

**An After-school Physical Activity Intervention for Children: Examining the YMCA
CATCH Kids Club Program**

by

Renee Marie Elliott

Submitted in partial fulfillment of the requirements
for the degree of Master of Science

at

Dalhousie University
Halifax, Nova Scotia
July 2010

DALHOUSIE UNIVERSITY
SCHOOL OF HEALTH AND HUMAN PERFORMANCE

The undersigned hereby certify that they have read and recommend to the Faculty of Graduate Studies for acceptance a thesis entitled “An After-school Physical Activity Intervention for Children: Examining the YMCA CATCH Kids Club Program” by Renee Marie Elliott in partial fulfillment of the requirements for the degree of Master of Science.

Dated: July 19, 2010

Supervisor: _____

Readers: _____

DALHOUSIE UNIVERSITY

DATE: July 19, 2010

AUTHOR: Renee Marie Elliott

TITLE: An After-school Physical Activity Intervention for Children: Examining
the YMCA CATCH Kids Club Program

DEPARTMENT OR SCHOOL: School of Health and Human Performance

DEGREE: M.Sc CONVOCATION: October YEAR: 2010

Permission is herewith granted to Dalhousie University to circulate and to have copied for non-commercial purposes, at its discretion, the above title upon the request of individuals or institutions.

Signature of Author

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

The author attests that permission has been obtained for the use of any copyrighted material appearing in the thesis (other than the brief excerpts requiring only proper acknowledgement in scholarly writing), and that all such use is clearly acknowledged.

TABLE OF CONTENTS

LIST OF TABLES.....	vi
ABSTRACT.....	viii
LIST OF ABBREVIATIONS USED.....	ix
GLOSSARY.....	x
ACKNOWLEDGMENTS	xi
CHAPTER 1 – INTRODUCTION	1
1.1 SIGNIFICANCE OF THE STUDY.....	1
1.2 PURPOSE AND HYPOTHESES.....	4
CHAPTER 2 – LITERATURE REVIEW	6
2.1 THE OBESITY EPIDEMIC IN ADULTS, CHILDREN AND YOUTH.....	6
2.2 THE PREVALENCE OF OBESITY IN CHILDREN AND YOUTH.....	8
2.3 HEALTH CONSEQUENCES FOR OVERWEIGHT CHILDREN.....	10
2.4 HEALTH CONSEQUENCES FOR ADOLESCENTS.....	12
2.5 WHAT CAUSES OBESITY?.....	14
2.6 TECHNOLOGY & SCREEN TIME.....	14
2.7 NUTRITION.....	16
2.8 LOW LEVELS OF PHYSICAL ACTIVITY AND DECREASED CARDIORESPIRATORY FITNESS IN CHILDREN AND YOUTH.....	18
2.9 SOCIAL INFLUENCES FOR PHYSICAL ACTIVITY IN CHILDREN AND YOUTH.....	23
2.10 PHYSICAL ACTIVITY INTERVENTIONS – COORDINATED APPROACH TO CHILD HEALTH (CATCH).....	26
2.11 TECHNIQUES FOR ASSESSING PHYSICAL ACTIVITY.....	30
2.12 TECHNIQUES TO ASSESS CARDIORESPIRATORY FITNESS.....	32
CHAPTER 3 -METHODOLOGY	38
3.1 INTERVENTION OVERVIEW.....	38
3.2 RECRUITMENT.....	40
3.3 MEASUREMENTS.....	42
3.3.1 Anthropometric Measures.....	42
3.3.2 Physical Activity.....	43
3.3.3 Cardiorespiratory Fitness.....	46
3.3.4 Questionnaire.....	47
3.4 STATISTICAL ANALYSIS.....	48
3.5 ETHICAL CONSIDERATIONS.....	48
3.6 DIFFICULTIES IN METHODOLOGY.....	49
CHAPTER 4 – RESULTS	50
4.1 SAMPLE.....	50
4.2 DESCRIPTIVE STATISTICS.....	52
4.3 OVERALL MVPA.....	53
4.4 AFTERSCHOOL MVPA.....	54
4.5 SIX-MINUTE WALK-TEST.....	56
4.6 QUESTIONNAIRE DATA.....	58

4.7 SUMMARY OF RESULTS	63
CHAPTER 5 – DISCUSSION	64
5.1 CHANGES IN PHYSICAL ACTIVITY	64
5.2 CHANGES IN PHYSICAL ACTIVITY DURING AFTER SCHOOL TIME	68
5.3 CHANGES IN CARDIORESPIRATORY FITNESS	72
5.4 SCREEN-TIME AND ACTIVE TRANSPORTATION.....	74
5.5 STUDY LIMITATIONS	75
5.6 STRENGTHS OF THE STUDY	77
5.7 FUTURE DIRECTIONS.....	77
5.7.1 Researchers	77
5.7.2 Childcare Providers / Parents.....	78
5.8 CONCLUSION	78
APPENDIX A	80
APPENDIX B	83
APPENDIX C(1).....	85
APPENDIX C(2).....	90
APPENDIX D	92
APPENDIX E.....	94
APPENDIX F.....	95
REFERENCES	101

List of Tables

Table 1. Number of subjects with sufficient data for each portion of the study at baseline.	51
Table 2. Number of subjects with sufficient data for each portion of the study (post-test).	51
Table 3. Descriptive statistics for baseline and post-test measures for height (cm), weight (kg), body mass index (kg/m ²).	52
Table 4. Number of children classified as overweight, at risk for being overweight, healthy weight and underweight according to the age- and sex-specific CDC Growth Charts.	53
Table 5. Mean weekday and weekend minutes of MVPA at baseline and post-test measures.	54
Table 6. Mean after school MVPA minutes at baseline and post-test.	55
Table 7. Mean minutes of MVPA for boys and girls at baseline and post-test.	56
Table 8. Mean (m) and standard deviation (m) for the six-minute walk-test at baseline and post-test.	57
Table 9. Mean (m) and standard deviation of six-minute-walk-test for boys and girls at baseline and post-test and the analysis of variance between the two groups.	58
Table 10. Questionnaire data – frequencies.	59
Table 11. Students reported whether or not they walked to school on most days of the week.	60

Table 12. Mean minutes of MVPA for students who reported walking to school vs. those driven or who took the bus at baseline and post-test.60

Table 13. Mean minutes of weekday MVPA according to self-reported daily time spent watching television, playing video games and playing on the internet.....62

Abstract

Children who are overweight and physically inactive are a great concern due to the potential negative health consequences. Afterschool physical activity interventions have become increasingly popular in hopes of addressing these health risks. An afterschool program that has drawn attention in recent years is one with a physical activity component known as Coordinated Approach to Child Health (CATCH). The present study examined the effect the CATCH program had on MVPA and physical fitness in children in grades 3 to 6 attending the YMCA afterschool program. Results indicated a significant increase in overall daily MVPA ($p=0.047$) as well as physical fitness ($p=0.000$) from baseline to post-test. It was also found that children attending the afterschool program were already accumulating substantial daily MVPA during their regular afterschool program. These findings indicate that while CATCH was successful in increasing MVPA, students attending afterschool programs may already be obtaining sufficient MVPA during afterschool time.

List of Abbreviations Used

MVPA – Moderate to vigorous physical activity

6MWT – Six-minute walk-test

BMI – Body mass index

CATCH – Coordinated approach to child health

VO₂max – Maximal oxygen uptake

Glossary

Physical activity - Physical activity is defined as any bodily movement produced by contraction of skeletal muscle that substantially increases energy expenditure (Howely, 2001).

Physical inactivity – Physical inactivity is defined as a sedentary state.

MVPA – Moderate to vigorous physical activity (brisk walking, jogging, etc).

Physical fitness – a set of attributes (i.e. Cardiorespiratory endurance, muscle endurance, muscle strength, flexibility, agility balance and body composition) that people have or achieve that relate to the ability to perform physical activity (Howely, 2001).

Cardiorespiratory fitness - a measure of how well your body is able to transport oxygen to your muscles during prolonged exercise, and also of how well your muscles are able to absorb and use the oxygen, once it has been delivered, to generate adenosine triphosphate (ATP) energy via cellular respiration.

Snow days – A snow day is defined as a day where unfavourable weather determines that transportation to school is unsafe therefore school is cancelled

Acknowledgments

I would like to sincerely thank my supervisor Dr. Laurene Rehman for her continuous support during my thesis progress. I am very thankful for her patience and guidance throughout my time at Dalhousie University and believe it would have not been possible without her assistance. Special thanks to Dr. Phil Campagna for his guidance and expertise with accelerometers and the subject area. His passion for physical activity in children was truly inspiring for me and led me in this direction. Finally, I would also like to thank Dr. Angie Thompson for taking the time to sit on my committee despite the distance between us. Her optimistic and encouraging attitude kept me motivated and I am very appreciative for her feedback and extensive knowledge in the field.

My research project would not have been possible without the help of Paula Latham, Director of YMCA- Physical Healthy Development (Y-PHD) in Greater Halifax. Allowing me to use her program as a study group was instrumental for my thesis completion. In addition, I would like to thank the program leaders at each of the afterschool locations for their kindness and patience in the recruitment and data collection process. Last, but not least, extended gratitude to my mother for her motivation and support and to Bill and my friends for their continuous encouragement throughout my experience in the program.

Chapter 1 – Introduction

1.1 Significance of the Study

Obesity is now considered a growing public health crisis in much of the developed world. It is a major problem since carrying excess fat increases the risk of numerous health consequences including cardiovascular disease, type 2 diabetes, orthopaedic problems and certain types of cancer (Abelson & Kennedy, 2004; Baker, Olsen & Sorensen, 2007). The World Health Organization (WHO) has shown great concern for the issue and estimates that nearly 1 billion adults are overweight (BMI > 25) and 300 million are obese (BMI > 30) around the world (Abelson & Kennedy, 2004). According to the 2009 Canadian Community Health Survey (CCHS), the most recent national self-report, approximately 12.7 million (51.6%) of adults in Canada were classified as overweight or obese (Statistics Canada, 2010). The problem of obesity in developed countries is of concern not only because of the resulting health problems it is creating, but also due to its escalating costs on societies around the world. In 2001, it was estimated that the total direct cost of obesity in Canada was over \$1.6 billion of total health care expenditures (Katzmarzyk & Janssen, 2004). The World Health Report (2004) identified unhealthy dietary intakes and physical inactivity as among the leading causes of non-communicable diseases and a large contributor to the global burden of disease, death and disability. Obesity is currently the second leading cause of preventable deaths in developed nations after cigarette smoking (Miller, Rosenbloom & Silverstien, 2004) and is a growing problem that must be addressed globally.

Based on this overwhelming evidence, obesity is an issue that should be taken seriously at all levels. Not only does obesity affect adults, but also an increasing number of children and youth in Canada and other developed countries (Dehghan, Akhtar-Danesh & Merchant, 2005; Douglas, Tremblay & Katzmarzyk, 2003). Similar to adults, overweight and obese children are at risk for various physical health problems and are often subject to mental and emotional negative health outcomes (Dietz, 1998; Dutoit, Venter & Potgieter, 2005). As well, children that are overweight are more likely to grow into adults who are overweight or obese and are therefore not only at risk for immediate health issues but also long-term health problems (Bagley, Salmon & Crawford, 2006). In fact, as cited by Powers et al., (2006) it has been found that children who are overweight over the age of six years have more than 50% chance of becoming obese as adults while adolescents who are overweight have 70-80% chance of being obese as adults.

Although it has been suggested that genetics may play a role in the onset of obesity for some individuals (Hill & Peters, 1998), low levels of physical activity and high calorie diets are two of the main contributors (Coleman et al., 2005). Low levels of physical activity are associated with lower daily energy requirements and will result in weight gain and obesity over time unless food intake is limited (Hill & Peters, 1998). Physical activity levels among children are believed to be insufficient (less than 60 minutes of moderate physical activity on most days of the week, Campagna et al., 2002) which, in turn, is placing young people at risk for several health concerns (van Sluijs, McMinn & Griffin, 2007). Research indicates an inverse relationship between physical activity and obesity. In other words, children who participate in higher levels of physical

activity are less likely to suffer from weight related problems (Salmon et al., 2007). In addition, regular participation in physical activity of sufficient intensity improves strength, body composition and cardiorespiratory fitness. Since obesity and its risk factors are present in children and these factors track through adolescence into adulthood, primary prevention programs involving physical activity should begin early in life (Sirard & Pate, 2001). Further, it is believed that patterns of lifestyle behaviours are often established in childhood and adolescence, therefore, to promote lifelong physical activity, programs should be implemented early in life as well.

The literature indicates various methods that can be effective in reducing the risk of children being or becoming overweight; however, these methods need to be examined more seriously and rigorously. Opportunities for physical activity both during and outside of school, as well as active alternatives for sedentary behaviours, such as television watching and videogames, need to be applied. Increased activity should not only aid in weight control, but also have a tremendous positive impact on several physiological systems, psychological issues and overall health. Although some school based physical activity interventions have proven to be effective in preventing obesity in childhood (Veugelers & Fitzgerald, 2005 b), many schools are reluctant to release class time for non academic activities (Kelder et al., 2004). Increasing physical activity time in afterschool programs is important as it can aid children in reaching the recommended 60 minutes or more of moderate or more intense physical activity per day (Campagna et al., 2002), and decrease time spent in sedentary activities after school. One after school program that has demonstrated efficacy in increasing physical activity in elementary school aged children is the Coordinated Approach to Child Health (CATCH) Kids Club

program (Kelder et al., 2004). The CATCH Kids Club program is a physical activity and nutrition education program designed to promote healthy physical activity and nutrition behaviours.

The CATCH Kids Club program is of particular interest in Nova Scotia as it was implemented in the Halifax area in January of 2009 via the YMCA (YMCA CATCH Kids Club program). The program took place in 12 pilot schools throughout the Halifax Regional Municipality (HRM) and was delivered by YMCA staff members trained on the curriculum components of the program. The implementation of this program is very timely considering the decreasing levels of physical activity in Nova Scotia children and youth in recent years (Campagna et al., 2005). The CATCH program, described in detail in chapter 2, focuses on: (1) involving children in at least 30 minutes of daily physical activity, (2) with at least 50% of the activities at a moderate to vigorous intensity, (3) the opportunity to practice skills and participate and (4) to provide students with a variety of enjoyable activities (Kelder et al., 2004).

1.2 Purpose and Hypotheses

The main purpose of the present study was to examine the effectiveness of the program in increasing physical activity and cardiorespiratory fitness levels of elementary aged children. Accelerometers were utilized to objectively measure physical activity for seven full days at base line (January) and again at the end of the academic year (June). In addition, the children completed a 6-minute walk-test (6MWT) at base line and post-test to measure cardiorespiratory fitness. It was hypothesized that moderate to vigorous physical activity (MVPA) of the children participating in the YMCA CATCH Kids Club

program would increase significantly from base line testing. In addition, mean minutes of moderate to vigorous physical activity were expected to increase during the after school time frame. It was also expected that there would be an improvement in cardiorespiratory fitness.

Chapter 2 – Literature Review

The aim of chapter 2 is to acquaint readers with the risks and severity in children “at risk of overweight” and “overweight” and to help readers better understand the importance in preventing this problem that is now considered a global epidemic (Hill & Peters, 2004). Further, this chapter aims to outline the role that low levels of physical activity play in this issue, evidence of low physical activity levels in today’s children and youth and potential interventions designed to address the problems.

2.1 The Obesity Epidemic in Adults, Children and Youth

Because obesity is a sensitive topic and difficult to identify in children and youth, rather than defining children as being obese, the terms “at risk of being overweight” or “overweight” are commonly used. Similar to adults, a typical method for classifying children who are “overweight” or “at risk for being overweight” is body mass index (BMI). BMI is calculated by dividing a person’s weight in kilograms by their height in metres squared. BMI is then used to indicate whether a person’s weight is appropriate for his/her height (Canadian Physical Activity and Lifestyle Approach Manual, 2004). A healthy range on the BMI scale for adults is a score between 18.5 and 24.9, overweight is between 25.0 and 29.9, obesity is a value greater than 30.0, and a score greater than 40.0 is considered to be morbidly obese. Although BMI scores are calculated the same for adults and children, they are interpreted differently for two reasons: 1. height and weight changes with age and growth 2. The amount of body fat differs for boys and girls. In 2000, the Center for Disease Control and Prevention (CDC, 2000) presented BMI-for-

age-growth-charts to classify children and youth (ages 2-20) and to identify possible weight problems in children. The CDC's growth charts classify children with a BMI between 85% and 95% as "at risk for being overweight" and a BMI at or above the 95th percentile are categorized as being overweight. The percentile that the child falls into represents the relative position of the child's BMI among children of the same sex and age. For example, a girl at the 45th percentile has a BMI greater than 45% of other girls her age and a BMI lower than 55% of other girls her age. Although these standards of BMI were established by the CDC in the United States, they are well recognized in Canada and are endorsed by organizations such as Dietitians of Canada, the Canadian Paediatric Society, The College of Family Physicians of Canada and the Community Health Nurses Association of Canada Nutrition Committee (He & Beynon, 2006).

While BMI is simple to calculate, it is important to note that BMI is not a measure of body composition, but simply a ratio of height to weight that can change rapidly as children progress through normal growth (Dehghan et al., 2005). Since BMI fails to distinguish between fat and fat free mass, an additional measurement of waist circumference is often used. Evidence shows that waist circumference – an indication of abdominal fat - may in fact be a better means to predict those at greater risk for negative health consequences (Janssen, Katzmarzyk & Ross, 2004). Central obesity, or adipose tissue primarily found around the trunk (apple-shape figures), shows a stronger correlation with cardiovascular disease than gynoid obesity (pear shaped figures). For adults, waist circumferences greater than 102cm in men and 88cm in women commonly define potential health risks from abdominal fat. A combined "unhealthy" waist girth and

a BMI category of “overweight” or higher would indicate the greatest health risk (Canadian Physical Activity and Fitness Lifestyle Approach Manual, 2004).

Similar to adults, waist circumference is useful in identifying obesity related risks in children since it targets central obesity (Dehghan, et al, 2005). Maffeis et al. (2001) found that prepubertal children with a waist circumference above the 90th percentile for sex and age have a higher probability of cardiovascular risk factors, particularly lower HDL cholesterol levels and higher blood pressure than children with a waist circumference less than or equal to the 90th percentile (Maffeis et al., 2001). Ongoing studies continue to define specific cut off points for waist circumference to be used to identify health risk related to levels of body fat.

