Cardiovascular Health Risk Profiling of Niagara Region Grade 9 Students:

Implications for Elementary Curriculum

Corey H. Canham, B.A. (Honours)

Department of Graduate and Undergraduate Studies in Education

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Faculty of Education, Brock University
St. Catharines, Ontario

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Abstract

The purpose of this study was to determine if Ontario’s health and physical education curriculum contributes sufficiently to ensure the health of our children and young adults. To determine the curriculum effect, the health risk profile of Niagara Region’s grade 9 students was compared to Canada’s adolescent population. All subjects completed a “Heart Health Lifestyle” survey and were measured for height, weight, percent body fat, blood pressure, and total cholesterol and performed the 20-metre shuttle run test as part of their physical and health education classes. The Niagara Region grade 9 population had a healthy risk profile. Aerobic power was inversely related, and cholesterol levels were positively associated to body mass index and percent body fat in the whole group analysis. These results indicate that physical education can offer unique and essential aspects allowing individuals a means to learn and control body movements and keep physically fit while providing protection against modern disease. Ontario’s health and physical education curriculum does contribute to the health of our children and adolescents; however, there is a need to implement a stronger mandate for daily vigorous physical activity.
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CHAPTER ONE: INTRODUCTION

Foreword

Coronary heart disease (CHD) is a growing problem in society and is the primary cause of mortality in Canada. More than 2 million people with CHD were discharged from hospitals in 1998 (American Heart Association, 2001). Men and women of all cultures, races, religions, and abilities are affected by CHD. There is a 1.5-15 times greater risk of morbidity and mortality after surviving a heart attack—within one year 25% of men and 38% of women will die. Within 6 years of the first myocardial infarction (MI) 18% of men and 34% of women will experience another heart attack; 7% of men and 6% of women will experience sudden death; 22% of men and 46% of women will be disabled with congestive heart failure (CHF); and 8% of men and 11% of women will have a stroke (American Heart Association).

Through many affecting causes, our vascular system has greatly degenerated. Often people who have had cardiovascular (CV) dysfunction do not have ill-affecting problems with their heart. Rather, the most likely cause is fatty deposits throughout the arterial system.

Over the past 200 years, the societal impact of the Industrial Revolution has caused much sedentary behaviour for the industrialized countries. Walking, bicycling, and horseback riding have been replaced by cars and public transportation. The active component of transportation has virtually been eliminated. Industrialization has also allowed for an easier work environment; there is less manual labour now than ever before.
Lifestyle habits have also greatly changed. Food production is much easier now than 200 years ago; there is more food produced with less effort. The daily average caloric intake has grown from 1,800 calories to 3,000 calories (Heart Niagara Inc., 2002); this tendency will continue to make individuals fatter. Furthermore, children are more often watching television, surfing the internet and playing video games instead of engaging in physical activity (Tremblay & Willms, 2000).

To aid in the appreciation of the severity of CHD, children and adolescents need to know the natural chronicity of CHD: the incubation, preclinical, and clinical phases (Kashani & Nader, 1986). The natural history of CHD begins in childhood—the incubation phase refers to the period from infancy to adolescence in which the initial fatty streaks and fibrous plaques develop in the arterial system (Kashani & Nader; Walter, Hoffman, Vaughan, & Wynder, 1988). The varying severity of the asymptomatic disease encompasses the preclinical (or latent) phase of CHD. The clinical phase of CHD is distinguished with signs and symptoms and often requires intervention.

Currently there is minimal CHD research providing childhood profile information, especially in Canada (Boreham et al., 1999; Twisk, Kemper, van Mechelen, & Post, 1997). In general, adolescence is a very influential period of life since many lifestyle habits are formed during this period. If CHD risk factors develop and are uncontrolled in the adolescent years, the likelihood of CHD development may be significantly enhanced later in life.
Atherosclerosis starts early in life, in the form of fatty streaks, fibrous plaque, proliferation of smooth muscle, and formation of atheroma (Misra, 2000). There are not any longitudinal studies that show the presence of fatty streaks in children as being a predictor of premature CHD (Vaccaro & Mahon, 1989); however, fatty streaks do precede atherosclerotic lesions and CHD. The presence of fatty streaks in the coronary arteries can be detected prior to 10 years of age; by 20 years of age, most people have evidence of fatty streaks (Vaccaro & Mahon).

Although the clinical phase of CHD does not usually occur until 50 years of age, CHD is a paediatric problem (Vaccaro & Mahon, 1989). The extrapolation of risk to children is speculative, but it may indicate potential CHD candidates in adulthood (Freeman, et al., 1990). Atherosclerotic development begins in childhood, perhaps even infancy (Garcia & Moodie, 1989), and develops rapidly between 15 and 34 years of age (Berenson, Srinivasan, Nicklas, & Webber, 1988; Kardia, Haviland, & Sing, 1998). The development of CHD throughout childhood exemplifies the need for primary prevention strategies.

Unfortunately, knowledge regarding the development of the disease from childhood to the clinical phase is inadequate (Weidner, Hutt, Connor, & Mendell, 1992). Many modifiable risk factors are largely determined by behavioural patterns established in childhood and adolescence. Although CHD effects are predominant during midlife, with an increasing prevalence in more elderly years, adolescents with high-risk behaviours may accelerate the clinical manifestations of CHD into the second decade of life (Boreham, Twisk, Savage, Cran, & Strain, 1997). Preventative approaches should be emphasized in the early years of child development; altering the behaviour of children
and decreasing the modifiable risk factors will help decrease the incidence of CHD (Iwata, Okada, Harada & Okuni, 1998).

