Wizards of Motion: An Evaluation of An Elementary School Cardiovascular Intervention

Faculty of Health and Behavioural Sciences

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Lakehead University

Thunder Bay, Ontario, Canada

In partial fulfillment of the requirements for the

Degree of Master of Science in

Kinesiology

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Your file Votre référence
ISBN: 978-0-494-71770-7
Our file Notre référence
ISBN: 978-0-494-71770-7

Abstract

Introduction

The Wizards of Motion Cardiovascular Module was designed to introduce the concepts of cardiovascular disease as a preventable lifestyle outcome. Scientific experts in cardiovascular physiology, health, and education visited Grade 5 Northwestern Ontario classrooms with a portable, self-contained laboratory experience that focused on the basic structures and functions of organs within the cardiovascular systems while highlighting specific factors that contribute to a positive state of physical health. The purpose of the study was to evaluate whether the Wizards of Motion Cardiovascular Module was effective in changing students' knowledge and attitudes related to cardiovascular disease and to adopting healthy lifestyle behaviours.

Methods

A Knowledge Test was developed based on concepts of cardiovascular disease. As part of the pilot work, the instrument went through several phases of testing in order to establish validity. A second instrument, with established measures of validity and reliability, was selected to evaluate the students' attitudes about those lifestyle behaviours which are related to either preventing or perpetuating the development of the cardiovascular disease condition. The study was set up in a two group pre-post comparison design. Seventy students from four Grade 5 Northwestern Ontario classrooms participated in the main study. Thirty nine students participated in the intervention group, while thirty one students comprised the control group. Students who were part of the intervention group completed pre- Knowledge Test and Attitudes Questionnaires before and after the intervention phase. The students who were part of the control group completed the same Knowledge Test and Attitudes Questionnaire during the same time frame.

Results

The data from the Knowledge Test, and the Attitudes Questionnaire, although analyzed separately were evaluated using a five step process which began with the computation of descriptive statistics to show means and standard deviations between groups and across tests. Main effects of grouping and the interaction across grouping levels were next evaluated using a two way mixed factor ANOVA, with post hoc Scheffe test. A test of the equality of variances across all levels of the independent variables was tested using the Fmax test, while the Welch-Satterthwaite t-approximation was used to compare the pre to post test difference scores between the intervention and control groups, respecting the inequality of variance and unequal sample sizes between groups. Finally, the effect size was computed for all possible pairwise comparisons using the Common Language effect size estimator of McGraw and Wong (1992). The results indicate that the intervention group showed a statistically significant ($p<0.01$) increase on post-test scores on both the Knowledge Test and Attitudes Questionnaire compared to the control group. Although this main finding was shown in the initial ANOVA, it was also supported in the t-test and measures of effect size.

Conclusion

The positive findings from the Wizards of Motion Cardiovascular Intervention show that the Module was effective in increasing the sample of students' level of knowledge about cardiovascular disease and changing their attitudes towards adopting healthy lifestyle behaviours in order to prevent the development of cardiovascular disease. These findings support previous research which has emphasized the importance of health education for young students. The success of increasing grade 5 student's knowledge and attitudes related to cardiovascular disease and adopting healthy lifestyle behaviours illustrates that a program such as the Wizards of

Motion is a valuable education tool in order to assist in health promotion within elementary schools. Educating children at a young age about the risks of cardiovascular disease and ways in which they can prevent the disease is becoming increasingly important with today's youth. The school and home environment must foster these lifestyle changes in order to sustain a positive state of health for all students. Causing students to change their knowledge and attitudes are two crucial steps needed in order to promote healthy heart campaigns.

Acknowledgements

First and foremost I would like to thank my supervisor Dr. Moira McPherson for all her encouragement, direction and passion throughout my Master's program.

Secondly, I would like to thank my other committee members Dr. William Montelpare, and Dr. Christina van Barnelveld for all their enthusiasm and unrelenting assistance whenever needed.

Lastly I would like to thank my family and friends for all their love and support over the past seven years at Lakehead University. I would not have made it without all of you.

Table of Contents

List of Figures

List of Tables

Chapter 1
Introduction and Literature Review

Introduction to the Wizards of Motion Program

The Wizards of Motion program at Lakehead University is funded by the Natural Science Engineering and Research Council (NSERC) PromoScience program and is designed to introduce the concepts of cardiovascular disease as a preventable lifestyle outcome. Scientific experts in cardiovascular physiology, health, and education visited Grade 5 Northwestern Ontario classrooms with a portable, self-contained laboratory experience that focused on the basic structures and functions of organs within the cardiovascular system while highlighting specific factors that contribute to a positive state of physical health. The Wizards of Motion curriculum links closely with the Ministry of Education's science curriculum while enhancing the content with a school health message. Students collect and analyze data from a classroom activity where they create a model of the circulatory system and simulate the restriction of blood flow. The program also provides support to teachers to expand their science delivery programs and to encourage the students' interest in the study of human movement. The objectives of the Wizards of Motion program are to:

- Provide an exciting and interactive introduction to the functions of the circulatory and cardiovascular system
- Motivate and encourage interested youth to consider pursuing post secondary education in the science of Kinesiology, specifically focusing on human health and wellness.
- Provide teachers with enriched science modules involving hands on technology and interactive activities in order to teach and captivate the interest of their students.
- Foster interest in applied scientific research

McPherson, Marsh, Montelpare, Van Barneveld, & Zerpa (2009) conducted a study to evaluate changes in students' head safety knowledge and attitudes toward helmet use after participating in the Wizards of Motion Head Safety Module. Data was collected from five grade 7 classrooms. A significant pre-post change in the level of knowledge scores was observed between intervention and control group illustrating the potential usefulness of linking a public health promotion message with the classroom science curriculum. However, the authors acknowledged the need for future research to focus on establishing psychometric properties for the evaluation tools used to assess both change in knowledge and attitude.

The present study was designed to:

1. Develop and establish valid and reliable tools for assessing the level of knowledge and attitudes related to healthy lifestyle behaviours and the prevention of cardiovascular disease; and
2. Evaluate any changes in students' attitudes and knowledge following the implementation of the Wizards of Motion Cardiovascular Intervention Module in Grade 5 science classrooms.

Cardiovascular Disease and Associated Risk Factors

There are a variety of different forms of cardiovascular disease including: atherosclerosis, coronary heart disease, angina pectoris, arrhythmia, congestive heart failure, congenital and rheumatic heart disease (Kavey, Daniels, Lauer, Atkins, Hayman & Taubert, 2003).

Cardiovascular disease is one of the leading causes of death among Canadians (Heart and Stroke Foundation, 2010). Yet more important is the number of individuals affected by the progressive characteristics of the disease. According to the Center for Disease Control and

Prevention, (2008) about one out of every three adults in Canada has one or more types of cardiovascular disease. Conditions such as obesity, hypertension, and diabetes, are known contributing factors to cardiovascular disease, and as such increase the prevalence within Canadian society.

The term prevalence refers to the number of cases within a population at a given point in time. With regard to cardiovascular disease, the point prevalence rate is considered to be higher than cancer, chronic lower respiratory diseases, injuries, and Type I diabetes. This notion of the magnitude of the impact is shown in a comparison illustration between deaths from breast cancer and deaths from cardiovascular disease among women. While breast cancer is an attributable risk factor as a cause of death in approximately 1 in 30 women each year, the rate of death from cardiovascular disease is 1 in 2.6 women per year (Rosamond, Flegal, Furie, Go, Greenlund, Haase, et al., 2008). The impact of cardiovascular disease on death rate and loss of quality of life years remaining is so profound that, Donatelle (2009) suggested if all forms of cardiovascular disease were eliminated, the life expectancy in the United States could increase by seven years.

In general terms it is difficult to establish the direct costs associated with the impact of a disease. However, in 2008 it was estimated that the economic burden of cardiovascular disease in the United States was more than 448.5 billion dollars (Rosamond et al., 2008). This estimated cost is attributed to several factors, such as, the cost of physician and nursing services, in-hospital care charges, as well as nursing home services, medications and various home health care needs. In addition to the direct medical costs of cardiovascular disease related illnesses, there are also other economic considerations which contribute to the financial burdens in a society. Such economic impacts include the loss of productivity due to illness, absenteeism-

replacement workers, health insurance increases, family hardship, and decreased quality of life years remaining.

The coronary system, which is comprised of the myocardium and coronary vasculature, is responsible for blood flow to carry oxygen as well as nutrients to the entire body. The heart contracts roughly 100,000 times per day pumping the equivalent of 7570 liters of blood throughout the body (Tortora, 2005). The coronary system is responsible for transporting nutrient rich blood, oxygen, waste products, hormones, and enzymes throughout the body. Coronary artery disease has been defined as the effects of the buildup of atherosclerotic plaque in coronary arteries that lead to the reduction in blood flow to the myocardium (Tortora, 2005). One of the conditions that is responsible for cardiovascular health problems is arteriosclerosis. Atherosclerosis is a type of arteriosclerosis that refers to the process involving the thickening of the walls of the arteries and loss of elasticity due to the accumulation of plaque. Over time this reduction in blood flow could result in a myocardial infarction, also known as a heart attack. In addition to the build-up of plaque, the potential accumulation of blood can result in the artery becoming weak and rupturing. There is an increased recognition that the atherosclerotic process starts in children as early as six months of age (Harrell, McMurray, Gansky, Bangdiwala & Bradley, 1999). A direct effect of atherosclerotic plaque development is the reduction of oxygenated blood to the myocardium. This condition is referred to as ischemia and may result in a variety of degrees of chest pain also known as angina pectoris. The symptoms of angina pectoris could range from a sensation similar to mild indigestion to the profound feeling that the heart is being crushed within the chest.

Congestive heart failure occurs when the heart muscle is overworked or damaged and does not have the capacity to continue to circulate blood normally throughout the body. If the

heart is weakened there will be a reduction in the head pressure required to push blood throughout the arterial system. This will eventually reduce the pressure which drives the blood returning through the veins. Blood will accumulate causing congestion in the body tissue. As a result, the heart muscle can hypertrophy, or become larger, and therefore decrease its efficiency. The decreased efficiency can limit the amount of blood that is transported throughout the body. As a result, blood can eventually accumulate in the lower extremities or the lungs (Kavey et al., 2003).

It is crucial that children are aware of the potential health implications of not taking care of their heart health at an early age. Congestive heart failure is a result of previous harm done to the heart muscle. The condition can be avoided if care is taken at a young age. The fundamental problem of the congestive heart failure condition is that the necessary nutrients and oxygen transported by blood is limited or blocked. This constriction causes damage to the heart hindering it from performing at its optimal level. Since children who are overweight often carry this condition into adulthood, an increased number of adults will be at risk of developing cardiovascular disease (Veugelers & Fitzgerald, 2005).

Cardiovascular disease and cardiovascular disease risk factors can be categorized into two separate groups: i) those factors that can be controlled and ii) those factors that cannot be controlled. Among the factors that we cannot control are: heredity, age, sex and race. "Considering these two groups of predisposing risk factors, it is important to recognize that cardiovascular disease risk factors begin in childhood and tend to persist through adulthood" (Harrell et al. 1999, p.1529). Further, it is also important to recognize that among First Nations and Inuit populations, there is a threefold increase in the rate of heart related problems compared to Canadians in general (Health Canada, 1997).

The group of risk factors that can be controlled include: smoking, exercise, diet, stress and cholesterol level. These behaviours are choices that if attended to in the pre-pubescent years can change the risk for cardiovascular disease as well as many other health related problems. Children have the ability to improve their health status by consciously maintaining a healthy diet while adopting a lifestyle that includes daily physical activity and avoiding exposure to tobacco products such as cigarettes, cigars, pipes and chewing tobacco (Donatelle, 2009).

Diet.

