403 students would adequately power the study. Additionally, using conservative response and completion rates at the elementary school level of about 40%, and considering incomplete surveys, response and completion rate at the junior high and high school level, we estimated the completion rates to be around 35%, for which we needed to invite 1,151 students to participate in the study.

Data for APPLE Schools were first collected in 2008 and 2009. Initial socio-demographic information, knowledge, attitudes, self-efficacy, diet and weight status variables were collected in 2008 while pedometer data were first collected in 2009. Data for the comparison schools were derived from the Raising healthy Eating and Active Living Kids in Alberta (Real Kids Alberta) survey conducted in 2008 and 2009. This is a large population-based survey that collects data on

health, nutrition, physical activity, lifestyle factors, and measured height and weight among grade five students, and data on the school and home environment among their parents and school administrators<sup>53</sup>. The same variables measured in the APPLE Schools evaluation were measured in Real Kids Alberta.

The Human Research Ethics Board and the Cooperative Activities Program of the University of Alberta approved this study, including data collection and parent informed consent.

### **Data Collection and Measures**

Trained research assistants collected data in the schools in the 2015/16 school year. School boards were contacted to identify junior high and high schools with a high enrolment of students from APPLE elementary schools. These schools were then invited to participate in the YHS, which comprised of a home survey to be completed by parents at home, and a student survey on knowledge, attitudes, self-efficacy and diet, and an objective assessment of students' physical activity and weight status which was conducted in the schools. As part of the student survey, respondents were asked to identify the elementary schools they attended. Based on the schools indicated, and the grades in which they attended these schools, participants were classified as having attended an APPLE School (APPLE School graduate) or not (comparison school graduate). The participation rates of the YHS at each stage of the study are presented in Figure 1. A total of 1765 home surveys and consent forms were distributed to parents. Of the 626 (35%) students who returned completed home surveys to school, 600 (34%) received parental consent to participate in the study. A total of 540 students completed the YHS (completion rate: 31%).

### ***Health-related knowledge, attitudes and self-efficacy***

The YHS included questions on health-related knowledge, attitudes, and self-efficacy for healthy eating and active living. Knowledge was assessed using six questions: three related to physical activity and three related to healthy eating. For physical activity, participants were asked how strongly they agreed that being physically active influences or affects: i) their health, ii) their body weight, and iii) how well they do in school. For healthy eating, participants were asked how strongly they agreed that the type of food they eat influences or affects: i) their health, ii) their body weight, and iii) how well they do in school. Response options on a four-point scale ranged from 'strongly agree' to 'strongly disagree'.

Eight questions were used to assess attitude. Participants were asked how much they cared about: i) being physically active, ii) eating healthy foods, and iii) getting enough sleep. Response options on a four-point scale ranged from 'a lot' to 'not at all'. Participants were also asked how strongly they agreed that schools should: i) limit the availability of unhealthy foods, ii) ban the serving of unhealthy foods at school, iii) discourage students from bringing unhealthy foods to school, iv) not allow students to bring unhealthy foods to school, and v) promote healthy eating and active living among students. Response options on a four-point scale ranged from 'strongly agree' to 'strongly disagree'.

Self-efficacy was assessed using eight questions: three related to self-efficacy for physical activity and five related to self-efficacy for healthy eating. For physical activity, participants were asked how confident they were that they could be physically active on their own time outside of school hours: i) no matter how tired they might be, ii) even if they had a lot of homework, and iii) on most days of the week. For healthy eating, participants were asked how confident they were that they could: i) eat healthy food at school, ii) choose a healthy snack

between school and dinner, iii) eat healthy food or choose a healthy snack when with friends, iv) choose a healthy snack when alone at home, and v) choose a healthy snack when bored or sad.

Response options on a four-point scale ranged from 'very confident' to 'not at all confident'.

A score (range 1 to 4) was assigned to each response option and confirmatory factor analysis with varimax rotation was used to confirm four factors and to generate factor scores. Internal consistency of the scale items for four factors was high (Cronbach's  $\alpha$  for: knowledge = 0.80; attitude = 0.75; self-efficacy for healthy eating = 0.83; self-efficacy for = 0.77). For each factor (knowledge, attitudes, self-efficacy for physical activity, and self-efficacy for healthy eating), responses were summed across all items to obtain an easy to interpret composite score, which was used to characterize graduates from APPLE Schools and comparison school graduates for the purpose of descriptive analyses<sup>76</sup>. However, factor scores were used for the statistical models.

### ***Dietary intake***

The students completed an online 24-hour dietary recall using the Waterloo Eating Behavior Questionnaire (WEB-Q 24), which has been validated for use with children and youth<sup>77-80</sup>.

Participants' caloric intake was calculated based on recorded intake from the online 24-hour dietary recall and from the Canadian Nutrient File<sup>81</sup>.

### ***Pedometer-determined physical activity***

Physical activity was measured in the form of hourly step counts recorded over nine consecutive days, using the Omron HJ-720 ITC time-stamped pedometer (Omron Canada Inc., Toronto, Ontario, Canada). The validity of the Omron time-stamped pedometer has been demonstrated under various conditions<sup>82,83</sup>. Trained research assistants explained to students how to use the

pedometers. Students were asked to wear the pedometers on the right hip directly in line with the knee during all waking hours except when showering, swimming, or participating in any activities that an adult regarded as unsafe to wear the pedometer. Students had the opportunity to receive daily text message reminders to wear their pedometers. Because of variations in administration and collection of the pedometers in each school, step count records from the first and ninth day were excluded from the analyses. Pedometer readings were considered complete if the pedometer was worn for a minimum of eight consecutive hours per day on at least two school days and one non-school day (weekend and/or holiday).

Steps during school hours (8:00 am – 3:59 pm) and non-school hours (7:00 am – 7:59 am and 4:00 pm – 8:59 pm) were considered for the physical activity assessment. Steps were normalized to hourly-accumulated steps during these periods by dividing total steps during school hours and non-school hours by eight and six hours, respectively. Average steps during school days and non-school days steps were also estimated. Students' step counts were averaged to represent a typical week (i.e. five school days and two non-school days).

### ***Weight status***

Student standing height was measured using a Seca 213 stadiometer (Seca gmbh & co., Hamburg, Germany) to the nearest 0.1 centimeter after students had removed their shoes. Body weight was measured to the nearest 0.1 kilogram on a calibrated digital scale (Health o Meter<sup>®</sup>, Sunbeam Products, Inc., USA). Body mass index (BMI) was calculated as weight divided by height squared ( $\text{kg}/\text{m}^2$ ). Obesity and overweight were defined using age and sex specific categories of the World Health Organization standard for children and youth<sup>84</sup>.

### ***Socio-demographic information***

Students' gender and age were self-reported. Information on geographic residence (metropolitan, city, rural-town), household income (<\$50,000, \$50,001-\$100,000, and > \$100,000) and parental education attainment (secondary or less, college, university or above) were reported by parents and used as a proxy for socioeconomic status.

### **Statistical analyses**

All analyses were conducted using the STATA version 14 software<sup>85</sup>. Differences between APPLE School and comparison school graduates were assessed using the Chi-square test or t-test where appropriate. As observations of students are nested within those of their schools, mixed effects regression models were employed to examine differences between APPLE School graduates and comparison school graduates. Unstandardized regression coefficients and 95% confidence intervals (CI) were obtained from the multivariable cross-sectional comparisons of APPLE School graduates and comparison school graduates (2015/16) for the outcomes knowledge, attitude, self-efficacy (for healthy eating and for physical activity), diet (dietary energy intake) and physical activity (step counts for typical week, school days, non-school days, school hours, and non-school hours). Odds ratios (OR) and 95% CI were obtained for weight status outcomes (overweight and obesity).

Cross-sectional comparisons of the assessments of self-efficacy, physical activity and weight status in elementary school (2008/09) and junior high/high school (2015/16) were also examined. Only these variables were used as they had comparable measures in 2008/09. The multilevel regression analyses were adjusted for the confounding potential of gender, age, geographic residency, household income, and parental education. An interaction term, defined as the product of the year variable (2008/09 = 0, 2015/16 = 1) and the binary intervention variable (Comparison



Schools = 0, APPLE Schools =1), was included in the multilevel models to estimate the difference in regression coefficients and OR, for the outcomes as a measure of intervention effect, i.e. the difference between APPLE School students and graduates relative to the difference between comparison school students and graduates.

## **2.1 Introduction**

The school environment is an important setting for promoting and supporting healthy lifestyles among children and youth<sup>22,39,40</sup>. Schools provide an opportunity to reach a wide range of children over a considerable amount of time. Therefore, enhancing the school environment to promote and support healthy lifestyles can improve children's health and well-being<sup>43</sup> as well as academic performance<sup>86</sup>.

Comprehensive School Health (CSH) is *“an internationally recognized approach to supporting improvements in students' educational outcomes while addressing school health in a planned, integrated and holistic way”*<sup>29</sup>. This approach may be referred to in other jurisdictions as health promoting schools, coordinated school health and healthy school communities. All of these approaches have similar underlying concepts, which are based on the World Health Organization's Ottawa Charter for Health Promotion (1986). CSH uses an inclusive approach to promote health and educational achievement by engaging parents, the community and other stakeholders, along with the use of policies and programs to provide supportive social and physical environments<sup>87</sup>. As a population-based approach to health promotion, CSH has the potential to reduce the risk of negative health outcomes by shifting the distribution of risk factors in a favourable direction<sup>69</sup>.

APPLE Schools is a school-based health promotion project that uses the CSH approach to create healthy school communities<sup>51</sup>. Though it began in 2008 in ten elementary schools located in socio-economically disadvantaged neighbourhoods, it currently reaches seventy schools in Northern Alberta (regardless of socio-economic status)<sup>51</sup>. The mission of APPLE Schools is to inspire and empower school communities to lead, choose, and be healthy by recommending and supporting measurable and sustainable changes. APPLE Schools aim to effect change in the school, home and community by promoting healthy eating, physical activity and good mental health. Each school is provided with dedicated staff time in the form of a school health facilitator trained in nutrition, physical activity, and community development, who works with students, parents, school staff and community members to develop school action plans specific to the needs of each school<sup>51</sup>. School action plans include, but are not limited to, student-led activities that are designed to make healthy living fun and engaging, such as planting classroom gardens, after-school cooking classes and physical activity programs. Baseline evaluations in 2008 showed that students in schools selected to be part of APPLE Schools had higher dietary energy intake, lower fruit and vegetable intake, lower physical activity levels and a higher prevalence of obesity compared to other students in Alberta<sup>52</sup>. Subsequent evaluations have established the effectiveness of APPLE Schools in improving diets, increasing physical activity and reducing the prevalence of childhood obesity<sup>52,53,74</sup>. However, the long-term effects of APPLE Schools, as with other CSH programs, have not been documented.

Few studies have conducted follow-up assessments on behavior maintenance or continued effects of school-based interventions in the long-term, beyond the intervention endpoint or outside the intervention environment<sup>57</sup>. The issues associated with the transition from one school environment to another, including losses to follow-up and difficulty acquiring appropriate

sample sizes, make long-term evaluations challenging<sup>56,57</sup>. However, such evaluations are needed to determine behavior maintenance and continued effects of intervention programs in improving healthy lifestyle habits in school settings, and to justify investments in such programs. We therefore assessed whether the effects of APPLE Schools on health-related knowledge, attitudes, self-efficacy, diet, physical activity, and weight status are sustained in junior high and high school students who attended an APPLE School in elementary school. Considering the relatively disadvantaged position of APPLE School students at baseline, we hypothesized that junior high and high school students who attended APPLE Schools in elementary school would have knowledge, attitudes, self-efficacy, health behaviors and weight status similar to that of students who did not attend APPLE Schools.

### **2.3 Results**

The characteristics of students are shown in Table 1. Our sample included 13 junior high/high schools with an average of 41 participants from each school. The comparison school graduates included more girls (59.1% vs. 48.3%;  $p = 0.021$ ) and had a higher mean age (14.0 years vs. 13.8 years;  $p = 0.045$ ) than the APPLE School graduates. Significant differences existed in household income and geographic location ( $p < 0.001$ ), with greater proportions of APPLE School graduates being from families earning more than \$100,000 per year and residing in cities. APPLE School graduates also reported lower health-related attitudes (2.72 vs. 2.81;  $p = 0.04$ ) and a higher percentage of overweight (44.6% vs. 32.3%;  $p = 0.005$ ) in comparison with graduates from comparison schools. No statistically significant differences were found for knowledge, self-efficacy, diet, physical activity-step counts, and obesity.