Although slightly more complicated than BMI and waist circumference measurements, determining body fat percentage is a common and more accurate method in identifying obesity in individuals. Although there are many techniques used to calculate body fat (i.e. skinfold thickness, MRI, underwater weighting, bioelectrical impedance, etc.), dual energy x-ray absorptiometry (DXA) is considered the gold standard for such measurements. It is generally agreed that men with more than 25% body fat and women with more than 30% body fat on DXA scans are obese. Problems with using the most accurate techniques (DXA, MRI, underwater weight) to assess total body fat in large populations include high costs, irradiation exposure, and limited availability outside the research setting (Maffeis et al., 2001).

2.2 The prevalence of obesity in children and youth

Due to the growing concern for children who are at risk for overweight and overweight, researchers have attempted to better understand the trends and prevalence of such cases. Tremblay and Willms (2000) provided convincing evidence that BMI of children in Canada have increased progressively from 1981 to 1996. Their analysis sought to examine the secular changes in BMI scores in Canadian children over a period of 15 years. Through nationally represented data (1981 Canada Fitness Survey, the 1988 Campbell's Survey on the Well-being of Canadians and the 1996 National Longitudinal Survey of Children and Youth), Tremblay and Willms (2000) were able to illustrate that since 1981, BMI in Canadian children has increased at a rate of 0.1kg/m^2 per year for both sexes and most ages. The results showed that from 1981 to 1996 there was an increase in overweight boys from 15.0% to 28.8% and an increase in overweight females from 15.0% to 23.6%. The prevalence of obese children (BMI > 95th percentile) more than doubled from 5.0% in boys and girls in 1981 to 13.5% for boys in 1996 and 11.8% for girls in 1996. More recently, data from the National Health and Nutrition Survey (NHANES) in the USA also showed a continuous increase in the prevalence of overweight children from 1963-1965 through 2007-2008 (Ogden & Carroll, 2010).

Willms, Tremblay and Katzmarzyk (2003) further examined the prevalence of overweight in children and youth based on geographic and demographic variation in Canada. Using the same data, Willms et al. (2003) determined that although all provinces showed a significant increase in BMI over the 15 years, the rate of increase was greater in the four Atlantic Provinces than anywhere else in Canada. In 1996, it was found that the prevalence of overweight children in the Prairie Provinces was 24.4% compared with a significantly higher number of 35.3% in the Atlantic Provinces. This is

an issue that should be of concern to many people in the province of Nova Scotia and the other Atlantic Provinces.

More specific to Nova Scotia, the 2005 Physical Activity in Children and Youth and dietary intake (PACY) study conducted by Campagna and his colleague's (2005) revealed even more specific insight into the alarming number of children and youth who are overweight in the province. Campagna et al.'s (2005) study revealed that in Nova Scotia, the amount of children "at risk for being overweight" and "overweight" was extremely high with 47.1% of grade three boys and 40.5% of grade 3 girls classified as at risk for overweight or overweight. In grade 7, 40.3% of boys and 30.3% of girls were at risk or overweight and in grade 11, 30.7% and 30.2% fell into either the at risk or overweight classifications (Campagna et al., 2005). This study examined several factors, including body mass index scores in children and youth in grades 3, 7 and 11 throughout the province. Veugelers and Fitzgerald (2005) also conducted a research study involving Nova Scotia youth and identified 32.9% of grade 5 students as overweight and 9.9% as obese (BMI >95th age and sex-matched percentile) based on BMI scores. Due to the early onset of overweight and its associated risks, overweight in youth is an important issue that needs to be tackled in Nova Scotia and Canada due to the health implications.

2.3 Health Consequences for Overweight Children

Like adults who are overweight or obese, there is the risk for children who are overweight to develop several life-threatening diseases, as well as more psychological concerns than their healthy weight counterparts (Reilly, et al, 2003). Must and Strauss (1999) identified that children who are overweight may suffer from such problems such

as gallstones, type 2 diabetes, sleep apnea and increased intracranial pressure. In addition children who were overweight also had a propensity to have more irregular sleep patterns, headaches and elevated blood pressure. Being overweight as a child has also been linked to disorders in almost every system in the body, including the cardiovascular, pulmonary, gastrointestinal and skeletal systems. Among these disorders are atherosclerosis (hardening of the arteries), dyslipidemia (abnormal changes in cholesterol and triglycerides), insulin resistance (the action on insulin is retarded) and fatty liver disease (inflammation of the liver) to name a few (Daniels, 2006). The emergence of metabolic syndrome is another frightening problem that parallels the rising rates of overweight seen in youth worldwide (Steele et al, 2008). In short, metabolic syndrome in children is defined as a combination of medical disorders including central obesity plus any two of raised triglyceride level, a reduced HDL-cholesterol level, hypertension, and elevated fasting plasma glucose (Steele et al., 2008). The problem with metabolic syndrome is the increased risk for children to develop critical medical problems like cardiovascular disease (Steele et al., 2008).

Along with the physical health concerns children who are overweight face, the emotional impacts are equally severe. Children and adolescents who are overweight are often stigmatized in western societies resulting in an increased risk for poor body image, low self-esteem and psychological disorders such as depression (Anderson, Cohen, Naumova & Must, 2007). These children and youth are often subject to mental and emotional damage due to sociocultural pressures to be thin (DuToit, Venter & Potgieter, 2005) and may be targets of discrimination (Dietz, 1998). Evidence of this discrimination has been shown as far back as the 1960s when Staffieri (1967) conducted

a study examining the body-image stereotypes in children. In this study, 90 children from 6 to 10 years of age were asked to look at silhouettes of different body types and to assign one of 39 adjectives to each of the silhouettes. Each of the silhouettes represented one of three body types; fat, thin or muscular. Results of this study showed that the mesomorphs, or muscular body types, were consistently favoured over the thin or fat silhouettes. The children frequently used negative adjectives such as lazy, sloppy, ugly, and mean when describing the overweight silhouettes. They also believed that the overweight silhouettes tend to cheat and be teased (Staffieri, 1967).

Schwimmer, Burwinkle and Varni (2003) conducted a study examining health related quality of life in children classified as overweight or obese. In this study, health related quality of life (QOL) was defined as a comprehensive and multidimensional construct and included physical, emotional, social and school functioning (Schwimmer et al., 2003). As hypothesized, researchers in this study found that children who are obese reported significantly lower health-related QOL than healthy children. The children who were overweight were found to be five times more likely to have an impaired health-related QOL than children at a healthy weight and those diagnosed with cancer.

2.4 Health Consequences for Adolescents

Although children are often stigmatized and affected by body image, adolescents may perhaps be even more psychologically vulnerable due to enormous social pressures to be thin. Anderson and colleagues (2007) conducted a study investigating the relationship between adolescent obesity and the risk for major depressive disorder (MDD) and anxiety disorders. Using structured diagnostic interviews from the

Diagnostic and Statistical Manual of Mental Disorders, MDD and anxiety disorders were identified, and BMI calculated from direct measurements of height and weight for each of the adolescents. As hypothesized, Anderson et al. (2007) found that obesity in adolescent females was associated with higher risk for MDD and anxiety disorders. When compared to females who were not overweight, the adolescent females who were overweight had almost four times greater risk for MDD or anxiety disorders.

Another study conducted by Falkner et al. (2001) looked more specifically at the social, educational and psychological correlates of weight status in an adolescent population. In this study male and female students in grades 7, 9 and 11 were administered questionnaires comprised of social, psychological and social factors. BMI was calculated from the students self reported height and weight. Students were categorized into one of four groups (underweight, average weight, overweight and obese) based on their BMI values. Consistent with their hypothesis, Falkner and colleagues found that adolescent females who were obese were more likely to report more adverse social, educational, and psychological correlates. More specifically, these girls who were overweight were more likely to report not “hanging out” with friends, feelings of hopelessness, serious emotional problems and thoughts of suicide (Falkner et al, 2001). These findings are consistent with other studies suggesting that adolescents who are overweight and obese, particularly females, will tend to face more adverse psychosocial issues than their average weight counterparts. While young males and females often suffer stereotypes of being overweight, teenage girls are often pressured more than boys to obtain the ideal body shape.

2.5 What Causes Obesity?

Throughout the world the underlying correlates of obesity are largely the same. Elevated consumption of energy dense, nutrient poor foods that are high in fat, sugar and salt and reduced levels of moderate and vigorous physical activity at home, at school, at work and for recreation and transport, all play a key role in the epidemic (Nader et al., 1999; World Health Report, 2004). Although past research determined several genetic factors that may contribute to the susceptibility of obesity, it is believed that it is our environment that promotes the behaviours that cause obesity (Hill and Peters, 1998). Some of these environmental factors include food availability, portion sizes and advances in technology and transportation which have reduced the need and desire to be physically active. The use of electronic devices such as televisions, computers and video games, which are important components of young people's daily lives (Sallis & Glanz, 2006) have also resulted in children, adolescents and adults in more sedentary states than in the past (Hill & Peters, 1998). It is believed that television viewing and other electronic devices contribute to obesity due to reduced energy expenditure from displacement of physical activity and increased dietary energy intake during these more sedentary activities (Robinson, 1999). Television advertising and marketing of energy dense foods and soft drinks has also been suggested as a contributing factor to obesity (Dehghan et al., 2005).

2.6 Technology & Screen Time

In a study conducted by Andersen, Crespo, Bartless, Cheskin and Pratt (1998), 26% of children (11-13 yrs) reported watching four or more hours of television per day. This rate was moderately lower in girls (23%) than boys (29%). Boys and girls who reported watching four or more hours of television on a daily basis had the highest skinfold thicknesses and BMIs. Conversely, individuals that reported watching less than one hour of television per day had the lowest BMIs. In short, there was a strong relationship between increased time spent watching television and skinfold thickness. In addition, children who watched more television were found to be less likely to participate in vigorous activity (Andersen et al., 1998). Studies have shown that parents often avoid setting time limits for television watching and use it as a means of distraction for their children thus promoting more sedentary behaviours (Floriani & Kennedy, 2008).

Another study regarding modern technology and physical activity conducted by Robinson (1999) sought to determine if reducing time spent watching television, movies and playing video games would initiate a change in adiposity, physical activity and dietary intake. Using two socio-demographically matched elementary schools; third and fourth grade students in one school were the intervention group and received an 18-lesson, six month classroom curriculum to reduce television, videotape and videogame use (Robinson, 1999). Baseline measures were calculated for height, weight, triceps skinfold thickness, waist and hip circumference and cardiorespiratory fitness for each of the groups. These variables were measured again upon completion of the program. The results of this study found that the children in the intervention group had a statistically significant decrease in BMI, triceps skinfold thickness, waist circumference and waist to hip ratio.

2.7 Nutrition

Another major correlate of child and adult obesity that should be mentioned is dietary intake. There is increasing evidence that Canadian children are making poor food choices leading to dietary excesses and inadequacies (Taylor, Evers & McKenna, 2005). More specifically it appears as though they have low intakes of nutrient rich foods such as fruits and vegetables, and high intakes of less healthy choices such as soft drinks and foods with high fat and sugar content. These dietary deficiencies during childhood may interfere with optimal growth and contribute to epidemic of overweight children (Taylor et al, 2005).

A persistent energy imbalance (decreased energy expenditure plus increased energy consumption) over a long period of time often results in overweight or obesity (Moreno & Rodriguez, 2007). Even an energy imbalance as little as 100-200 kcal / day has been found to contribute to weight gain over time (Moreno & Rodriguez, 2007). Contemporary eating habits such as eating more bakery foods, sweetened beverages, low quality foods, low consumption of fruits, vegetables and grain products and irregular meal patterns have all added to dietary risk factors. Dietary data from Campagna et al.'s (2005) Physical Activity Levels and Dietary Intake of Children and Youth study showed evidence that grade 7 and 11 Nova Scotia youth are consuming too few servings per day of fruits and vegetables, grain products and milk products compared to recommendations by Canada's food guide (Health Canada, 2009). In addition, these students reported consuming on average 6.5 servings per day of foods in the "other" category of Canada's

Food guide. Foods that fit into this “other” category tend to be high energy density, low quality foods. They provide little to no nutritional substance, and are packed with excess calories which often lead to compensatory eating responses that may not sufficiently suppress hunger or delay eating (Moreno & Rodriguez, 2007).

Another example of one of these contemporary eating habits that has become of greater concern is lack of breakfast consumption by children and youth. In previous studies, children who were overweight reported eating breakfast less frequently and consuming more calories at dinner time (Moreno & Rodriguez, 2007). Eating breakfast contributes to the overall quality of a diet and provides an opportunity to consume servings from the grain products and vegetables and fruits groups; nutrients imperative in weight control (Moore et al., 2007). Moreover, those who eat breakfast consistently make better food choices throughout the day and may also benefit from psychological mechanisms hypothesized to reduce appetite and therefore aid in the prevention of obesity (Timlin et al., 2007).

Diets high in fat are also seen as one of the major correlates of overweight and obesity. In a study cited by Hill and Peters (1998) participants attended a research “supermarket” for a 6-month trial to obtain either full-fat or reduced-fat foods. They found that subjects who chose a full-fat diet tended to have higher energy intakes and gained more weight than those who chose a reduced fat diet. The study suggests that restrained eaters would be less likely to have increased energy intake and weight gain. Although there is some debate whether high fat diets are a major cause of obesity, it has been agreed that increased levels of food intake act as a major contributor to overweight and obesity.

2.8 Low Levels of Physical Activity and Decreased Cardiorespiratory Fitness in Children and Youth

Other correlates of overweight that have received a great amount of attention in recent years are decreased participation in physical activity and decreased levels of physical fitness in children and youth. Although physical activity and physical fitness often go hand in hand, it is important to understand the differences between the two. Physical activity has been defined as any bodily movement produced by contraction of skeletal muscle that substantially increases energy expenditure (Howely, 2001). Physical fitness, on the other hand, has been defined as a set of attributes (i.e. cardiorespiratory endurance, muscle endurance, muscle strength, flexibility, agility, balance and body composition) that people have or achieve that relate to the ability to perform physical activity (Howely, 2001). One important distinction between physical activity and physical fitness is the intra-individual day-to-day variability. There is no doubt that physical activity will vary on a day to day basis whereas physical fitness will remain relatively static, taking time to change (Steele et al., 2008). It has been well documented that lack of physical activity often plays a key role in the onset and maintenance of obesity (Thompson et al., 2005). In addition, low levels of physical fitness have also been associated with higher fatness and decreased metabolic health in children (Stratton et al., 2007; Steele et al., 2008). Since growth is associated with rapid changes in height, weight and body composition, physical activity is believed to modify how these changes occur (Ara et al., 2006).

Because a mismatch between energy intake and energy expenditure results in an accumulation of energy stores, this usually leads to increased fat in the body. Ara and colleagues (2006) suggested two main approaches to avoid body fat accumulation; reducing energy intake or increasing energy expenditure. Often times it is difficult to reduce and maintain energy intake in children, yet may be somewhat easier to increase energy expenditure by simply increasing participation in physical activity (Ara et al., 2006). Ara et al. (2006) conducted a study over three years examining the influence of extracurricular activities with no dietary restrictions on body fat accumulation during growth in pre-pubertal children. They hypothesized that the children who improved their physical fitness the most would show the greatest positive effect on body composition and physical fitness. Consistent with their hypothesis they found that over the three year period the children who participated in extracurricular activities had a lower increase in total fat mass and trunkal fat mass. In addition, the physically active children were better able to maintain their physical fitness and body composition than the less active children (Ara et al., 2006).

An additional study that produced similar results was conducted by Tayler et al. (2003). These researchers developed a physical activity and nutrition intervention program group for children between 5 and 12 years old. These researchers sought to examine whether or not widening an intervention groups exposure to more lifestyle-based activities and non-traditional sports could reduce weight gain in children. Community Activity Coordinators worked to maximize opportunities in school and in leisure time and also provided simple dietary advice to the children involved in the study. As hypothesized, Taylor and colleagues found that the children involved in the intervention

group had significantly lower BMIs, waist circumferences and systolic blood pressure after one year compared to the control group.

Although children involved in team sports are often more physically fit than their overweight peers, such activities have been found to be promising methods in helping children who are overweight control their weight (Weintraub et al., 2008). One problem that often arises for children who are overweight is that they often perceive more barriers to physical activity and sport participation than those who are more physically fit and active (Weintraub et al., 2008). Weintraub and colleagues (2008) conducted a pilot study evaluating the feasibility, acceptability and efficacy of an after school soccer program for reducing weight gain, increasing physical activity and improving psychological health in children who are overweight. Children with a BMI greater than the age and sex-matched 85th percentile were assigned to either a 6-month team sport (soccer) program or a 6-month health education program. The main findings of this study indicated that after 6-months, the soccer groups showed significant decreases in BMI scores than the health education group. Total daily physical activity, moderate physical activity and vigorous physical activity were also significantly higher in the soccer groups after just 3 months (Weintraub et al., 2008). Results from this study indicate that after school, organized programs involving moderate to vigorous intensity activity may be a useful technique for weight control in children.

The previously mentioned studies provide convincing evidence that increasing time spent in physical activity, particularly activities that promote physical fitness, can reduce the risk for weight problems in children and youth. Interventions should be considered for the school system and in the community to effectively increase physical

activity levels for children and youth. As mentioned, a major problem that currently exists is the apparently decreasing physical activity levels. In 2005, Tremblay and his colleagues looked at physical activity levels in children in Saskatchewan, Canada. They sought to compare physical activity levels of contemporary children with those of Old Order Mennonite Children (OOM). Researchers in this study chose to use OOM children due to their “steady resistance to social and technological changes” (Tremblay, et al., 2005). Through direct measures by accelerometers and fitness testing, the fitness levels of the two groups were compared. Tremblay and his colleagues hypothesized that despite the fact that OOM children do not participate in physical education classes or organized sport, they would be more “fit” and more “active” due to their lack of more modern technology and everyday living habits. As hypothesized, the OOM children tended to be stronger, leaner and more aerobically fit than the contemporary, urban children (Tremblay et al, 2005). A similar study was conducted looking at Old Order Amish children compared with urban children and results showed similar findings; the Old Order Amish children had higher levels of physical fitness than their urban counterparts (Basset, Schneider & Huntington, 2004). These studies illustrate the fact that modern lifestyles are negatively affecting physical activity levels in Canada’s children and youth.

Not only is the increase of overweight children in Nova Scotia well documented, so is the decrease in physical activity. In 2002, Campagna et al. conducted a study regarding levels of physical activity in children throughout Nova Scotia. Prior to this study, the Sport and Recreation Commission and Dalhousie University hosted a conference to discuss physical activity among children and youth. A leader in the research on children and physical activity, Dr. James Sallis from San Diego State

University, headed the conference. During this conference, Sallis and colleagues developed two key recommendations:

1. That children and youth accumulate 60 minutes of moderate activity within each 24 hour period. Nevertheless, it must be recognized that every minute of physical activity makes some contribution to health.
2. That an objective measure be used to study children's physical activity level for a provincial study.