With the convenience of fast food restaurants and the cheaper costs of unhealthy food, the global epidemic of childhood obesity is on the rise. Therefore, it is important to focus on the factors that contribute to excess weight gain and strategies for weight control. Type II diabetes and obesity in children are associated with cardiovascular disease. Children with Type II diabetes are unable to produce sufficient amounts of insulin to control their glucose levels. Type II diabetes usually results in a child having to take medication on a daily basis for the rest of their life unless they are able to make substantial changes in their lifestyle. Some of these alterations can consist of a change in diet and exercise. Individuals who have Type II diabetes show an increased risk for renal failure and the hypertensive condition (McGavock, Sellers & Dean, 2006).

Canada's Food Guide provides parents with the opportunity to consider a variety of food choices for their children in order to sustain a healthy lifestyle. One of the problems associated with using this food guide is the substantial costs of purchasing the suggested foods. Many families are unable to buy enough fresh fruits, vegetables and meats in order to meet the daily

requirements. Lack of finances may force individuals to turn to less expensive foods that may be less healthy and of lower quality.

Exercise.

Inactivity is also a key contributing factor to an individual's elevated risk of developing cardiovascular disease. Many individuals who do not partake in regular physical activity and lead a sedentary lifestyle, have a greater chance of being overweight, taking up smoking and take less care of their overall health (Donatelle et al., 2004). Being physically active in activities such as walking can reduce an individual's risk of chronic disease and premature death through improvement of body composition, reduced blood pressure, enhanced lipid lipoprotein profiles, improved glucose homeostasis and insulin sensitivity , improved autonomic tone, improved coronary blood flow, and augmented cardiac function (Warburton, Nicol & Bredin, 2006). Many people think physical activity refers to participating in intense sports when in fact it involves moderate physical exertion and including activities such as walking or gardening. By adopting small changes such as walking to work or the store, people can increase their daily levels of physical activity and improve their overall health.

During the developmental stages of childhood, physical and psychological health are directly related to participation in regular physical activity (Pangrazi, Beighle, Vehige & Vack, 2003). The Public Health Agency of Canada developed this guide in order to assist individuals in implementing the recommended amounts of moderate and vigorous physical activity into their daily routines (Canada's Physical Activity Guide to Healthy Active Living, 2009). There are three separate versions of the CPAG developed to target different populations; children, youth and older adults. Children are participating insufficiently in physical activity and do not meet the

standards of the Canadian Physical Activity Guide (CPAG). This inactivity results in children leading sedentary lifestyles and increasing their risk of obesity and the development of cardiovascular disease.

When looking at the school environment, the association between obesity levels and frequency of physical education classes is striking, and reinforces the need for increased amounts of physical activity (Veugelers & Fitzgerald, 2005). On October 6th, 2005, the Ontario Minister of Education announced that a minimum of 20 minutes of Daily Physical Activity (DPA) were required for all elementary students as part of the governments Healthy School Program (Daily Physical Activity, 2009). The implementation of DPA into the curriculum reinforces the importance of physical activity as a preventable measure in order to reduce the chances of cardiovascular disease and other health related illnesses.

"Dietary habits and physical activity levels of children are risk factors for subsequent morbidity and mortality in adolescence and adulthood, including increased risk of cardiovascular disease, obesity, and diabetes mellitus" (Gortmaker, Cheung , Peterson, Chomitz, Cradle, Dart, et al.,1999, p.975).

Smoking.

A smoker has a 70 percent greater chance of developing cardiovascular disease compared to a non-smoker (Donatelle et al., 2004). An individual who smokes and suffers from cardiac arrest, has a greater chance of dying than a non-smoker. It is also believed that smoking is the single most important risk factor for cardiovascular disease (Libby, Bonour, Mann, Zipes, Braunwald, 2008).

Cardiovascular disease risk factors are more closely related to the number of cigarettes currently smoked rather than the number of years a person has smoked. It has been well noted that after one year of quitting smoking there is a 50% decrease in the probability of developing cardiovascular disease. If this individual continues to refrain from smoking, their risk of cardiovascular disease will be similar to a non-smoker (Jonas, Oates, Ockene & Hennekens, 1992).

Although there has been an enormous increase in the amount of knowledge concerning the health risk associated with tobacco smoking, there are still a considerable number of people who sustain this habit. Smoking can have detrimental effects on the human heart. The nicotine that is inside cigarettes increases heart rate, heart output, blood pressure and the hearts oxygen usage. The carbon monoxide that is present in cigarette smoke displaces oxygen in the heart tissue, which causes the heart to work even harder in order to receive sufficient oxygen. It has also been thought that the considerable number of chemicals in smoke damage and inflame the lining of the coronary arteries further allowing plaque to build up at a faster pace. Since this causes a buildup it increases blood pressure which in return causes the heart to work harder (Jonas et al., 1992).

Barriers to adopting healthy lifestyle habits

It is important to be aware of the barriers to physical activity for children and adolescents. Parental as well as peer pressures are one of the greatest contributing factors to an individual's level of involvement in physical activity. If a child's parent or guardian does not support and encourage them to lead an active lifestyle, then it is less likely that the child will take part in physical activity. Another hindering factor associated with participation in physical activity is the

individual's level of self-efficacy. This can be defined as the manner in which an individual perceives their ability to achieve a particular task or goal. Some adolescents may be fearful of physical activity since they see it as a strenuous and daunting task, and avoid participating.

Geographical location can play a monumental role in one's risk of developing cardiovascular disease. Depending on where one lives, they may have to spend an extensive amount of time driving to and from school/work each day. This can take away from a possible form of physical activity such as walking. In addition to hindering the amount of exercise, certain foods may be more difficult to obtain depending on where one resides. For the most part, the nutritional foods are more expensive in comparison to less healthy food choices. On top of this, the cost of food is even more expensive living in rural locations, which may cause individuals to select less healthy options in order to preserve their money.

On average, children spend six hours a day at school. This is a considerable portion of a child's day during which they may obtain knowledge and tendencies that are not necessarily desirable from a public health perspective. Educating children as well as adolescents at school about healthy lifestyle choices is an integral part to increasing awareness of health related issues such as cardiovascular disease. Behavioral changes are difficult to sustain if the school and home environment do not uphold these lifestyle changes.

Health Education

According to Edelman and Mandle (2002), health education should result in behaviour change that is first and foremost voluntary, but is a function of the integration of knowledge (past and present) with attitudes, personal skills, and environmental conditions. Sound health

education will assist individuals in leading a normal healthy life and enable them to rely on themselves rather than others.

Cardiovascular disease risk factors are well recognized and can be reduced through a variety of intervention strategies. Most important, it is well recognized that teaching about reducing cardiovascular disease risk factors should begin early in a child's life (Kavey, et al., 2003). The health consequences of poor lifestyle leading to progressive cardiovascular disease have a heavy burden on the health care system and as such primary prevention, through health education and illness awareness must be implemented with children at a young age.

School-based healthy eating and physical activity programs provide a great opportunity to enhance the future health and well-being of children because they can reach almost all children and may improve health during critical periods of growth and maturation and decrease the risk of chronic diseases in adulthood (Veugelers & Fitzgerald, 2005).

Edelman and Mandle (2002) also suggested that "health behaviors can be defined as activities that an individual undertakes to enhance health or specifically intends to prevent disease or control the symptomatic stages of a disease. When we assist in the individual's identification and understanding of lifestyle behaviors that need to be changed, then we are taking the first step toward assisting an individual to move from knowledge to action" (Edelman and Mandle, 2002, p.251).

Previous school health interventions which have focused on cardiovascular health have involved children between the ages of 7 to 14 years of age. Children at this age are not responsible for purchasing food and making meals at home, although they have the ability to 'pester' their parents into being more health conscious. Many people may think that in order to be physically active they need to be participating in a sport. However, students can be physically

active by walking to school, playing outside in the school yard, running, riding a bike, even rollerblading. As explained by Warren, Henry, Lightowler, Bradshaw & Perwaiz, (2008) programs should strive to change behaviours so that there will be a measurable long-term influence on health. The following section presents a summary of programs which have been designed to promote and/or assess cardiovascular health in elementary schools.

School Interventions Designed To Assess and/or Promote Cardiovascular Health

The Child and Adolescent Trial for Cardiovascular Health (CATCH) program was created for children in grades 3-5 and incorporates behavioral, educational and school environmental components (Perry, Stone, Parcel, 1990). The CATCH program was based on the noted success of school health education in the 1980's. In this program, the children's food choices, knowledge and self-efficacy regarding diet were assessed. These three specific objectives were measured by having each student complete a self-administered questionnaire. Schools who took part in this study obtained guidance to improve the nutritional value of their school meals, physical education interventions, as well as classroom guidelines to help educate students about nutrition, physical activity and smoking. The rationale behind the program was that these changes need to me made prior to particular behavior patterns and lifestyle choices becoming entrenched. The extensive program involved 3714 students from 96 schools from four different states within the United States. The findings from the CATCH study suggest that a program that combines health education with behavioral components and school environmental modifications are the cornerstone to improving physical activity and nutrition-related behaviors (Perry et al., 1990).

The Cardiovascular Health in Children study (Harrell et al., 1999) was a unique study that targeted children in grades three and four who exhibited positive cardiovascular disease risk factors. This study involved two school based interventions focused on improving cardiovascular disease risk factors. There were 18 schools in North Carolina who took part in this public health education based study. This first intervention involved classes using the American Heart Association school site kits twice a week over an eight week period. Subject matter focused on 'heart healthy foods', the harmful effects of smoking as well as the importance of participating in regular physical activity. In addition to the classroom based presentations, students participated in a physical activity class three times each week. For the second intervention students were assigned to the risk-based intervention if they showed one or more cardiovascular disease risk factors. This particular intervention involved a possibility of three separate approaches; nutrition class, physical activity class, 'don't start smoking' class which students would attend based on the risk factors they exhibited (Harrell et al., 1999). At the end of the study it was evident that self-reported physical activity scores and total healthy heart knowledge, the students involved in the intervention decreased their risk factor(s). The results of the Cardiovascular Health in Children study indicated that, "Many lifelong health behaviors are formed in the early years of life, suggesting that the elementary school years offer a critical time to intervene" (Harrell et al., 1999, p.1534).

The Pathways study was conducted to change American Indian females' behavior, knowledge and attitudes towards diet and physical activity (Stevens, Cornell, Story, French, Levin, Becenti, et al., 1999). Due to the alarming rates of childhood obesity, the program was implemented in six American Indian cohorts at eight different schools. Based on the findings from the CATCH study, it was believed that a self-report classroom administered questionnaire

was the best way to obtain valid measures of the students' knowledge and attitudes. There was a substantial amount of attention focused on cultural sensitivity during the developmental process of this questionnaire. In total, the questionnaire consisted of 130 questions that were administered in three separate sections over a period of two to three days. Each section of the test took the students approximately 30 minutes to complete. The Pathways study relied heavily on previously conducted studies related to nutrition health interventions. The purpose of the PATHWAYS study was to assess whether the questionnaire was valid and reliable for the given population. After conducting an initial pilot study a few revisions were completed before administering the questionnaire. The researchers concluded that the majority of nutrition education programs that resulted in positive behavioral changes, were based on concepts associated with the social learning theory (Stevens et al., 1999). The social learning theory will be discussed in greater depth later in this section.

In 2003, the Children's Lifestyle and School-performance Study (CLASS) survey was given to grade 5 students in Nova Scotia (Veugelers, Fitzgerald, 2005). This study targeted 242 of the 291 public schools in Nova Scotia and focused on nutrition, health and lifestyle behaviours. The survey used in this study was a modified version of the Harvard Youth/Adolescent Food Frequency Questionnaire. The CLASS survey included questions from the previous study pertaining to nutritional intake along with questions related to physical activity levels. After analyzing the data from this study, it became increasingly apparent that the frequency of physical activity seems to be the only activity-related factor associated with being overweight. The researchers also concluded that parents, who received higher levels of education and had an income over $60000/year, had a lower risk of becoming overweight. The results of the CLASS study also suggest that integrated school programs that involved physical education,

healthy lunches, health and nutrition education, training of staff, parental involvement and that stopped the sale of soft drinks were successful in improving the students' diets and reducing overweight by 59% and obesity by 72% (Veugelers & Fitzgerald, 2005).