Table 2 shows a cross-sectional comparison of graduates of APPLE Schools and comparison schools. APPLE School graduates did not significantly differ from comparison school graduates

with respect to health-related knowledge, attitude, self-efficacy, diet, physical activity and weight status.

Comparisons between elementary school (2008/09) and junior high/high school (2015/16) of self-efficacy, physical activity and weight status are presented in Table 3. After adjusting for covariates, the analysis showed that between 2008/09 and 2015/16, no statistically significant differences existed in self-efficacy for physical activity and self-efficacy for healthy eating.

Physical activity declined between 2008/09 and 2015/16 for both APPLE School graduates and comparison school graduates. The difference in step count between 2008/09 and 2015/16 in APPLE School graduates was not statistically different from the observed difference in comparison school graduates. The comparison of weight status between elementary school (2008/09) and junior high/high school (2015/16), also showed no statistically significant differences between the two groups.

## **2.4 Discussion**

We assessed whether the effects of APPLE Schools are sustained in junior high and high school students who attended elementary schools participating in the project. APPLE School graduates did not significantly differ from comparison school graduates with respect to all outcomes (i.e. health-related knowledge, attitude, self-efficacy, diet, physical activity, and weight status).

Comparisons of self-efficacy, physical activity and weight status in elementary school (2008/09) and junior high/high school (2015/16), also showed no statistically significant differences between the two groups.

APPLE School students started worse off with regards to healthy dietary habits, physical activity levels and obesity prevalence relative to other students<sup>52</sup>. However, within two years of the

APPLE Schools program, they showed substantial improvements such that energy intake, physical activity and weight status of students had become similar as that of students in comparison schools<sup>52</sup>. We had hypothesized that the effects of the APPLE Schools program would remain and thus the absence of a difference between students from APPLE Schools and comparison schools would continue into junior high/high school. Therefore, finding no significant differences between the two groups suggests a possibility that the effects of APPLE Schools continue into junior high/high school. However, since both groups are now in the same junior high/high school environment, the lack of significant difference between the two groups could also be because the new school environment has an equalizing effect on the students regardless of where they started.

The decrease in physical activity-step counts between elementary school and junior high/high school in both APPLE School graduates and comparison school graduates reflects observations from other studies that physical activity generally declines in the transition from childhood through to adulthood<sup>51,57,88-91</sup>. This decline likely reflects the biological processes related to growth and maturation<sup>92,93</sup>, and possibly the increasing social demands at the different life stages<sup>91</sup>. Since lifestyle practices and habits are primarily developed in childhood and adolescence<sup>8,55</sup>, the school environment can play an important role in promoting and supporting healthy lifestyles among children and youth<sup>22,39,40</sup>. As the junior high/high school environment also exerts its own influence on student behaviors<sup>7,28,35</sup>, it is therefore insufficient to focus successful CSH programs only on elementary schools. This is because people are successful in maintaining behavior if they have adequate environmental and social support, and also when the behaviours have become habits<sup>8,94</sup>. Thus, there is a reasonable expectation that extending CSH programs into junior/high schools could mitigate the relapse in health behaviours (i.e. reduction

in physical activity) during adolescence by providing the needed support and to consolidate healthy lifestyle messages and practices adopted in elementary school to sustain health behaviours.

Some studies have assessed long-term effects of school-based health promotion, most of which are focused on physical activity outcomes. Lai, Costigan, Morgan, Lubans, Stodden, Salmon, Barnett <sup>57</sup> systematically reviewed school-based interventions that focus on physical activity to assess whether they produced a sustained impact in children and adolescents. ‘Follow-up assessment’ was defined as data collection at least six months after post-intervention testing. Of the fourteen studies identified, ten studies measured and reported a sustained impact in physical activity. However, some reported a sustained impact only for boys or only for girls, and nine studies used self-reported methods of assessment. Tarro, Llaurodo, Morina, Sola, Giralt <sup>56</sup> and Nader, Stone, Lytle, Perry, Osganian, Kelder, Webber, Elder, Montgomery, Feldman, Wu, Johnson, Parcel, Lucpker <sup>62</sup> also reported sustained effects on physical activity, two and three years respectively after the cessation of the school-based intervention. These findings too were based on self-reported physical activity. Tarro, Llaurodo, Morina, Sola, Giralt <sup>56</sup> also reported a reduced obesity prevalence. In contrast, Meyer, Schindler, Zahner, Ernst, Hebestreit, van Mechelen, Brunner-La Rocca, Probst-Hensch, Puder, Kriemler <sup>63</sup>, objectively measured physical activity, three years after the cessation of an intervention in elementary schools. They found that apart from aerobic fitness, previously observed beneficial effects on physical activity (accelerometer measurements) and body fat after one year were not sustained in the intervention arm. The relatively short duration of the intervention (nine months) may have impacted the sustainability of the intervention. Systematic reviews of school-based physical activity programs among children and adolescents show that duration, frequency and intensity of interventions can

influence the effectiveness of the interventions<sup>57,66</sup>. Thus, the most effective programs have characteristics such as being of long duration and high intensity, involving the whole school, being a multifactorial intervention, and comprising changes to the school environment<sup>30</sup>. These are characteristics of APPLE Schools as well as some other CSH-oriented programs, which have demonstrated beneficial effects on students' diet, physical activity and weight status<sup>28,30,48</sup>.

To our knowledge, this is the first study aimed at assessing the long-term effects of CSH (7 years after the initial implementation) on multiple outcomes – health-related knowledge, attitude, self-efficacy, diet, physical activity, and weight status. The strengths of this study include the uniqueness of the APPLE Schools project and the use of objective measures for physical activity and weight status. This study is not without limitations. First, we were unable to separate the effects of APPLE Schools from the effects of the new school environment because of the study design. High school students are likely to have spent a shorter time in APPLE Schools compared with junior high school students. However, our sample sizes were inadequate for the separate analyses, and such analyses may raise concerns about biases in attributing differences to an eroded effect of APPLE Schools. Furthermore, we did not account for duration (i.e. how long the elementary school had been an APPLE School) and intensity of the APPLE Schools intervention (i.e. number of days per week that the school had access to a school health facilitator). Varying durations and intensities in APPLE Schools could have impacted the outcomes of interest measured. The use of one 24-hour recall instead of repeated 24-hour recalls allowed the assessment of average intake at a group level but not the usual intake at an individual level. Another limitation is the cross-sectional design, by which causality cannot be established. Incomes in the more northern areas of Alberta, are inflated because of the economic boom and labour demands, which do not reflect on levels of education. Thus, parental education may be a

better proxy for socioeconomic status in this sample rather than income. However, we adjusted for the socioeconomic status proxies (parent education, household income, geographic residence) in our analyses.

## **2.5 Conclusion**

Our findings of no difference between APPLE School graduates and comparison school graduates suggest that either the effects of CSH still continue into adolescence or the new school environment may have an equalizing effect on the students regardless of where they started. However, since lifestyle practices are adopted throughout childhood and adolescence, and the school environment is recognized as an important influence on children and adolescents' development, an extension of CSH initiatives into junior high/high schools should be considered. This will help to consolidate and support the continuance of healthy lifestyle messages and practices throughout childhood and adolescence.



Table 2.1: Characteristics of APPLE School students, APPLE School graduates, comparison school students and comparison school graduates

|   | 2008/09         |                    | 2015/16                    |                                 | p*    |
|---|-----------------|--------------------|----------------------------|---------------------------------|-------|
|   | APPLE Schools   | Comparison Schools | APPLE Schools graduates*** | Comparison Schools graduates*** |       |
| No. of schools  | 10              | 163                | 13                         | 13                              |       |
| No. of students   | 277             | 3,300              | 202                        | 338                             |       |
| Gender, %   |                 |                    |                            |                                 |       |
| Girls   | 50.2            | 52.0               | 48.3                       | 59.1                            | 0.021 |
| Boys  | 49.8            | 48.0               | 51.7                       | 40.9                            |       |
| Age, mean $\pm$ SD (years)  | 10.8 $\pm$ 0.4  | 10.9 $\pm$ 0.4     | 13.8 $\pm$ 1.4             | 14.0 $\pm$ 1.3                  | 0.045 |
| <b>Knowledge (mean <math>\pm</math> SD)**</b>                           | 2.73 $\pm$ 0.69 | 2.81 $\pm$ 0.71    | 3.26 $\pm$ 0.54            | 3.34 $\pm$ 0.49                 | 0.07  |
| <b>Attitude (mean <math>\pm</math> SD)**</b>                            | 3.42 $\pm$ 0.55 | 3.44 $\pm$ 0.57    | 2.72 $\pm$ 0.51            | 2.81 $\pm$ 0.41                 | 0.04  |
| <b>Self-efficacy for healthy eating (mean <math>\pm</math> SD)**</b>    | 3.12 $\pm$ 0.63 | 3.11 $\pm$ 0.61    | 2.77 $\pm$ 0.73            | 2.81 $\pm$ 0.65                 | 0.51  |
| <b>Self-efficacy for physical activity (mean <math>\pm</math> SD)**</b> | 2.99 $\pm$ 0.63 | 3.09 $\pm$ 0.59    | 2.91 $\pm$ 0.76            | 2.83 $\pm$ 0.71                 | 0.259 |
| <b>Dietary outcomes</b>   |                 |                    |                            |                                 |       |
| Mean dietary energy intake (kcal)/day $\pm$ SD                          | 2117 $\pm$ 1242 | 1998 $\pm$ 1157    | 2173 $\pm$ 1034            | 2155 $\pm$ 1059                 | 0.848 |
| <b>Physical activity, mean <math>\pm</math> SD</b>                      |                 |                    |                            |                                 |       |
| Typical week, steps/day   | 9081 $\pm$ 2638 | 9798 $\pm$ 2960    | 6810 $\pm$ 2549            | 6667 $\pm$ 2586                 | 0.615 |
| School days, steps/day  | 9943 $\pm$ 2834 | 10540 $\pm$ 3242   | 7616 $\pm$ 2833            | 7413 $\pm$ 2960                 | 0.528 |
| Non-school days, steps/day  | 6928 $\pm$ 3799 | 7944 $\pm$ 3851    | 5177 $\pm$ 3476            | 5067 $\pm$ 3188                 | 0.787 |
| School hours, steps/hr  | 777 $\pm$ 218   | 839 $\pm$ 245      | 653 $\pm$ 221              | 634 $\pm$ 231                   | 0.445 |
| Non-school hours, steps/hr  | 621 $\pm$ 300   | 638 $\pm$ 55       | 340 $\pm$ 222              | 323 $\pm$ 227                   | 0.488 |
| <b>Weight status</b>  |                 |                    |                            |                                 |       |
| Overweight, %   | 44.4            | 37.6               | 44.6                       | 32.3                            | 0.005 |
| Obesity, %  | 19.5            | 14.0               | 18.7                       | 15.7                            | 0.381 |
| Parental education, %   |                 |                    |                            |                                 |       |
| Secondary or less   | 30.5            | 27.2               | 23.0                       | 21.8                            | 0.112 |

|                        |      |      |      |      |           |
|------------------------|------|------|------|------|-----------|
| College                | 41.1 | 42.1 | 32.8 | 24.9 |           |
| University or above    | 28.5 | 30.7 | 44.3 | 53.2 |           |
| Household income, %    |      |      |      |      |           |
| <\$50,000              | 34.5 | 21.6 | 13.7 | 24.8 | p < 0.001 |
| \$50,001 - \$100,000   | 37.4 | 40.4 | 15.3 | 34.2 |           |
| >\$100,000             | 28.1 | 38.0 | 71.0 | 41.1 |           |
| Geographic Location, % |      |      |      |      |           |
| Metropolitan           | 64.9 | 24.9 | 23.8 | 60.2 | p < 0.001 |
| City                   | 0.0  | 30.8 | 76.2 | 39.8 |           |
| Rural-town             | 35.1 | 44.3 | -    | -    |           |

\* p < 0.05 – statistically significant difference between APPLE School graduates and comparison school graduates.

\*\* Mean score on the four-point scale (please see text).

\*\*\* Average number of participants from each school was 41.