In 2005, Campagna and fellow researchers conducted a follow up to the first Provincial study (2002) to better understand the changing activity patterns of children and youth in Nova Scotia. The Physical Activity in Children and Youth (PACY 2001-02) study examined physical activity levels of 1653 elementary, junior and secondary school students from across the Province. Along with several others, two of the main findings of this study were older youth were less active than younger and girls were less active than boys. It was found that the grade 11 boys and girls in this study were significantly less active than the grade 7 students who were in turn less active than the grade 3 boys and girls (Thompson et al., 2005). More specifically, in the 2002 PACY study it was found that by the time children reached grade 7, only 66% of males and 44% of females were achieving the recommended 60 minutes or more per day of moderate physical activity. Even more alarming were the results indicating that by grade 11 only 12.6% of males and 6.9% of females were achieving the recommended amounts. With just four years between the two data sets, the physical activity levels of children decreased even more for all grades and sexes. By 2005 only 45.3% of boys and 23.8% of girls in grade 7 were

active enough. Perhaps the most shocking statistic was the data revealing that of the grade 11 students in 2005 less than 9% of boys and less than 1% of girls (only one girl) obtained the recommended amounts of physical activity (Campagna et al., 2005). These results indicate a greater need for increased physical activity in children and youth in the province of Nova Scotia (Campagna et al., 2002; Campagna et al., 2005).

2.9 Social Influences for Physical Activity in Children and Youth

To explain the decline in physical activity levels, researchers examine influences that may promote participation in physical activity and barriers to physical activity participation. Social support appears to be an imperative factor in determining whether or not children and youth are participating in regular physical activity. Encouragement, role modelling and logistical support are examples of social support positively associated with physical activity participation in youth (Hoepa et al., 2007). One of these factors believed to influence participation is parental influence. Throughout childhood and adolescence, parents are important teachers and social references (Krahnstoever–Davidson, et al, 2003). Not only do parents act as social references, but they are also the central role in funding and planning participation in extracurricular activities for their children. Children are more likely to have higher levels of physical activity when parents value and encourage participation and are physically active themselves. The research of Cleland et al. (2005) examined the relationship between parental exercise and the cardiorespiratory fitness and extracurricular activities of their children. The results of this study indicated that the exercise levels of the parents were positively associated with extracurricular involvement and cardiorespiratory fitness in their children, particularly when the families had two physically active parents as opposed to one or none.

Along with parental encouragement, it has been found that siblings and friends also play a prominent role in promoting physically active lifestyles. In 2007, Hohepa et al. examined the times of day in which encouragement from parents, siblings, friends and schools were most prominent. Through the use of questionnaires 3271 youth from low SES schools in New Zealand aged 12 to 18 years reported their physical activity levels and quantity of encouragement from parents, siblings, friends and schools. Results indicated that the support from parents, siblings, friends and schools to be physically active depended on the time of school day being examined. For example support after school from parents, siblings and friends were key contributors for youth to be active. In contrast, during lunch time activities, friends appeared to be the only consistent source of support to be more physically active. Those who reported having low social support from their peers also reported being more likely to sit, stand or walk around during their lunch time rather than playing games or participating in other activities (Hohepa et al, 2007).

In 2000 Sallis and his colleagues described physical activity as a complex behaviour that is determined by many factors. Correlates common across youth included perceived physical competence, intention, barriers, parents support and assistance, support from significant others, opportunities to be active and time outdoors (Sallis et al., 2000). In order to increase physical activity amongst youth, interventions must target changes in all categories to achieve sufficient physical activity. When looking at the correlates, it appears that several of them (barriers, parent support, direct help from parents, support from significant others, etc.) are categories that involve other people other than the youth themselves, particularly parental involvement. Theoretical

approaches to studying physical activity provide researchers with a better understanding of the factors influencing physical activity participation (Downs et al., 2006). Theory of Reasoned Action is a construct that can be used to help better understand the attitudes and behaviours of individuals towards activities (McKenzie et al, 2004).

The Theory of Reasoned Action suggests that an individual's intent to perform a given behaviour depends partly on their belief that others think they should do so and partly on the fact that they care about what others think (McKenzie, Neiger & Smeltzer, 2004). Understanding the Theory of Reasoned Action can help to recognize why others may play such an important role in promoting physical activity of young people. Since parents, teachers, program leaders, peers, etc. are such important social references, children would be more likely to participate in physical activity and more healthful behaviours if they believed these people close to them think they should be engaging in such behaviours. Although it is important that children and youth are aware of the benefits of physical activity, perhaps further educating parents, teachers and program leaders on the importance is just as, if not more, important. The children's attitudes towards the behaviour (physical activity in this case) will also depend on the type of reinforcement they receive from those important social references. By understanding the thoughts, feelings and beliefs about physical activity in children, interventions can be better developed to target the needs for all youth. These interventions should begin with a top down approach ensuring that all leaders involved are educated about the important roles physical activity can play in developing healthy children and youth. In addition to being educated, important social references should also participate in physical activity themselves as they are role models for young people.

2.10 Physical Activity Interventions – Coordinated Approach to Child Health (CATCH)

Interventions intended to promote child health and prevent childhood obesity have been of great interest in recent years. Many researchers examined potential venues and settings to increase healthy behaviours and found that public schools may provide the ideal setting because of the access to the majority of children and youth in a particular community. Public schools represent potentially important venues for primary prevention programs because they allow access to large populations and have existing systems to support the development of healthful behaviours at an early age (Nader et al., 1999). While schools appear to be a logical environment for promoting public health through physical activity, most of the students' time at school is spent in sedentary pursuits. In addition, studies indicate that physical education classes occur infrequently and the students are often relatively inactive in these classes (McKenzie et al., 1996). Because increasing the frequency and duration of PE classes is difficult due to all other school subjects, it is believed that the time allotted for physical education in the schools should be used efficiently and should include a curriculum that promotes ample amounts of physical activity (McKenzie et al., 1996).

As increasing physical activity during the school day has proved difficult, one venue physical activity interventionists and researchers have recently begun examining is afterschool time. Afterschool programs have the ability to provide children with a key setting to promote physical activity (Troost et al., 2008). A recent meta-analysis of afterschool programs revealed that such programs including a physical activity component have the ability to improve physical activity levels, physical fitness, body composition and blood lipid protein profiles of children and adolescents (Beets et al.,

2009). From the meta-analysis conducted by Beets et al. (2009) it was determined that afterschool settings hold considerable promise for increasing overall activity levels of youth.

While several interventions to increase physical activity have been developed, one in particular is called CATCH (Coordinated Approach to Child Health), previously known as the Child and Adolescent Trial for Cardiovascular Health. The program originally began as a study in 1988 at University of Texas to decrease risk factors for cardiovascular disease in elementary school-aged children (McCullum-Gomez et al., 2006). The main goals of the original CATCH program were to increase levels of physical activity, increase consumption of foods low in fat, saturated fat and sodium and to discourage smoking through a program that included school environment changes, a 3 year sequential classroom curriculum, and a family component (Nader et al., 1999). Although the CATCH curriculum focuses on physical activity, nutrition and tobacco use, the area of particular interest in this study is the physical activity intervention.

The original CATCH was designed to modify and improve existing physical education classes in 96 elementary schools in four states. Its goals were to promote children's enjoyment of and participation in moderate-to-vigorous physical activity (MVPA) during physical education classes and to provide skills to be used throughout life (MacKenzie et al., 1996). In the preliminary trials of the CATCH program, randomized schools agreed to participate in at least 90 minutes a week of the CATCH curriculum over 2.5 years (from grade 3 through to grade 5). The teachers were also expected to engage students in MVPA for at least 40% of the class time while using

appropriate CATCH teaching methods and enthusiasm. The teachers were provided with the curriculum and materials, teacher training and on-site consultation.

Several base line and post-test measures were taken including the amount of time children spent in MVPA, which was monitored by the *System for Observing Fitness Instruction Time (SOFIT)*. SOFIT has shown high validity and reliability and is considered an objective tool for assessing the quality of physical activity instruction (McKenzie, 2002). SOFIT provides a measure of student activity levels by direct observation of trained observers. The SOFIT codes have been calibrated through heart rate monitoring and correspond highly with accelerometer readings (McKenzie, 2002). Lessons were examined over the program delivery period and the analysis indicated that the MVPA for the intervention group increased from 37.4% of total physical activity during class time at baseline to 51.9% and participated in 12 more minutes of MVPA than their control group counterparts (McKenzie et al., 1996). In addition to the CATCH program providing more MVPA, the teachers responsible for teaching CATCH indicated through questionnaires that they were highly satisfied with the CATCH intervention and would recommend the program to other teachers (McKenzie et al., 1996). In addition to the changes made in terms of physical activity, the CATCH intervention resulted in food service changes as well as changes in eating behaviours. The original intervention of the CATCH curriculum indicated that its multi component intervention had a favourable impact on child diet and physical activity patterns (Kelder et al., 2003).

Since the initial intervention, CATCH has been considered one of the most comprehensive and ambitious evidence based programs in the United States (Coleman et al., 2005). Following the first trial, materials from the CATCH program were made

available to the public and efforts are now made to disseminate the program to elementary schools throughout the US (Coleman et al, 2005). In 1999 Coleman and colleagues sought to examine the effects of the CATCH program on four schools in El Paso Texas and found that over the two-year study participation in the CATCH program successfully slowed the epidemic increase in overweight compared with the control schools (Coleman et al., 2005). Even more interesting was that children in the El Paso CATCH program began the program with at risk of overweight or overweight rates higher than the national rates for Hispanic children, and ended the program below the national rates for Hispanic children. In contrast children in control schools ended the study with higher than the national rates for at risk of overweight or overweight for Hispanic children (Coleman, 2005).

Based on results from the original CATCH study, Kelder et al. (2004) believed that CATCH was well suited to adapt to an after school program they referred to as CATCH Kids Club (CKC). The CKC was pilot tested and formatively evaluated in 16 Texas afterschool programs (8 intervention and control sites) (Kelder et al., 2004). In short, CKC was designed as a physical activity and nutrition education program for elementary school children in an afterschool setting. The pilot program included a five module education program, an inclusive physical activity component and a snack component which were all designed to provide concise information and instructions for the staff to implement (Kelder et al., 2004). Activities were developed to be fun and entertaining in order to compete with the after school activities in which children typically engage. The CKC physical activity box included a variety of activities including warm ups, main activities (walk/jog/run and aerobic recreation games) and cool downs.

The CKC program had four main objectives to consider:

1. involvement of students in at least 30 min of daily physical activity;
2. involvement of students in MVPA for at least 50% of daily physical activity time;
3. providing students with many opportunities to participate and practice skills in physical activities that could be carried over into other times of the day and maintained later in life; and
4. providing students with a variety of enjoyable activities

Similar to the CATCH pilot studies in schools, results from the CKC pilot study showed that the CKC was able to increase moderate to vigorous physical activity significantly (29.46% MVPA at baseline vs. 56.84% MVPA post test) and was also easy to implement and enjoyed by teachers and students (Kelder et al., 2004). Kelder et al.'s (2004) pilot study demonstrated the efficacy that the CKC has in delivering an enjoyable intervention to increase physical activity levels in children. Since the original CKC pilot study, the CATCH after school programs have spread throughout several states in the US, Ontario and more recently Nova Scotia. In February 2009 the CATCH curriculum was used at 12 afterschool programs in Halifax Regional Municipality (HRM).

2.11 Techniques for Assessing Physical Activity

In order for researchers to better understand levels of physical activity among children, several research tools have been developed for accurate assessment. These tools not only help to better understand current levels of activity they also can be used to assess the effectiveness of intervention programs developed to increase physical activity (Sirard & Pate, 2001). While many methods are used to evaluate physical activity is

important to understand the strengths and limitations of each method. Although doubly labelled water and indirect calorimetry are considered two of the primary standards for assessment (Sirard & Pate, 2001), they are often too expensive and difficult to use for research purposes. The ideal instrument used to measure physical activity should not only be valid and reliable, but also practical for the research team and participants being investigated.

Subjective techniques, such as self-report questionnaires, interview administered questionnaires and proxy reports are often used to assess physical activity levels in children. Although these techniques are easy to administer and cost effective, they are usually less reliable than more objective techniques. Self-report questionnaires can be difficult for children because of their lower cognitive functioning compared with adults resulting in a lower capacity to recall intensity, frequency and duration of their physical activities accurately, particularly for any length of time (Sirard & Pate, 2001). Inability to recall intensity, frequency and duration may also be a problem with interview administered questionnaires; however an interview format produces more valid and reliable estimates than self-report. Proxy reports of children's physical activity by teachers and parents appear promising as they can eliminate recall errors caused by children's cognitive limitations; however it is often difficult for others to accurately assess subjective physical activity behaviours of children (Sirard & Pate, 2001). It has been suggested that validating these subjective techniques against some objective measure will increase their reliability.

Two of the most common objective techniques used to assess physical activity are pedometers and accelerometers. Pedometers are relatively inexpensive and easy to use

device that estimate mileage or number of steps taken over a period of time (Sirard & Pate, 2001). Pedometers are a reliable and valid tool, however they only detect total counts or steps over the observational period and cannot assess the intensity or pattern of the activities performed (Sirard & Pate, 2001). Accelerometers, however, are a more sophisticated device capable of measuring accelerations produced by body movement (Sirard & Pate, 2001). Accelerometers (uniaxial) are designed to detect vertical accelerations using piezoelectric transducers that convert recorded accelerations to digital signals known as counts (Sirard & Pate, 2001). Unlike pedometers, accelerometers can provide information about the frequency, intensity and duration of the activity. Actigraph's Computer Science and Applications Inc. (CSA) accelerometer in particular has shown to be a valid and reliable tool for assessing physical activity and will be discussed further in chapter 3.

2.12 Techniques to Assess Cardiorespiratory Fitness

Measuring physical fitness is also important for researchers in order to better comprehend how it relates to obesity and physical activity. Physical fitness encompasses several different attributes, however, cardiorespiratory fitness is of particular interest due to the direct effect it appears to have on weight control and chronic health issues. It is important to mention that determining VO_{2max} is the best single measure of cardiorespiratory fitness, and can be defined as the maximum capacity of an individual's body to transport and utilize oxygen during incremental exercise (Cairney et al., 2008). The current gold standard for measuring VO_{2max} is through use of a metabolic cart to analyze oxygen uptake during a maximum incremental cardiopulmonary exercise test to exhaustion (Li et al., 2005). Although this direct measure of VO_{2max} has proven to be

the most reliable method, it requires expensive laboratory equipment, is technically complex and is time consuming which makes it an impractical test for general use. In the past, researchers interested in determining the physical fitness of individuals developed several, well known field tests to predict $VO_2\text{max}$. Although these field tests are not a direct measure of cardiorespiratory fitness, they have all been tested and validated against a true measure of $VO_2\text{max}$ and provide scientific evidence showing moderate to good validity (Cairney et al., 2008). Field tests used to predict $VO_2\text{max}$ have numerous advantages such as being easy to administer, relatively safe, involve minimal equipment and are low in cost (Harris & Cale, 2007). In contrast, there are also some disadvantages to such tests, particularly for children. One disadvantage that must be considered extensively when choosing an appropriate test for children is the many factors that may influence performance. Some of these factors include children not working to their maximum capacity and disliking the competitive nature of some field tests.

One test that has shown high reliability in estimating $VO_2\text{max}$ is Leger's 20-meter shuttle run test. This test is a progressive, multistage, maximal exercise test that is capable of imitating the speed incremented treadmill test that is used in laboratory settings (Cainery et al., 2008). Running speed is controlled in this test and allows participants to withdraw when they are fatigued and feel like they can not run any longer. Advantages of Leger's 20-metre shuttle run are that it is easy to administer to a large group of participants and is a relatively quick test that is has shown to be a valid estimator of $VO_2\text{max}$. A large problem with this test is that it involves a maximal protocol, however most daily activities are performed at sub maximal levels of exertion (Li et al., 2007) which would suggest that sub maximal fitness tests would be more

predictive of physical capabilities. Other problems include motivating children to work at maximal exertion, low self efficacy on performance (Cairney et al., 2008) and the “elimination” nature of the test as it stresses competition. These disadvantages indicate that other, submaximal tests may be more appropriate in determining physical fitness in children.

Submaximal, timed, distance tests are also very popular methods in predicting cardiorespiratory fitness. The 1.5 mile run /walk test, for example, is commonly used and designed to have participants run or walk a 1.5 mile distance in the shortest possible time. Problems with tests like this are that participants will often try to work at levels they are not used to, which in turn may make the test potentially dangerous and lead to negative feelings of exercise (Larsen et al., 2002). For children, this can also be discouraging as it clearly distinguishes differences in fitness levels as the children with higher fitness levels will finish the test first while the less fit children are still walking or running to finish.

To avoid fitness tests that clearly distinguish fit and non-fit individuals, tests that require participants to walk as far as possible in a predetermined amount of time have proved to be a reliable and perhaps more sensitive method of assessment. As Li et al. (2007) mention, the ability to walk as far as possible in a set duration is a quick and feasible way to evaluate physical functioning. The two most popular examples of these types of tests are the 12 minute walk/run test and the 6-minute walk-test (6MWT). In the 12 minute test, participants run for 12 minutes and the total distance covered is recorded. Walking is allowed, however participants are required to push themselves as hard as they can to cover the maximum distance possible. This test may be problematic for children

because of its focus on intense exertion. In addition, because this test focuses on running, a larger surface, such as an oval track, is required.

Geiger et al. (2007) identify the 6MWT as safe, easy to perform and an acceptable method for determining functional exercise capacity in children. Similar to the 12 minute test, the objective of the 6MWT is to walk as far as possible at a constant, uninterrupted pace in 6 minutes (Lammers et al., 2007). Using a self-paced walking method to assess cardiorespiratory fitness has been found to accurately reflect submaximal functional capacity of healthy children and patterns of their daily activities (Geiger et al., 2007). The 6MWT has been increasingly used in young children due to the high degree of cooperation, coordination and motivation required to perform most cardiopulmonary exercise tests (Lammers et al., 2007).

Li et al. (2005) sought to examine the reliability and validity of the 6MWT for children. Test-retest reliability was evaluated in 52 subjects. Results showed no significant difference between the two mean walking distances (662.21 +/- 55.1 vs 677.23 +/- 50.8) over the 18 day interval, thus showing reliability of the test. In addition a significant correlation ($r = 0.44$, $p < 0.0005$) was established between the 6MWT and VO_2 max obtained during a treadmill exercise stress test indicating support for the validity of the test (Li et al., 2005).