The Physical Activity and Teenage Health (PATH) program is a school based intervention that was instituted in three ethnically diverse New York City high schools (Bayne-Smith, Fardy, Azzollini, Magel & Schmitz, 2004). Four hundred and forty two adolescent females took part in a 12 week program that encompassed a collaboration of vigorous physical activity and discussions on nutrition, exercise, stress and smoking. This program was conducted five days a week for the duration of the 12 weeks. Before and after the 12 week program heart health knowledge, health behaviors, cardiovascular risk factors and physical fitness were assessed using a questionnaire and physical activity standard. Some of the lectures covered in this personal wellness program included topics such as anatomy and physiology of the heart, cardiovascular risk factors and strategies for decreasing high risk health behaviors (Bayne-Smith et al., 2004). Physical education teachers were responsible for teaching this program and used a manual as a tool for guidance. These teachers also took part in a training program before and during the intervention. Due to the multicultural diversity amongst this sample population, it is believed that "long-term health implications of this high prevalence group are a matter of concern, because risk factors often track into adulthood and are associated with the early onset of atherosclerosis" (Bayne-Smith et al., 2004, p.1539). Following completion of this study, the researchers noted a significant difference in body fat, blood pressure and health knowledge.

The Coronary Artery Risk Detection In Appalachian Communities (CARDIAC) program was developed to screen individuals for cardiovascular disease risk factors (Cottrell, Spangler-Murphy, Minor, Downes, Nicholson & Neal, 2005). This risk detector has been used in almost

half of the grade five classes in Western Virginia where it was noted that childhood obesity was on the rise and could be attributed to many factors including a sedentary lifestyle and the consumption of an unhealthy diet. There are also many environmental factors that contributed to the high rates of overweight children and obesity within this geographical area. Constraints on grocery selection, poverty and driving distance all played a role on the state of health. This study was unique as it created to evaluate the effectiveness of incorporating parental involvement and of increasing parental knowledge about a healthy diet and more opportunities for physical activity for their child. Students were given pedometers to keep track of their daily step count as well as they recorded their daily food intake. Parents within this study completed a questionnaire about their perceptions of their child's health. The results of the study showed that 31% of the students within the study were overweight or already obese and 65% of their parents believed that their child received the sufficient amount of daily physical activity (Cottrell et al., 2005). This study demonstrates how much parental influence there is in a child's life with regards to their health. The researchers concluded that both parents and children need to be educated on the benefits of eating a healthy balanced diet, as well as participating in regular physical activity.

In 2006, Addison et al. conducted a study where they looked at whether a cardiovascular disease intervention program was able to change students' knowledge about cardiovascular disease and preventable risk factors. The study involved 50 high school students who completed a survey about their knowledge of hypertension before then again after the intervention activity. At the end of the study it was noted that there were significant gains in knowledge. The results support the positive impacts that school based health promotion programs can have on improving students' knowledge about health related issues, and/or possibly altering their behaviours.

In 2007, Subramaniam and Silverman conducted a study on middle school students' attitudes towards physical education. For their study, they used a ordinal scale attitudes questionnaire that was developed based on concepts of attitude theory. There were 995 students from grades six to eight who participated in this study. For the most part, the findings showed that overall students had positive attitudes towards physical activity, although as the students progressed in grade level, their attitude scores declined. This study illustrated the need for health practitioners and teachers to find ways to keep students engaged in physical activity as they progress through the upper grades by stimulating and empowering them.

The Eat Well and Keep Moving Program was a school-based interdisciplinary health behaviour intervention focused on nutrition and physical activity (Warren, Henry, Lightowler, Bradshaw & Perwaiz, 2008). The program was targeted towards grade four and five African American children in Baltimore. The overall goal of this program was to decrease the consumption of foods high in saturated and total fat, increase fruit and vegetable intake, reduce television viewing time and increase levels of physical activity. One of the unique concepts of this program was that the health messages were incorporated into the regular math, science, language arts and social science classes. The interdisciplinary approach allowed students the opportunity to learn about health in a variety of settings. There were 2103 students who participated in the intervention and control schools. At the end of the intervention data collection the control schools also received the intervention materials. As part of the study, students took part in two recall interviews which focused on food intake within the past 24 hours as well as two recall interviews that related to physical activity participation within the past 24 hours. Schools provided students and parents with community links that provided free or low cost nutrition and physical activity programming. At the conclusion of the Eat Well and Keep

Moving Program, it was recommended that it be incorporated into all elementary schools within the school board.

The Trial of Activity for Adolescent Girls (TAAG) program was created to offer accommodating links between the schools and the community in order to increase the physical activity level of adolescent girls (Young, Steckler, Cohen, Pratt, Felton, Moe, et al., 2008). This multi-dimensional program was supported by the National Heart, Lung and Blood Institute and included health and physical education as well as promoted a variety of physical activity programs within the community. The TAAG study was evaluated through formative research using a variety of techniques such as oral and written reports with the intention of looking at the implementation of the program. Conclusions based on the results of this study highlighted that "complex intervention characteristics necessitate the inclusion of a thorough process evaluation that assesses factors, indicating whether an intervention was delivered and received as intended (Young et al., 2008, p. 976)." The fidelity and dose of the intervention were two of the key factors that needed to be analyzed when conducting the evaluation process.

Social Learning Theory, Planned Behaviour, and the Health Belief Model

Social Learning Theory.

Arvidson developed The Children's Cardiovascular Health Promotion Attitude Scale (CVHPAS) to target students between the ages of 8 and 12 years old. This age group was targeted since health promotion should begin early in a child's life in order to have the greatest impact (Arvidson, 1990). The instrument was developed using methods to establish the psychometric properties and was based on concepts consistent with the Social-Learning Theory. Bandura, (1965) stated that it is difficult to change student's attitudes without using motivation

or modeling. The Social Learning Theory provides researchers with a framework that exposes children to a modeled concept (adopting healthy lifestyle behaviours). Bandura, (1971) suggested that modeling is not only used to produce imitative behaviours, but also the internalization of the behaviours into the students own. Arvidson (1990) stated that in order to promote cardiovascular health in children, the concept of motivation and the influence of motivation on behaviours and attitudes must be investigated. She went on to emphasize that changes in attitude precede changes in behaviour, therefore highlighting the importance of examining attitudes (page 5). After conducting the study it was determined that the CVHPAS has significant potential to provide health professionals and other researchers with a reliable and valid tool for measuring children's attitudes towards cardiovascular health (Arvidson, 1990).

The social learning theory states that "behavior is not simply a function of unconscious motives or underlying predispositions. An individual behaves according to how she has learned to behave, as this is consistent with environmental constraints" (Cox, 2002, p.157). From a health perspective, this theory suggests that children ascertain their diet and lifestyle behaviors based on their surrounding environment such as school and home. Changing negative health behaviours into positive ones can be a very lengthy process. There are several factors that can influence behavioural change including predisposing, enabling and reinforcing factors. Predisposing factors encompass a variety of issues such as culture, knowledge, experiences and current beliefs. All these factors can be influenced by ones age, gender, socioeconomic status, education and family background. For many people their predisposing factors contribute a large amount to whether or not they are able to make a particular behavioral change in their life (Cox, 2002).

There are four processes within the social learning theory which determine whether a particular behaviour was learned from modeling (Bandura, 1965). The input is considered to be the modeled event for example a mother exercising. A child must be aware that their mother is physically active in order to understand this behaviour. Next in the retention process, the child will form a memory of this modeled activity (their mother exercising). In the production phase within the modeling process, the comprehension and memory of the activity (exercise) is translated into purposeful knowledge of the modeled behaviour. In this stage, the behaviour activity is perfected and the knowledge of the behaviour is integrated into action in the form of attitude and behaviour (Arvidson, 1990, p.5).

Enabling factors are the next aspect that will influence behavioural change. These factors include physical, emotional and mental capabilities as well as resources to health facilities (Bandura, 1965). The last component is the reinforcing factors which are considered to be the presence or absence of support, or discouragement of influential people in one's life. This is a very important component to understand with regards to this particular study since the target population is Grade 5 students who live at home with their parents/guardians and rely on them for food and support. If a student's parent only provides unhealthy options for their child to eat, it will be very difficult for them to maintain a balanced nutritious diet. On the other hand, if parents encourage their child to eat healthy and participate in regular physical activity, it is more likely that they will maintain a healthy lifestyle.

Theory of planned behaviour.

The theory of planned behaviour as well as the theory of reasoned action appear to be very prominent in the domain of health attitudes research. Theodorakis (1994) aimed to look at

the relationship between attitude and exercise behaviour. The foundation of his research was based on the concepts of the theory of reasoned action with a few components of the theory of planned behaviour incorporated. Attitude towards behaviour and subjective norms are the two variables examined in Theodorakis's study. Exercise is a behaviour which all able-bodied individuals have high control of, therefore the reasoned action model is effective in measuring this behaviour. Theodorakis's study looked at the effect of attitude strength in relation to an exercise program. Specifically seven separate variables were analyzed through the completion of a questionnaire. These variables included intention, attitude, subjective norms, perceived behavioural control, role identity, attitude strength and behavior.

According to Torabi & Jeng, (2001), attitudes are a central part of the learning process. As such, an individual's selection of health practices can be influenced by attitude towards a health behavior. In short, attitudes are one of the many preconditions of behavior.

Health Belief Model.

The health belief model in conjunction with the social learning theory assists in the development of an action plan that targets the needs of the person to make behavioral changes that will affect their overall health status. According to Miller, Wilkoff, McMahon, Garrett & Johnson (1982), attitudes help to form intentions that lead to actions. Yet the outcomes from such decisions may be difficult to measure. Further, attitudes are learned and can initiate specific responses to objects and tasks. When conducting research that is related to patients' attitudes, it is important to understand that knowledge by itself does not determine whether a patient will comply with a particular lifestyle habit. An individual's attitude is formed from their beliefs, past experiences, feelings and levels of motivation. A person has the ability to change or develop

attitudes towards health practices. Interventions are a particular teaching strategy that are used with a person or specific population to promote health changes (Edelman & Mandle, 2002).

The Health Belief Model provides a clearer understanding of how a person's beliefs may shape their attitudes that in turn cause behaviour change. The Health Belief Model states that there must be a variety of factors to support ones belief in order for change to happen. These factors include perceived susceptibility to the health problem, cues to action, demographic variables, socio-psychological variables and structural variables (Edelman & Mandle, 2002). For example, an overweight individual may know other people who have developed heart complications due to lack of exercise and poor diet. This person may then perceive that since they are overweight they have an increased risk of developing health problems. At the same time there are numerous overweight people who know that they have health problems yet still fail to change their daily lifestyle habits. If an individual despises physical activity, it is less likely that they will become active. All of these factors play an important contributing role in determining whether or not an individual will change their attitude toward physical activity and begin to adopt a balanced diet. "A belief is an appraisal of the relationship between an object, action or area and some attribute of that object (Donatelle et al., 2004, p.18)." Individual's beliefs can be shaped based on past life experiences or what their surroundings may tell them. On the other hand "an attitude is a relatively stable set of beliefs, feelings, and behavioural tendencies in relation to something or someone (Donatelle et al., 2004, p.19)."

Due to the recent alarming rate of childhood obesity in Greece, Christodoulos et al. (2006) decided to examine the short-term effects of a health education program on primary school children in Greece. For this particular study students' attitudes and intentions towards physical activity where measured using a modification of the planned behaviour questionnaire. It

was concluded that individuals who were part of the intervention group demonstrated more positive attitudes towards physical activity and scored a great deal higher on their intentions to participate in regular physical activity. Although this study involved a smaller group of participants, it suggests that school health education programs may have the capability to limit the age decline in physical activity and assist individuals in developing lifelong physical activity habits.

Summary.

Psychometric theory creates a foundation for determining the measurement of attitude for cardiovascular health promotion in children. It has been well established in the literature that self-report inventories (attitude scales) are best suited for measuring attitudes (Nunnally, 1978). Modeling has been recognized as a means for obtaining knowledge, values, attitudes, and patterns of thought and behaviour (Bandura, 1986). According to Bandura (1965), social learning is done through the exposure of role models who display, either deliberately or unknowingly, behaviour that is going to be conceptualized and mimicked by others.