Table 2.2: Cross-sectional comparison of APPLE School graduates and comparison school graduates on knowledge, attitudes, self-efficacy, diet, physical activity and weight status

| Variable                                     | coefficient (95% CI)*    |
|--|--------------------------|
| <b>Knowledge**</b>                           | -0.15 (-0.39, 0.09)      |
| <b>Attitude**</b>                            | -0.16 (-0.42, 0.09)      |
| <b>Self-efficacy for healthy eating**</b>    | -0.15 (-0.39, 0.08)      |
| <b>Self-efficacy for physical activity**</b> | 0.14 (-0.10, 0.39)       |
| <b>Dietary outcomes</b>                      |                          |
| Dietary energy intake (kcal/day)             | -75.88 (-316.65, 164.89) |
| <b>Physical activity</b>                     |                          |
| Typical week, steps/day                      | -149 (-865, 567)         |
| School days, steps/day                       | -303 (-1113, 508)        |
| Non-school days, steps/day                   | -76 (-1177, 1026)        |
| School hours, steps/hr                       | -9 (-66, 48)             |
| Non-school hours, steps/hr                   | -16 (-79, 48)            |
| <b>Weight status</b>                         | (odds ratio and 95%CI)*  |
| Overweight                                   | 1.25 (0.76, 2.08)        |
| Obesity                                      | 0.99 (0.53, 1.85)        |

\*Model adjusted for gender, age, parental educational attainment, household income and geographic location.

\*\*Used factor scores from the confirmatory factor analyses.

Negative values of  $\beta$  and OR values below 1 indicate lower values among APPLE schools graduates relative to comparison schools.

Table 2.3: Comparisons of self-efficacy, physical activity and weight status between elementary school (2008/09) and junior high/high school (2015/16)

|   | APPLE Schools <sup>†</sup><br>(Difference between<br>graduates, 2015/16 and<br>students, 2008/09) | Comparison schools <sup>†</sup><br>(Difference between<br>graduates, 2015/16<br>and students,<br>2008/09) | Difference between<br>graduates, 2015/16 and<br>students, 2008/09 in<br>APPLE Schools relative<br>to comparison schools <sup>‡</sup><br>(group x time<br>interaction) | ICC   |
|---|---|---|---|-------|
| <b>Self-efficacy (coefficient and 95% CI) *</b>             |   |   |   |       |
| Self-efficacy for healthy eating ( $\beta$ and 95% CI)      | 0.14 (-0.22, 0.49)  | 0.30 (-0.02, 0.62)  | -0.16 (-0.47, 0.14)   | 0.048 |
| Self-efficacy for physical activity ( $\beta^*$ and 95% CI) | 0.18 (-0.010, 0.47)   | -0.001 (-0.27, 0.27)  | 0.19 (-0.09, 0.45)  | 0.007 |
| <b>Physical activity (coefficient and 95% CI)</b>           |   |   |   |       |
| Typical week, steps/day                                     | -776 (-2171, 620)   | -1571 (-2912, -230)   | 795 (-317, 1908)  | 0.085 |
| School days, steps/day                                      | -608 (-2160, 944)   | -1260 (-2747, 227)  | 652 (-582, 1886)  | 0.096 |
| Non-school days, steps/day                                  | -1150 (-2985, 686)  | -1882 (-3638, -125)   | 732 (-770, 2235)  | 0.042 |
| School hours, steps/hr                                      | 54 (-76, 184)   | -32 (-154, 90)  | 86 (-17, 186)   | 0.182 |
| Non-school hours, steps/hr                                  | -235 (-369, -102)   | -244 (-374, -114)   | 8 (-101, 117)   | 0.041 |
| <b>Weight status (odds ratio and 95%CI)</b>                 |   |   |   |       |
| Overweight  | 0.82 (0.44, 1.54)   | 0.85 (0.46, 1.56)   | 0.96 (0.54, 1.72)   | 0.017 |
| Obesity   | 1.35 (0.59, 3.12)   | 2.36 (1.07, 5.20)   | 0.57 (0.27, 1.20)   | 0.039 |

\*Used factor scores from the confirmatory factor analyses.

<sup>†</sup>Negative values of  $\beta$  and OR values below 1 indicate a lower value of the outcome in graduates relative to students.

<sup>‡</sup>Negative values of  $\beta$  and OR values below 1 indicate a lower value of the outcome in APPLE Schools relative to comparison schools between 2008/09 and 2015/16.

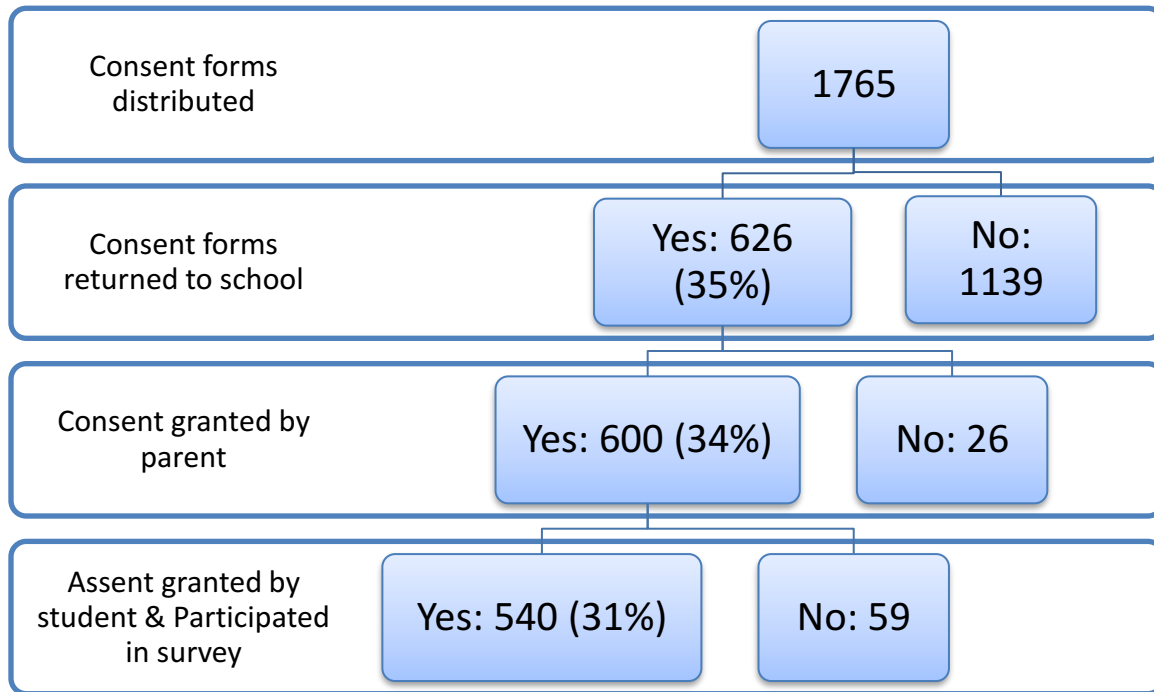


Figure 2.1: Description of enrolment of Youth Health Survey participants

## **CHAPTER 3: Association between duration of participation in APPLE Schools and health outcomes (dietary intake, physical activity levels and body weight status) of APPLE**

### **Schools graduates**

#### **3.0 Abstract**

**Background:** APPLE Schools is a school-based health promotion initiative that is based on the Comprehensive School Health (CSH) approach. The project has demonstrated effectiveness in improving diets, increasing physical activity and reducing the prevalence of childhood obesity among students. Projections on health and economic impacts of such effective CSH-based programs often assume positive outcomes which will continue into the future. However, studies evaluating the sustainability of learned health behaviors after the children leave such school environments are lacking. We examined whether there was a dose-response association between duration in APPLE elementary schools and the outcomes dietary intake, physical activity levels and body weight status of APPLE School graduates who are now in junior high/high school.

**Methods:** A Youth Health Survey was conducted in 2015/16, (seven years after the initiation of the APPLE Schools project), among junior high and high school students in Northern Alberta, Canada. Of the students who participated in the survey, 202 were APPLE elementary school graduates who have now moved on to junior and high school (grades 7-12). Data collected included dietary (24-hour dietary recall), physical activity (pedometer step count) and weight status assessments. Mixed effects linear/logistic regression models were employed to examine the association between duration in APPLE Schools and the respective outcomes.

**Results:** Duration in APPLE Schools ranged from 0.5 years to 6 years with mean duration of 2.4 years. Overall, the results showed no statistically significant dose-response associations between

duration in the project and the outcomes diet intake, physical activity levels and weight status of APPLE School graduates.

**Conclusion:** Our findings of no significant dose-response associations between duration in APPLE Schools and the outcomes – diet, physical activity and weight status of APPLE School graduates supported the possibility that the junior high/high school environment may mask the APPLE School effect or have an equalizing effect on all students regardless of where they started. Behaviors and habits are formed both in childhood and adolescence, thus providing life-stage appropriate health promotion throughout childhood and adolescence can provide supportive environments for grounding learned behaviors into habits.

### 3.1 Introduction

School-based health promotion plays an important role in improving young people's knowledge, attitudes and skills<sup>37,38</sup> as well as health behaviors and health outcomes<sup>22,39-41</sup>. However, diversity in program approaches and implementation has resulted in varying impacts of such programs. Evaluations of school-based health promotion initiatives have shown that programs that use a whole school approach tend to be more effective<sup>28,47,48</sup>.

APPLE Schools is a health promotion project based currently in Northern Alberta, Canada which uses a whole school approach. The mission of APPLE Schools is to inspire and empower school communities to lead, choose, and be healthy by recommending and supporting measurable and sustainable changes<sup>95</sup>. Therefore, the project is organized to effect change in the school, home and community by promoting healthy eating, physical activity and good mental health.

Evaluations of APPLE Schools have established its effectiveness in improving diets, increasing physical activity and reducing the prevalence of childhood obesity among students while still in the program<sup>52,53,74</sup>.

Projections on health and economic impacts of such school-based health programs often assume positive outcomes which will continue into the future. However, studies evaluating the sustainability of learned health behaviors after the children leave such school environments are lacking. We previously assessed whether the benefits of APPLE Schools are still evident in students who have left the APPLE Schools elementary school environment (APPLE School graduates) and moved into junior high/high schools<sup>96</sup>. The findings suggested that the effects of the APPLE Schools may continue into adolescence. However, we also acknowledged the new school environment, i.e. junior high/high school could also influence similarities in patterns of behavior in the student. In this paper, using data from only the APPLE School graduates, we



examined whether there is a dose-response association between duration in APPLE elementary schools and the levels of health behaviors and health outcomes (i.e. healthy eating, being physically active and healthy body weights) observed in APPLE School graduates who are now in junior high/high school.

## **3.2 Methods**

### **Study population**

This is a subgroup study within the Return on Investment for Kids' Health (ROI4Kids) research project. ROI4Kids employs a multidisciplinary approach to evaluate and improve school health programs and policies that promote healthy eating and active living. As part of the ROI4Kids' objectives, a Youth Health Survey (YHS) was conducted. Details on ROI4Kids and the YHS can be found at <https://www.ualberta.ca/public-health/research/groups-and-units/roi4kids> and Ofosu, Ekwaru, Bastian, Loehr, Spence, Storey, Veugelers<sup>97</sup>. In summary, the survey was conducted during the 2015/16 school year (7 years after the start of the APPLE Schools program), among students from thirteen junior high and high schools in Northern Alberta. Of the participants, 202 students who had attended APPLE elementary schools participated in the YHS. Analysis to examine the association of the outcomes with duration in the program was done using only data on the 202 APPLE School graduates.

### **Data Collection and Measures**

Trained research assistants collected the YHS survey data in the schools. School boards were contacted to identify junior high and high schools with a high enrolment of students who previously attended APPLE elementary schools. These schools were then invited to participate in the YHS. Consent forms were sent out to parents. Consenting parents completed a home survey that included questions on parental education, family income and geographic location.

Completed consent forms and home surveys were returned to the schools. Students were also required to provide assent to participate in the YHS. They then completed a student survey on knowledge, attitudes, self-efficacy and dietary intakes. Research assistants conducted objective assessment of students' physical activity (pedometer step counts) and weight status (height and weight measurements) in the schools.

The Human Research Ethics Board and the Cooperative Activities Program of the University of Alberta approved this study, including data collection and parent informed consent.

### ***Dietary intake***

The students completed an online 24-hour dietary recall using the Waterloo Eating Behavior Questionnaire (WEB-Q 24), which has been validated for use with children and youth<sup>77-80</sup>. Participants' energy intake, and vegetable and fruit intake were calculated based on recorded intakes from the online 24-hour dietary recall and from the Canadian Nutrient File<sup>81</sup>.