While all of the field cardiorespiratory fitness tests mentioned have several advantages, the 6MWT appears to be the most appropriate for children. Unlike Leger's 20-metre shuttle run, there is no elimination involved as all children will walk for an equal amount of time. Additionally, having all children participate for the same amount

of time at their own pace avoids having the more fit participants being finished first and the less fit taking longer to finish like in distance tests (i.e. 1.5 mile run). The protocol for the 6MWT will be further discussed in Chapter 3.

2.13 Conclusions Based on the Literature

After reviewing the literature, the severity and consequences of childhood obesity have become clear. The increasing rates of the epidemic are frightening and will only continue to rise unless action is taken to change behaviours promoting weight gain and low levels of physical activity. If these behaviours fail to change, societies around the world will face a future generation with a higher degree of cardiovascular disease risk and mortality as well as other chronic diseases (Brunet, Chaput & Tremblay, 2007). Although obesity is a chronic disorder with multiple causes (Strauss & Knight, 1999) primary prevention programs targeting young people have shown to be effective in promoting lifelong, healthy behaviours. In particular, these programs should include components that promote healthy behaviours like physical activity in a positive and enjoyable manner. Programs like this need both short term and long term evaluation to determine the actual impact on participants and their level of physical activity.

While the large majority of children attend some sort of schooling system, it is often difficult to accumulate significant amounts of physical activity throughout the day (Troost et al., 2008). Recently, afterschool programs have been defined as a promising environment for increased levels of increased MVPA and physical fitness (Beets et al., 2009; Coleman et al., 2005; Kelder et al., 2004; Troost et al., 2008) Campagna et al.'s (2002; 2005) data illustrate the problem of inactivity in the province of Nova Scotia, and

therefore, physical activity interventions need to be examined and implemented to prevent the issue from worsening. Since CATCH is one afterschool program that has produced successful results in terms of increasing physical activity in children and youth, it should be further explored as an option in Nova Scotia.

Chapter 3 -Methodology

3.1 Intervention Overview

The CATCH Kids Club (CKC) is a physical activity and nutrition education afterschool program for elementary school aged children. In February of 2009, CATCH was implemented in 12 YMCA afterschool programs throughout HRM and delivered by trained YMCA staff. Each of the YMCA afterschool programs started when the children were dismissed from regular school time and each program took place at the schools in which the children attended. The typical end time for the program was between 5:30 pm and 6 pm, or whenever parents picked their children up. The CATCH program was originally scheduled to begin in January, however, the director of the YMCA afterschool program agreed to delay the start date of the program to ensure baseline testing for this study. When the YMCA program was originally approached by the principal investigator in August 2008 there were 351 children ages 4 -12 registered in the YMCA afterschool programs throughout HRM (males n=174, females 177). During August of 2008 YMCA staff completed extensive training to prepare for the implementation. The 8-hour training session was delivered by the Supervisor of Children and Youth Programs (and early adopter of CATCH) from the Oakville, Ontario YMCA. The program used the same curriculum and tools as Kelder et al.'s (2004) study and anticipated substantial behaviour changes in the children regarding physical activity and nutrition habits. The tools the YMCA staff used to deliver the program included an activity box containing hundreds of 5 x 8 inch cards describing fun, active and inclusive games and activities appropriate for

children in grades primary to six (appendix F). The materials on each card were flexible and included concise information and instructions to help staff implement the program (Kelder et al., 2004).

A typical CATCH lesson would begin with a warm-up activity to get children engaged and moving. Next would be a variety of activities from the activity box that would focus on overall fitness. The “Go fitness” cards focus on all components of fitness including cardiovascular efficiency, muscular strength and endurance and flexibility. Finally, children had the opportunity to participate in organized activities or freeplay which was called the “Go activities” portion of the session (DeLine, 2008). The CATCH activity boxes provided an array of large group games (Hot feet, Shadow ball, gotcha! See’ya), partner and small group activities and games (Toe fencing, Grab the go!, Happy feet) and active classroom games (Sit up sit down sing-a-long, Letter line, Stare & glare joggin’ showdown) (see appendix F). The activity boxes also provided instructional format activities with 2-line games, grid stations, interval stations, stationary stations, race track stations and relays (appendix F).

The main purpose of the present study was to examine the effectiveness of the program in increasing overall physical activity levels and afterschool physical activity levels of elementary aged children. It was hypothesized that overall MVPA of the children participating in the YMCA CATCH Kids Club program would increase significantly from base line testing, and that afterschool MVPA (between 3 and 6pm) would also increase significantly.

3.2 Recruitment

Once ethical approval was obtained on January 23, 2009 from the Dalhousie Health Sciences Research Board, participants were approached for participation. Information packages were distributed on January 27, 2009 to all boys and girls, in grades 3 to 6 at the 12 after school locations. This accounted for approximately 200 of the 351 children enrolled in the YMCA afterschool programs. Children in grades primary to two were excluded due to their young age. These grades (3 to 6) were chosen based on Campagna et al.'s (2005) Physical Activity and dietary intake of Children and Youth (PACY) study on physical activity levels in grade 3, 7 and 11 students in Nova Scotia. The PACY physical activity data for the grade 3 students provided a comparison for students in this study. In addition, the data for the grade 4, 5 and 6 children collected in this study help to better understand activity trends between grades 3 and 7.

The information package included letters for parents and their children describing the study in detail. Informed consent (appendix C2) was required from parents before children were allowed to participate and verbal assent from the children was obtained at the time of data collection. The information letters (appendix C1) were distributed via the YMCA leaders at each location; however, there was an initial slow return of consent forms. In order to better recruit participants, the principle investigator attended a staff meeting at the YMCA on February 10, 2009 to further explain the study to the leaders to improve the response rate. In addition, the principal investigator met with the students at the larger schools to explain the purpose of the study to the children and was also available to meet with parents who had any questions. Meeting with the leaders and students seemed to improve the interest in participating, and by February 15, 2009, 45

consent forms had been returned and data collection began on February 18. Prior to starting data collection a Nova Scotia Child Abuse background check was required and cleared. In the end, five of the 12 afterschool programs were used for data collection due to a high return of consent forms from these five schools. The final sample size at baseline was $n=39$ (boys: $n=16$, girls: $n=23$) in grades 3 – 6. Although 45 consents were originally returned, only 39 of the students were available on the day of data collection. Due to participant withdrawal, the post-test sample size was $n=27$ (boys: $n=10$, girls: $n=17$). At the time of data collection students were informed that their participation was voluntary and that they were able to withdraw from the study at any time. Those who chose not to participate in the research still participated in CATCH activities; however, their physical activity was not monitored. Their activities were not interrupted during data collection time.

The statistical analysis used to determine an appropriate sample size was based on a few different variables. First, the reliability of the MTI accelerometers was considered, and in the past was found to be $r = 0.80$ (Sirard & Pate, 2001). Second, data from Campagna et al.'s (2005) study regarding students in grade 3 provided an estimate of baseline physical activity levels and their variance. Third and finally, a treatment effect was expected to produce a mean increase of at least 15 minutes of MVPA per day. At a significance level of $\alpha = 0.01$ ($t = 3.5$) it was found that a sample of $n = 50$ children would be well above the threshold for statistical significance ($t = 5.14$). Although a sample of 50 was originally anticipated, it was not obtained. As mentioned, the final sample of participants who completed all measures for baseline and post-test was $n = 27$.

3.3 Measurements

The variables examined in the present study included anthropometric measures, physical activity levels and cardiorespiratory fitness. Anthropometric measures consisted of height, weight and BMI. Waist circumference was originally going to be measured, however, due to time constraints at some of the afterschool sites; it was not feasible to obtain waist measures for all participants. Physical activity was assessed by accelerometer data and cardiorespiratory fitness through a six-minute walk-test. All measures were taken before the program began in February and then again once the program had been in place for more than two months. The first set of data collection occurred between February 18 and March 8 and the second set of data collection occurred between May 26 and June 8. It was originally proposed that several volunteers would aid in the data collection process, however, in the end the principal investigator collected all data to ensure consistency in measures.

3.3.1 Anthropometric Measures

Height was measured to the nearest 0.1cm using a stadiometer and weight to the nearest 0.1kg on a calibrated scale. These measures were chosen based on their non-invasive nature and because they are relatively easy measurements to take. When height and weight are taken carefully and compared with appropriate growth charts and recommended cut-offs, BMI provides an excellent indicator of overweight for children (Hines, 2009). All measures were recorded in private and no results were shared. All of these measures were taken based on the protocol suggested in the Canadian Physical Activity and Fitness Lifestyle Approach manual (2004). BMI was calculated by dividing

weight in kilograms by height in metres squared (kg/m^2). The status of the children's BMI was then categorized based on clinical growth charts presented by the American Center for Disease Control and Prevention (CDC) using their adjustment for age and sex. The CDC's growth charts suggest that children with a BMI value between 85% and 95% are "at risk for being overweight" and a BMI at or above the 95th percentile of age and sex specific BMI growth charts can be categorized as overweight (CDC, 2000).

3.3.2 Physical Activity

The Manufacturing Technologies Inc. (MTI) accelerometer (Actigraph model 7164, formerly known as the Computer Science and Applications CSA Inc. (CSA)) were used to objectively monitor activity levels and were obtained from the School of Health and Human Performance at Dalhousie University. The accelerometer is able to detect vertical accelerations ranging in magnitude from 0.05 to 2.00 Gs with a frequency response of .25 to 2.50 hertz. The MTI accelerometer is designed to detect normal human motion and reject high frequency vibration from other sources. It is engineered to filter and digitize the acceleration signal and sum the magnitude over an interval of time. A one minute sampling rate was used and data was collected for at least 7 consecutive days. Although MTI accelerometers allow users to select the interval length (ranging from one second to several minutes), a one minute interval was chosen because the majority of users performing research in this area select an epoch length of one minute (Esliger et al., 2005) and therefore would be more feasible for comparison. The summed activity counts of the individuals were stored into the memory of the accelerometer and were then uploaded and analyzed using custom made software at Dalhousie University (Campagna et al. 2002). The software has the ability to categorize each count per minute value into

light (<3 METS), moderate (3-5.9 METS), hard (6-8.9METS) or very hard (>9METS) activity. A MET (metabolic equivalent) is an index of the intensity of activities (Campagna et al., 2002). For adults, the usual method of defining 1 MET would be 3.5 ml O₂ / kg. This definition of 1 MET would be incorrect in predicting activity counts for children since their resting metabolic rate declines from ~6 ml O₂ / kg per minute at five years of age to 3.5 ml O₂ / kg per minute at 18 years of age (Puyau, Adolph, Vohra & Butte, 2002). The custom made software at Dalhousie University required each participant's age and weight so that the resting metabolic rate could be predicted for each participant and controlled for age. The equation used was developed by Freedson, Melanson & Sirard (1998) and used age specific count ranges corresponding to the above intensity (METS) levels. The following equation was used to ensure age was accounted for when examining activity levels of the participants: $METS = 2.757 + (0.0015 \times \text{counts/min}) - (0.08957 \times \text{age [yrs]}) - (0.000038 \times \text{counts/min} \times \text{age [yrs]})$ (Freedson et al., 1998).

Previous research provides evidence that accelerometers are a valid and reliable tool for measuring physical activity and that a 7-day monitoring protocol is suggested in providing reliable estimates of usually physical activity behaviour in children (Troost et al., 2000; Eslinger et al., 2005). Although a 7-day monitoring period has been suggested, research has also shown that children in grades 1 through 6 exhibit less day-to-day variability than adolescents and therefore 4 or 5 days of monitoring would be sufficient with a reliability of 0.80 (Troost et al., 2000).

These devices were explained and distributed to the children at the time of data collection. Children were asked to wear the activity monitor on the right hip at the

beginning of each day. The units were placed in a Velcro pouch and secured with a waist strap to insure consistency and proper positioning of the accelerometer. The accelerometer is a small (5 x 4 x 1.5cm) and lightweight (43 grams) device that comfortably fits at the hip and did not interfere with daily living activities. The children were asked to wear the devices for eight consecutive days (to ensure seven full days of data) during all waking hours with the exception of showering or swimming. Children were also asked to record on the questionnaire any activities they participated in while not wearing the device (i.e. swimming). The devices were then collected by the primary researcher at their CATCH location at the end of the eight day period. Although the participants were required to wear the device for seven full days, those worn for four full days (three week days plus one weekend day) have been considered sufficient for data analysis (Eslinger et al., 2005). Because all parents were required to pick their children up from the after school program, the primary researcher was able to personally explain the study and how the accelerometers worked to all parents. It was reiterated that their children should wear the device during all waking hours with the exception of swimming and showering, and that they were expensive devices that should be handled with care. They were also given the opportunity at this time to ask any questions or concerns they may have had regarding the study. There were no major concerns from the children regarding the study; however two parents raised concerns via email. The first email contained several concerns including: whether or not ethical approval had been obtained, questions regarding who would be delivering the CATCH curriculum, curiosity as to what questions were being asked on the questionnaire, whether or not anthropometric measures would be taken in private or not, and if the final results would be available for all those involved. The second email was concerning whether or not the children would

be able to wear the accelerometers during sporting events and whether or not the data collection would take place any time other than during their after school program. All concerns were addressed in a timely manner via email and a phone number was provided again in case any more concerns arose. There were no additional concerns.

3.3.3 Cardiorespiratory Fitness

Physical fitness was assessed using a six-minute walk-test (6MWT) based on the guidelines provided by the American Thoracic Society (Crespo et al., 2002). The 6MWT was performed indoors along a long, flat, straight surface that was either 15m or 20m in length, depending on the school. Markers were be set at 3m intervals to determine the additional distance beyond each lap and cones were placed at the beginning and end of the 15m or 20m distance to indicate turnaround points. Each child was tested individually to avoid competition and to allow them to walk at his/her own pace. A stop watch was used to time the six minute test, and a recording sheet, clipboard and pencil were used to record each lap completed by the participants.

The children were given very specific instructions as to how the 6MWT was to be completed and a brief demonstration was given from the primary researcher. An information sheet with the exact protocol was used to ensure consistency in instructions (appendix D). The children were told that the object of the test was to walk as far as possible for six minutes walking back and forth around the cones. Participants were asked to walk at their own pace and told that they could step aside to rest if necessary; however, none of the children chose to do so. They then lined up at the start line and began walking when they heard the cue “go”. A lap was recorded every time each

individual passed the start line on their appropriate recording sheet. Words of encouragement such as “great work” and “you’re doing well” were used throughout each test at every minute to ensure the children are able to stay motivated during the six minutes. An announcement of time remaining was also given to the children after every minute they completed. Once each test was completed, the number of laps and the additional distance (3m markers) were determined and recorded. The children all performed well during this test, and appeared to be working their hardest. There were a few complaints about “sore shins” throughout the tests, but this did not lead any of the participants to stop at any time. It was easy to motivate the participants throughout this test, and seemed enjoyable for most participants because it did not involve a competitive nature. It seems to be a feasible test to use on children, however, some of the children wanted to run and exert more energy.

3.3.4 Questionnaire

Finally, participants were asked to complete a brief questionnaire (Appendix A). Questions from the questionnaire were adopted from Campagna et al.’s (2002; 2005) study to understand demographic information (age, grade, sex) and habits related to physical activity (activities the children participated in, screen time and how they travelled to and from school). In this questionnaire, children were asked to check off any activities they did the previous week before or after school and were given options like: play outside with friends, play outside alone, watch TV (# of hours per day), play on the computer (# of hours per day), etc. The questionnaire also asked about any changes in activity patterns in the last week (joined new sports teams, stopped participating in an activity, did not participate due to illness). Finally, the questionnaire sought to examine

how most children travelled to school on most days of the week (walk, bike, bus, car, other). Participants completed the questionnaire at baseline when accelerometers were collected.

3.4 Statistical Analysis

All data were analyzed using the statistical software package SPSS 11.0 and Microsoft Excel 2003. Descriptive statistics were calculated for anthropometric, physical activity and physical fitness data at base line and post-intervention. BMI was interpreted using the age-sex specific growth charts. Dependent t-tests were calculated to examine a difference in height, weight, BMI, physical activity and cardiorespiratory fitness from base line to mid intervention testing. Additionally, ANOVA tests were used to examine differences physical activity and physical fitness by sex at base line and mid intervention testing. ANOVAs were also conducted to detect any differences in MVPA between those who reported walking to school vs. those who did not and MVPA vs. screen time. Descriptive statistics were calculated as a means to explore differences in physical activity during weekdays and weekend days. Frequencies were reported for all questionnaire data.

3.5 Ethical considerations

All data collected were coded to ensure anonymity and was stored in a locked cabinet. Only the primary researchers have had access to the names of the participants and all results of data analysis are reported, presented or published without identifying the children's identity. To avoid discomfort, all anthropometric measures were taken in private and results were recorded according to the participants' codes.

3.6 Difficulties in Methodology

Although the final results of recruitment and data collection were a success, there were several obstacles to be addressed. To start, it was difficult to get staff interested in recruiting students for the study; however, after meeting with them and explaining the study in person, they were more highly motivated to promote the study to the children in their program. Meeting with the staff also provided the opportunity for program leaders to ask any questions, and also to obtain a more detailed description of the study. Second, it took much longer to obtain consent than anticipated. Again, having the principal investigator meet with the students resulted in more motivation to participate, and in turn resulted in a faster recruitment process. Third, snow storm days caused many delays in both recruitment and data collection. School cancellations delayed three of the five original start dates for data collection and also slowed the process of collecting consent forms. A final minor difficulty in the methodology was having only one person collecting data. This made the data collection period take longer than anticipated, however, it allowed for consistency in data collection methods.

Although there were some difficulties in the methodology, once the initial problems were resolved, the actual data collection process went well. All children were cooperative and attentive while given the accelerometer instructions and during all measures. Collecting data after school worked well because all parents were required to pick their children up at the sites which allowed communication between the primary investigator and parents. In addition, communication with the after school leaders at each site went considerably well since only five sites were used. All contact happened via telephone or in person.

Chapter 4 – Results

The following chapter includes results from data collected for the present study. Descriptive statistics regarding demographics of the sample and sample size for each component of testing are provided. This data is followed by anthropometric measures, physical activity data from accelerometers as well as physical fitness measures from the six-minute walk test. The last section includes data from the questionnaires to provide context for the participants' physical activity behaviours. The main purpose of the study sought to examine whether or not overall and after school MVPA would increase from baseline to post-test due to participation in the CATCH program. In addition, changes in physical fitness and differences between sexes were examined.