Components of the social learning model, planned behaviour and health belief model have been incorporated in school health education interventions over the past twenty years. Educating students about cardiovascular disease with the hopes of improving their level of knowledge does not necessarily mean that these students will change their health related behaviours. Health education interventions need to combine information that will lead to improvements in both knowledge and attitudes in order to acquire behavioural change. An individual must first have knowledge about healthy lifestyle behaviours in order to shape their attitude towards healthy lifestyle choices such as exercising. Students must be aware of why they

should be adopting healthy lifestyle behaviours in order to justify their actions. The students' attitudes are formulated based on numerous factors such as their beliefs and past experiences. Attitudes are the central part of the learning process that help to further form intentions which lead to action (Miller et al., 1982; Torabi & Jeng, 2001). Behaviour change is a complex process and involves attention to both the level of knowledge and changes in attitude.

Chapter 2

Measuring Change in Knowledge and Attitudes: Establishing the Instruments

Introduction

Validity refers to the appropriateness, meaningfulness, and usefulness, of the specific influences inferred from test scores. In addition, validity refers to the extent to which evidence supports the inferences that are made from scores (American Psychological Association, 1985). The purpose of this preliminary study was to develop and establish valid and reliable tools for assessing the level of knowledge and attitudes related to healthy lifestyle behaviours and the prevention of cardiovascular disease.

Methods

Informed consent.

Before conducting this study, ethics approval was required from the Lakehead University Research Ethics Board and the Lakehead Public School Board of Education. The ethics proposal detailed the potential harm and risks to participants, benefits of participating in the study, dissemination of research results, storage of data as well as the procedures required to ensure anonymity and confidentiality. Once University approval was obtained, the required ethics documents were submitted to the Lakehead Public School Board (October, 2009). The School Board package included the following information: title of research, name of researcher, position of researcher, name of faculty advisor, brief abstract of research project, research type, data collection techniques, schools potentially involved, sample size, budget, time, legal implications, and prospective completion of work.

Following ethics approval from both the Lakehead University Research Ethics Board and the Lakehead Public School Board of Education, emails were sent out to specific schools inviting Grade 5 classrooms to take part in the Wizards of Motion program and study. Once teachers volunteered to participate, they received a cover letter explaining the study and a consent form for the students to take home in order to obtain parental consent. Students were told that their participation was completely voluntary and they may choose to withdraw from completing the test/questionnaire at any point if they felt uncomfortable. The students were also informed that they would remain anonymous and that their responses would not be attributed to them. Likewise, students were aware that their responses would not have any implication on their overall science mark. Two classes were invited to participate in the assessment of validity and reliability for the knowledge test.

Development of the Knowledge Test.

Using the social learning theory as a framework for addressing the main purpose of the study and research questions, a knowledge test was developed. The level of students' knowledge related to cardiovascular health was determined through a 14-item multiple choice test which was derived directly from the concepts presented in the Wizards of Motion cardiovascular module. The introductory multi-media presentation included video clips that allowed the students to observe the importance of adopting an active lifestyle. This was considered to be part of the input stage of the social learning model. Through-out the presentation, the Wizards of Motion team discussed and modeled positive lifestyle behaviours. Following the introduction, the students were required to use the information highlighted during the completion of a cardiovascular model building and laboratory activity. According to the social learning theory,

this activity was considered to be part of the attentional process since the students must be aware of the functional anatomy of the heart in order to perceive the purpose of the activity. Cardiovascular workbooks included a variety of fun educational activities that were designed to increase the retention process of the information presented. It was hoped that the content information presented in the Wizards of Motion Cardiovascular Module would be translated into purposeful knowledge that would be displayed when the students completed the post test.

Establishing validity and reliability for the Knowledge Test.

Content-related evidence.

Content-related validity demonstrates the degree to which the sample of questions is representative of a previously defined construct. The domain of content for this study was cardiovascular health. The first task was to specify the universe of content that the knowledge test was intended to represent, given its proposed use. It was determined that this particular test was to be used to measure the Grade 5 student's level of knowledge towards adopting healthy lifestyle behaviours.

The content validity of the knowledge test was determined using a panel of experts. An expert was considered to be someone who is recognized as a reliable source of skill, knowledge and/or ability in a particular field. Experts in the field of cardiovascular health (as it relates to the Grade 5 Science curriculum), and in instrument design analyzed the knowledge test in order to gather evidence based on test content. The experts were asked to determine whether the test reflected the domain of interest, cardiovascular health behaviors in Grade 5 students in Northwestern Ontario. The panel of experts consisted of three health experts who have an educational and professional background in the area of cardiovascular heath; two Grade 5

teachers who understand the domain of the curriculum and the student's knowledge and reading level; and one content expert who has a background in instrument design and who was able to critique the items and overall format of the knowledge test.

Validity based on response processes.

In order to gather evidence based on response processes, four volunteer students from two different Grade 5 classrooms were invited to take part in a Think Aloud interview as they completed the test (Trochim, 2005). The Think Aloud technique involved the participants verbally communicating their thoughts to the researcher as they were answering the questions on the knowledge test. The students were asked to say what they were looking at, thinking, doing and feeling, as they answered the questions. While the students took part in the interview, the researcher recorded notes about their communication without interference. The student's responses provided information on how the questions were interpreted by students at the Grade 5 level. Each of the interviews took approximately 20 minutes to complete and were conducted by the primary researcher. The classroom teachers were not present during the interviews. The interviewer used a standardized script in order to ensure consistency between each of the interviews. This script also included cognitive probes that were used to reduce any confusion and to ensure that there was constant dialogue between students.

Selection of a valid and reliable attitude questionnaire.

In order to explore cardiovascular health and children's motivation for cardiovascular health activities, attitudes should be measured. Previous research (Bandura & Walter, 1963; Bandura, 1969; Bandura, Adams, & Beyer, 1977; Bandura, 1986) supports that an individual

must first change their attitude before behavior change will occur. In order to measure attitudes using a self-report questionnaire, the researcher must be clear and concise with the questions they are asking the participants. Also, in order to obtain valid responses from the participants, measures to ensure confidentiality must be followed. When using psychometric theory to assist in the development of an attitudes questionnaire it is important to use norm referenced measures. This will assist in the differentiation between participants with different attitudes (Nunnally, 1978).

In 1990, Arvidson published 'The Children's Cardiovascular Health Promotion Attitude Scale (CVHPAS): an instrument development which explained the in-depth process of developing and validating a questionnaire. Arvidson's instrument contained 22 multiple choice questions using a 4-point ordinal scale and focused on four controllable lifestyle contributing factors to the development of cardiovascular disease: physical activity, nutrition, smoking, and stress control (Appendix 1). Arvidson collected evidence to support both content and construct validity. Content validity estimates the extent to which the items on a questionnaire represent an apriori defined universe, content domain, or construct. In order to establish this, a thorough review of literature was conducted and a group of experts was recruited from the specific area of interest and asked to review the items on the questionnaire. The next step in the validation process was to examine construct validity. This was used to determine if the instrument was accurately measuring the theoretical measures for which it was intended. A Pearson correlation was used to analyze the relationship between each subscale (nutrition, physical activity, smoking and stress) on the questionnaire. After evaluating the correlation coefficient between subscales it was evident that there was a significant correlated coefficient at the 0.30 level. A factor analysis of the questionnaire was completed to summarize the associations among items. As a result, the

questions were revised and reduced. Reliability, which refers to the stability or consistency of the questionnaire, was assessed using Cronbach's alpha calculations. This calculation provided a measure of the internal consistency reliability coefficient of 0.7933 which is above the acceptable 0.7 value. Minor edits were made to five questions on the CVHPAS questionnaire in order to adapt it for the current study. The adapted attitude questionnaire is presented in Appendix 2.

Piloting the Knowledge Test and Attitude Questionnaire.

A pilot study was conducted in order to determine whether additional modifications needed to be made to the data collection instruments or to the methods of data collection. The pilot consisted of a convenience sample of 14 students from one Grade 5 classroom within the Lakehead Public School Board. Students were given both the knowledge test and attitude questionnaire to complete. While completing the test/questionnaire students were asked to circle any words they did not know. The researcher recorded the amount of time it took the students to complete both tests. Once all the tests/questionnaires were returned, students were asked if there were any questions they had difficulty understanding.

Results and Discussion

Evidence based on test content.

After reviewing the feedback provided by the panel of experts, minor changes were made to five questions and an additional question was added to the knowledge test. Table 1, shows the feedback comments obtained from each of the experts. If more than one expert suggested a specific change, then alterations to the test were made. The main issue addressed when making alterations to the test was the wording. The results of the evaluation indicated that the original form of the test consisted of vocabulary that was too advanced for students at a Grade 5 level.

Table 1

Changes Suggested By the Panel of Experts

Question	Changes suggested by panel of experts
1. What is the leading cause of death in Canada?	
2. How big is your heart?	- I am wondering if the students will be able to differentiate between the size of an apple and an orange-might they think that these are similar in size - Might be problematic since the comparisons are based on items that may be similar in size - For a student in grade 5 their fist may not be an exact comparison to their heart, but it's close enough
3. What does athero mean?	
4. What does sclerosis mean?	
5. What does the term vascular refer to?	
6. Where does blood flow, even during exercise?	- Possibly re-word - Move question to follow question #2
7. Where does plaque buildup when you have cardiovascular disease?	
8. Why is cardiovascular disease referred to as a lifestyle disease?	
9. What happens if you develop atherosclerosis?	
10. How can high blood pressure be reduced?	- The wording in item (c) in confusing: should read "by choosing not to smoke and avoiding second hand smoke"
11. What can happen to an individual who develops severe atherosclerosis and high blood pressure?	- I would change the remove the word 'individual' and replace it with 'person'
12. How often should you participate in physical activity each week?	
13. What lifestyle habit can you control to prevent the development of cardiovascular disease	- I would modify this to say "What things in your life can you do to stop cardiovascular disease"
14. Which of the following behaviours will help to prevent the development of cardiovascular disease?	- Change option 'c' to 'playing video games' instead of playing 'Wii'
Is there any questions you would add	- I would add an introductory question about blood pressure

Evidence based on response processes.

The student's responses provided during the Think Aloud interview resulted in information on how the questions were interpreted by students at the Grade 5 level. Based on the information retrieved from these interviews, additional refinements to the questions were made. Table 2 presents the student's comments while completing the knowledge test.

Table 2

Comments from Think Aloud Interviews

Question	Comments from students
1. What is the leading cause of death in Canada?	- What does cardiovascular mean - I can't read that (cardiovascular) word
2. How big is your heart?	
3. What does athero mean?	- I don't know what this (athero) word means - I don't get number 3 - I don't get this, I don't know what that (athero) word means - I'm going to guess this answer cause I don't know
4. What does sclerosis mean?	- I don't know what this (sclerosis)word is - I don't know what that (sclerosis) word is - I don't remember what (sclerosis) is but I did my science project on something like it - I guessed at this answer too
5. What does the term vascular refer to?	- What does this (vascular) word mean - I don't know what this (vascular) means
6. Where does blood flow, even during exercise?	- I am confused - I don't know what they are asking
7. Where does plaque buildup when you have cardiovascular disease?	- Is this like plaque on your teeth?
8. Why is cardiovascular disease referred to as a lifestyle disease?	- What does this (lifestyle) mean? - What's this (lifestyle) mean? Does that mean that 'd' is the right answer
9. What happens if you develop atherosclerosis?	- That (atherosclerosis) is a big word
10. How can high blood pressure be reduced?	- I don't remember what blood pressure is - I don't get what high blood pressure is - I don't get why teachers use the answer all of the above in tests
11. What can happen to an individual who develops severe atherosclerosis and high blood pressure?	- (student couldn't read the word 'individual')
12. How often should you participate in physical activity each week?	- I would say its answer 'd'
13. What lifestyle habit can you control to prevent the development of cardiovascular disease	- What is lifestyle mean?
14. **Which of the following behaviours will help to prevent the development of cardiovascular disease?**	- I think that healthy food choices is the best answer but I think Wii fit is good for you but not the answer you want.