### ***Pedometer-determined physical activity***

Physical activity was measured in the form of hourly step counts recorded over nine consecutive days, using the Omron HJ-720 ITC time-stamped pedometer (Omron Canada Inc., Toronto, Ontario, Canada). The validity of the Omron time-stamped pedometer has been demonstrated under various conditions<sup>82,83</sup>. Research assistants explained to students how to use the pedometers. Students were asked to wear the pedometers on the right hip directly in line with the knee during all waking hours except when showering, swimming, or participating in any activities that an adult regarded as unsafe to wear the pedometer. Students received daily text message reminders to wear their pedometers for nine days. Because of variations in administration and collection of the pedometers in each school, step count records from the first

and ninth day were excluded from the analyses. Pedometer readings were considered complete if the pedometer was worn for a minimum of eight consecutive hours per day on at least two school days and one non-school day (weekend and/or holiday).

Steps during school hours (8:00 am – 3:59 pm) and non-school hours (7:00 am – 7:59 am and 4:00 pm – 8:59 pm) were considered for the physical activity assessment. Steps were normalized to hourly-accumulated steps during these periods by dividing total steps during school hours and non-school hours by eight and six hours, respectively. Average steps during school days and non-school days steps were also estimated. Students' step counts were averaged to represent a typical week (i.e. five school days and two non-school days).

### ***Weight status***

Student standing height was measured using a Seca 213 stadiometer (Seca gmbh & co., Hamburg, Germany) to the nearest 0.1 centimeter after students had removed their shoes. Body weight was measured to the nearest 0.1 kilogram on a calibrated digital scale (Health o Meter<sup>®</sup>, Sunbeam Products, Inc., USA). Body mass index (BMI) was calculated as weight divided by height squared ( $\text{kg}/\text{m}^2$ ). Obesity and overweight were defined using age and sex specific categories of the World Health Organization standard for children and youth <sup>84</sup>.

### ***Socio-demographic information***

Students' gender and age were self-reported. Information on geographic residence (metropolitan, city, rural-town), household income (<\$50,000, \$50,001-\$100,000, and > \$100,000) and parental education attainment (secondary or less, college, university or above) were reported by parents and used as a proxy for socioeconomic status.

### **Statistical analyses**

Descriptive statistics were presented as means  $\pm$  SD or frequencies. Graphs of duration in APPLE Schools and the outcomes dietary intake (average calorie intake, average fruit and vegetable intake), physical activity (step counts for typical week, school days, non-school days, school hours, and non-school hours), and weight status (overweight and obesity) were also examined. Linear regression analysis was used for the outcomes dietary intake and physical activity, and logistic regression analysis was used for weight status outcomes. To account for clustering of observations of students within schools, mixed effects linear/logistic regression models were employed to examine the effect of duration in APPLE Schools on the respective outcomes. Stratified analyses by age and location were also examined. All analyses were conducted using the STATA version 14 software<sup>85</sup>.

### **3.3 Results**

Table 3.1 shows the participant characteristics. A total of 202 APPLE School graduates from 13 junior high/high schools from the Northern Alberta area participated in the YHS and were included in the analyses. Duration in APPLE Schools ranged from 0.5 years to 6 years with mean duration of 2.4 years. There was no statistically significant dose-effect association between duration in APPLE Schools and the outcomes dietary intake (average calorie intake, average fruit and vegetable intake), physical activity (step counts for typical week, school days, non-school days, school hours, and non-school hours), and weight status (overweight and obesity) (table 3.2).

### **3.4 Discussion**

We examined whether there was a dose-response association between duration in APPLE Schools and health outcomes (i.e. dietary intake, physical activity levels and body weight status)

of APPLE School graduates. Overall, our results showed no statistically significant associations between duration in the program and the outcomes – diet, physical activity and weight status.

The effectiveness of APPLE Schools while the children were in the program in the elementary schools was clearly established<sup>52,71,98</sup>. However, whether the positive behaviors learned while the children were in APPLE Schools are retained long after the students leave the program environment into junior high and high schools still needs to be established. The results of our previous work<sup>97</sup> suggested that the effects of APPLE elementary schools may continue into junior high/high school. However, we also acknowledged the possibility that our findings could also reflect the effect of the junior high/high school environment on student behaviors and practices.

The findings from this paper show no dose-response association between duration in APPLE Schools and the health outcomes assessed – diet, physical activity and weight status. There are several possible explanations for this. First, schools as with all environments, influence behaviors<sup>28,48,99</sup>, thus moving from an APPLE elementary school into a non-APPLE junior high/high school environment, APPLE School graduates face a new culture they have to adapt to. As indicated by other research, the impact of school health initiatives are most evident when the school culture and environment are fully immersed in the program<sup>100,101</sup>. Thus, the strength of the new environment may cause students to assimilate some of the standards of the new environment and in combination with other competing interests of adolescence, the APPLE School effects gained while participating in the program in elementary school may be masked., if the new environment is significantly different from the APPLE School environment.

Second, the adolescent years are filled with competing interests that may interact with learned positive behaviors from childhood. These competing interests arise from the changes adolescence presents, including biological changes and social-role transitions<sup>36</sup>. As part of the social and emotional development in adolescence, there is the struggle with and discovery of self-identity, more independence in decision-making for self, navigating issues related to peer relationships and finding their feet in the new school environment (junior high/high school).<sup>99</sup>. Thus, amid the myriad of interests and factors that compete for the attention of the adolescent, providing supportive environments for the reinforcement and continuity of learned healthy lifestyles is important.

Third, the students' exposure to the APPLE Schools program only in elementary school creates room for other behaviors in junior high and high schools to occupy the "space" created. This will especially happen when the positive behaviors acquired in APPLE Schools have not fully taken root in the form of habits. Intervention effects diminish over time<sup>94</sup> as such, if the learned behaviors are not engrained into habits, they may wane. People tend to be effective with maintaining behaviors which have become habitual and are supported by automatic responses to relevant cues<sup>94</sup>. Habit formation takes time, and young people develop lifestyle practices and habits both in childhood and adolescence<sup>8,55</sup> thus continued support for healthy lifestyles at each life-stage is important.

Fourth, and perhaps more debatable is that, there is the possibility that such interventions bring students up to a certain level of behavior after which the program effect plateaus. For instance, within the first few years, there is an increase in uptake of behaviors, especially with the excitement surrounding the novelty of the program. When the program saturates the school environment, a 'healthy' school culture may be established. Given that school environments

influence behaviors <sup>7,28,35</sup>, students entering that school may readily pick up and exhibit the school culture. As such, whether the students are exposed to the program environment for a longer period or not, we may not see a difference in the outcomes based on duration of participation.

Although we did not find a dose-effect association between duration in APPLE Schools and the health outcomes assessed, program duration is still recognized as important to any intervention. Systematic reviews have shown that effective school-based health promotion programs have characteristics such as being of long duration and high intensity, involving the whole school, and being a multifactorial intervention, comprising changes to the school environment <sup>48</sup>. A systematic review by Lai, Costigan, Morgan, Lubans, Stodden, Salmon, Barnett <sup>57</sup> to determine whether children and adolescents, who participated in school-based interventions have sustained outcomes in physical activity, fitness, and/or fitness movement skill, found that intervention durations of longer than 1 year and interventions that utilize a theoretical model or framework were effective in producing a sustained impact. Meyer, Schindler, Zahner, Ernst, Hebestreit, van Mechelen, Brunner-La Rocca, Probst-Hensch, Puder, Kriemler <sup>63</sup>, objectively measured PA, three years after the cessation of an intervention in elementary schools. They found that apart from aerobic fitness, previously observed beneficial effects on PA (accelerometer measurements) and body fat after one year were not sustained in the intervention arm. The relatively short duration of the intervention (nine months) may have impacted the sustainability of the intervention. Dassanayake, Springett, Shewring <sup>44</sup> assessed the impact of CSH initiatives on mental health (i.e. anxiety and depression). The schools involved in the study were categorized into pre-funded, actively-funded and post-funded schools. The outcome indicated that actively-funded schools (hence longer duration) were associated with lesser percentage of students with

anxiety and depression. The authors recommended that schools need to have a steady focus on the CSH approach for a longer period, even after funding support ends to prevent the benefits of CSH from waning. This suggests that there is a possibility of benefits fading out without adequate support to establish behaviors.

A likely implication of our observations for public health is that continuity in health programs may be needed to reinforce acquired healthy lifestyle behaviors and to prevent waning of acquired behaviors. According to the Harvard University Centre on the Developing Child, the experiences children have early in life and the environments in which they have these experiences – food environments, physical and built environments, all get “under the skin” and influence lifelong learning, behavior, physical and mental health for better or worse <sup>102</sup>.

Additionally, a person’s ability to thrive from birth throughout life is affected by the environments they are located in (social, physical, etc.) and the degree to which these environments are healthy and supportive <sup>8,102</sup>. Thus, the impact of environmental or contextual influences in a person’s life is a process that lasts throughout their lifespan. This supports the need for continuity in providing healthy environments to support the growth and development of children and adolescents. The public health community is increasingly recognizing adolescence as a neglected life stage for which attention is needed <sup>103</sup>. As adolescents tend to be healthy on a general level, it is easy to overlook this important life stage in matters of health. However, adolescents are central to the global health agendas as their health and well-being are important means to creating healthier, more sustainable societies <sup>8,103,104</sup>. The WHO report for the World’s Adolescents emphasized that considerable gains from investments in maternal and child health programs are at risk of being lost without corresponding investments in adolescent health <sup>103</sup>. The 2012 Lancet Series on Adolescent Health also highlights the need to invest in adolescent



health arguing strongly that investments in adolescent health are essential due to the long-term benefits in all respects<sup>8,36,104-106</sup>. Current global actions to support adolescent health involve the inclusion of adolescent health and development as an integral part of the 2016-2030 Global Strategy for Women's, Children's and Adolescents' Health<sup>107</sup>. The World Health Organization (WHO) has also launched a Global Accelerated Action for the Health of Adolescents (AA-HA!) – a guide to support countries as they respond to the health needs of adolescents<sup>103</sup>.

Investments in adolescent health bring a triple dividend of benefits for adolescents now, for their future adult lives, and for the next generation<sup>103</sup>. Investments in adolescent health will therefore become investments not only in economic productivity and effective social functioning, but also in worldwide population health (Resnick, 2012). Considering the huge costs associated with diet related noncommunicable diseases which stands at \$2.0 trillion dollars per year for obesity (roughly the same economic impact as smoking or armed conflict at \$2.1 trillion dollars per year)<sup>108</sup>, the long term benefits of maintaining life-stage appropriate interventions would far outweigh the costs.

Most of the evidence currently available on benefits of school-based interventions are usually related to the short-term effects (benefits or risks) of the program. There is a dearth of studies on the impact of the duration of interventions on retained behaviors over time, particularly when students leave the program environment. Thus, this study contributes to the gap in knowledge by assessing dietary intake, physical activity levels and body weight status of APPLE School graduates in relation to duration in APPLE Schools. The limitations of this study include the small sample size, which did not provide adequate power for stratified analyses to examine the details of the interactions observed.

### **3.5 Conclusion**

The results showed no dose-response association between duration in the APPLE Schools project and the outcomes. This supported the possibility that the new school environment (junior high/high school) may have an impact on behaviors of the students, having an equalizing effect on student behaviors regardless of where they started. Behaviors and habits are formed both in childhood and adolescence, thus a continuity in effective health promoting interventions and supportive environments throughout childhood and adolescence can provide supportive environments for grounding learned behaviors into habits.