4.1 Sample

A total of 200 children from grades 3 to 6 attending the YMCA after school program in the Halifax Regional School Board were approached to participate. Parental consent was obtained for 45 children at five of the 12 different YMCA after school locations, however only 39 were present to participate on baseline data collection days. These 39 children agreed to participate and completed the first set of data testing. Of these 39 children, 35 (89.7%) wore the accelerometer for the required amount of time (at least three weekdays and one weekend day). Thirty-seven (94.9%) completed the 6-minute walk-test and 39 (100%) filled out the questionnaire and had their height and weight measured (see table 1). The average age of participants at baseline was 9.58 ± 1.06 years. Seventeen of the students were in grade 3 (43.5%), 16 students in grade 4 (41%), 5 students in grade five (12.8%) and one student in grade six (2%).

Table 1. Number of subjects with sufficient data for the baseline portion of the study.

Baseline	Total sample (n = 39)
Wore accelerometer for required number of days (at least three weekdays and one weekend day)	n = 35 (89.7%)
Completed six-minute walk-test	n = 37 (94.9%)
Height and weight measures for BMI	n = 39 (100%)
Completed questionnaire	n = 39 (100%)

Since 12 students who participated in baseline testing did not meet the required number of days for wearing the accelerometers at post-testing, the final sample size was n=27. Those who failed to wear the accelerometer for sufficient time at baseline testing were excluded from the second session of data collection (Table 2).

Table 2. Number of subjects with sufficient data for each portion of the study (post-test).

Post-test	Total sample (n = 39)
Wore accelerometer for required number of days (at least 3 week days and one weekend day)	n =27 (85.3%)
Completed six-minute walk test	n = 29 (74.4%)
Height and weight measures for BMI	n = 31 (88.6%)
Completed questionnaire	n = 31 (88.6%)

4.2 Descriptive Statistics

Thirty one students were measured for height and weight at baseline and post-test. Although average height increased, as expected between data testing sessions, this difference ($p = 0.2452$) was not significant. Weight increased significantly between the two trials ($p = 0.0045$). There was no significant difference ($p = 0.3702$) in BMI values between trials.

Table 3. Descriptive statistics for baseline and post-test measures for height (cm), weight (kg) and body mass index (kg/m²).

	N	Mean	Maximum	Minimum
Height (cm)				
Baseline	31	139.0 ± 8.50	156.5	122.0
Post-test	31	140.9 ± 8.10	158.0	123.4
Weight(kg)				
Baseline	31	37.9 ± 8.79	60.0	23.0
Post-test	31	38.6 ± 8.42	60.0	24.0
BMI (kg/m²)				
Baseline	31	19.34 ± 3.42	28.86	14.60
Post-test	31	19.28 ± 3.19	29.51	14.76

Body mass index (BMI) was calculated for the final sample of children (n=31) and categorized based on the CDC's BMI for-age-growth-charts. These sex-specific charts describe the normal growth of BMI for children between the ages of 2 and 20 years. Further, these charts can be used to describe the weight of a child using percentile curves. Specifically, these charts compare the body mass index of each child to other children of

the same age and sex. The following tables display the number and percentage of boys and girls in each BMI category.

Table 4. Number of children classified as overweight, at risk of overweight, healthy weight and underweight according to the age- and sex-specific CDC Growth Charts.

Category	Total n=31	Boys n=11	Girls n=20
Overweight *BMI at or above the 85 th percentile	N=7 (22.6%)	N=2 (18%)	n=5 (25.0%)
At risk for overweight *BMI at the 85 th and below the 95 th percentile	N=9 (29.0%)	N=2 (18%)	n=7 (35.0%)
Healthy weight *BMI at the 5 th and less than the 85 th percentile	N=13 (41.9%)	N=7 (63.6%)	N=6 (30.0%)
Underweight *BMI below the 5 th percentile	N=2 (6.5%)	N=0 (0.0%)	N=2 (10%)

4.3 Overall MVPA

The main question addressed in the present study was whether overall minutes of moderate to vigorous physical activity increased from baseline to post-test in children who participated in the YMCA CATCH program. Activity intensities were defined using the following categories: light, moderate, hard and very hard. Results show that the

combined mean weekday minutes of moderate and vigorous intensity physical activity (MVPA) increased significantly ($p = 0.047$).

Table 5. Mean weekday and weekend minutes of MVPA at baseline and post-test measures.

	Baseline (n=35)	Post-test (n=27)	p-value
Mean minutes of MVPA (Monday to Friday)	141.92 ± 49.57	171.56 ± 45.03	.047*
Mean minutes of MVPA (Saturday)	117.73 ± 63.76	129.26 ± 57.32	.276
Mean minutes of MVPA (Sunday)	94.15 ± 57.02	175.61 ± 83.27	.006*

* Indicates statistical significance at $\alpha=0.05$.

Mean minutes of MVPA were calculated for all participants for weekend days as well (Saturday and Sunday). There was no significant difference between baseline MVPA minutes and post-test MPVA minutes on Saturday ($p=.276$), however, there was a significant difference in MVPA minutes from baseline to post-test on Sunday ($p=.006$).

4.4 Afterschool MVPA

Moderate to vigorous activity was calculated for after school time (3 to 6pm) while the participants were at their afterschool programs. Although participants were attending the YMCA afterschool program at both baseline and post-test, CATCH

activities only began after baseline testing had been administered. There was no significant difference ($p = 0.260$) between the mean minutes spent in MVPA at baseline and post-test.

Table 6. Mean after school MVPA minutes at baseline and post-test.

	Baseline (n=35)	Post-test (n=27)	p-value
Mean MVPA minutes after school (Monday – Friday)	44.60 ± 6.77	48.32 ± 7.88	0.260

One way ANOVAs were conducted to examine a difference in MVPA between boys and girls for both baseline results and post-test results. There was no significant difference ($p=.582$) between the two sexes for average minutes of MVPA at baseline.

Table 7. Mean minutes of MVPA for boys and girls at baseline and post-test.

Baseline	n	Mean	f	p-value
Boys	14	147.67 ± 51.21		
Girls	21	138.08 ± 49.34		
Total	35	141.92 ± 49.57		
Between groups			.309	.582
Post-test				
Boys	10	199.98 ± 44.41		
Girls	17	154.84 ± 37.19		
Total	27	171.56 ± 45.03		
Between groups			8.042	.009*

* Indicates statistical significance at $\alpha=.01$.

At post-test, the average minutes of MVPA for boys was significantly higher ($p=.009$) than for girls.

4.5 Six-minute Walk-test

Another major question in the present study was whether cardiorespiratory fitness as measured by the six-minute walk-test increased from baseline to post-test. Thirty seven students completed the six-minute walk-test at baseline and 29 students at the post testing session. Students who did not provide sufficient accelerometer data during baseline testing were not included in post-test measurements, thus the n examined for this analysis was 29. The mean distance walked increased significantly ($p = .000$) at post-test ($n=29$).

Table 8. The mean (m) and standard deviation (m)for the six-minute walk-test at baseline and post-test.

	n	mean	t	df	significance
Walk-test at baseline	37	590.97 ± 85.44			
Walk-test at post-test	29	659.77 ± 96.42			
			36.85	28	.000

An ANOVA was conducted to compare the boys and girls results from the six-minute walk-test. There were no significant differences for the six-minute walk-test scores between boys and girls either at baseline or post-test.

Table 9. Mean (m) and standard deviation of six-minute-walk-test for boys and girls at baseline and post-test and the analysis of variance between the two groups.

Baseline	n	mean (m)	f	significance
Boys	16	603.45 ± 67.05		
Girls	21	574.64 ± 87.10		
Total	37	590.97 ± 85.44		
Between groups			1.204	.280
Post-test				
Boys	10	687.85 ± 79.63		
Girls	19	644.27 ± 22.44		
Total	29	659.77 ± 96.42		
Between groups			1.427	.242

4.6 Questionnaire Data

Questionnaire data was recorded at baseline only and frequencies of activities calculated. A high percentage (82.1%) of children reported “playing outside with friends” as a frequent activity that they do. All children reported watching TV everyday. Physically active games were also common with 71.8% reporting that they participated. Table10 displays the frequencies and percentages of participants for activities included in the questionnaire (Appendix A).

Table 10. Questionnaire Data – Frequencies.

Activity	“Yes”	Percent (%)
Play outside with friends	32	82.1
Play outside alone	15	38.5
Watch TV	39	100
Less than 1 hour	12	33.3
1 hour	14	35.9
More than 1 hour	13	33.3
Play video/ computer games	29	74.4
Less than 1 hour	18	46.2
1 hour	10	25.6
More than 1 hour	1	2.6
Play on the internet	26	66.6
Less than 1 hour	20	51.3
1 hour	4	10.3
More than 1 hour	2	5.1
Play active games	28	71.8
Sit and Talk with Friends	25	64.1
Play in a sports club	19	48.7
Play sports teams	22	56.4
Play in a youth group	9	23.1
Participated in an after school program	32	82.1
Other activity	18	46.2

Participants were asked how they traveled to school on most days during the week; 16 (41.0%) participants reported walking to school and 23 (53.8%) either were driven or took the bus.

Table 11. Students reported whether or not they walked to school on most days of the week.

N=39	Yes	Percentage (%)	No	Percentage(%)
Walks to school	16	41.0	23	59.0

An ANOVA was conducted to compare the students who walked to school to those who did not regarding minutes of MVPA. Although those who reported walking to school had more minutes of MVPA for both testing sessions, these differences were not significant at baseline ($p = .496$) or at post testing ($p=.288$).

Table 12. Mean minutes of MVPA for students who reported walking to school vs. those driven or who took the bus at baseline and post-test.

	Baseline minutes	Post test minutes
Walk (n=16)	149.03 ± 50.16	182.88 ± 46.71
Drive/bus/other (n=23)	137.18 ± 48.83	163.78 ± 43.60

Data regarding daily screen time (television, video games, and internet) were examined to compare weekday MVPA between those who spent less than one hour, one hour, or more than one hour watching television, playing video games or spending time on the internet. There were no significant differences at baseline or at post testing between MVPA and

self-reported television ($p=.619$ at baseline and $p=.549$), video game ($p=.864$ at baseline and $p=.219$ at post-test), or internet ($p=.957$ at baseline and $p=.064$ at post-test) “screen time”.

Table 13. Mean minutes of weekday MVPA according to self-reported daily time spent watching television, playing video games and playing on the internet.

Time spent watching television	Baseline minutes spent in MVPA	Post-test minutes spent in MVPA
< 1 hour/day n = 12	154.55 ± 48.83	164.66 ± 27.27
1 hour/day n = 14	131.96 ± 17.93	186.97 ± 33.99
> 1 hour/day n = 13	142.56 ± 62.72	167.81 ± 64.36
Time playing video games		
< 1hour/day n = 18	148.72 ± 45.98	177.73 ± 30.36
1 hour/day n = 10	129.36 ± 44.45	196.76 ± 69.46
> 1 hour/day n = 1	130.40	140.50
None n = 10	144.52 ± 56.45	146.47 ± 34.65
Time on the internet		
< 1hour/day n = 20	139.34 ± 46.30	170.47 ± 38.75
1 hour/day n = 4	139.97 ± 35.04	240.10 ± 23.05
> 1 hour/day n = 2	159.50 ± 50.48	205.70 ± 78.48
None n = 13	144.07 ± 53.21	155.84 ± 38.01

4.7 Summary of Results

Results showed a significant increase in mean weekday MVPA from baseline to post-test for all children in the present study. Furthermore, a significant increase was also detected in results of the six-minute-walk-test which would indicate an increase in cardiorespiratory fitness. Boys were significantly more active than girls at post-test; however there were no sex differences for the six-minute walk test. Surprisingly, there was little change in mean MVPA during after school time. Students who reported walking to school did have more mean minutes of MVPA, yet the difference was not significant. There were no significant findings between screen time and MVPA.

Chapter 5 – Discussion

The main purpose of the present study was to determine if those attending the YMCA after school CATCH program increased their MVPA and cardiorespiratory fitness. After school MVPA was examined to investigate the direct impact of the CATCH program in increasing overall participation in physical activity. Changes in height and weight were explored to further examine potential changes in body mass index from baseline to post-test. Finally, questionnaire data regarding self-reported screen time was used to examine whether or not it had an impact on levels of MVPA.

As displayed in chapter 4, there were significant improvements in physical activity and cardiorespiratory fitness for all participants in the present study . Specifically, participants' weekday MVPA and six-minute walk-test increased significantly from baseline to post-test. Although average after school minutes of MVPA showed a slight increase from baseline to post-testing, this difference was not significant. A significant increase was also detected in weight from baseline to post-test, however, no significant increase was found in height or BMI. Any changes that did occur in anthropometric measures were expected due to normal growth of children in this age range. This section will explore and interpret these findings to better understand the role the CATCH program had and can play in after school settings.

5.1 Changes in Physical Activity

Results of this study support the importance of afterschool programs including a physical activity component to improve physical activity levels (Beets et al., 2009) and

physical fitness in children. As hypothesized, overall minutes of moderate to vigorous physical activity significantly increased

Weekday physical activity levels of the children in the present study can be compared to that of the participants in Campagna et al.'s (2005) PACY study where the mean minutes of MVPA for students in grade 3 was slightly higher. In contrast, mean MVPA minutes for participants in the present study were much higher than those of Campagna et al.'s (2005) participants in grade 7. Campagna et al. (2005) noted a mean MVPA of 167.1 minutes for boys in grade 3 and 148.2 minutes for girls in grade 3 where the present study found a mean MVPA of 147.7 ± 51.21 minutes for boys and 138.1 ± 49.34 minutes for girls. Boys in grade 7 in Campagna et al.'s study achieved a mean of 95.5 minutes of daily MVPA and the girls had a mean of 74.8 daily MVPA minutes. A possible explanation for the slightly lower minutes of MVPA in the present study than the results from participants in grade 3 in Campagna et al.'s (2005) could be that the sample included children in grades 4, 5 and 6 as well. Campagna et al.'s research in 2002 and 2005 as well as others (Nyberg, 2009) have found that physical activity is lower for older age groups and this finding was consistent with the data from the current study. Data in the present study were not further broken down into grade due to the low sample size which may explain why students in the present study are more active than those in grade 7 in Campagna et al.'s research (2002; 2005).

In regards to the CATCH program, the average increase in overall minutes spent in MVPA through the week suggests that the program was successful. The mean increase of 31.28 minutes of MVPA during weekdays was greater than expected (a mean increase of 15 minutes was hypothesized). A similar study by Gorely et al. (2009) also

found an increase in physical activity of children aged seven to nine years old after a school-based intervention. This study used accelerometers to detect changes in physical activity participation over an intervention period of ten months and found a mean increase of 16 minutes per day of MPVA by the end of the intervention. Like the present study, the main focus of Gorely et al.'s (2009) study was to examine whether or not a PA intervention would be effective in increasing overall PA habits. This study included simple physical education lessons highlighting walking and running events, and encouragement for the students reflect on their own activity levels and to more voluntarily perform activities. Studies like Gorely et al.'s and the present study demonstrate the feasibility behind the ability to increase physical activity in children and youth if administered effectively.

Also consistent with Campagna et al.'s (2002, 2005) and others (Beets et al., 2009; Nyburg, 2009; Trost et al., 2008) findings, boys tended to be more active than girls, boys in the present study accumulated more minutes of MVPA at baseline and post-test, however, the difference was only significant at post-test. Although there is a steady trend of lower physical activity with age for both sexes, it is more rapid and significant for girls as they reach early adolescence (Lytle et al., 2009). The consistency of this trend of higher levels of physical activity for boys than girls indicates that extra attention should be paid to providing additional opportunities and/or encouragement for young girls to be active. Programs aimed at helping girls become more active should consider adding more appealing activities as well as encouragement to ensure increased physical activity. Recommended activities could include more non-competitive, life time physical activities such as dance, yoga, walking, running, hiking and swimming. Another suggestion would

be to provide opportunities for girls to be active outside on fields, trails and playgrounds whenever possible. Afterschool programs are an excellent way to ensure such activities occur given that the majority of children and youth attend some type of schooling and are already handy to facilities. In the CATCH locations examined, all children had access to a regulation sized gym and outdoor playing surfaces (fields, courts, etc.). While there were no activities created specifically for girls, all CATCH activities were created with the intentions of: 1. providing many opportunities to participate and practice skills in physical activities that could be carried over to other times of the day and later in life and 2. providing a variety of enjoyable activities (Kelder et al., 2004). Programs with similar objectives should be considered as they may provide to opportunity to build confidence and ensure lifetime participation in physical activity, particularly in young girls.

In regards to weekend MVPA, results varied significantly between Saturday and Sunday and, particularly, between days from baseline to post-test. At baseline, children were more active on Saturday (117.73 ± 63.76) than Sunday (94.15 ± 57.02) and at post-test more MVPA occurred on Sunday (175.61 ± 83.27) than Saturday (129.26 ± 57.32). The increase in MVPA on Saturdays was not significant from baseline to post-test, however, Sunday's MVPA almost doubled from baseline to post-test. Consistent with other findings (Campagna et al., 2002;2005; Soric & Misigoj-Durakovic, 2010), children in this study tended to be less active on weekends than weekdays, however, Sundays at post-test showed unusually high amount f MVPA. There appears to be no consistent trend in weekend MVPA for students in the present study. This could be due to seasonal variation (snowy / rainy days vs. sunny / warm days) or to environmental barriers or supports in the home environment. For example, some children may have more access to

physical activity opportunities at home or with families where others may not. Specific home environments would need to be further explored to understand trends in weekend MVPA for each child.

While the daily average increase in MVPA at post-test is a promising finding for the CATCH program, there is a major limiting confounding factor to consider these conclusions. The seasonal variation that tends to occur with physical activity should be considered particularly given that baseline testing occurred during the month of February and post-test occurred in May and June. A study by Kolle and colleagues (2009) examined physical activity trends and seasonal variation and found that nine-year olds were significantly more active in the spring than in the fall and winter. Unfortunately, due to time constraints of this project, it was not possible to collect both sets of data during the same season.

5.2 Changes in Physical Activity during After School Time

While overall weekday minutes of MVPA were significantly greater at post-test than baseline, it is important to note that although there was a slight increase during afterschool time, this increase was not significant. In other words, although the children in this study were more physically active overall, it was total physical activity time vs. time in the CATCH program that explained the increase. The specific results from the after school time (i.e., CATCH program time) in this study contradict others who also examined the effect of the CATCH program on MVPA. Mackenzie et al. (2006) found that MVPA significantly increased from 37.4% of lesson time to 51.9% of lesson time with the CATCH intervention. Another pilot study examining the effectiveness of the

CATCH program in El Paso, Texas also found similar results where MVPA increased from 29.46% during lesson time to 56.84% of lesson time after the intervention had been implemented (Kelder et al., 2005). Perhaps with a larger sample size, the small increase in afterschool MVPA in the present study may have been significant.