Evidence based on internal structure.

Finally, the pilot test helped to provide information relative to the time required to administer both the knowledge test and attitude questionnaire. It was determined that both the knowledge test and attitudes based questionnaire took the class between 11 and 18 minutes to complete. After reviewing the test/questionnaire it was evident that the students had difficulty understanding the words: cardiovascular, atherosclerosis, vascular, lifestyle, and individual. Since these words were related to the content of the cardiovascular module, they were not removed from the test or questionnaire. One of the questions was eliminated due to the confusion and lack of clarity among the students. Due to the small sample size used in the pilot investigation of the instruments a measure of inter-item correlation for the Knowledge Test was not computed. The final version of the Knowledge Test is presented in Appendix 3.

Chapter 3

Evaluating The Wizards Of Motion Cardiovascular Module

Introduction

The Wizards of Motion Cardiovascular Module was developed to link to the Human Organ System Unit of the Ontario Grade 5 Science Curriculum. The program was designed to present theory related to the basic structures and functions of organs in the cardiovascular systems while highlighting specific factors that contribute to positive states of overall health. The relationships between eating habits and the cardiovascular system, as well as the importance of daily physical activity and avoiding smoking were emphasized. The Wizards of Motion Team members both demonstrated, and through their presentation modeled, examples of healthy lifestyles. Students were presented with the opportunity to critically evaluate concepts of atherosclerosis and cardiovascular disease as well as to explore various ways to avoid the progression of these conditions through the formal presentation, the hands on laboratory activity, and the independent workbook. The laboratory activity was designed to stimulate further understanding, and hopefully promote retention of the health content and messages and is consistent with a constructivist approach learning (Shechter, 2001).

The laboratory activity involved the construction of a model of the cardiovascular system. Students created a model of the circulatory system using colored water, tubing, valves, a pump, and a vascular clamp in order to and simulate the restriction of blood flow. The lab experience demonstrated the relationship between blood volume changes and vessel blockages. Following the collection of data for a series of trials and conditions, the students calculated averages and graphically presented the results.

The purpose of this study was to evaluate whether the Wizards of Motion program was effective in changing student's attitudes and knowledge related to adopting healthy lifestyle habits and the prevention of cardiovascular disease.

Methods

Objectives of the study.

The main objective of this study was to increase Grade 5 students' understanding of cardiovascular disease as a preventable lifestyle outcome. A second objective was to improve the Grade 5 student's knowledge and attitudes towards, healthy food choices and physical activity.

Research questions.

a) Does the Wizards of Motion Grade 5 Cardiovascular Module result in a change in student's knowledge related to healthy lifestyle habits and cardiovascular disease?
b) Does the Wizards of Motion Grade 5 Cardiovascular Module result in a change in student's attitudes related to healthy lifestyle habits designed to prevent cardiovascular disease?

Informed consent.

Before conducting this study, ethics approval was required from the Lakehead University Research Ethics Board and the Lakehead Public School Board of Education. The ethics proposal detailed the potential harm and risks to participants, benefits of participating in the study, dissemination of research results, storage of data as well as the procedures required to ensure anonymity and confidentiality. Once University approval was obtained, the required ethics

documents were submitted to the Lakehead Public School Board (October, 2009). The School Board package included the following information: title of research, name of researcher, position of researcher, name of faculty advisor, brief abstract of research project, research type, data collection techniques, schools potentially involved, sample size, budget, time, legal implications, and prospective completion of work.

Following ethics approval from both the Lakehead University Research Ethics Board and the Lakehead Public School Board of Education, emails were sent out to specific schools inviting Grade 5 classrooms to take part in the Wizards of Motion program and study. Schools were matched by the School Board based on demographic variables (socio-economic status, ethnicity, level of education). Once teachers volunteered to participate, they received a cover letter explaining the study and a consent form for the students to take home in order to obtain parental consent (Appendix 4). Students were told that their participation was completely voluntary and they may choose to withdraw from completing the test/questionnaire at any point if they felt uncomfortable. The students were also informed that they would remain anonymous and that their responses would not be attributed to them. Likewise, students were aware that their responses would not have any implication on their overall science mark. Four classes were invited to participate in the main study.

Participants.

The study involved 70 students from four different Grade 5 classrooms from two different schools within the Lakehead Public School Board. Classrooms were randomly assigned to be part of the control or intervention group. The classes which formed the control group received the cardiovascular intervention after the data collection process was complete Thirty-

nine students were included in the intervention group while 31 students were in the control group. An analysis of the sample by gender showed that, in total, 41 participants were female and 29 participants were male.

Table 3

Number of Participants for Each Class

	INTERVENTION Group 1	INTERVENTION Group 2	CONTROL Group 3	CONTROL Group 4
# of students in class	26	25	24	26
# of participants	18	21	15	16

Note. Total number of students in intervention group: 39; total number of students in control group: 31

The researcher met with each teacher to arrange the dates for completion of the pretest knowledge test and attitude questionnaire, the delivery of the Wizards of Motion Cardiovascular Module, and the completion of the post-test test and questionnaire. The intervention group was given the tests and questionnaire to complete on Day 1, followed by the cardiovascular presentation on Day 2. The intervention group was given the same test/questionnaire to complete again on Day 3. Meanwhile, the control group was given the test and questionnaire on Day 1, then nothing on Day 2, then the same test and questionnaire on Day 3. Once all data was collected, the classrooms that were part of the control group had the opportunity to participate in the Wizards of Motion program. As a token of our appreciation for participating in the study, all teachers and students received a Wizards of Motion keychain.

The return rate for the participants within this study was 69.3%. Each of the students' questionnaires were coded to ensure that they completed both the pre-test and post-test. If students were absent for either the pre-test or post-test, their test and questionnaire were

eliminated from the analysis process. There were eight students absent within the treatment group on the post-test and nine absent from the control group.

Table 4

Implementation of the Wizards of Motion Program

	DAY 1	DAY 2	DAY 3
INTERVENTION	Pre-test	Intervention	Post-test
CONTROL	Pre-test	X	Post-test

Instruments.

Two different instruments were used to assess the student's attitudes and the students' knowledge related to healthy lifestyle habits and cardiovascular disease. The first instrument was a Knowledge Test that was developed based on the concepts presented in the Wizards of Motion cardiovascular module (Appendix 1). This test consisted of 14 multiple choice questions. Validity measures were established for the knowledge test as part of the preliminary pilot work. The second instrument was the attitudes based questionnaire, which was based on the Arvidson CVHPAS (2008), and was adapted to assess the Grade 5 students' current attitudes related to healthy lifestyle habits and the prevention of cardiovascular disease (Appendix 2). In addition, a Delivery Team's Presentation Logbook was completed by a Wizards of Motion team member after each presentation (Appendix 5). Classroom teachers were also given a Teacher Logbook to complete before each presentation (Appendix 6). The logbooks were used to record information which provided anecdotal information and helped to support and interpret the findings of the study.

Research Design and Data Analysis

A two group pre - post comparison design was used to evaluate both the knowledge test and the attitudes based questionnaire, separately. Two Grade 5 classrooms received the Wizards of Motion Cardiovascular Intervention and were denoted as the intervention group, and two Grade 5 classrooms acted as the control group, and did not receive the intervention. The data from each groups' Knowledge Test and Attitude Questionnaire were analyzed, independently in a two-way mixed analysis of variance.

The results of the Knowledge Test and Attitude Questionnaire were analyzed using SAS: the Statistical Analysis System Version 9.2. Statistical analyses included: an evaluation of frequency distributions and computation of percentages of responses calculated for each question within the Knowledge Test. In addition, estimates of means and measures of dispersion (standard deviations), were computed for each question on the Knowledge Test as well as for each item on the Attitude Questionnaire. Both the Knowledge Test and the Attitude Questionnaire were further analyzed, independently, using the general linear model ANOVA from SAS followed by a post-hoc Scheffe test to evaluate the significant interaction term. Effect size was determined using the common language effect size of McGraw and Wong (1992).

The data were subsequently restructured to create a pre to post test difference score for each subject within the intervention and control groups. This data set was used to evaluate the homogeneity of variance under the assumption that although the populations were normally distributed the groups had unequal variance. Likewise, the Welch-Satterthwaite t approximation for pre-post differences was used to confirm the output from the ANOVA in both the Knowledge Test and Attitude Questionnaire.

Results and Discussion

Knowledge Test.

The purpose of the Knowledge Test was to assess the students' level of knowledge about cardiovascular disease processes, specifically atherosclerosis, and the value in adopting healthy lifestyle behaviours as a mechanism of disease prevention. The Knowledge Test used a multiple choice format for each question and a correct answer was given a value of 1. The number of correct answers was summed for each respondent. The average number of correct responses was calculated separately for the intervention and the control groups, across test session (pre versus post). These data are reported in Table 5. The intervention group had an average correct response score of 6.23 (1.94) on the pre-test followed by an average correct response score of 13 (0.92) on the post-test. In comparison, the control group had an average correct response score of 6.23 (1.86) on the pre-test followed by an average correct response score of 5.94 (1.77) on the post-test. These results suggest that there was little difference in the average number of correct responses between the intervention and control groups on the pre test, but that there was a substantial improvement in the intervention group's average number of correct responses on the post-test.

Table 5

Descriptive Statistics for Knowledge Test

Group	Pre-test *M(SD)*	Post-test *M(SD)*
Intervention ***n*=39**	6.23 (1.94)	13.0(0.92)
Control ***n*=31**	6.23(1.86)	5.93(1.77)

The percentage of correct response for each question on the Knowledge Test for both the intervention and control groups are displayed in Table 6. This table illustrates the intervention group's improvement in the students' knowledge about cardiovascular disease and their knowledge of the suggested benefits of healthy lifestyle behaviours. The data also illustrate that there was no change following the interim period in the control group students' knowledge about cardiovascular disease or their knowledge of suggested benefits of healthy lifestyle behaviours. In other words, the first exposure to the concepts of healthy lifestyle and atherosclerosis did not cause a change in the level of knowledge within the control group students.

Table 6

Percent of Correct Responses for Intervention vs. Control Group

	Intervention	Intervention	Control	Control
Question	**Pre-test %**	**Post-test %**	**Pre-test %**	**Post-test %**
1	28.21	94.87	29.03	32.26
2	94.87	100	90.32	77.42
3	10.26	82.05	16.13	19.35
4	30.77	82.05	29.03	25.81
5	46.15	94.87	61.29	61.29
6	35.90	97.44	41.94	41.94
7	41.03	94.87	35.48	35.48
8	35.90	92.31	35.48	32.36
9	28.21	100	29.03	25.81
10	89.74	100	93.55	83.87
11	46.15	87.18	41.94	41.94
12	30.77	79.49	38.71	38.71
13	64.10	100	61.29	58.06
14	25.64	94.87	19.35	19.35

The results presented in Table 6 also indicate that while there appears to be a consistent improvement in the knowledge scores within the intervention group, there are specific questions which are based on general knowledge and are easy to guess correctly, regardless of exposure to a knowledge based program. For example, in question #2, the control group respondents had a 90% success rate on the question, "How big is your heart", in the pre-test. Although this was clearly a guess as shown by the subsequent drop to 77% in the post-test, the higher scores indicate that the item may have evaluated logic rather than specificity of knowledge and understanding of cardiovascular anatomy. Similarly, in question #10 the student is asked,

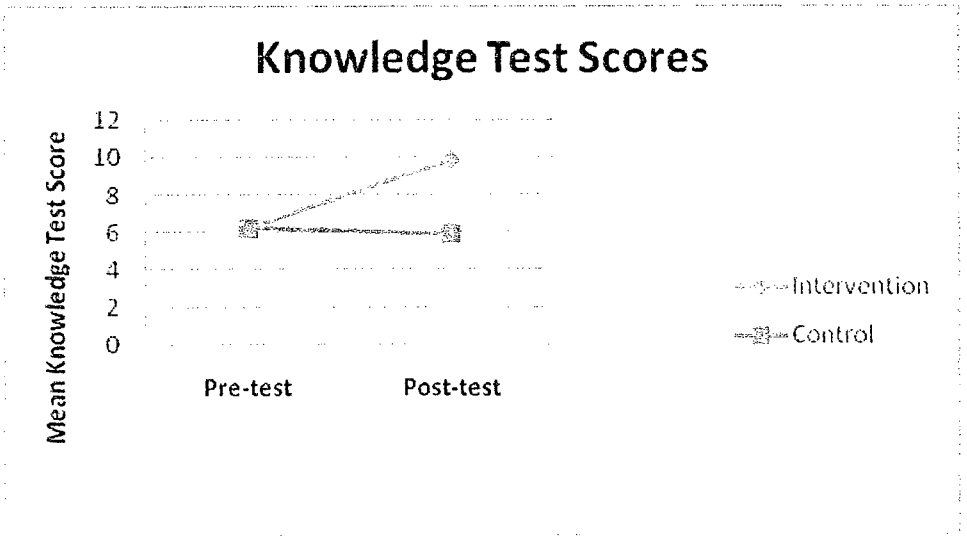
"*Which of the following behaviours will help to prevent the development of cardiovascular disease?*" The obvious answer is given as *making healthy food choices*, against the less likely alternatives: drinking soda pop, reading a book, or playing computer games.