Table 3.1: Characteristics of APPLE School graduates

|   |                 |
|---|-----------------|
| No. of schools  | 13              |
| No. of students   | 202             |
| Range of duration in APPLE Schools (years)              | 0.5 - 6         |
| Mean duration $\pm$ SD (years)                          | 2.4 $\pm$ 1.4   |
| Gender, %   |                 |
| Girls   | 48.3            |
| Boys  | 51.7            |
| Age, mean $\pm$ SD (years)                              | 13.8 $\pm$ 1.4  |
| Age range (years)                                       | 11.7 – 18.0     |
| <b>Dietary outcomes</b>                                 |                 |
| Mean dietary energy intake (kcal/day $\pm$ SD)          | 2173 $\pm$ 1034 |
| Mean fruit and vegetable intake (servings/day $\pm$ SD) | 3.6 $\pm$ 2.9   |
| <b>PA, mean <math>\pm</math> SD</b>                     |                 |
| Typical week, steps/day                                 | 6810 $\pm$ 2549 |
| School days, steps/day                                  | 7616 $\pm$ 2833 |
| Non-school days, steps/day                              | 5177 $\pm$ 3476 |
| <b>Weight status</b>                                    |                 |
| Overweight, %   | 44.6            |
| Obesity, %  | 18.7            |
| Parental education, %                                   |                 |
| Secondary or less                                       | 23.0            |
| College   | 32.8            |
| University or above                                     | 44.3            |
| Household income, %                                     |                 |
| <\$50,000   | 13.7            |
| \$50,001 - \$100,000                                    | 15.3            |
| >\$100,000  | 71.0            |
| Geographic Location, %                                  |                 |
| Metropolitan  | 23.8            |
| City  | 76.2            |

Table 3.2: Association between duration in APPLE Schools and diet, physical activity and weight status outcomes

| Outcome variables                         | Unadjusted analyses | Adjusted analyses <sup>†</sup> |
|---|---------------------|--------------------------------|
|   | <u>β (95% CI)</u>   | <u>β (95% CI)</u>              |
| <b>Dietary outcomes</b>                   |                     |                                |
| Dietary energy intake (kcal/day)          | 49.8 (-49.9, 149.4) | 103.7 (-7.1, 214.5)            |
| Fruit and vegetable intake (servings/day) | 0.07 (-0.20, 0.35)  | 0.09 (-0.22, 0.41)             |
| <b>Physical activity (steps/day)</b>      |                     |                                |
| Typical week                              | -132 (-444, 180)    | -68 (-410, 273)                |
| School days                               | -118 (-464, 228)    | 2.0 (-374, 377)                |
| Non-school days                           | 81 (-399, 561)      | 68 (-420, 556)                 |
|   |                     |                                |
|   | <u>OR (95% CI)</u>  | <u>OR (95% CI)</u>             |
| <b>Weight status</b>                      |                     |                                |
| Overweight, %                             | 1.05 (0.9, 1.2)     | 0.9 (0.7, 1.2)                 |
| Obesity, %                                | 1.02 (0.87, 1.19)   | 1.00 (0.84, 1.20)              |

<sup>†</sup>Model adjusted for gender, age, parental educational attainment, household income and geographic location.

## **CHAPTER 4: Adolescents' perspectives on environmental and individual factors influencing their health behaviors**

### **4.0 Abstract**

**Background:** Adolescence is an important life phase in which future patterns of adult health are established. However, the adolescent years are filled with competing interests that may interact with and impact on learned positive behaviors from childhood. We explored adolescents' perspectives on factors influencing their health behaviors.

**Method:** A qualitative descriptive approach, based on naturalistic inquiry was used. In-depth interviews were conducted with 22 junior high and high school students in Northern Alberta, who had participated in a 2015/16 Youth Health Survey. The interview data were analyzed using content analysis. Codes were generated, grouped into categories, and subsequently reflected upon to create themes.

**Results:** Findings revealed three themes: 1) knowledge, 2) contextual factors (home environment and school environment) and 3) individual factors (self-motivation and personal responsibility). Overall, the students were knowledgeable about what a healthy lifestyle entails. The factors influencing how this knowledge was used were described in terms of the themes, contextual factors and individual factors. Students perceived the home and school environment as contextual factors which influenced their health behaviors and practices. They recognized the importance of the home and school environment in supporting healthy lifestyles, particularly by providing the right kind of knowledge, structure and opportunities to cultivate and maintain a

healthy lifestyle. Students also identified self-motivation and personal responsibility as individual factors of influence on their health behaviors and practices.

**Conclusion:** Although adolescents placed a great emphasis on personal responsibility for their health behaviors, environmental and social supports were key influences for encouraging healthy lifestyles. Therefore, health promotion programs that address both individual-level influences and the environmental influences may be relevant to support healthy lifestyles in adolescence.

## 4.1 Introduction

Adolescence is an important phase in life in which lifestyle habits that are established can influence adulthood. Therefore, how young people negotiate the adolescent years can have a significant effect on their future health, and national economic and social prospects <sup>8,36</sup>.

Consequently, cultivating healthy lifestyles (e.g. healthy diets and adequate physical activity), is important for attaining good health outcomes including chronic disease prevention <sup>15</sup> and good mental health <sup>44</sup>. Having good health also impacts on learning, since *“health and education are interdependent; healthy students are better learners and better-educated individuals are healthier”* <sup>29</sup>. However, the adolescent years are filled with competing interests that may interact with and impact on learned positive behaviors from childhood. These competing interests arise from the diverse changes accompanying puberty, including biological and mental development, and social-role changes <sup>36</sup>. Examples of the changes which impact on adolescents’ behaviors include struggles with and discovery of self-identity, trying to attain more independence in decision-making for self, and navigating issues related to peer relationships <sup>99</sup>.

In light of the developmental issues adolescents face, providing the right kind of supports for healthful decisions is critical to adolescents’ well-being. Following an assessment of a Youth Health Survey (YHS) in 2015/2016, we recently reported that the benefits of elementary school health promotion programs may be sustained into the junior high/high school environment, but we also acknowledged the potential for the junior high/high school environment to also impact student behaviors <sup>96</sup>. Given that school-based health promotion involves students as participants and beneficiaries, their perspectives on factors influencing their health behaviors are relevant to executing such initiatives. The knowledge generated could be incorporated into health promotion

strategies to enhance their impact. This study explores the YHS participants' perspectives on factors influencing their health behaviors in the junior high/high school environment.

## **4.2 Methods**

A qualitative descriptive approach was used as this provides a comprehensive description of the phenomenon of interest<sup>109,110</sup>, which in this case is adolescents' perspectives regarding factors that influence their health behaviors. The theoretical perspective of the qualitative descriptive method is based on the general tenets of naturalistic inquiry, i.e. a commitment to studying a phenomenon in its natural state, where the researcher has no a priori commitment to any one theoretical view but rather uses techniques that allow issues to be presented in its natural state<sup>109</sup>. Data were generated using semi-structured one-on-one interviews, which is consistent with this approach. One-on-one interviews also provided an opportunity for participants to express their perspectives independently, without the influence of their peers.

### ***Study Participants***

This research was part of the Return on Investment for Kids' Health research project, which employed a multidisciplinary approach to evaluate and improve school health programs and policies that promote healthy eating and active living. In the 2015/16 school year, 540 students from junior high and high schools (grades 7-12) in northern Alberta, Canada participated in a youth health survey (YHS). Details on the survey are provided in Ofosu, Ekwaru, Bastian, Loehr, Storey, Spence, Veugelers<sup>96</sup>.

As part of the information and consent process for the YHS, parents and students were notified about a forthcoming qualitative study and invited to express their interest in being contacted for the study. Students from the Edmonton area who expressed interest in the qualitative study were



invited to participate, because of their proximity to the research unit, which allowed them to have ample time to participate at their convenience and in a location of their choice. Only students who had written parental consent and provided assent participated in the study. One-on-one qualitative interviews were utilized as the data generation strategy. This allowed for individual perceptions regarding the phenomenon, as opposed to a collective discussion that could be influenced by peers. A sample size of 25 to 30 participants was estimated for this study<sup>111</sup>, however, with 22 participants (17 girls and 5 boys), no new insights were forthcoming and, therefore data saturation was achieved. The average age of the students was 14 years.

The Human Research Ethics Board and the Cooperative Activities Program of the University of Alberta approved this study (Pro00060175), including data generation and consent procedures.

### ***Data generation***

In March 2016, the selected students were contacted through their schools and the telephone numbers provided on their consent forms to schedule a time and place for interviews. Interviews were conducted between April and June 2016 either on the school premises during lunch or class time (with permission from the school), or at the home of the student. Interviews were audio-recorded as consented to by the parents and students. Although an interview guide was used for the interviews, participants were encouraged to speak freely. The topic guide addressed the areas of conception of health and healthy lifestyles, sources of health information, personal health behaviors and, facilitators and barriers to healthy lifestyles. Each participant received a \$25 gift card to a local bookstore after the interview.

### ***Data analysis***

The interview audio recordings were transcribed verbatim and transcription accuracy was verified. Participants were assigned a numerical indicator (e.g. Student 1 = S1). Content analysis in an iterative process (i.e. concurrent data collection and analyses) was used as it is appropriate for descriptive qualitative studies<sup>110</sup>. This involved an iterative process of coding, categorizing and generating themes from the data. The NVivo Enterprise 11 for Mac analytic software was used to organize the data for analyses. The researcher throughout all stages of data collection kept field notes and memos, which were referred to during the analysis to incorporate additional contextual information.

### ***Researcher's Position***

Clarifying the researcher's position from the onset of qualitative research enhances the quality of the research results as the researcher becomes more aware of their potential biases and beliefs that may impact on the way they approach the study<sup>112</sup>. It also helps define the way that an individual's position in the social hierarchy compared to other groups potentially "limits or broadens" one's understanding of others<sup>113</sup>. This study was approached from a constructivist's perspective, rooted in a relative ontology and subjectivist epistemology, whereby the research acknowledges that she and the participants are co-creators of understanding, and that the data generated and subsequent interpretations represent one possibility of multiple realities and multiple truths<sup>110,114</sup>. The researcher recognized that her personal background and perspectives (given the differences in culture and race) may influence her interactions with the participants. Additionally, coming from a research unit focused on promoting comprehensive school health, this could potentially introduce some bias into the research process. Thus, the researcher maintained a reflexive stance throughout the research process. Reflexivity refers to the continuous process of self-reflection that researchers engage in to generate awareness about their actions, feelings and perceptions, whereby, attention

is paid to how and why decisions and interpretations along the research process were made and being willing to relinquish ideas that are poorly supported by the data <sup>110,115</sup>. The researcher critically reflected on her own assumptions and beliefs, and those of the participants in the research, and kept a reflexive journal during the process to enhance interpretation of the data. Additionally, the researcher sought to establish rapport with participants in the data generation process, by interacting with participants in their own settings of choice and relating with them in a manner that promoted respect to reduce feelings of intimidation and ambiguity.

### ***Rigour***

Steps to ensure rigour or trustworthiness of the data and the results were incorporated into the research process as it provides a constructive rigour enhancing procedure <sup>116</sup>. Credibility, a criterion to assess whether the findings are an accurate representation of the participants and/or data, was ensured through member checking with members of the research team at various stages of the research process <sup>110</sup>. Dependability, the post hoc opportunity to review how decisions were made through the research was also ensured by an audit trail of methodological decisions <sup>110</sup>. Other rigour verification strategies incorporated in the research process included methodological coherence in the qualitative descriptive approach used, incorporating the use of field notes and memos, saturation in data collection and, an iterative data collection and analysis process <sup>110,116</sup>.

### **4.3 Results**

Findings revealed three themes: 1) knowledge, 2) contextual factors (home environment and school environment) and 3) individual factors (self-motivation and personal responsibility).

Overall, the students had good knowledge of what it takes to be healthy. The factors influencing how this knowledge was put to use, are described in terms of the themes contextual factors and individual factors (both described in detail below).

## **Knowledge**

Students were knowledgeable about what a healthy lifestyle entails; their descriptions were well developed and comprehensive. From their perspective, a healthy lifestyle was multifaceted, involving components such as eating healthy, being physically active, having adequate sleep, good mental health, not eating too much junk food, and not being sedentary. They indicated that these components of a healthy lifestyle should be a daily practice. A person with a healthy lifestyle was portrayed as someone who was able to incorporate the various components of a healthy lifestyle into their daily lives. One student described this as follows: *“I’d say it’s someone who is not on a strict diet but always eats healthy foods. And junk food is not really an option .... I feel like they’re the people that are always driven to like work out, like do yoga or meditate or something that drives them every single day. And just people who seem like happy with their life in general I feel like that’s part of having a healthy lifestyle”* (S4). One student explained the importance of incorporating the various components into one’s lifestyle as follows: *“It’s important because without these things it will be hard to function properly. Like if you’re not eating healthy then you can’t, you can’t be active, you can’t play sports or do anything. And if you aren’t eating healthy you can’t get enough sleep at the same time. So, they like go hand in hand”* (S5).

## **Contextual factors**

Students identified the home and school environments as factors that significantly influenced their health behaviors. These environments provided them knowledge, structure and opportunities in support of their health behaviors. In their view, having support from the home and school encouraged them to pursue healthy lifestyles. As shared by a student, *“I like pushing myself in physical activities like doing things that will help me. But I also get pushed or*

*encouraged by my parents or teachers to stay healthy and it helps a lot.*” (S5) Participants also expressed that when they were not in a supportive environment, their ability to make healthy choices was limited.