Although the studies mentioned by Mackenzie et al (2006) and Kelder et al (2005) showed increases in MVPA, the method of data collection to determine MVPA was different from the present study. The present study used an objective measure (accelerometry), whereas the previously discussed studies used a subjective measure of MVPA. Specifically, the *SOFIT* protocol employed in the studies by MacKenzie et al (2006) and Kelder et al (2005) used direct observation to obtain a simultaneous measure of students' physical activity levels and lesson context during class time. Although, the standardized protocol for *SOFIT* was administered by trained observers, human error in the observations should be taken into consideration. Also, it is difficult to compare objective and subjective measures.

While there were no significant differences in MVPA during the afterschool time period (i.e., 3 to 6 p.m.) at baseline compared to post-test, both sets of data had a weekday mean greater than 40 minutes (44 minutes at baseline and 48 minutes at post-test). These results should be recognized since during afterschool time at baseline, participants were already accumulating almost 75% of the daily total recommended MVPA for children. This evidence itself indicates that children have the opportunity to accumulate significant MVPA during afterschool program time. Trost, Rozenkranz and Dzieweltoski (2008) also examined PA in children in grades 3 to 6 who participated in afterschool programs and found an average of 20.3 minutes of MVPA during afterschool

time. Interestingly, they noted time in MVPA was an important contributor to the overall physical activity of the children in the study. Taking Trost et al.'s (2008) conclusions into consideration, the present study provides strong evidence that the YMCA afterschool program provides ample opportunity for physical activity.

Results of the present study are comparable to a similar study conducted by Sharpe, Forrester and Mandigo (2009) at Brock University in Ontario. Like the present study, Sharpe and colleagues (2009) examined the effectiveness of the CATCH program in several YMCA afterschool programs. Their findings also revealed that although there were no significant differences in MVPA between CATCH participants and control participants, both groups were participating in substantial amounts of MVPA. Through use of the SOFIT protocol, Sharpe et al. (2009) determined that those participating in the CATCH sites accumulated 45 minutes of MVPA and those in the control sites accumulated 43 minutes of MVPA. A very noteworthy similarity between the present study and Sharpe et al.'s (2009) is both studies found participants participating in the same number of minutes of MVPA (whether using observation or direct measurement). Evidence of this study as well as that by Sharpe et al. (2009) indicates that the YMCA afterschool programs already had a large physical activity component prior to implementation of the CATCH activities.

Coleman et al. (2008) found similar levels of MVPA when reviewing seven afterschool boys and girls club programs. In their study 47 minutes were spent in MVPA with 51% of this time in free play and 49% in organized activities. Although past studies report higher MVPA during organized activities as opposed to free play in school time, Coleman et al (2008) found that children were more vigorously active during their free

play time than during organized activities in the after school programs as measured by minutes of MVPA. After school programs provide students with opportunity for free play and organized activities with program leader behaviours being a key factor in enhancing the physical activity experiences. Specifically, it was noted in Coleman et al.'s (2008) study that the after school program leaders tended to have more discouraging comments when the children were not moving enough in organized activities resulting in decreased participation and tended to be less discouraging during free play. Training for after school program leaders, regarding motivation and encouragement of MVPA may be a key factor in increasing the quality of programs aimed at increasing and promoting MVPA in children. Educating the leaders on the importance of physical activity and the role it plays in overall health could start the top down approach to help educate children and youth involved in the program. Trost et al. (2008) suggest that leaders could assist in increasing time spent in MVPA by a) enhancing program leaders' awareness of the importance of adequate physical activity, b) developing program leaders' administrative and instructional skills related to physical activity programming, and c) selecting developmentally appropriate physical activity experiences that emphasize enjoyable participation and enhancement of self-efficacy.

One problem that has been noted is the high turnover rate in such leadership or staffing positions which makes it more difficult to ensure all leaders are sufficiently trained. A benefit of the CATCH program is that its games and activities are designed to help leaders with minimal training conduct positive and structured activities with minimal management and discipline (Kelder et al., 2005). Ongoing, shorter bouts of training may ensure that all staff is properly trained despite high turnover rates.

Perhaps the most interesting finding of the present study was the amount of MVPA children are achieving while enrolled in an afterschool program. It appears that unstructured free-play opportunities presented to those attending afterschool programs regardless of the program structure. These opportunities include the presence of other children and friends in a safe environment for free-play. The importance of the environment to physical activity participation has been well documented (Barnett et al., 2009; Binns et al., 2009). Maintaining simple environmental measures such as providing open space, supplying sports equipment and increasing access to playground areas can all be associated with increased physical activity.

Conclusions of the present study support the importance of afterschool programs as an excellent and feasible setting for increased MVPA in elementary school aged children. Programs aimed at increasing MVPA must provide an encouraging setting for all young people to be active. Additionally, providing young people with the appropriate environment for free-play may be a partial solution for increasing physical activity in children and youth.

5.3 Changes in Cardiorespiratory Fitness

The measure used to assess cardiorespiratory fitness, the 6-minute walk-test, also showed a significant increase from baseline to post-test. Results increased from 590.97 ± 85.44 m walked at baseline to 659.77 ± 96.42 m at post-test. Compared to Lammers et al.'s (2007) data of normal values of the six-minute walk-test for healthy children nine to eleven years of age (496 ± 53 m), children in the present study had greater distances both before and after implementation of the CATCH program. Thus, the children in this study

were more physically fit, even at baseline. Results from the six-minute walk-test in the present study were comparable to those reported by Limsuwan, Wongwandee and Khowsathit (2009) where students with a mean age of 10.3 ± 1.0 years walked a mean distance of 586.1 ± 44.0 m.

The improvement in results from the six-minute walk-test from baseline to post-test could be attributed to a change in cardiorespiratory fitness over the CATCH intervention period. Kriemler et al. (2010) also looked at the effects of a physical activity intervention on physical fitness and found a significant change from baseline to post-test. In her study, 297 children in grade 1 to 5 were included in an intervention group where they received two extra physical education classes per week, 10 minutes a day of physical activity homework and short five-minute bursts of exercise throughout the school day. The intervention lasted over a nine month period throughout the school year. At post-test children in Kriemler et al.'s study ran 20 seconds longer in Leger's multistage shuttle run, an average increase of 5% from baseline. This change was substantial considering the large decline in physical fitness found in children in recent decades. Thus, results from Krimler et al.'s (2010) study are similar to findings in the present study where the activity intervention appeared to be successful in improving fitness levels in participants.

No significant sex differences were found for the cardiorespiratory fitness test. Boys walked slightly, but not significantly, further at baseline and post-test. Geiger and colleagues (2007) examined sex differences in the six-minute walk-test for 119 children ages 9 to 11 yrs and found that results were similar for boys and girls. Limsuwan et al. (2009) also found no significant sex difference for distances walked. The authors did, however, report a significant correlation between leg length and distance walked in the

six-minute-walk-test. Let length is an important factor that was not examined in the present study. Results of the six-minute walk-test in the present study were not controlled for growth.

Another factor that needs to be considered in terms of the increase in the six-minute walk-test is that the participants were better acquainted with the protocol of the test at post-test. This could have possibly been avoided if the participants had the opportunity to practice the protocol prior to baseline testing. At post-test the children knew what to expect and therefore may have exerted more energy.

5.4 Screen-time and Active Transportation

The questionnaire data from the present study provided insight into the trends and habits of the participants. Two key topics explored that have been identified in previous research in relationship to physical activity are screen time and active transportation.

For screen time, similar to Campagna et al.'s (2002; 2005) findings, the elementary school-aged children in this study reported more time watching television than playing on the internet or video games. All of the children in the present study reported watching television at least once a day and 66.7% reported watching television for at least an hour every day. In contrast, very few children reported playing on the internet more than one hour a day (5.1%) or playing video games more than one hour a day (2.6%). Time spent with a screen was much lower in this study than other studies where children ages 8 to 10 years have been found to spend on average 7.38 hours daily of accumulated media use (Rideout, Roberts & Foehr, 2005). An interesting trend that

has been reported in other studies is the significant increase in time spent on computers, including internet with age (Campagna et al., 2002; 2005). This increase in time spent on the internet could be due to increased importance in social networking for older youth, which in turn, may be contributing the decreased physical activity with age.

When examining active transportation patterns of the participants in this study, only 16 of the 39 children (41%) surveyed reported walking to school on most days. Interestingly, those who reported walking to school also had a greater mean MVPA minutes (149.03 ± 50.16 vs. 137.18 ± 48.83) min at baseline; (182.88 ± 46.71 vs. 163.78 ± 43.60) at post-test, but this difference was not significant ($p = 0.496$; $p = 0.288$). Walking and other forms of active transportation to school are considered excellent and easy modes to increasing MVPA throughout the day. In recent years increased attention has been directed to examining the effect that the built environment can play in physical activity levels. Again, locations where trails and sidewalks make active transport easier and safer for children can support increased participation in MVPA.

5.5 Study Limitations

While this study provided interesting findings for the YMCA and in particular with their implementation of the CATCH program, there are some limitations that must be noted. To begin, the sample size was small and changed considerably from start to finish which made it difficult to interpret each section. Some children provided sufficient accelerometer data (at least 4 days) at baseline but failed to do so during post-test, and therefore could not be included or could not be compared. A larger sample size would provide greater opportunity for generalization to the broader population.

Second, because there were five different sites examined in the present investigation, it was difficult to determine whether or not the change in MVPA noted was due to “CATCH activities”, leadership styles, or the afterschool environment in which the children participated. Of the five sites, only two had access to a gym and equipment all of the time. All had access to outdoor playing space (playground) however the activities occurred inside during the baseline testing. Another limitation to consider was the seasonal variation in activities. Having baseline in the winter and post-test in the spring made it difficult to affirm that the increase in MVPA was due to the CATCH program rather than better environmental or weather conditions.

An additional limitation of the study was that the only test of physical fitness used in the present study was of cardiorespiratory fitness using the six-minute walk-test. In other words, no measures of muscular strength or endurance or flexibility were taken. Although previous research shows that the six-minute walk-test is a valid measure for cardiorespiratory fitness in healthy children (Li et al., 2007; Limsuwan et al., 2009), a direct measure of maximal oxygen consumption would be a more reliable method in determining an increase in fitness. Because this method is difficult with a large sample and not suggested for children under the age of ten, it would be suggested that Leger’s multi-stage shuttle run be used to predict maximal oxygen consumption. Again, it should also be noted that in the present study, results of the six-minute walk-test were not controlled for growth and therefore it could be presumed that the increase in distances walked could be partially related to growth that occurred over the study period.

The final, and perhaps most significant limitation of the present study, was the lack of a control group for comparison. With no control group it makes any findings

difficult to contribute solely to the CATCH program and not to other factors such as the change in seasons or environmental factors. Having a control group in this particular type of study would have been beneficial to examine the minutes of MVPA between 3 and 6 pm in children participating in no afterschool program as data is lacking in this area.

5.6 Strengths of the Study

While several limitations have been noted, it is important to highlight the strengths of the present study. First, using an objective, direct measure of physical activity can be considered a major strength in this type of research. As mentioned, many other studies examining physical activity use subjective measures like SOFIT or questionnaire type surveys which can be more arbitrary. Having access to the accelerometers used in the present study allowed this objective measure to occur. Second, having one person collect all of the data allowed consistency in measures. The principal investigator collected all data therefore, the exact same technique was used for anthropometric measures (height and weight) and the protocol for the six-minute walk-test was explained the same every time it was performed.

5.7 Future directions

5.7.1 Researchers

Given the results from the present study and others similar in nature, it is highly recommended that extensive research be conducted examining afterschool environments and existing afterschool programs. Understanding the impact afterschool programs can have on promoting physical activity would contribute immensely to the planning and

implementation of successful programs. It is also recommended that afterschool MVPA is examined for those not enrolled in any type of afterschool program or activity. It appears there is very little existing data examining levels of MVPA between 3 and 6 pm for those children not attending afterschool programs. This may help to better understand the impact afterschool programs may be having on those participating.

5.7.2 Childcare Providers / Parents

Research in this field provides ample evidence that between the hours and 3pm and 6pm children have the opportunity to accumulate significant amounts of physical activity that may be missed during the school day. Providing children with an active environment and avoiding sedentary activities is a simple step in supporting a physically active lifestyle. Afterschool programs like CATCH are simple to implement and appear to be effective in increasing MVPA. In addition, such programs may eliminate sedentary activities during the afterschool time period.

5.8 Conclusion

Perhaps the most important conclusion from the current study is that it appears that afterschool programs with appropriate environment, amenities and leadership can provide children and youth to be physically active. Even before the CATCH intervention, the children in this study were already accumulating an average of 44 minutes of MVPA during their regular YMCA afterschool program. This is a substantial percentage of the recommended 60 minutes or more of MVPA to be accumulated throughout the day. Results from the present study strongly support the notion that organized afterschool programs, similar to that provided by the YMCA in the greater Halifax region, may be an

easy and effective way to increase overall physical activity levels in children. Programs like CATCH with a physical activity component could have a tremendous impact on increasing MVPA in children and youth when properly implemented. Every lesson should be designed with the goal of keeping children active for 50% of lesson time and involve children in at least 30 minutes of activity session (Kelder et al., 2005) to ensure this increase in MVPA. Motivation and experience of staff are a large factor in ensuring that CATCH objectives are met. In addition, all staff should have the opportunity to receive ongoing training to facilitate each program. Similar to the instructors in Kelder et al.'s (2005) study, leaders for the YMCA have a high turnover rate, which suggest that continuous training to ensure all leaders are up to date on the CATCH program and efficient and effective implementation of it. As previously mentioned, enhancing leaders' awareness of the importance of physical activity, developing administrative and instructional skills and educating leaders on developmentally appropriate physical activities would aid in effective leadership (Troost et al., 2008). In the present study it was difficult to monitor activities taking place each day because of the five separate locations with different instructors at each location. It is recommended that future research with the CATCH program include a component where the delivery of the program is well monitored as delivery of a program is critical in any successful intervention.

Appendix A

An Afterschool Physical Activity Intervention for children: Examining the YMCA CATCH Kids Club

Questionnaire for Children

Please take a few minutes to fill out the following questionnaire as completely as possible. If you are not sure of an answer, please write UN. You may ask questions at any time while answering this questionnaire.

Physical Activity = **Any type of body movement (e.g., walking, skipping, running, rollerblading, skateboarding)**

1) **What is your birth date?** _____ (day/month/year)

2) **What grade are you in?** _____

3) **Are you:** male female

4) **Think of the last week and check off any things that you did before or after school.**

_____ Play outside with friends

_____ Play outside alone

_____ Watch TV _____ (# of hours per day)

_____ Play video/computer games _____ (# of hours per day)

_____ Play on the Internet _____ (# of hours per day)

_____ Play active games (e.g., ultimate Frisbee, rollerblading)

_____ Sit and talk with friends

_____ Play sports in a club (e.g., figure skating, gymnastics)

_____ Play team sports (e.g., hockey, soccer, baseball)

_____ Play sports in a youth group

_____ Participated in a regular after school program

_____ Other (Name of activity _____)

5) Think of the last week and check off any things that may have changed in your physical activity patterns.

_____ Joined a new sports team or activity (If yes, what sport(s) / activity?)

_____ Stopped participating in a sport / activity (If yes, what sport(s) / activity?)

_____ Did not participate in an activity due to an illness or injury (If Yes, what Activity?)

6) How did you travel to school most days in the last week?

_____ Walk

_____ Bicycle

_____ Bus

_____ Drive in car

_____ Other (Please specify) _____

7) **Did you participate in any activities in the last week when you were not**

wearing the activity monitor (i.e. swimming?)

_____ **Yes**
indicate) _____

(please

_____ **No**

Thank you for your time!

Appendix B

Description of study for student & Assent- Script

Accelerometer, Six-minute walk test, General Questionnaire

Title: A Physical Activity Intervention for Children: Examining the YMCA CATCH Kids Club

Dear Student,

You are invited to take part in a study by a student at Dalhousie University. Taking part in this study is voluntary and you may choose to stop at any time.

The purpose of this research study is:

1. To see if participating in the YMCA CATCH program will increase how active you are.
2. To examine the impact of the CATCH program on your heart health.

You will be asked to wear an activity monitor at four different times for one week each time. The activity monitor fits comfortably onto a belt and is placed over your right hip. You may choose to wear the monitor, attached to a belt, over or under your clothes. This device is easy to use and does not interfere with normal activities. During the week we ask that you simply carry on with your normal weekly routine. Before placement of the activity monitor, height, weight and waist circumference will be measured. A questionnaire will also be given to you. The questionnaire contains questions about activities you may have done when you weren't wearing the accelerometer, changes in activity and how you traveled to and from school.

You are not responsible for loss or damage of the activity monitor used in the study. However, we request that you be careful with the activity monitor so it works well during the study.

The activity monitor is small and lightweight and worn on a belt around the waist, so the chance of injury from falling on it during physical activity is small. You will not be asked to participate in any physical activity other than your normal activities and a brief 6 minute walking test. During the walking test, you may find you are walking at a speed faster than you would in your everyday activities which may cause you to sweat a little.

Participation in this research study titled “A Physical activity intervention for children: Examining the YMCA CATCH kids club” is voluntary and you are free to withdraw from the study at any time for any reason. You can tell me now or you can contact me by email or telephone to let me know if you change your mind. Do you wish to continue your participation in the study?

Yes / No?

Renee Elliott

Email: rn608878@dal.ca

Telephone: 902-497-1030

Appendix C(1)

Information Letter (Parent/Guardian)

Accelerometer, six-minute walk test, General Questionnaire

Title: A Physical Activity Intervention for Children: Examining the YMCA CATCH Kids Club

Local Principal Investigator:

Renee Elliott, MSc. Kinesiology (candidate)

School of Health & Human Performance, Dalhousie University

(902) 497-1030

Rn608878@dal.ca

Supervisor

Laurene Rehman, Ph.D, Associate Professor

School of Health & Human Performance, Dalhousie University

6230 South Street

Dalhousie University

Halifax, Nova Scotia, B3H 3J5

(902) 494-1145

lrehman@dal.ca

If you have any questions or concerns about the upcoming study or require any further information or clarification about the study procedures at any time please contact either of the people mentioned above.