In summary, the percent of correct responses for each of the items included on the Knowledge Test illustrates a noticeable difference following the intervention, with the exception of question 2 and 10. On the pre-test, the majority of students correctly answered these two questions, most likely because they were too simple. It is apparent that these two questions should either be eliminated from the Knowledge Test or rewritten to provide more of a challenge in the response set.

Figure 1, presents the average scores for the correct responses by the intervention and control groups. The graph illustrates the change in the level of knowledge between the pre-test and the post-test response scores of the intervention group in comparison to the control group.

Figure 1

Comparison of Mean Scores on Knowledge Test Between Groups Across Test Session



The difference in average number of correct responses (i.e. the dependent variable) for the intervention and control group were tested across the pre and post test sessions using a general linear model analysis of variance procedure with a post hoc Scheffe test. The results, which show a statistically significant difference in the intervention group responses at a p value of < 0.01 are presented in Table 7.

Table 7

Two Way ANOVA with Repeated Measure on Knowledge Test

Source	***df***	***SS***	***MS***	***F***	***p***
GROUP Intervention Group vs Control Group	1	431.59	431.59	157.70	<0.01
SESSION Pre-Test vs Post-Test	1	362.49	362.49	132.45	<0.01
GROUP * SESSION	1	430.38	430.38	157.25	<0.01

Note. The dependent variable is the number of correct responses

The results indicate that there was a significant interaction between the intervention and control groups on the pre-test versus post test measures $F(3,136)=157.25$, $p<0.01$. This interaction was further evaluated using a post-hoc Scheffe test. The results of the Scheffe Test indicated that the post-test knowledge scores were significantly higher than the pre-test scores in the intervention group ($p<.05$) but not in the control group. Similarly, the higher success in the post test knowledge scores for the intervention group were significantly different than the post test knowledge scores for the control group ($p<.05$).

Next, the homogeneity of variance was evaluated using the pre to post Knowledge Test difference scores between the intervention and control groups. The statistic to test the homogeneity of variance assumption was the F_{max} test option of the SAS t-test procedure for the evaluation of difference scores in two independent groups with unequal sample sizes. The result indicated that there was a violation of the homogeneity of variance as shown by the large F statistic $F_{max}(38,30)=7.46$, $p<.01$. As a result, a comparison of the pre to post Knowledge Test difference scores between the intervention and control groups was evaluated using the Welch-Satterthwaite t-test $t(50.1)=17.23$, $p<.0001$. These results indicate that despite the unequal sample sizes in the two groups, and while controlling for unequal variance, the significant average post-test knowledge score computed for the intervention group was supported.

Finally, an effect size estimate was computed to evaluate the magnitude of the difference in the pre to post Knowledge Test scores between the intervention and control groups. The approach used the *Common Language* effect size estimator of McGraw and Wong (1992). This estimator is used in a two-group design to compute a z-statistic that illustrates the likelihood that an individual selected at random from one sample of interest will have a score that is greater than an individual selected at random from the comparison sample. The results of the CL effect size estimator comparing the Knowledge Test difference scores between the intervention versus control groups produced an effect size of $z=2.64$, $p<.01$. The effect size estimator indicates that there is a 99% chance that a participant drawn at random from the intervention group will have a significantly higher Knowledge Test score than a participant drawn at random from the control group.

The main objective of this study was to increase Grade 5 students' understanding of cardiovascular disease as a preventable lifestyle outcome. The first research question focused on evaluating the Grade 5 student's knowledge related to healthy lifestyle behaviours and cardiovascular disease. The results indicated that although both the intervention and control groups scored similarly on the Knowledge Test prior to the intervention period, there was a noticeable influence on the students' level of knowledge as a result of exposure to the intervention program. That is, the students receiving the cardiovascular disease prevention program scored higher on the level of Knowledge Test following participation in the program. This information is supported by the Teacher Logs (Appendix 6) which were completed by both the intervention and control classroom teachers. All teachers confirmed that their class had not been taught the cardiovascular system as part of the science curriculum prior to taking part in the Wizards of Motion Cardiovascular Module. The Delivery Logs (Appendix 5) were completed by the Wizards of Motion Team Members and indicated that the delivery team had a positive interaction with the students, which could also contribute to the students change in attitudes towards adopting healthy lifestyle habits.

The results of the present study support the previous research of Harrell et al, (1999), which demonstrated that students who participated in an eight week cardiovascular disease prevention program, increased their level of total heart health knowledge, compared to an age/grade matched control group, as determined by a self-report test. As part of the Cardiovascular Health in Children study (Harrell et al., 1999), students who displayed one or more cardiovascular disease factors were assigned to the risk-based intervention. This intervention was taught by the school nurse and took place over an eight week period and consisted of educational activities that covered the topics of nutrition, physical activity and

smoking. At the end of the study, these students showed a significant increase in their level of total healthy heart knowledge, as determined by a self-report test, compared to those in the control group. In 2006, Addison conducted a study, with similar objectives to the Wizards of Motion module, to determine whether a cardiovascular disease intervention program was effective in changing students' knowledge about cardiovascular disease and preventable risk factors. Addison concluded that there were significant gains in knowledge for the treatment group. The gains were attributed to the students attending a weekend conference which involved lectures that incorporated information about hypertension and risk factors for developing cardiovascular disease.

The importance of school based health promotion programs on improving students' knowledge about health related issues is based on the belief that changes in knowledge are related to changes in lifestyle behaviours. According to the Social Learning Theory, children ascertain their diets and lifestyle behaviours based on their surrounding environment (Cox, 2002). By implementing a health education program such as the Wizards of Motion Cardiovascular Module, students were presented with opportunities to critically evaluate concepts of cardiovascular health and disease prevention. The Wizards of Motion Team, had the opportunity to positively influence the students' knowledge about cardiovascular disease through the process of modeling. The social learning theory states that individuals will model (mimic) another person's behavior if they understand the reasons why this particular behaviour is being exhibited. Every day teachers have the opportunity to set positive examples for their students. Many students will subconsciously model their teachers' behaviour since the teachers are seen as role models.

Health education in schools must focus on ways to increase students' knowledge about the prevention of cardiovascular disease and the importance of avoiding tobacco smoke, physical activity and a balanced diet.

When discussing the results on the Knowledge Test, it is important to acknowledge a number of limitations. The main study involved a total of 70 Grade 5 students. These students represented four Grade 5 classes from two different schools out of a possible 25 schools that made up the public school board. The sample represents a small portion of the total population of Grade 5 students. In addition, the two schools that participated in the main study, while similar, represented a higher socio-economic status compared to other schools within the board. It is not possible to generalize the results of this study to students or schools with different demographics. The students were required to complete the pre and post Knowledge Test within a short timeframe (two days apart). This short timeframe only allowed the researcher to determine the short term effects of the cardiovascular module on the students' level of knowledge about cardiovascular disease rather than any long term effects. Future research should focus on the long term implications of the Wizards of Motion Cardiovascular Module.

Within the control group it was noted that there was no difference in the average knowledge scores across test sessions (Table 5). The consistency of these results, although considered aposteriori, highlight the stability of the results from the pre test session to the post test session, with a between test interval of two weeks. This finding provides an approximation of test-retest reliability, however an estimate of reliability for the knowledge test should be a component of future research.

Attitude Questionnaire.

The purpose of the Attitude Questionnaire was to assess the students' attitudes related to cardiovascular disease processes, specifically atherosclerosis, and the value in adopting healthy lifestyle behaviours as a mechanism of disease prevention. In order to increase the probability of students answering the questionnaire honestly, they were reminded that their answers would be completely anonymous and that there would be no marks given for the completion of the questionnaire. It was hoped that students who answered the questions on the Attitudes Questionnaire did so honestly rather than providing the most desirable response.

The Attitude Questionnaire used a multiple choice format for each question and responses were given a value of 1 to 4. A value of 4 was given for the most desirable response whereas a value of 1 was given for the least desirable response. The number of responses was summed for each respondent. The average sum of responses was calculated separately for the intervention and the control groups, across test session (pre versus post). These data are reported in Table 8. The intervention group had an average score of 72.67 (4.45) on the pre-test followed by an average score of 83.15 (2.87) on the post-test. In comparison, the control group had an average score of 70.26 (6.13) on the pre-test followed by an average score of 70.16 (5.71) on the post-test. These results suggest that there was little difference in the average responses between the intervention and control groups on the pre test, but that there was a substantial change in the intervention group's average responses on the post-test.

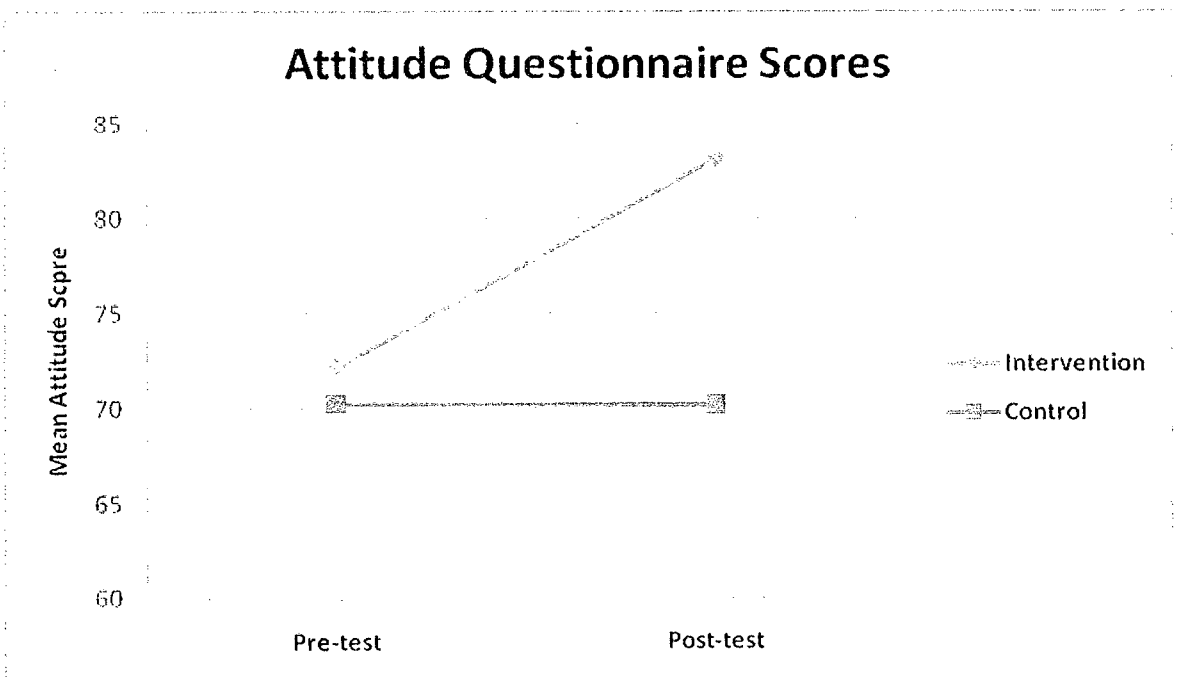
Table 8
Descriptive Statistics for Attitude Questionnaire

Group	Pre-test *M(SD)*	Post-test *M(SD)*
Intervention ***n*=39**	72.67 (4.45)	83.15(2.87)
Control ***n*=31**	70.26(6.13)	70.16(5.71)

Figure 2, presents the average scores by the intervention and control groups. The graph illustrates the change in attitudes between the pre-test and the post-test response scores of the intervention group in comparison to the control group.