### ***The home environment sets the tone for health behaviors***

The students described their home as the environment that sets the foundation for behavior. Specifically, the home was viewed as particularly influential in directing eating behaviors since parents often purchased the food and planned most meals. Thus, students adopted their family’s value system and culture around food, and this in turn influenced their own food choices and eating behaviors. As explained by one student, *“I was always taught at home that you need to be healthy and that’s always a good thing. So, we’ve never really been an unhealthy family. My mom and my dad sometimes, but mostly my mom, she’s a real pusher for healthy food”* (S2). In addition to parents influencing the food environment, some students mentioned that they (students) also influenced the food environment at home. They described incorporating knowledge and practices learned through a school-based health promotion program into the home environment. Where parents supported their initiatives for changes to the food environment, students were encouraged to engage and to practice the learned behaviors. As described by one student (referring to the time in elementary school), *“I told my mom we should start eating more healthy, because of what I was learning from school, and she’s like, ‘yeah, we should’, and we started to buy more fruits, less junk food and all that. We go on runs to the park, play baseball, do activities and all that”* (S22). Consequently, even when such students had graduated into junior high/high school, they continued to reference their learned behaviors to influence the home environment: *“I encouraged my mom to get new stuff [food], because, before, we used to just, like be like, the old, normal things, but ever since, like even in Grade 7,*

*when I was out of the school, I used to get my mom to always get new things. I love trying new things” (S21).*

### ***School environment as a channel for health promotion***

Students felt that the school provides both knowledge and opportunities to practice healthy lifestyles. They identified health classes in schools as important sources of information on different aspects of health. As described by one student, “...*Especially from health class because we talk about all the food and stuff like how much sugar – like all the stuff like everything has sugar in it. And it’s not healthy for people*” (S12) and “*Yeah, because we have to learn about the Food Guide every year and then also in the options foods, we make a lot of healthy food. Because of the teacher we had, we liked healthy food and we just made a lot of it*” (S15).

Students further identified physical activity programs such as physical education, team sports, and exercise programs as some of the channels through which they acquired healthier behaviors. As one student stated in response to a question on factors that facilitate his pursuit of a healthy lifestyle: “...*being at school and having to do gym and fitness and stuff like that*” (S2). School activities also contributed to the development of skills for healthy lifestyles and school policies determined the type of healthy environment available to students.

Students were sensitive to the role the school environment played in supporting healthy lifestyles. Many students felt that there was a clear difference between the environment of their elementary school and the environment of their current junior high/high school, and that these environments influenced their health behaviors. They felt that their current junior high/high schools were more relaxed in supporting a healthy food environment in comparison to their elementary school. The context of the junior high/high schools was reflective of the relative independence afforded to students in their adolescent years as well as the nature of school

policies. As described by one student, *“Well, the environment it’s in. For, like [previous school], they push us towards eating healthier whereas [current junior high/high school], it’s not a [health promotion project] school so you can bring chips and pop. They sell stuff here, but it’s not close to healthy eating”* (S22). Consequently, these students felt that health promotion programs in schools are important for influencing and supporting healthy lifestyle choices. They felt that such programs *“are useful because kids right now don’t realize the food they’re eating has an impact on their body. So, these programs enable them to understand this”* (S9) and also, *“They’re very useful, because you won’t have so many kids eating junk food and getting sick. And then you have more healthy kids for the next generation”* (S3).

### **Individual factors**

Students identified self-motivation and a sense of personal responsibility as individual factors that influenced their health behaviors.

#### ***Self-motivation***

An intrinsic attribute that emerged as a factor that influenced adolescents’ health behavior is self-motivation – the desire or willingness to make healthy choices. Students indicated that self-motivation was tied to certain contextual situations. For instance, involvement in some form of organized sports in school or in the community encouraged them to take care of their health. A student described this as: *“There’s like times where I’m just like I really want to be healthy. And I really want to eat healthy. It’s usually certain times of the year when I’m in sports season then I’m like really focusing on eating healthy”* (S16). Students also indicated that good comprehension of the importance of cultivating a healthy lifestyle motivated them to adjust their health behaviors accordingly. One student explained this as follows: *“I want to keep a healthy lifestyle so I don’t have problems later on in life”* (S3). Students further indicated that pursuing a

healthy lifestyle was challenging. As such, for some students, healthy lifestyle practices were perceived to be an extra to or addition to one's daily routine, rather than being a lifestyle. They therefore felt there were periods where they would want to engage in healthy lifestyle activities while at other times, they felt they needed a break from it. As described by a student, *"On a weekday, I would probably try to be as healthy as possible and, like, make a lot of vegetables, like, salads and stuff to eat with my meals but like, I would have, like, a weekend, where I would just be lazy and stuff"* (S1). The challenges they faced included inadequate social support to maintain a healthy lifestyle, time constraints, the perceived realities of being a teenager and the temptations of fast food, namely, ease of access, convenience, time-saving, and taste. Some participants admitted that pursuing a healthy lifestyle was not a priority for them, since as adolescents, they had other interests and priorities that demanded their time and attention. This included schoolwork, learning to drive, and getting a job. One student shared that: *"If I had more motivation for myself, because, like, a lot of people around me are very supportive, it would be easier. Like, let's do it, let's work out, let's exercise, let's go out and do something, eat something healthy. But I'm at the point where it's like there's none, and I'm so lazy I don't want to get out"* (S2). Another student added that: *"I like eating a lot of junk food so it's like, it's hard to eat healthy sometimes cause there's so much sugar in foods like everywhere. And there's a lot of programs to get physical health, to be active but most of them, at least at my age, is like they start at eight at night so it's hard to get enough sleep and then school. And it's like, it's crazy"* (S5). Overall, students felt that self-motivation for healthy lifestyles required a lot of willpower and social support. Both the environment and the availability of social support affected the students' self-motivation.



### *A sense of personal responsibility*

Students indicated that attaining a healthy lifestyle was the individual's responsibility. Although they identified that making healthy lifestyle choices is affected by a combination of the individual's efforts and the contextual environmental, for the most part, they felt that ultimately, they were responsible for their own health. Some students articulated this as: *"It's a little bit of both. It depends on where you live, and who your family is, but it's usually up to your own choice"* (S6) and *"I feel that, if you want to be healthy, then you have to follow it yourself"* (S15). Even when they acknowledged not having control over certain contextual conditions, such as having so much school work that they are unable to get adequate sleep or an unhealthy food environment, they still felt they were the ones ultimately responsible for making changes in their lives, and making the right choices: *"Well, like most of the times I actually sleep late. It's because I have all these projects to do and all that stuff. But I really think that I have to have discipline to sleep early"* (S12). Based on their in-depth description of what healthy lifestyles entail, students placed great expectations and responsibility on themselves to achieve what they perceived as a healthy lifestyle. Their ideal picture of what a healthy lifestyle should look like involves meeting practically all the entailments they described as part of a healthy lifestyle, thereby posing an enormous challenge for themselves. Consequently, a healthy lifestyle seemed not only burdensome, but it generated a sense of guilt and stress when their healthy lifestyle ideals were not met. Those who felt this way rated themselves poorly on their perceived health status and attributed their shortfalls to *"being a fan of junk food"* *"being lazy"* and/or *"lack of motivation"*. Students with this perspective tended to blame themselves for perceived lapses in maintaining healthy lifestyles. This is illustrated by the following: *"Like sometimes I think like I should do something healthy and then when I try something then I feel like, no I don't feel like it."*

*Well I feel like I can't help if I'm not motivated” (S8). And “I think about it [healthy living] a lot, but I don't do it. I'm a very lazy person (S2).”* Some then eventually lost motivation to make a conscious effort at healthy choices. One student described her situation: *“I want to do like jogging or something for 30 minutes every day, but I have to admit I'm a little lazy. So, I will just stay inside and just do nothing. So yeah, that's why” (S2).* Overall, the students acknowledged that they knew what to do to maintain a healthy lifestyle, however they felt that translating the knowledge to practice was their responsibility and it required self-discipline and motivation on their part.

#### **4.4 Discussion**

Our findings highlight the home environment and school environment as contextual factors perceived to influence the sustainability of health behaviors and practices in the junior high/high school environment. The students recognized the importance of the home and school environment in supporting healthy lifestyles, particularly by providing the right kind of knowledge, structure and opportunities to cultivate and maintain a healthy lifestyle. Some had good insights into how the school environment could support healthy lifestyles. Students also identified self-motivation and personal responsibility as individual factors of influence on the sustainability of their health behaviors and practices.

A considerable body of evidence exists in support of the importance of the home environment and school environment to students' lifestyles and development. Theoretical themes relevant to behavior maintenance highlight the role of environmental and social influences, whereby behavior, whether under conscious control or occurring involuntarily and habitually occurs within an environmental and social context <sup>94</sup>.

Thus, these influences serve to either facilitate or hinder behaviour change maintenance. The nature of the individual's interactions in the home (positive or negative) for instance, have been shown to be strong predictors of health and health behaviors such as eating habits <sup>117</sup>, physical activity <sup>118</sup>, childhood obesity<sup>119,120</sup> and mental health <sup>121</sup>, and academic achievement <sup>122</sup>.

Additionally, the potential of the school environment to influence student's knowledge, attitudes and skills <sup>38</sup> and, health behaviors and outcomes <sup>39,41</sup> has also been widely recognized. In summary, stable, supportive contexts make acquired health behaviors and habits easier to sustain.

Our findings of self-motivation and personal responsibility as important influences on health behaviors and practice are also supported in the literature. From a theoretical bases, having a motivation for maintenance significantly impacts on the individual's ability to sustain a behavior. Kwasnicka, Dombrowski, White, Sniehotta <sup>94</sup> suggest that individuals need at least one sustained motivator to maintain behavior. These may include behavior enjoyment, satisfaction with behavioral outcomes and behaviors that are congruent with their identity, beliefs and values. Thus, in supporting healthy lifestyles among students, there is the need to incorporate the aspect of motivation. Contento <sup>123</sup> for instance, outlines 'enhancing motivation' (e.g. get students personally excited about the importance of good nutrition) as one of the three components for effective nutrition education, alongside 'facilitate ability' and 'create supports'. By this, the personal meanings and values people bring to healthy behaviors should be addressed, and then the relevant skills and support for engaging in these behaviors should be provided to help enhance self-motivation <sup>123,124</sup>. The feeling of personal responsibility for their health as exhibited by students in this study was consistent with other research among Canadian youth. Woodgate, Leach <sup>125</sup> identified sentiments of frustrations and struggles to maintain a healthy lifestyle as part

of their daily routine were expressed by young people. Kenney, Moore <sup>126</sup> also found intense views on personal responsibility toward one's health among Canadian adolescents. These views were attributed to school curriculums that place a greater emphasis on the individual and their lifestyle behaviors, without providing the needed support to sustain these behaviors. When society or the education system takes an individualistic approach to health behaviors, it can make people feel guilty about their own actions, mask the power and influence of their environment on choices available and associated behaviors, and potentially stifle change <sup>124</sup>. The sense of personal responsibility is also in line with the theoretical theme of self-regulation which is relevant to behavior maintenance. This theme suggests that people tend to maintain behavior if they successfully monitor and regulate the newly adopted behavior and have effective strategies to overcome barriers to the performance of the new behavior. Thus, there is the need to empower students to successfully navigate the challenges pursuing a healthy lifestyle may bring.

The contextual and individual factors influencing health behaviors and practices are interrelated in their impact. As indicated in the systematic review findings from Shepherd, Harden, Rees, Brunton, Garcia, Oliver, Oakley <sup>127</sup> on barriers to and facilitators of healthy eating among young people (11 – 16 years), contextual factors such as poor school meal provision and ease of access to, relative cheapness of fast foods, as well as individual factors like personal taste preferences for fast foods were perceived as barriers to healthy eating. Support from family, wider availability of healthy foods; desire to look after one's appearance and will power were identified as facilitators of healthy eating. This implies that in health promotion, approaches that account for the different contexts of influences should be incorporated. For children and adolescents, health promotion programs that engage the multiple spheres of influences on students' health (i.e. school curriculum, ethos and environment, home environment and community at large) tend

to be more effective in developing and sustaining healthy lifestyles<sup>7,28</sup>. The Comprehensive School Health (CSH) approach provides a platform for various environmental influences – social and physical environment, teaching and learning environment, policy, partnerships and services – to liaise in providing support for healthy behaviors<sup>29</sup>. Students attending schools with a CSH focus have been shown to have healthier eating habits, be more physically active and less likely to be overweight<sup>43,52,128</sup>. Therefore, CSH initiatives in the junior high/high school environment could provide adolescents with the necessary support to acquire and maintain healthy lifestyle behaviors. It could also serve as a platform to address the internal tensions or sense of inadequacy adolescents may feel when they are unable to meet their perceived standards of healthy lifestyles.