Introduction:

We invite your child to take part in a research study affiliated with Dalhousie University. Taking part in this study is voluntary and your child may choose to stop at any time without penalty. The study is described below. This description tells you about the expected time commitment, possible risks, or discomforts, which he/she may experience. Participating in the study might not benefit your child, but we might learn things that will benefit others. You should discuss any questions you have about this study with the people conducting the study.

Purpose of the Study:

The purpose of this research study is:

1. to examine how effective the YMCA CATCH program is in increasing physical activity levels to help meet the recommended amounts of daily physical activity (an accumulated 60 minutes or more of moderate intensity physical activity).
2. to examine the impact of the CATCH program on your child's fitness.

Study Design:

Your child and the others in his / her after school program are being asked to participate based on their enrolment in the YMCA CATCH Kids club program. There will be approximately 200 children approached to participate in this study.

Your child will be asked to wear an accelerometer for one week on four different occasions between January and April. The accelerometer (activity monitor) fits comfortably onto a belt and is placed over your child's right hip. They may choose to wear the monitor, attached to a belt, over or under your clothes. Previous use has shown that the device is easy to use and does not interfere with normal activities. During the time your child is wearing the device, we ask that your child simply carries on with their normal weekly routine. Before placement of the accelerometer your child's height, weight and waist circumference will be measured. A brief questionnaire will also be

given to your child at the beginning of each period when he / she is wearing the accelerometer. The questionnaire for your child contains questions about their activity levels within the last seven days, activities he/she may have done when not wearing the accelerometer, changes in activity and how he/she traveled to and from school. Your child can choose not to answer any question, if he / she so wish. The child questionnaires will take about 15 to 20 minutes each to complete. The questionnaire contains questions about your child's activities and changes in physical activity behaviors.

The total time commitment of the study will include two sessions of approximately 30 minutes to collect height, weight, walk test and questionnaire answers. In addition, the children will be wearing the devices for four, one week periods, however, they will be simply be asked to carry on with their normal activities.

Please note that participants, parents, and the YMCA CATCH leaders are not responsible for loss or damage of any accelerometer used in the study. However, it is assumed that participants will be careful with the equipment used in the study.

In addition to wearing the accelerometer, your child will also be asked to participate in a six-minute walk test under the supervision of the principle investigator. The test will take place during your child's regular after school program time. Your child will be asked to continuously walk around 2 points at a marked distance of 30 meters apart as many times as possible in six minutes. He / she will be allowed to walk at his/her own pace and will be allowed to stop or rest at any point during the test.

You and your child have the right to ask questions about the study at anytime before, during, and after the study.

Possible Risks and Discomforts:

Your child may find some discomfort in walking a faster speed than normal during the six-minute walk test as they will likely increase their body temperature.

Possible Benefits:

There is likely little if any benefit for you or your child in participating in this study. You may benefit by becoming more aware of your child's physical activity level. If we find that our children and youth are not sufficiently physically active we will be able to work toward ways to improve opportunities for physical activity in the lives of children and youth.

Confidentiality:

Your child will be assigned a code number. This code will be placed on all the questionnaires and assigned to the physical activity data that is collected from the accelerometer. Your child's name will not appear on any of the documents. A list of names and matching codes will be stored in the project research office at the School of Health and Human Performance at Dalhousie University and all computer data will be stored on a password protected computer that only the principal investigator and her supervisors will have access to. Only the researchers will have access to the names of the participants. The physical activity and all results of data analysis will be reported, presented or published without identifying your child or any other individual children. You and your child have the right to request a summary of your data after the study is over.

Once the study has been completed all data will be presented anonymously in a final thesis report and presented at relevant conferences. It is also anticipated that the final draft will be submitted to relevant journals for publication.

Voluntary Participation:

Taking part in this study is completely voluntary, and your child is free to stop at any time for any reason without penalty. If you choose to stop taking part, you can tell the researchers in

person or by phone (902-497-1030), or send a message by email (rn608878@dal.ca). If you choose to stop taking part in this study, any data collected from you or your child will be destroyed immediately.

If you require any further information or have any questions concerning the study you can contact the principal investigator Renee Elliott (Dalhousie graduate student) at 902-497-1030; rn608878@dal.ca or Dr. Laurene Rehman (Associate professor at Dalhousie University) at 902-494-1145; lrehman@dal.ca.

Appendix C(2)

Consent (Adult)

Title: A Physical Activity Intervention for Children: Examining the YMCA CATCH Kids Club

I have read the attached letter and the above information describing the research study, and I agree to allow my child to participate in the study. I understand that my child's participation is voluntary, and that he / she may withdraw from the study at any time for any reason. My signature below shows that I give permission for my child to participate in the study if my child gives verbal assent to participate.

Name of parent or legal guardian

Signature of parent or legal guardian

Name of principal investigator

Signature of principal investigator

Date

We are asking that you provide your phone number. We will only be using this information to inform you that your child has been selected and has given assent to wear an activity monitor.

Phone # _____

Appendix D

Script for the six-minute walk test - Modified

From ATS Statement:

Guidelines for the Six-Minute Walk Test

American Journal of Respiratory Critical Care and Medicine

Vol. 166. pp. 111-117, 2002.

Geiger, R., Strasak, A., Tremil, B., Gasser, K., Kleinsasser, A., Fischer, V., Geiger, H., Loekinger, A., & Stein, J.I. (2007). Six-minute walk-test in children and adolescents. *The Journal of Paediatrics*. 150: 395-399.

The following script will be used to ensure consistent instructions and encouragement for each of the children participating in the test.

Description:

“The object of this test is to walk as far as possible for 6 minutes. You will walk back and forth in this hallway. Six minutes is a long time to walk, so you will be working hard.

You will probably get out of breath or become tired. You are allowed to slow down, to stop, and to rest if you need to. You may lean against the wall while resting,

but resume walking as soon as you are able. You will be walking back and forth around the cones. You should turn quickly around the cones and continue back the other way without slowing down. Now I’m going to show you. Please watch the way I turn without slowing down.”

Demonstrate by walking one lap yourself. Walk and turn around a cone briskly.

“Are you ready to do that? I am going to use this counter to keep track of the number of laps you complete. I will click it each time you turn around at this starting line.

Remember that the object is to walk AS FAR AS POSSIBLE for 6 minutes, but don’t run or jog. Start now, or whenever you are ready.”

Encouragement:

After the first minute, tell the student the following (in even tones): *“You are doing well. You have 5 minutes to go.”*

When the timer shows 4 minutes remaining, tell the student the following: *“Keep up the good work. You have 4 minutes to go.”*

When the timer shows 3 minutes remaining, tell the student the following: *“You are doing well. You are halfway done.”*

When the timer shows 2 minutes remaining, tell the student the following: *“Keep up the good work. You have only 2 minutes left.”*

When the timer shows only 1 minute remaining tell the student: *“You are doing well. You have only 1 minute to go.”*

Do not use other words of encouragement (or body language to speed up).

If the student stops walking during the test and needs a rest, say this: *“You can lean against the wall if you would like; then continue walking whenever you feel able.”*

Do not stop the timer. If the student stops before the 6 minutes are up and refuses to continue (or you decide that they should not continue) note on the worksheet the distance, the time stopped, and the reason for stopping prematurely.

When the timer is 15 seconds from completion, say this: *“In a moment I’m going to tell you to stop. When I do, just stop right where you are and I will come to you.”*

When the timer rings (or buzzes), say this: *“Stop!”* Walk over to the student. Consider taking the chair if they look exhausted. Mark the spot where they stopped by placing a bean bag or a piece of tape on the floor.

Appendix E

Letter Of Support From YMCA Director

November 7, 2008

Renee Elliott

Dalhousie University

School of Health and Human Performance

6230 South Street, Halifax Nova Scotia, B3H 3J5

Dear Renee Elliott;

I am writing this letter of support to verify the YMCA of Greater Halifax/ Dartmouth involvement with your study called, A Physical Activity Intervention for Children: Examining the YMCA CATCH Kids Club. We are delighted to be part of this study and are eagerly awaiting approval from the ethics committee in order to proceed.

Sincerely

Paula Latham

Manager, Early Childhood Education and Y-PHD

Appendix F

Examples of CATCH activities provided in activity box

http://www.sph.uth.tmc.edu/catch/PDF_Files/Iowa_AHPERD_Nov%20'08.pdf

Large group games

Hot Feet

Create an area large enough for a tag game and fast movement. Each student has a juggling scarf, plastic grocery bag, or bean bag. Objective is to throw your object and hit someone else's feet while trying to dodge throws at your own feet. If hit on the foot (or below the knee), players must stop and do 5 jumping jacks before resuming play.

Shadow Ball

Great social studies integration. Shadow Ball was a routine developed by the Negro League Baseball teams of the 1930-40's. Often depleted of basic equipment, i.e., enough baseballs for pre-game warm up, players would warm up using an imaginary baseball. Throwing, catching and batting was all done with a "shadow ball." The routine became so entertaining; it became a regular pre-game ritual at most Negro League Baseball games. Have students shadow ball their favorite sport. Play *Sweet Georgia Brown*. Every 30-60 seconds call out a new sport for them to shadow ball. Work in pairs or small groups of 3-4.

Gotcha! See'ya!

Create an activity area adequate for a tag game. Designate one student for every 3- 4 students to be "it." Its attempt to tag any student not designated as an "it." When a student gets tagged both the "it" and the tagged student must stop. Its say,

“Gotcha,” and hand over the scarf to the student they tagged, then say “See’Ya!”

The new it attempts to tag other students.

Partner and small group activities and games

Toe Fencing

Students work in pairs. Each student has an activity wand. One end of wand must slide along the floor at all times. Partners begin by crossing wands to make an ‘X’ and tap wands together 3 times. Objective is to touch partner’s toes with the wand. Parry, block and lunge are all encouraged!

Grab the GO!

Most of us could use another serving of fruits and vegetables. The object is to grab the Go Food (your beanbag) is to take that serving before your partner does! Start the music and assign different tasks (hands on knees, push-ups, snap fingers to the beat of the music, touch palms to floor in rhythm with the beat of the music, etc.). When the music stops, try and grab the apple before your partner!

Happy Feet

Students work in pairs and stand 3-5 yards apart. One student is the dodger, the other the thrower. The dodger puts their beanbag on the ground (this will mark the dodger spot and never gets picked up). The objective is for the thrower to try and hit the dodger on the feet with the beanbag. Partners trade places after each throw (remember that the one beanbag stays on the ground and is used only for the purpose of marking the dodging spot).

Active classroom games

Stand Up Sit Down Sing - a - long

Good game for K-2 to help with phonemic awareness (letter sounds). Teacher

sings *My Bonnie Lies Over The Ocean*. On each /b/ sound, students alternate standing up or sitting down. Variation: Read the nursery rhyme *Peter Piper*. Students sit down or stand up on the /p/ sound. Really, any tongue twister will do...Sally sells seashells by the seashore. Peter Piper picked a pickle peppers. You get the idea...

Letter Line

Letter line is an activity to help students remember how letters should be formatted. Some letters reach above the line, e.g., **h, t, f**. Some letters go below the line, e.g., **p, q, g**. And others are written on the line, e.g., **a, r, s**. Simply call out letters at random and students respond as follows:

Reach Tall – for letters above the line

Squat in a Seated Position – for letters on the line

Touch Toes – for letters below the line.

Now Try This: Give a word, i.e. *pat*. Spell the word with movement only, e.g., touch squat-reach.

Stare & Glare Joggin' Showdown

Students work with a partner. The challenge is to stare and glare eye-to-eye your partner. Challenge is over when one player breaks eye contact or is the first to smile or laugh. Begin 6-8 feet apart. Pairs start jogging in place. Blow a whistle every 4-5 seconds – students must take a step closer to each other.

Variation: dribble a basketball while staring.

Instructional format activities

Two line stations

Huddle Up

2-Line Game (15-20 yards apart). Students work with a partner – one starts as offense, the other starts as defense. One Football per pair. Defensive team stands on one line. Offensive players start with a football and huddle up on other line.

Quarterback calls a “wellness play”, e.g. brush your teeth. Offense breaks huddle and pantomimes (without speaking) the play to their partner. When partner guess play correctly, partner takes football becomes offensive player and sprints to huddle. Plays to call: drink lots of water, wear a helmet, get plenty of sleep, use the crosswalk, exercise at home, etc.

Meet Me in the Middle

2-Line Game (15-20 yards apart). Students work with a partner. One basketball per pair. Partner with ball always dribbles to the center. Pairs have 15 seconds to meet in the middle, perform a task and return to their respective lines. In order to structure activity so that partners take turns dribbling to center, first task is 3 back to back ball handling passes (turn and hand ball to partner). On second trip to middle, repeat first task and add a second. On third trip repeat first two tasks then add the third, etc. Tasks to add in the middle are 2 chest passes, 2 bounce passes, 2 overhead passes, 2 shots, etc.

Grid Stations

Setup: Designate 6 -10 small grids or activity stations (depending on the size of the class). Typically, each station has a different task or assignment, and 4-6 students are assigned to each station. The size of the activity station and the number of students per station will vary with the size of the instructional area available.

Managing With Music: Use music intervals to cue students when how much time to spend at each station. The silence intervals are their signal to stop work, clean up, and rotate to the next station.

Passing Challenges

Grid Station (approximately 10'x 10'). Students work in groups of 3-4. How many passes can the group make in 30 seconds? 60 seconds? Variation: (1) use different passes, e.g., bounce pass, overhead pass, shooting, etc.; (2) sound a signal and students must change passing direction.

Give & Go

Grid Station (approximately 10'x 10'). Students work in groups of 4. One ball per group.

Student with the ball must establish a pivot foot. Other students move randomly around the grid space. Student with the ball can only pass to a player that is moving to open space. How many passes can your group make in 30 seconds? 60 seconds?

Interval stations

Setup: Use when students are working with a partner or small group, and students will need to take turns, rotate tasks, or find a new partner or group member. Pairs or small groups are scattered about the activity area.

Managing With Music: Music Intervals cue students to work with their partner / group.

The silence intervals cue students to find a new partner/group, or switch roles, or take turns with equipment.

Stationary stations

Setup: Used when students practice assigned tasks in their own personal space.

Scatter students throughout the activity area and “anchor up,” i.e., don’t drift into someone else’s space (designating their space with a spot marker or cone is helpful).

Managing With Music: Music intervals cue students when to practice and work.

Reinforce teaching cues, provide feedback, take heart rates, or preface the next task during intervals of silence.

Dribbling Tasks Using Stationary Stations:

- 30 seconds music – students practice cross over dribble.
- 15 seconds silence – rest while teacher reinforces dribbling cues (eyes up, waist high, finger pads)
- 30 seconds music – students practice cross over dribble again.
- 15 seconds silence – take heart rate.
- 30 seconds music – students practice figure eight ball handling skills, etc.

Station relay

Setup: Students work in groups of three. Student #1 is stationed on one side of the activity area; Student #2 is stationed on the other side (use cones or spot markers to designate where students should be positioned). The third student begins as the “traveler,” and is stationed in the middle between the two other students.

Movement Rotation: This is essentially a 3-person weave drill. Travelers (student #3) move to student #1 and exchange places → student #1 travels across to exchanges places with student #2 → student #2 travels across and exchanges places with student

#3 → student #3 travels across and again changes places with student #1, etc.

Once students get the hang of the movement rotation, give the Traveler (student #3) a piece of equipment to use as they move across. After exchanging equipment, students not traveling perform an exercise (jumping jacks, stretch), or use a piece of equipment

(jump rope, beanbag, hula hoop) while they are waiting. They merely exchange their equipment with the traveler once the traveler arrives at their cone.

References

Abelson & Kennedy (2004). The Obesity Epidemic. *Science Magazine*; 304 p. 1413.

Andersen, R., Crespo, C., J. Bartless, S., J. Cheskin, L., J. Pratt, M. (1998).

Relationship of physical activity and television watching with body weight and level of fatness among children. *The Journal of the American Medical Association*, 279 (12), 938-42.

Anderson, S.E., Cohen, P. Naumova, E.N., Jacques, P.F. & Must, A. (2007). Adolescent obesity and risk for subsequent major depressive disorder and anxiety disorder: Prospective evidence. *Psychosomatic Medicine*, 69 (8), 740-747.

Ara, I., Vicente-Rodriguez, G., Perez-Gomez, J., Jimenez-Ramirez, J., Serrano-Sanchez, J.A., Dorado, C. & Calbert, J. (2006). Influence of extracurricular sport activities on body composition and physical fitness in boys: a 3-year longitudinal study. *International Journal of Obesity*, (30),1062-1071.

Bagley, S., Salmon, J. & Crawford, D. (2006). Family structure and children's television viewing and physical activity. *Medicine & Science in Sports & Exercise*, 38(5), 910-918.

Baker, J.L., Olsen, L.W. & Sorensen, T.I.A. (2007). Childhood body-mass index and the risk of coronary heart disease in adulthood. *The New England Journal of Medicine*, (357) 2329 – 2337.

- Barnett, T., O'Louhlin, J., Gauvin, L., Paradis, G. & Hanley, J. (2009). Opportunities for student physical activity in elementary schools: A cross-sectional survey of frequency and correlates. *Health Education and Behavior*, 33(2), 215-232.
- Basset, D.R., Schneider, P.L. & Huntington, G.E. (2004). Physical activity in an old order Amish community. *Medicine & Science in Sports & Exercise*, 36(1),79-85.
- Beets, M.W., Beighle,A., Erwin, H., & Huberty, J. (2009). Afterschool program impact on physical activity and fitness: A meta-analysis. *American Journal of Preventative Medicine*, 36(6), 527-537.
- Binns H.J., Forman J.A. & Karr C.J. (2009). The Built Environment: Designing Communities to Promote Physical Activity in Children. *Paediatrics*, 123,1591-8.
- Brunet, M., Chaput, J.P., & Tremblay, A. (2007). The association between low physical fitness and high body mass index in children: the 'Quebec en Forme' Project. *International Journal of Obesity*, (4), 637-643.
- Cairney, J., Hay, J.A., Faight, B.E., Leger, L. & Mathers, B. (2008). Generalized Self-Efficacy and Performance on the 20-metre Shuttle Run in Children. *American Journal of Human Biology*, (20), 132-138.
- Campagna, P., Ness, G., Murphy, R., Rasmussen, R., Thompson, A., Porter, J. & Rehman, L. (2002). Physical Activity Levels in Children and Youth in the Province of Nova Scotia. Halifax, NS; Sport and Recreation Commission, Government of Nova Scotia, 2002, pp. 1-27.
- Campagna, P., Amero, M., Arthur, M., Durant, M., Murphy, R., Porter, J., ... Wadsworth, L. (2005). Physical activity and dietary intake of children and youth:

Report to be conducted for the Office of Health Promotion, Government of Nova Scotia. Halifax, N.S.