Figure 2

Comparison of Mean Scores on Attitude Questionnaire Between Groups Across Test Session



The difference in average scores (i.e. the dependent variable) for the intervention and control group were tested across the pre and post test sessions using a general linear model analysis of variance procedure with a post hoc Scheffe test. The results, which show a statistically significant difference in the intervention group responses at a p value of < 0.01 are presented in Table 9.

Table 9

Two Way ANOVA with Repeated Measure on Attitude Questionnaire

Source	***df***	***SS***	***MS***	***F***	***p***
GROUP Intervention Group vs Control Group	1	2048.35	2048.35	87.83	<0.01
SESSION Pre-Test vs Post-Test	1	1177.40	1177.40	50.48	<0.01
GROUP * SESSION	1	967.37	967.37	41.48	<0.01

Note. The dependent variable is the sum of responses

The results indicate that there was a significant interaction between the intervention and control groups on the pre-test versus post test measures $F(3,136)=41.48$, $p<0.01$. This interaction was further evaluated using a post-hoc Scheffe test. The results of the Scheffe Test indicated that the post-test attitude scores were significantly higher than the pre-test scores in the intervention group ($p<.05$) but not in the control group. Similarly, the higher attitude scores in the post test period for the intervention group were significantly higher than the post test attitude scores for the control group ($p<.05$).

Next, the homogeneity of variance was evaluated using the pre to post Attitude Questionnaire difference scores between the intervention and control groups. The statistic to test

the homogeneity of variance assumption was the F_{max} test option of the SAS t-test procedure for the evaluation of difference scores in two independent groups with unequal sample sizes. The result indicated that there was a violation of the homogeneity of variance as shown by the large F statistic $F_{max}(38,30)=21.99$, $p<.01$. As a result, a comparison of the pre to post attitude difference scores between the intervention and control groups was evaluated using the Welch-Satterthwaite t-test $t(42.3)=11.49$, $p<.0001$. These results indicate that despite the unequal sample sizes in the two groups, and while controlling for unequal variance, the significantly higher average post-test attitude score computed for the intervention group was supported.

Finally, an effect size estimate was computed to evaluate the magnitude of the difference in the pre to post Attitude Questionnaire scores between the intervention and control groups. The approach used the *Common Language* effect size estimator of McGraw and Wong (1992). This estimator is used in a two-group design to compute a z-statistic which illustrates the likelihood that an individual selected at random from one sample of interest will have a score that is greater than an individual selected at random from the comparison sample. The results of the CL effect size estimator comparing the Attitude Questionnaire difference scores between the intervention versus control groups produced an effect size of $z=1.82$, $p<.01$. The effect size estimator indicates that there is a 94.5% chance that a participant drawn at random from the intervention group will have a significantly higher Attitude Questionnaire score than a participant drawn at random from the control group.

Pearson product moment correlation coefficients between the Knowledge Test scores and responses on the Attitude Questionnaire were also computed. No significant correlation was found between the Knowledge Test and Attitude Questionnaire (pre-Knowledge Test with pre-

Attitude Questionnaire or post-Knowledge Test with post-Attitude Questionnaire) within either the intervention group or the control group.

Educating students about cardiovascular disease with the hopes of improving their level of knowledge does not necessarily mean that these students will change their health related behaviours (Edelman & Mandle, 2002). Health education programs need to combine information that will lead to improvements in both knowledge and attitudes in order to acquire behavioural change. An individual must first have knowledge about healthy lifestyle behaviours in order to shape their attitude towards healthy lifestyle choices.

The change in attitudes scores observed for the Grade 5 students following exposure to the intervention support the findings of previous studies (Christodoulos et al., 2006; Perry et al., 1990). The CATCH study (Perry et al, 1990) delivered a multi-component school based program focused on changing the school environment and health related behaviours. The program involved a physical activity intervention in conjunction with classroom learning about healthy lifestyle behaviours such as healthy eating. The researchers concluded that the CATCH program was successful in changing attitudes related to physical activity and nutrition. Both the CATCH study and the Wizards of Motion Cardiovascular Intervention utilized a variety of teaching strategies that allowed students to critically evaluate healthy lifestyle behaviours. The results of the Wizards of Motion Cardiovascular Intervention support the findings from the CATCH study and the important role health education programs can have on changing students' attitudes towards adopting a healthy lifestyle. Christodoulos et al. (2006), assessed whether a physical activity intervention was effective in changing students' attitudes towards participating in physical activity. The intervention involved daily physical activity supplemented by the integration of health education into all classroom subjects. At the conclusion of the study,

Christodoulos et al. stated that participants who were part of the intervention group displayed more positive attitudes towards physical activity compared to the control group.

Cox (2002) stated "that an individual behaves according to how she has learned to behave" (Cox, 2002, p.157). The Wizards of Motion Team presented content in order to increase knowledge and awareness of healthy lifestyles and also demonstrated and presented healthy role models to enhance the learning experience and retention of the students. The results of the study indicate that the intervention enhanced student's knowledge. According to Bandura (1965), changes in awareness may help stimulate the motivation process and result in a change in both attitude and behaviour. The success of the Wizards Of Motion cardiovascular intervention in changing students' attitudes about cardiovascular disease and healthy lifestyle behaviours may influence motivation and promote changes in behaviour.

The health belief model uses a guideline of progressive processes that an individual must go through in order to change their health related behaviour. The Wizards of Motion Cardiovascular Module uses this model to educate students about the perceived threats of cardiovascular disease. The presentation allows students to be aware of the severity of cardiovascular disease if they do not adopt healthy lifestyle habits. The cardiovascular module also informs the students about the benefits of physical activity and eating a balanced diet while providing them with cues to action. Behaviour change is met once the individual performs the desirable behaviour on a regular basis (Edelman & Mandle, 2002). The objective of the Wizards of Motion Cardiovascular Intervention is for students to be physically active and eat healthy foods on a daily basis. Promoting healthy lifestyle behaviours in schools is the foundation to academic success (Edelman & Mandle, 2002). Adopting healthy lifestyle behaviours will benefit students' academic success in life as well as physiological health.

Although the results from the Attitude Questionnaire are promising, it is important to keep in mind that the sample size only represented a portion of the Grade 5 students within one city school board. As noted earlier, this program involved a single delivery session that may have not been sufficient to elicit sustained changes in students' knowledge and attitudes toward cardiovascular disease and adopting healthy lifestyle behaviours. Future research should include a larger sample size and a design that would allow the researcher to see the long-term implications of the Wizards of Motion Cardiovascular Module on the students' attitudes towards cardiovascular health and adopting the suggested healthy lifestyle behaviours.

Chapter 4

Summary, Conclusions & Recommendations

According to Manuel, Leung, Nguyen, Tanuseputro, and Johansen (2003), cardiovascular disease is the leading cause of death in women and the second leading cause of death in males. Although atherosclerotic lesions have been identified in children as young as 6 months of age, atherosclerosis is considered as a preventable lifestyle disease with known modifiable risk factors (McPherson, Frohlich, Fodor, and Genest, 2006).

The Wizards of Motion Cardiovascular Disease Prevention Module was developed to introduce Grade 5 students to the concepts of cardiovascular disease at an elementary level, and to make students within this age cohort aware that it is never too early to adopt a cardiovascular disease prevention lifestyle.

Through a classroom presentation which combined an interactive multimedia discussion with a hands-on laboratory exercise, healthy lifestyle behaviours such as eating a balanced diet, participating in regular physical activity and avoiding smoking were exemplified as a strategy to prevent the development of atherosclerotic plaque and subsequent cardiovascular disease. This classroom presentation and laboratory exercise took two hours to complete.

Both public and primary health care providers have accepted that the increases in childhood obesity rates to epidemic proportions over the past decade are due to the adoption of a sedentary lifestyle combined with poor diet. Inactivity and the consumption of foods that are high in sucrose, saturated fat, and cholesterol are the precursors to risk factors for subsequent development of atherosclerosis, obesity, and diabetes.

The increase in such behaviours is disconcerting since cardiovascular disease risk factors have been well known for more than 60 years and such risk factors can be reduced through a

variety of intervention strategies. More importantly, it is generally accepted that teaching about reducing cardiovascular disease risk factors should begin early in a child's life (Kavey, et al., 2003). School health education programs have the ability to positively shape an adolescent's health behaviours and are considered to be an integral part of disease prevention/awareness campaigns, such as those used in the prevention of cardiovascular disease.

With heightened awareness to the prevalence of cardiovascular disease rates over the past ten years, it is apparent that there is a need to educate the public about primary prevention, rather than dealing with the burden of disease. Yet behavioral changes are difficult to initiate and maintain among pre-adolescent aged individuals if the school and/or home environments do not support the changes in lifestyle needed to reduce the risk factors. Schools need to develop and adopt heart healthy policies in order to promote an environment that encourages healthy eating and being physically active every day. Since adolescents spend approximately six hours each weekday in the classroom, teachers, administrators, and parents, need to be aware of the substantial positive effects heart healthy behavior choices will have on the students' learning.

As part of the Wizards of Motion Cardiovascular Disease Prevention Module students had the chance to create a model of the cardiovascular system and then simulate the restriction of blood flow that may be incurred in the coronary heart disease patient. It was hoped that by having the students experience through simulation, the association between blood vessel blockage (simulated atherosclerotic plaque) and blood volume changes, they would be more inclined to adopt healthy lifestyle behaviours.

The main objectives of this study were to increase Grade 5 students' understanding of cardiovascular disease as a preventable lifestyle outcome and to improve the students' knowledge and attitudes associated with making healthy food choices and participating in daily

physical activity. The research was designed to address whether the Wizards of Motion Cardiovascular module was effective in changing students' attitudes and knowledge related to adopting healthy lifestyle behaviours and the prevention of cardiovascular disease. Although knowledge and attitude change were measured, it is important to keep in mind that sustained long term changes were not evaluated.

The findings reported provide evidence to support the ongoing development and delivery of the Wizards of Motion Cardiovascular Disease Prevention Module. In addition, the effectiveness of enabling students to develop knowledge about cardiovascular disease as well as presenting a stimulus to change students' attitudes towards healthy lifestyle behaviours, are two preliminary steps in promoting healthy heart campaigns.

Conclusions

The two most important conclusions of this study are that the Wizards of Motion cardiovascular disease prevention module was effective in:

- increasing a sample of Grade 5 students' knowledge related to healthy lifestyle behaviours and cardiovascular disease;
- changing and improving a sample of Grade 5 students' attitudes toward adopting healthy lifestyle behaviours that have been shown to prevent cardiovascular disease.

Although the Knowledge Test and the Attitude Questionnaire was demonstrated to be effective in assessing the changes in knowledge and attitudes for the sample selected for this study, the researcher also notes that:

1. Minor revisions should be made to the Knowledge Test in order to remove two questions which were identified to be too simple through the analyses.
2. An estimate of reliability for the knowledge test should be computed as a component of future research investigations.

Program and Recommendations for Future Research

Based on the findings of the present study, the following list of recommendations is intended to improve and advance the continued development and delivery of the Wizards of Motion Cardiovascular Disease Prevention Module.