The use of a qualitative approach is a strength in this study, as it allows for a more personal and detailed exploration of the factors affecting sustainability of healthy behaviors and practices among adolescents. The lessons from the practical experiences shared can inform health promotion initiatives for children and adolescents. From the students' voices in this study, we understand that there is the need for supportive social environments for adolescents, to provide them the needed motivation to sustain healthy lifestyles. Regarding limitations, given the subjective nature of qualitative responses, there is the possibility that some of the issues highlighted in the interviews may not be representative of the experiences of other adolescents. Time constraints for some of the interviews because of the school curriculum could have impacted on some opportunities to probe deeper into participant responses, but data generation was continued until saturation was reached. Social desirability issues could have biased some responses. However, the researcher worked to build rapport with the students and conducted the

interviews at students' convenience in a setting of their choice to enhance the quality of the data generated.

#### **4.5 Conclusion**

Contextual and individual factors are interrelated in their influence on lifestyle. Although adolescents placed a significant emphasis on personal responsibility for their personal choices and behaviors, continued environmental support is relevant to promoting healthy lifestyles in the junior high /high school environment. Therefore, health promotion strategies that address both individual-level behaviors and the environmental influences are relevant to supporting healthy lifestyles in adolescence.

## **CHAPTER 5: General Discussion**

This discussion provides an overview of key findings in relation to the three objectives of this thesis. Following that summary, these findings will be positioned within the current literature. Methodological considerations and strengths and limitations of the thesis will subsequently be discussed and concluded with implications and recommendations for public health and suggestions for future research.

### **5.1 Summary of key findings**

The first objective of this thesis was to assess whether the positive outcomes of APPLE Schools on health-related knowledge, attitudes, self-efficacy, diet, physical activity, and weight status are sustained in junior high and high school students who attended APPLE elementary schools.

However, APPLE School students in 2008 had started worse off with regards to healthy dietary habits in physical activity levels and obesity prevalence relative to other students, but within two years of the APPLE Schools program, were at par with students in comparison schools.

Therefore, finding no significant differences between the two groups suggested one of two possibilities: 1) that the effects of APPLE Schools continued into junior high/high school or 2) that the new school environment has an equalizing effect on students regardless of where they started. In moving from an APPLE elementary school into a non-APPLE junior high/high school environment, APPLE School graduates faced a new culture they had to adapt to. There was therefore the possibility that the findings of no difference between the two group could also be because the junior high and high school environment may have had an equalizing effect on both groups of students regardless of where they started.

The second objective was to assess whether there was a dose-response association between duration in APPLE elementary schools and the health outcomes (dietary intake, physical activity

levels and body weight status) of APPLE School graduates. The results showed no dose-response association between duration in the APPLE Schools project and the outcomes. This supported the possibility that the junior high/high school environment may mask the strength of APPLE Schools effects established while students were in elementary school. Thus, to continue to sustain the positive behaviors that were observed when students were in the program <sup>52,53</sup>, it will be useful to extend life-stage appropriate health promoting programs into junior high/high schools.

The third objective was to explore adolescents' perspectives on factors influencing how their health behaviors are sustained within the junior high/high school environment. The results showed that, overall, the students had good knowledge of what it takes to be healthy. The home environment and school environment were highlighted as contextual factors perceived to influence the sustainability of health behaviors in the junior high/high school environment by providing the right kind of knowledge, structure and opportunities to cultivate and maintain a healthy lifestyle. Students identified self-motivation and personal responsibility as individual factors influencing sustainability of their health behaviors. Having a supportive environment is key in influencing the type of health behaviors exhibited, as highlighted from my data and in the literature. Therefore, health promotion initiatives should focus on providing supportive environments for adolescents to have the needed motivation and social support for healthy lifestyles.

## **5.2 Positioning findings in existing literature**

The current global increase in chronic diseases has prompted the need for appropriate, effective, and wide-reaching health promotion initiatives. To date, approximately 70% of all deaths and 43% of the global burden of disease and disability are attributed to major chronic diseases such



as obesity, diabetes, cardiovascular disease and cancer <sup>129</sup>. Additionally, the economic costs associated with diet related noncommunicable diseases stand at \$2.0 trillion dollars per year for obesity (roughly equivalent to the costs associated with smoking or armed conflict at \$2.1 trillion dollars per year) <sup>108</sup>. Besides medical interventions and advocacy for lifestyle changes towards more healthy lifestyles, attention is increasingly being focused on health promotion among young people. This is because chronic disease management or treatment in adults is difficult and often unsuccessful, however, prevention and reversing risk factors in childhood and adolescence usually holds more promise and reward for addressing chronic disease <sup>23,24</sup>. Also considering that adolescent health and health behaviors correspond strongly to adult health <sup>8</sup>, how they negotiate the adolescent years can have a significant effect on their future health, and subsequently national economic and social prospects. This provides the impetus for the public health community to seek to lay foundations for healthy lifestyles in young people and thereby reduce chronic disease risk in adulthood.

Schools have been identified as one of the important areas through which population level interventions among young people can be conducted. The bid to reduce and prevent childhood obesity has led to extensive research of design, implementation, and evaluation of school-based health promotion initiatives <sup>28,130,131</sup>. Reviews of the literature have shown the potential of school-based health promotion programs which use a whole-school or comprehensive approach to impact positively on young people's knowledge, attitudes and skills <sup>37,38</sup> and, health behaviors and outcomes <sup>22,39-41</sup>. Of these, approaches based on the World Health Organization's Ottawa Charter for Health Promotion (1986) namely, Health Promoting Schools, CSH and Coordinated School Health have been largely impactful <sup>28,30,38,44,45,52</sup>. In addition to the school curriculum, ethos and environment, these approaches involve engagement with families, outside agencies

and the wider community in recognition of the importance of these other spheres of influence on young people's health <sup>30,47</sup>.

In Canada, school health initiatives using the CSH approach to health promotion are becoming increasingly popular <sup>44</sup>. Studies have shown the effectiveness of CSH in promoting positive health behaviors and outcomes such as healthy eating and physical activity, healthy body weights and mental health <sup>44,52,53,128</sup>. APPLE Schools for instance, have demonstrated positive impact on diet, physical activity and body weights <sup>52,53</sup>. Dassanayake, Springett, Shewring <sup>44</sup> found evidence to indicate that CSH initiatives have positive impact on mental health (specifically, lower levels of anxiety and depression). Day, Strange, Mckay, Naylor <sup>128</sup> also found modest results of impact of Action Schools! BC in effecting change in: 1) students' intake of vegetables and fruit, 2) students' knowledge, attitudes and perceptions regarding vegetables and fruit, and 3) students' willingness to try new vegetables and fruit. Despite the increase in uptake of CSH and other whole school approaches the empirical evidence to show their impacts are sustained in the long-term is lacking.

The findings from this thesis point out the relevance of continuity in interventions in both childhood and adolescence, and the importance of supportive environments. There is a large body of literature which confirms that most of the program impacts are evident when children are in the program environment <sup>7,28,30,54</sup>. However, when children who have experienced the CSH environment move into a new environment in which there is inadequate support for practicing the acquired healthy lifestyles, the program effects may wane, or be masked as seen in the studies presented in these thesis (chapters 2 and 3). Considering how crucial childhood and adolescent experiences are to later health outcomes in adulthood, it is needful to have continuity in learning to help establish behaviors. The qualitative study findings (chapter 4) show from the

perspective of the students, how important adequate support and motivation are to practicing healthy lifestyles. It highlights the role of supportive social environments for encouraging healthy lifestyles, whereby, the home and school environments provide the right kind of knowledge, opportunities and context needed to cultivate and maintain a healthy lifestyle. The school environment can play an important role in promoting and supporting healthy lifestyles.

The junior high/high school environment may pose a greater challenge for establishing such programs, however, working with the schools, programs could be designed to suite the junior high/high school situation. The Lifestyle Education Activity Program (LEAP) in the United States is an example of a whole school health promotion intervention executed in a high school environment <sup>132</sup>. Using a group-randomized control trial design, the program aimed to improve the physical activity levels of grade nine girls through a one-year multi-component-multi-site intervention. Results of LEAP showed that female participants in LEAP schools were significantly more likely to report engaging in regular vigorous physical activity during an average of one or more 30-minute time blocks per day over a 3-day period compared to girls attending control schools. Another high school-focused whole school program is the Health Promoting Secondary Schools' program in British Columbia <sup>133</sup>. This also used a randomized control trial design to address physical activity and healthy eating behaviors of grade 10 students. The intervention period was one school year with follow-up measures taken a year after the experimental year. Due to a teacher's strike during the intervention year, may have impacted the outcome, hence the findings of no statistically significant change pre to post intervention in the health outcomes assessed. However, improvements in physical activity level were found in the intervention group in the year following the strike. Such studies provide opportunity to learn and inform other interventions situated in the junior high/high school environment. A key lesson in

the process of establishing such programs is to build upon the existing practices of schools to enhance the likelihood of uptake of the program and success in implementation <sup>134</sup>. Sulz, Gibbons <sup>135</sup> further highlighted strategies for school-based health promotion intervention implementation in the junior high/high school environment. These include a) creating a school committee and/or establishing a school coordinator/champion; b) providing teachers with intervention workshops; c) providing teachers and schools with resources and support materials; d) providing financial support and incentives; and e) involving key stakeholders in the development and implementation process.

Increasingly, there is the recognition that, adolescence is a neglected life stage for which attention is needed <sup>103</sup>. The WHO report for the World's Adolescents emphasized that considerable gains from investments in maternal and child health programs are at risk of being lost without corresponding investments in adolescent health <sup>103</sup>. The 2012 Lancet Series on Adolescent Health also highlights the need to invest in adolescent health arguing strongly that investments in adolescent health are essential due to the long-term benefits in all respects <sup>8,36,104-106</sup>. Current global actions to support adolescent health involve the inclusion of adolescent health and development as an integral part of the 2016-2030 Global Strategy for Women's, Children's and Adolescents' Health <sup>107</sup>. The World Health Organization (WHO) has also launched a Global Accelerated Action for the Health of Adolescents (AA-HA!) – a guide to support countries as they respond to the health needs of adolescents <sup>103</sup>. It is therefore important to focus health promoting environments throughout the elementary and secondary school years to provide adequate time and exposure for habits to be formed and rooted in the lives of young people. Most of the CSH initiatives have usually focused on elementary schools because of the ease of implementation. However, there is the need to better understand implementation in junior

high/high schools as CSH practitioners seek to extend into those areas.

### **5.3 Methodological considerations**

This thesis was designed as a multi-method research, allowing for a quantitative evaluation of the sustained benefits of APPLE Schools and a qualitative exploration of factors influencing how adolescents' health behaviors are sustained within the junior high/high school environment.

#### ***5.3.1 Quantitative studies***

For the quantitative studies (chapters 2 and 3), data from the Youth Health Survey (YHS), APPLE Schools and REAL Kids were utilized. The APPLE Schools and REAL Kids data were collected prior to the beginning of this thesis as such, I was not part of the decision-making team on the survey structure and tools used. The YHS data were collected as part of a larger, on-going research project, the Return on Investment for Kids' Health (ROI4Kids) research project, for which I assisted in data collection. However, I was limited in the decision-making regarding the structure of the survey e.g. in the areas of measurement tools, sample size, and participant selection. Details on ROI4Kids and the YHS as planned by the decision-making team are described and can be found at <https://www.ualberta.ca/public-health/research/groups-and-units/roi4kids> and Oforu, Ekwaru, Bastian, Loehr, Spence, Storey, Veugelers<sup>97</sup>. Strengths and limitations associated with using these data sets and how I used these data sets will be discussed in the next section.

From the literature, evaluations of sustainability of school-based health initiatives in the long-term usually consider physical activity outcomes<sup>56,57,62,63</sup>. However, in this thesis, a wide range of outcomes were considered in addition to physical activity, including health-related knowledge, attitude, self-efficacy for health behaviors, dietary intake and body weight status.