Canada's Food Guide (2009). Health Canada, Web Source. Retrieved August 4, 2010 at <http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/index-eng.php>.

Canadian Physical Activity, Fitness and Lifestyle Appraisal Manual. (2004).

Center for Disease Control and Prevention (2000). <http://www.cdc.gov/growthcharts/>. Retrieved February 23, 2008 (Web Source).

Center for Disease Control and Prevention (2009). <http://www.cdc.gov/obesity/data/trends.html>. Retrieved August 4, 2010 (Web Source)

Cleland, V., Venn, A., Fryer, J., Dwyer, T. and Blizzard, L. (2005). Parental exercise is associated with Australian children's extracurricular sports participation and cardiorespiratory fitness: A cross-sectional study. *International Journal of Behavioural Nutrition and Physical Activity*, (2), 3-9.

Coleman, K., Geller, K., Rosenkranz, R. & Dziewaltowski, D. (2008). Physical Activity and Healthy Eating in the Afterschool Environment. *Journal of School Health*; 78 (12).

Coleman, K.J., Tiller, C.L., Sanchez, J., Heath, E.M., Sy, O., Milliken, G., Dziewaltowski D.A. (2005). Prevention of the Epidemic Increase in Child Risk of Overweight in Low-Income Schools. The El Paso Coordinated Approach to Child Health. *Archives of Paediatric Adolescent Medicine*; 159: 217 – 224.

- Crespo, R.O., Casaburi, R., Coates, A.L., Enright, P.L., MacIntyre, N.R., McKay, R.T., Johnson, D., Wanger, J.S. & Zeballos (2002). ATS Statement: Guidelines for the Six-minute Walk Test. *American Journal of Respiratory and Critical Care Medicine*, 166, 111-117.
- Daniels, S.R. (2006). The consequences of childhood overweight and obesity. *Childhood Obesity*, 16(1), 47-67.
- Dehghan, M., Akhtar-Danesh, N. & Merchant, A.T. (2005). Childhood obesity, prevalence and prevention. *Nutrition Journal*, 4(24)1-8.
- DeLine, J. (2008). CATCH activities and games. University of Texas School of Public Health. Retrieved on August 17, 2010 from: http://www.sph.uth.tmc.edu/catch/PDF_Files/Iowa_AHPERD_Nov%20'08.pdf.
- Dietz, W.H. (1998). Health Consequences of Obesity in Youth: Childhood Predictors of Adult Disease. *Pediatrics*. 101 (3): 518 – 525.
- Douglas, W.J., Tremblay, M.S. & Katzmarzyk, P.T. (2003). Geographic and demographic variation in the prevalence of overweight Canadian children. *Obesity Research*, 11(5), 668-73.
- Downs, D.S., Graham, G.M., Yang, S., Bargainnier, S. & Vasil, J. (2006). Youth exercise intention and past exercise behaviour: Examining the moderating influences of sex and meeting exercise recommendations. *Research Quarterly for Exercise and Sport*, 77(1), 91-99.

- DuToit, L., Venter, R.E. and Potgieter, J.R. (2005). The relationship between cardiorespiratory fitness, body composition and physical self perception of adolescent girls. *Journal of Human Movement Studies*, 48, 353 – 364.
- Esliger, D., Copeland, J.L., Barnes, J.D. & Tremblay, M.S. (2005). Standardizing and optimizing the use of accelerometer data for free-living physical activity monitoring. *Journal of Physical Activity and Health*, 2, 366-383.
- Falkner, N.H., Neumark-Sztainer, D., Story, M., Jeery, R.W, Beuhring, T. & Resnick, M.D. (2001). Social, Educational and Psychological Correlates of Weight Status in Adolescents. *Obesity Research*, 9(1), 32-42.
- Freedson, P. S., E. Melanson, and J. Sirad (1998). Calibration of the Computer Science and Applications, Inc. accelerometer. *Medicine & Science in Sport & Exercise*, 30,777-781.
- Floriani, V. & Kennedy, C. (2008). Promotion of Physical Activity in Children. Lippinott Williams and Wilkins, pp. 91-97.
- Geiger, R., Strasak, A., Treml, B., Gasser, K., Kleinsasser, A., Fischer, V., .. Stein, J.I. (2007). Six-minute walk test in children and adolescents. *Journal of Paediatrics*, 150, 395-399.
- Gorely, T. Nevill, M.E., Morris, J.G., Stensel, D.J. & Nevill, A. (2009). Effects of school-based intervention to promote healthy lifestyles in 7-11 year old children. *International Journal of Behavioral Nutrition and Physical activity*, 6(5).

- Harris, J. & Cale, L. (2007). Children's fitness testing: A feasibility study. *Health Education Journal*, 66(2), 153-172.
- He, M. & Beynon, C. (2006). Prevalence of overweight and obesity in school aged children. *Canadian Journal of Dietetic Practice and research*, 27 (3), 125-129.
- Hill, J.O. & Peters, J.C. (1998). Environmental Contributions to the Obesity Epidemic. *Science*, 280, 1371-1374.
- Hines, J. H. Challenges of accurately measuring and using BMI and other indicators of obesity in children. *Journal of the American Academy of Pediatrics*, 124, s3-s22.
- Hohepa, M., Scrahh, R., Schofield, G., Kolt, G.S., & Schaaf, D (2007). Social support for youth physical activity: Importance of siblings, parents, friend and school support across a segmented school day. *International Journal of Behavioral Nutrition and Physical Activity*, (4),54. doi: [10.1186/1479-5868-4-54](https://doi.org/10.1186/1479-5868-4-54).
- Howely, E.T. (2001). Types of Activity: resistance, aerobic and leisure versus occupational physical activity. *Medicine & Science in Sports & Exercise*, 33(6), 364-369.
- Janssen, I., Katzmaryzk, P.T., & Ross, R. (2006). Waist Circumference and not body mass index explains obesity related health risk. *American Journal of Clinical Nutrition*, 79, 379-384.

- Katzmarzyk, P.T. & Janssen, I. (2004). The economic costs associated with physical inactivity and obesity in Canada: an update. *Canadian Journal of Applied Physiology*, 29(1), 90-115.
- Kelder, S.H., Hoelscher, D.M., Barroso, C.S., Walker, J.L, Cribb, P. & Hu, S (2004). The CATCH Kids Club: a pilot afterschool study for improving elementary students' nutrition and physical activity. *Public Health Nutrition*, 8(2), 133-140.
- Kelder, S.H, Mitchell, P.D., McKenzie, T.L., Derby, C., Strikmiller, Luepker, R.V. & Stone, E.J (2003). Long-term implementation of the CATCH physical education program. *Health Education and Behaviour*, 30(4), 463-475.
- Kolle, E., Steene-Johannessen, J., Andersen, L.B. & Anderssen, S.A. (2009). Seasonal variation in objectively assessed physical activity among children and adolescents in Norway: a cross-sectional study. *International Journal of Behavior in Nutrition and Physical Activity*, 6(36). Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/19563650>.
- Krahnstoever-Davison, K., Cutting, T.M., & Birch, L.L. (2003). Parents' activity related parenting practices predict girls' physical activity. *Medicine & Science in Sports & Exercise*, 35 (9), 1589 – 1595.
- Kriemler, S., Zahner, L., Schindler, C., Meyer, U., Hartmann, T., Hebestreit, H., Brunner-La Rocca, H.P., van Mechelen, W. & Puder, J. (2010). Effect of school based physical activity program (KISS) on fitness and adiposity in primary

schoolchildren: cluster randomised controlled trial. *BMJ*; 340:c785.
doi:10.1136/bmj.c785.

Lammers, A.E., Hislop, A.A. & Haworth, S.G. (2008). The 6-minute walk test: normal values for children of 4-11 years of age. *Archives of Disabled Children*;93: 464-468.

Larsen, G.E., George, J.D., Alexander, J.L., Fellingham, G.W., Aldana, S.G. & Parcell, A.L. (2002). Prediction of maximum oxygen consumption from walking, jogging or running. *Research Quarterly for Exercise and Sport*, 73(1), 66-72.

Li, A.M., Yin, J., Au, J.T., So, H.K., Tsang, T., Wong, E., Fok, T.F. & Ng, P.C. (2007). Standard reference for the six-minute-walk test in healthy children aged 7 to 16 Years. *American Journal of Critical Care Medicine*, 176, 174-180.

Li, A.M., Yu, C.C.W, Tsang, T., So, H.K., Wong, E., Chan, D, Hon, E.K.L, & Sung, R. (2005). The six-minute walk test in healthy children: reliability and validity. *European Respiratory Journal*, 25(6), 1057-1060.

Limsuwan, A., Wongwandee, R. & Khowsathit, P. (2009). Correlation between 6-minute-walk-test and exercise stress test in healthy children. *Acta Paediatrica*, 99(3), 438-441.

Lytle, L.A., Murray, D.M., Evenson, K.R., Moody, J., Pratt, C.A., Metcalfe, L. & Parra-Medina, D.P. (2009). Mediators affecting girls' levels of physical activity outside of school: Findings from the trial of activity in adolescent girls. *Society of Behavioral Medicine*: 38; 124-136.

- Maffeis, C., Pietrobelli, A., Grezzani, A., Provera, S. & Tato, L. (2001). Waist Circumference and cardiovascular risk factors in prepubertal children. *Obesity Research*, 9(3): 179-187.
- McCullum-Gomez, C., Barroso, C.S., Hoelscher, D.M., Ward, J.L. & Kelder, S.H. (2006). Factors influencing implementation of the Coordinated Approach to Child Health (CATCH) Eat Smart Nutrition program in Texas. *American Dietetic Association*; 106(12): 2039-2044.
- McKenzie, T.L. (2002). System for Observing fitness Instruction Time: Overview and training manual. <http://www.drjamesallis.sdsu.edu/sofitprotocol.pdf> Retrieved September 11, 2008.
- McKenzie, T.L., Nader, P.R., Strikmiller, P.K, Minhua, Y., Stone, E.J., Perry, C.L., Taylor, W.C., Epping, J.N., Feldman, H.A., Luepker, R.V & Kelder, S.H. (1996). School Physical Education: Effect of the child and Adolescent Trial for Cardiovascular Health. *Preventative Medicine*, 25, 423 – 431.
- McKenzie, J.F., Neiger, B., & Smeltzer, J.L. (2004). Theories and models commonly used for health promotion interventions. In *Planning, implementing, and evaluating healthy promotion programs: A primer* (4th ed.). (pp.137-168). Boston: Benjamin Cummings.
- Miller, J., Rosenbloom, A. & Silverstein, J. (2004). Childhood obesity, *The Journal of Clinical Endocrinology & Metabolism*, 89 (9), 4211 – 4218.

- Moore, G.F., Tapper, K., Murphy, S., Lynch, R., Raisanen, L., Pimm, C. & Moore, L. (2007). Associations between deprivation, attitudes towards eating Breakfast eating behaviors in 9-11-year-olds. *Public Health Nutrition*, 10(6), 582-589.
- Moreno, L. & Rodriguez, G. (2007). Dietary risk factors for development of childhood obesity. Lippincott, Williams & Wilkins.
- Must, A. & Strauss, R.S. (1999). Risks and consequences of childhood and adolescent obesity. *International Journal of Obesity*, 23: 2-11.
- Nader, P.R., Stone, E.J., Lytle, L.A., Perry, C.L., Osganian, S.K., Kelder, S., Webber, L.S., Elder, J.P., Montgomery, D., Feldman, H.A., Wu, M., Johnson, C., Parcel, G.S., Luepker, R.V. (1999). Three-year maintenance of improved diet and physical activity; The CATCH Cohort. *Archives of Paediatric and Adolescent Medicine*, 153, 695-704.
- Nyberg, E. (2009). Physical activity in 6-10 year old children: variations over time, associations with metabolic risk factors and role in obesity prevention. Department of Clinical Science, Intervention and Technology (CLINTEC), Division of Pediatrics Karolinska Institutet, Stockholm, Sweden. Doctoral Thesis. Retrieved on July 15, 2010 from <http://diss.kib.ki.se/2009/978-91-7409-360-5/thesis.pdf>.
- Ogden, C. & Carroll, M. (2010). Prevalence of Obesity Among Children and Adolescents: United States, Trends 1963-1965 through 2007-2008. Center for Disease Control. Retrieved on June 17, 2010 from

[http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.p](http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.pdf)

df

Powers, S.K., Dodd, S.L., Thompson, A.M., & Condon, C.C (2004). *Total Fitness and Wellness*. Canadian Edition. Pearson Education Canada; 1 edition.

Puyau, M.R., Adolph, A.L., Vohra, F.A. & Butte, N.F. (2002). Validation and calibration of physical activity monitors in children. *Obesity Research*, 10 (3), 150 – 157.

Reilly, J.J., Methven, E., McDowell, Z.C., Hacking, B., Alexander, D., Stewart, L & Kelnar, C.J.H. (2003). Health consequences of obesity. *Archives of Disease in Childhood*; 88; 748-752.

Rideout, V., Roberts, D. F., & Foehr, U. G. (2005). *Generation M: Media in the Lives of 8-18 year olds*. Report from the Kaiser Family Foundation retrieved on June 13, 2010 from <http://www.kff.org/entmedia/7250.cfm>.

Robinson TN. (1999). Reducing children's television viewing to prevent obesity: a randomized controlled trial. *Journal of the American Medical Association*, 282, 1561-1567.

Sallis, J.F. & Glanz, K. (2006). The role of built environments in physical activity, eating, and obesity in childhood. *The Future of Children*, 16 (1), 89-103.

Sallis, J.F., Prochaska, J. & Wendall, T. (2000). A Review of correlates of physical activity of children and adolescents. *Journal of the American College of Sports Medicine*, 32 (5), 963 – 975.

- Salmon, J., Booth, M.L., Phongsavan, P., Murphy, N., & Timperio, A. (2007). Promoting physical activity participation among children and adolescents. *Epidemiologic Reviews*, 29, 144-159.
- Sirard, J.R. & Pate, R.R. (2001). Physical Activity Assessment in Children and Adolescents. *Sports Medicine*, 31(6), 439-454.
- Schwimmer, J.B., Burwinkle, T.M., & Varni, J.W. (2003). Health-Related Quality of Life of Severely Obese Children and Adolescents. *The Journal of the American Medical Association*, 289 (14), 1813 – 1819.
- Sharpe, E., Forrester, S. & Mandigo, J. (2009). Evaluation of CATCH Kids Club in Ontario afterschool programs: Final report. *Center for Healthy Development through Sport and Physical Activity*.
- Soric, M. & Misigoj-Durakovic, M. (2010). Physical activity levels and estimated energy expenditure in overweight and normal-weight 11-year-old children. *Acta Paediatrica*, 99(2), 244-250.
- Staffieri, J.R. (1967). A study of social stereotype of body image in children. *Journal of Personality and Social Psychology*, 7(1), 101 – 104.
- Steele, R.M., Brage, S., Corder, K., Wareham, N.J. & Ekelund, U. (2008). Physical activity, cardiorespiratory fitness, and the metabolic syndrome in youth. *Biology of Physical Activity in Youth*, 105, 342-351.
- Stratton, G., Canoy, D., Boddy, L.M., Taylor, S.R., Hackett, A.F. & Buchan, I.E. (2007). Cardiorespiratory fitness and body mass index of 9-11-year-old English children:

- a serial cross-sectional study from 1998 to 2004. *International Journal of Obesity*, 31, 1172 – 1178.
- Strauss, R.S. & Knight, J. (1999). Influence of the home environment on the development of obesity in children. *Paediatrics*, 103(6), 1-8.
- Taylor, J.P., Evers, S. & Mckenna, M. (2005). Determinants of healthy eating in children and youth.. *Canadian Journal of Public Health*; 96(3).
- Timlin, M., Pereira, M., Story, M & Neumark-Sztainer (2008). Breakfast Eating and Weight Change in a 5-Year Prospective Analysis of Adolescents: Project EAT (Eating Among Teens). *Journal of the American Academy of Paediatrics*, 121, 638-645.
- Thompson, A.P., Campagna, P., Rehman, L., Murphy, R., Rasmussen, R. and Ness, G. (2005). Physical activity and body mass index in Grade 3,7and 11 Nova Scotia students. *Medicine & Science in Sports & Exercise*, 37 (11), 1902 – 1908.
- Tremblay, M.S. & Willms, J.D. (2000). Secular trends in the body mass index of Canadian children. *Canadian Medical Association*; 163 (11): 1429 – 1433.
- Tremblay, M.S., Barnes, J., Copeland, J.L. and Esliger, D. (2005). Conquering Childhood Inactivity: Is the Answer in the Past? *Medicine & Science in Sports & Exercise*, 37 (7), 1187 – 1194.

- Trost, S.G., Pate, R.R., Freedson, P.S., Sallis, J.F., & Taylor, W.C. (2000). Using objective physical measures with youth: How many days of monitoring are needed? *Medicine and Science in Sports and Exercise*, 32, 426 – 431.
- Trost, S.G., Rosenkranz, R.R. & Dzewaltowski, D. (2008). Physical activity levels among children attending afterschool programs. *Medicine & Science in Sports & Exercise*, 40(4), 622-629.
- van Sluijs, A.M.F., McMinn, A.M. & Griffin, S.J. (2007). Effectiveness of interventions to promote physical activity in children and adolescents: systematic review of controlled trials. *British Medical Journal*; Web Source retrieved October 10, 2007 from www.bmj.com.
- Veugelers, P.J. & Fitzgerald, A.L. (2005a). Prevalence of and risk factors for childhood overweight and obesity. *Canadian Medical Association Journal*; 173 (6).
- Veugelers, P.J. & Fitzgerald, A.L. (2005b). Effectiveness of school programs in preventing childhood obesity: A multilevel comparison. *American Journal of Public Health*, 95, 432-435.
- Weintraub, D.L., Tirumalai, E.C., Haydel, F., Fujimoto, M., Fulton, J.E., Robinson, T. (2008). Team Sports for Overweight Children; The Stanford Sports to Prevent Obesity Randomized Trial (SPORT). *Archives of Paediatric and Adolescent Medicine*, 162(3), 232-238.

Willms, J.D., Tremblay, M.S. & Katzmarzyk, P.T. (2003). Geographic and Demographic Variation in the Prevalence of Overweight Canadian Children. *Obesity Research*; 11 (5): 668 – 673.

World Health Organization. Global strategy on diet, physical activity, and health. Geneva, Switzerland: World Health Organization; 2004.