1. Provide teachers with an introductory workshop in order to introduce concepts presented in the Cardiovascular Module in order to enhance the learning experience for the students
2. Adapt the existing cardiovascular module to target two or three different grade levels.
3. Provide parents with an information sheet highlighting the key issues discussed in the presentation.
4. Encourage schools to develop links with community agencies in order to promote healthy eating, being physically active and avoiding smoking

Future Research investigations should also consider the following:

1. Increase the sample size by including a greater number of classrooms across different school boards.
2. Explore the effectiveness of introducing the cardiovascular health module as an intervention attached to the science curriculum for specific groups of students who are at high risk for developing cardiovascular disease.

3. Develop a longitudinal research design in order to determine the sustained effects of the Wizards of Motion cardiovascular disease prevention module on both knowledge retention as well as associated changes in behaviour.

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Appendix 1

CHILDREN'S CARDIOVASCULAR HEALTH PROMOTION
ATTITUDE SCALE

The purpose of these questions is to find out how you and other children feel about exercise, nutrition, smoking, and problem solving. Please answer the following questions as truthfully as you can. There are no right or wrong answers. THIS IS NOT A TEST!

1. **I like to exercise daily.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree

2. **When I grow up I am going to exercise.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree

3. **Exercising is fun.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree

4. **I exercise because it makes me healthy**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree

5. **I would rather play video games than play outside.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree

6. **My parents want me to exercise.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree

7. **Playing sports or other physical activities is fun.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree

8. **I would rather read a book than play outside.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree

9. **I exercise because my parents or my teacher make me.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree

10. I eat a big breakfast every morning.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

11. I like to eat vegetables

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

12. I like to eat healthy food every day.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

13. My favourite snacks are cookies, candy, or cake.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

14. I try to eat food from the four food groups (vegetables & fruit, grain products, milk & alternatives) every day.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

15. You should not eat much food that contains lots of fat or cholesterol.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

16. When I am thirsty I like to drink a soft drink.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

17. When I am hungry after school I like to eat fruit or something good for me.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

18. It's ok to smoke if you don't inhale.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

19. I think smoking is bad for you.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

20. It bothers me if other people around me smoke.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

21. When I group up I am going to smoke.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

22. Smoking can cause cancer

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

Appendix 2

CHILDREN'S CARDIOVASCULAR HEALTH PROMOTION ATTITUDE SCALE

The purpose of these questions is to find out how you and other children feel about exercise, nutrition, smoking, and problem solving. Please answer the following questions as truthfully as you can. There are no right or wrong answers. THIS IS NOT A TEST!

1. Age (in years):_____
2. Grade:_____
3. Male: ____ Female: _____
4. **I like to exercise daily.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree
5. **When I grow up I plan to continue to exercise.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree
6. **Exercising is fun.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree

7. **I exercise because it makes me healthy.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree
8. **I would rather play with computer games than play outside.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree
9. **My parents want me to exercise.**
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree
10. **Playing sports or other physical activities is fun.**
    a) Strongly agree
    b) Agree
    c) Disagree
    d) Strongly disagree
11. **I would rather read a book than play outside.**
    a) Strongly agree
    b) Agree
    c) Disagree
    d) Strongly disagree

12. I exercise because my parents or my teacher make me.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

13. I like to eat a good breakfast every morning.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

14. I like to eat vegetables.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

15. I like to eat healthy food every day.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

16. My favourite snacks are cookies, candy, or cake.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

17. I try to eat food from the four food groups (vegetables & fruit, grain products, milk & alternatives, meat & alternatives) every day.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

18. You should not eat much food that contains lots of fat or cholesterol.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

19. When I am thirsty I like to drink a soft drink.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

20. When I am hungry after school I like to eat fruit or something good for me.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

21. It's ok to smoke if you don't inhale.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

22. Smoking is unhealthy

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

23. It bothers me if other people around me smoke.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

24. When I grow up I am going to smoke.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

25. I will not smoke because smoking causes disease.

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

Appendix 3

Wizards of Motion Knowledge Based Test

1. What is the leading cause of death in Canada?
a) car accidents
b) cardiovascular disease
c) diabetes
d) cancer

2. How big is your heart?
a) the size of your head
b) the size of your fist
c) the size of your foot
d) the size of your eye

3. What does athero mean?
a) block
b) porridge
c) before
d) soup

4. What does sclerosis mean?
a) stretching
b) slow
c) liquid
d) hardening

5. What does the term vascular refer to?
a) airways
b) blood vessels
c) muscles
d) the heart

6. Where does blood flow, even during exercise?
a) nerves
b) brain
c) stomach
d) kidneys

7. Where does plaque buildup when you have cardiovascular disease?
a) on the skin
b) inside the arteries
c) on the heart
d) in your hair

8. Why is cardiovascular disease referred to as a lifestyle disease?
a) everyone develops the disease
b) it is a lifelong disease
c) you can be born with the disease
d) you have the ability to prevent the disease through lifestyle choices

9. What happens if you develop atherosclerosis?
a) your muscles tighten when you exercise
b) you form a blockage in the artery
c) your blood flow increases through the arteries
d) you have more energy

10. **Which of the following behaviours will help to prevent the development of cardiovascular disease?**
a) Making healthy food choices
b) Reading about fitness
c) Playing computer games
d) Only drinking one glass of pop a day

11. What is blood pressure?
a) the pressure of blood inside the artery
b) the amount of blood you have inside your arteries
c) the amount your heart weighs
d) the amount of blood you can lose when you get a cut

12. How can high blood pressure be reduced?
a) by participating in regular exercise
b) by making healthy food choices and avoid fatty foods
c) by choosing not to smoke and avoiding second hand smoke.
d) all of the above

13. What can happen to a person who develops severe atherosclerosis and high blood pressure?
a) They will get a cold
b) They will suffer from a heart attack and possibly die
c) They may not be able to walk
d) They will have trouble speaking

14. How often should you participate in physical activity each week?
a) 5 minutes every day
b) At least 30 minutes every day
c) 20-30 minutes 3 days a week
d) 1 hour 2 days a week

Appendix 4

Title: Wizards of Motion: An Evaluation of An Elementary School Cardiovascular Intervention

Dear Parents/Guardians of Potential Participants:

My name is Kimberly Boardman and I am a graduate student at Lakehead University under the supervision of Dr. Moira McPherson. I am conducting a study on the evaluation of the Wizards of Motion Cardiovascular module.

The Wizards of Motion Cardiovascular Module is an 1 ½ hours enhanced science module designed for grade 5 students in Northwestern Ontario. This program is funded by the Natural Science Engineering Research Council Promo Science program and is designed to introduce the concepts of cardiovascular disease as a preventable lifestyle outcome. Scientific experts from Lakehead University visit Grade 5 classrooms with a portable, self-contained laboratory experience that focuses on the basic structures and functions of organs within the cardiovascular system while highlighting specific factors that contribute to a positive state of physical health. The Wizards of Motion curriculum links closely with the Ontario Ministry of Education's Grade 5 science curriculum while adding a health message.

The purpose of this study is to evaluate the effectiveness of the Wizards of Motion Cardiovascular Module. We hope that by completing this program, students will become more informed about the importance of healthy lifestyle habits in order to prevent cardiovascular disease; understand the basic structures and functions of the cardiovascular system and have the opportunity to develop a model of the cardiovascular system.

As a participant, the student will be asked to complete two questionnaires that survey their knowledge and attitudes towards healthy lifestyle habits and cardiovascular disease. A week later the students will then take part in the Wizards of Motion Cardiovascular Module. Two days after the presentation the student will complete the post questionnaires.

All personal data will be kept strictly confidential and all information will be coded so that your child's name is not associated with his/her results. Only the researchers will have access to the raw data. All data collected will be securely stored for five years with the Dr. Moira McPherson in the office of the Associate Vice President of Academics at Lakehead University.

There are no known harmful or potential risks to the participants involved in this study. In terms of potential benefits the following have been identified:

- The students will be given the opportunity to participate in a hands-on learning experience in the field of science and health.
- The students will be given some knowledge to help them make informed decisions regarding healthy lifestyle habits in order to prevent cardiovascular disease.

Your child's participation is voluntary and he/she may withdraw from the study at any time without any penalty. Students may choose to decline any question on the questionnaires. Students not willing to participate in this program, should not feel or experience any negative

repercussions with respect to future participation within their classroom. Therefore, no obligation is required for your child to answer any questions or to participate in any aspect of this project.

This study has been reviewed and approved by the Lakehead University Research Ethics Board, (File#), Office of Research, 1294 Balmoral Ave., (807)-343-8283. If you would like to receive more information about this study, review the questionnaires or the Wizards of Motion Cardiovascular module, please contact Kimberly Boardman, at (807)-343-1111 or Dr. Moira McPherson at (807)-343-8640.

Thanks for your assistance,

Kimberly Boardman
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Associate Vice President
(Academics)
Lakehead University
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Consent Form

Please ensure you and your child, have read and understood the following:

- I have read and understand the requirements of my child
- I am aware of the benefits and potential risk associated with this study as outlined in the cover letter
- Each participant is a volunteer and can withdrawal from the study at any time
- Individual data will be kept confidential for each individual student. Publication of results will not reveal the participant's identity
- The data will be securely stored for five years in the office of the Associate Vice President of Academics at Lakehead University
- By signing this consent you are giving permission for your child to participate in the study "Wizards of Motion: An Evaluation of An Elementary School Cardiovascular Intervention

Child's Name:_____ School Name:_____

□ I give permission for my child to participate in this study

□ I do NOT give permission for my child to participate in this study.

Signature of Parent/Guardian: _____ Date:_____

Signature of Child:_____ Date:_____

Appendix 5

Delivery Team Log

Question	Delivery Team Comments
Was there appropriate contact with the schools prior to your visit? Describe any issues/concerns.	- Yes there was appropriate contact make. No issues - Yes appropriate contact was made
Describe the space provided for the program. Describe the pros and cons for this location.	- The classroom size was a little small and crowded, which did not allow for students to move around the room - The classroom set up was great(science lab); students had sufficient space around their desks to move around
Describe any technical issues that arose during the presentation. Describe the issue and how it was resolved.	- Some of the rubber tubing from the lab activity leaked - Some of the rubber tubing leaked and some students needed to add additional 'blood' to their system in order to compensate for the lose
Was the program delivered as intended? Provide a description and reasoning for the necessary deviation.	- Yes the program was delivered as intended - Yes it was. There were no deviations from the delivery
Describe the student's reaction to the technology introduced in the program.	- Students were excited about the hands-on lab activity; they enjoyed pumping the 'heart' and seeing the 'blood' volume change - Students enjoyed the power point presentation and appeared to be engaged. The students got excited when they were building the model of the cardiovascular system and pumping the 'blood'
Describe how you (the delivery team) provided feedback to the students.	- After the presentation and lab activity one of the presenters did a wrap up of all of the material covered, including answering the students questions - At the end of the activity the main presenter wrapped up the presentation by orally quizzing the students on the material covered

Describe the interaction/collaboration which occurred between the students.	- Students worked in groups of 4; students wanted to each have a turn pumping the 'blood' - Students were put into groups of 4 or 5.
Describe the interaction which occurred between the students and the delivery team.	- There was a positive interaction between the students and the delivery team - The students had great communication with the delivery team.

Appendix 6

Wizards of Motion Teacher Log

Questions	Teachers Comments
1a) Have you taught your class the Life Systems: Human Organ System Unit to your class?	- I just started the unit but have not taught the circulatory system - We are starting the unit after you come in for the Wizards of Motion Cardiovascular Module - We started the unit last week - Not yet, we will be starting it this week
1b) If yes, have you taught the students anything about the cardiovascular system?	- Not yet - N/A - No - N/A
2) Are your students learning anything in Health and Physical Education class about prevention of cardiovascular disease (ie. Exercising, eating healthy foods and avoiding smoking)	- Not at the moment - The students get taught about exercise in physical education class - They will be as part of the Science Unit we just started - Not yet
3) Are there any programs being run in your school at the present time in relation to 'Heart Health'? If so, what programs.	- No programs at the present time - Not right now - Jump Rope for Heart convener spoke to the class last week - Jump Rope for Heart – students started to collect money