This is reflective of key areas in which such school-based health initiatives have demonstrated impact <sup>7,28,30,38,54</sup>. This thesis also focused on APPLE Schools, a CSH-initiative, and assessed the association between duration in the program and the outcomes. It thereby contributed towards filling in the current gaps in knowledge about the sustainability of CSH-focused program benefits beyond the program environment.

The choice of the most appropriate method to measure physical activity generally depends on several factors, including the dimensions of physical activity of interest (e.g. intensity, frequency, energy expenditure and duration), the study objectives, characteristics of the study population, and study feasibility in terms of costs and logistics <sup>136</sup>. In the YHS, we used the Omron HJ-720 ITC time-stamped pedometer (Omron Canada Inc., Toronto, Ontario, Canada) to measure physical activity in the form of hourly step counts recorded over 9 consecutive days. The validity of the Omron time-stamped pedometer has been assessed and demonstrated under various conditions <sup>82,83</sup>. Recommendations for obtaining reliable estimates of children's physical activity using pedometers indicate a minimum wear time of 8-10 hours on at least three days, including one non-school day (weekend or holiday) <sup>137-140</sup>. In the YHS, trained research assistants explained to students how to use the pedometers. Students were asked to wear the pedometers over nine consecutive days, on the right hip directly in line with the knee during all waking hours except when showering, swimming, or participating in any activities that an adult regarded as unsafe to wear the pedometer. Step count records from the first and ninth day were excluded from the analyses, because of variations in administration and collection of the pedometers in each school. Pedometer readings were considered complete if the pedometer was worn for a minimum of eight consecutive hours per day on at least two school days and one non-school day (weekend and/or holiday).

Dietary assessment in the YHS was by a 24-hour recall. The students completed an online 24-hour dietary recall using the Waterloo Eating Behavior Questionnaire (WEB-Q 24), which has been validated for use with children and youth <sup>77-80</sup>. This method reduced participant burden for recalling dietary intake and fit within the time constraints of the junior high/high school environment in which the survey was conducted. It also provided information on average intake at group level for the comparison between APPLE School graduates and comparison school graduates.

In the statistical analyses, clustering was considered. This was because the YHS survey data involved students clustered within schools, so some correlation between students within schools was expected. The variances within and between schools were considered through mixed effects regression procedures.

Regarding the data sets used, as the APPLE Schools project was originally aimed at supporting schools that were most in need of health promotion, there was no randomization of schools involved in the intervention. Thus, in this thesis, all analyses in the quantitative studies were adjusted for factors that could potentially confound the relationship between exposure and outcome variables. Potential confounders were selected a priori based on knowledge of the subject area and from previous studies. These included age, gender <sup>55,141,142</sup> and proxies of socioeconomic status, namely, parental educational attainment, household income level, and geographic location <sup>8,36</sup>.

### 5.3.2 Qualitative study

Qualitative research requires rigour (trustworthiness) to ensure that the work reflects the meaning in the data as accurately as possible <sup>110</sup>. For the qualitative study (chapter 4), steps to

ensure trustworthiness of the data and the results were incorporated into the research process as recommended by Morse, Barrett, Mayan, Olson, Spiers<sup>116</sup>. This included maintaining a reflexive stance throughout the research process, i.e. being attentive to how and why decisions and interpretations along the research process were made and being willing to relinquish ideas that were poorly supported by the data. Discussions with the research team (supervisory committee and other ROI4KIDS project members) occurred also at several stages of the analysis to maintain the credibility of the interpretations.

An audit trail of methodological decisions and reasons for them was maintained, along with field notes and memos<sup>110,143,144</sup>. Other steps used included ensuring methodological coherence in the qualitative descriptive approach used, convenience sampling participants and saturation in data collection<sup>110,116</sup>.

#### **5.4 Strengths and limitations**

One of the strengths of this thesis is the use of the multi-method approach to evaluate sustainability of the benefits of APPLE Schools, and factors that influence the sustainability of health behaviors. With this approach, the quantitative and qualitative studies are each conducted to answer a particular sub-question and the results of the research are linked to form a comprehensive whole<sup>145</sup>. This allowed for a broader evaluation and understanding of the thesis subject. Another strength is the use of objective measures of physical activity and weight status. This is preferred over self-reported measures as it limits incidences of recall bias that may produce an overestimation or underestimation of the measures of interest<sup>60,61</sup>.

Some limitations of this thesis should be acknowledged. First, the cross-sectional design of the quantitative studies necessitates caution with respect to interpretations of the associations



between APPLE Schools and the health behaviors and outcomes assessed. Linking students' data from the YHS to their data from APPLE Schools and REAL Kids could have helped to strengthen associations found in this study. Since there were no intentions to link the data at the planning stage of the YHS, measurement tools were not consistent across board for assessments in the YHS and in APPLE Schools / REAL Kids. For instance, the YHS uses one 24-hour recall which provides for assessment of average dietary intake at the group level only. Whereas the APPLE Schools / REAL Kids uses food frequency questionnaires, which allows for usual intake at an individual level. This therefore imposed limitations in making comparisons between dietary intake at the elementary school level and junior high/high school level. Additionally, there were differences in some of the questionnaires used to assess knowledge, attitudes and self-efficacy, thereby, limiting comparisons between the two data sets. Regarding the physical activity data, in 2008, physical activity assessments were conducted using validated physical activity questionnaires – the Physical Activity Questionnaire for older Children (PAQ-C)<sup>52</sup>. Pedometer assessments were introduced in 2009 and used in subsequent surveys including the YHS. Thus, physical activity comparisons in this thesis were made using pedometer assessments from 2009 and the YHS.

As there was no randomization in implementing the APPLE Schools project, potential confounding variables were considered in the analyses. However, there remains the possibility for residual confounding in the analyses conducted in the quantitative studies. Residual confounding arises if confounding variables exist but remain unidentified or if variables were not measured accurately<sup>59,146</sup>. As a result, the generalizability of the results may be limited. Another limitation is that the self-reported responses for assessing knowledge, attitude and self-efficacy, as well as parental education and income could have produced socially desirable responses.

Regarding the qualitative study, given the subjective nature of qualitative responses, there is the possibility that some of the issues highlighted in the interviews may not be faced by other adolescents. Time constraints for interviews because of the school curriculum, and social desirability issues could have impacted some responses. However, the researcher worked to build rapport with the students and conducted the interviews at students' convenience in a setting of their choice to enhance the quality of the data generated.

### **5.5 Implications for public health and education**

The findings from this thesis have several important implications for public health and education. First, there is a need to support school communities to become health-promoting schools using whole school approaches such as CSH. This is because, within such approaches is the recognition of the interdependence between health and education, linking health and education issues and systems, and the understanding that schools can directly influence students' health and behaviours <sup>29</sup>. Additionally, it encourages healthy lifestyle choices, incorporating health into all aspects of school and learning. It also recognizes the need for participation and support of schools, families and the community at large, which contributes to promoting social connectedness, and enhancing the social and emotional wellbeing of students.

Second, life-stage appropriate actions for health promotion should be considered as part of health promotion initiatives. As shown in this study, the period of adolescence presents its own challenges and issues that need addressing. For instance, participants in this research presented concerns about personal feelings of inadequacy and lack of motivation to pursue healthy lifestyles. These are genuine concerns to be addressed, particularly given the emotional turbulence of adolescent years as they seek self-identity. As such, health-promotion among adolescence should be able to address such life-stage issues identified. An example of a life-

stage appropriate model for health promotion, specifically nutrition education is suggested by Koch <sup>124</sup>. For lower elementary students (kindergarten to third grade), she suggests aiming for "good experiences with good food", whereby experiences which produce an open mind and palate, as well as good values about food are employed. This includes gardening, cooking, and tastings, which APPLE Schools also employ in their approach <sup>95</sup>. For upper elementary and junior high school students, she suggests building upon the "good experiences with good food" to include an understanding of the complexity of the food system and how it influences our views about food, food choices and health. In the high school years, the knowledge and experiences from the previous stages are topped up with experiences such as examining food policies and becoming advocates for change, and participation in programs where they educate younger students. Such an approach builds upon previous learning and results in a consolidation and reinforcement of the healthy lifestyle messages from the different life stages.

Third, there is the need for policy action to promote supportive environments. As shown in the findings of the thesis, and particularly from the perspectives of adolescents in the qualitative study, supportive environments are important to healthy lifestyle maintenance. In Canada, substantial public health and economic burden is attributed to chronic diseases that are largely preventable by adopting healthy lifestyles <sup>17,18</sup>. Specifically, it was found that many chronic diseases can be prevented by decreasing four main behavioral risk factors, namely, physical inactivity, poor nutrition, smoking and alcohol consumption <sup>19</sup>. Although people bear some personal responsibility for their health, environmental factors can support or undermine the ability of people to act in their own self-interest <sup>20,21</sup>. Supportive environments can help promote healthy behaviors and practices. Areas of policy action for young people include building healthy school communities, addressing marketing of unhealthy foods to children, and addressing the

food system to produce a system that has regard for health, ecological sustainability, social justice and equity <sup>124</sup>.

## **5.6 Recommendations for future research**

Based on the findings from this thesis, there are some areas that require future research. First, as a recommendation for research, evaluations of CSH initiatives and related initiatives based on the Health Promoting Schools approach are needed to provide a more comprehensive picture of the sustainability of whole-school approaches. The study designs should be such that can separate program effects from the environmental effects. This will provide knowledge on areas that need to be strengthened to establish long-term effectiveness. Such evaluations can guide public health and education decision makers in directing resources towards broader implementation of school-based interventions. In implementing CSH, there is the need for understanding and buy-in from teachers and school administrators as those responsible for delivering the curriculum. Systematic reviews could provide more useful information in such evaluations by grouping studies according to the approach or framework used. This will help the reader understand the level of effectiveness of the different types of school-based health promotion initiatives.

Second, although assessing individual program effectiveness is important, an additional research step that would be invaluable to health promotion initiatives would be to identify best practices or essential conditions which effective programs could incorporate into their structure. Having these guidelines will provide meaningful criteria for program evaluation. Currently, some researchers have initiated work to develop such guidelines. Storey, Montemurro, Flynn, Schwartz, Wright, Osler, Veugelers, Roberts <sup>100</sup> for instance, published a paper on essential conditions for the implementation of comprehensive school health to achieve changes in school

culture and improvement in health behaviours of students. The conditions identified were grouped into two categories, namely core conditions and contextual conditions. Core conditions are the conditions necessary for CSH to be successfully implemented and these include students as change agents, community support and evidence. The contextual conditions, i.e. those that have a great degree of influence on the ability for the core conditions to be obtained, include time, funding and project support, and readiness and prior community connectivity. Browne, Minozzi, Bellisario, Sweeney, Susta <sup>147</sup> also published a review in which they identify specific characteristics of interventions that are associated with effectiveness in promoting dietary behaviour change among different at-risk populations. These included having a theoretical basis, mode of delivery, intervention setting, intervention provider, and duration /intensity. Such studies will prove useful for future evaluations and informing the development and improvement of health promotion programs.

Third, research on effective implementation strategies for CSH programs in the junior high/high school environment is needed. Factors such as time constraints, curriculum and student schedules make the junior high/high school setting more challenging to implement such programs.

Fourth, qualitative studies exploring students' perspectives on health-promotion programs, and enhancers and barriers to positive health behaviours are also needed. As participants in school-based health initiatives, student perspectives are important to enhance the relevance and effectiveness of such initiatives and to tailor the program content to their needs. Thus, qualitative studies should be a part of evaluation studies.

Finally, economic analyses are also needed to establish the cost-effectiveness of CSH for disease prevention. This will help to evaluate and justify resources allocated to CSH initiatives to support healthy lifestyles.

For policy and practice, continuity in life-stage appropriate initiatives that promote and support healthy lifestyles are relevant. In addition to this, school communities should be supported to have a health promoting culture and environment.

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## **APPENDIX**

### Interview Guide

1. Overall conception/understanding of the term “healthy lifestyle”
2. Current lifestyle practices
  - a. Current practices in different settings (home, school, community)
  - b. Facilitators and barriers to healthy practices
  - c. Strategies to overcome these barriers
3. Perceived impact of school-based health promotion programs
  - a. Sources of health information
  - b. Perception of these sources (e.g. trustworthiness)
  - c. Recollection of APPLE Schools program or other school health program in elementary school
  - d. Perceived impact of school-based health programs