Research Questions

The major research question:

1. Is Ontario’s Health and Physical Education curriculum contributing sufficiently to ensure the cardiovascular health of our children and young adults?

To answer this question, the following specific questions were posed and investigated:

2. What is the cardiovascular risk profile of Niagara Region grade 9 male and female students? The risk assessment includes genetic profile, smoking status, blood pressure values, lipid profile, body composition, and physical fitness, as measured by aerobic power.

3. What gender differences are adopted in the Niagara Region grade 9 students?

4. How does the risk profile of Niagara Region’s grade 9 students compare to Canada’s adolescent population?

If risk factors were less prominent in the Niagara Region compared to Canada, the Ontario curriculum would be sufficiently designed and implemented (locally) to support healthy behaviours. However, if risk factors were greater in Niagara Region, alterations to mandates should be implemented to enforce regulation of effective, healthy curriculum.
Children Need Healthy Development

Children need fundamental knowledge to make healthy lifestyle decisions. The framework for this development should increase knowledge and persuade children to attain a healthier outcome—thus hypothetically lowering CHD morbidity and mortality. The Health Belief Model (HBM) of behaviour change suggests that individuals will take action to control for ill health if they regard themselves as susceptible, if there are potentially severe consequences, if the course of action will reduce the susceptibility or the severity of the outcome, and if the anticipated barriers and costs will be outweighed by the benefits (Strecher & Rosenstock, 1997). Associating cues to action and the development of self-efficacy are important in the process of change; developing these concepts can be achieved by promoting awareness and providing guidance and training (Strecher & Rosenstock). Although not always an easy task, these goals may be attained in the school system through curriculum development.

It is easier to prevent the initiation of unhealthy behaviours than it is to intervene and reestablish new behaviours (Purath, Lansinger, & Ragheb, 1995). In accordance with the HBM, teaching practical skills, providing social supports, modifying play environment, and implementing school policies and public policies will help to instill and sustain healthy behaviours in children (Puska, 1985). Promotion of habits that reflect optimal risk should be directed to children, parents, teachers, and the community. Children and adolescents should be provided general health information, self-assessment services, and the necessary practical skills to achieve optimal health (Puska).
Prevention programs starting in childhood, prior to the onset of vascular change and before negative nutrition and exercise patterns are established, may reduce CHD incidence (Freeman, et al., 1990; Purath et al., 1995). Applying interventions into the school curriculum will help to reach a diverse group of potential CHD patients. It is imperative to place emphasis on childhood prevention and increase children’s awareness about healthy lifestyle choices (Joseph, Ang, Ngo, & Yim, 1996). It is also crucial to increase teachers’ knowledge about CHD—especially in regard to the susceptibility and severity of the affected population. Physical education teachers, health education teachers, and school nurses are in an excellent position (Purath et al.) to increase child and adolescent understanding and help to reduce the risk of developing characteristic traits related to CHD.

Frequent positive health messages directed to children may improve cardiac risk profiles and reduce the incidence of CHD as they develop into adulthood (Purath et al, 1995). Addressing the subject of physical activity should begin in preschool with school officials, teachers, and parents melding to promote daily physical activity. Most children this age are intrinsically active, but some are sedentary by nature (Francis, 1996). There is an inverse correlation between time spent watching television and the amount of physical activity performed. A restriction of 2 hours per day of television and video games should be enforced (Francis).

Community-based health education may serve the needs of children by providing comprehensive family health programs that are based in the school. Education and behaviour change in family members, especially exercise, diet, and smoking cessation, may be methods of providing the very important and much needed positive role modeling
for school-age children (Francis, 1996; Purath et al., 1995). Promoting regular walking, bicycling, and backyard playing as well as the use of stairs, playgrounds, gymnasiums, and interaction with other children is essential. Weekly participation in age-appropriate organized sports, lessons, and clubs; daily school or daycare physical education that includes a minimum of 20 minutes of co-ordinated large muscle activity; regular participation in household chores; and weekly family outings involving recreational activities are vital to an optimally healthy lifestyle for children (Francis, 1996).

By the age of 12, 30-60% of children exhibit at least one modifiable risk factor for CHD (McArthur, 1998) and there is development of the potentially reversible fatty streaks in childhood and adolescence (Misra, 2000). The recommended sodium, fat, cholesterol, and sugar intake is exceeded by 50% of children (McArthur). Lifestyle factors, primarily physical hypoactivity, diet, and cigarette smoking, influence the metabolic profile starting in childhood. There is direct correlation of extensive and complex arterial lesions to smoking, hypertension, diabetes mellitus, and dyslipidemia; these connections have been developed in young individuals from various populations and geographic locations (Misra). Educational interventions should begin prior to grade 6, before behaviour patterns become too resistant to change.

Hyperinsulinemia, dyslipidemia, hypertension, glucose intolerance and their clustering effects initiate in childhood (Misra, 2000). If adolescents are obese, the aforementioned risk factors often persist and worsen during the metamorphism to young adulthood—50-60% of overweight adolescents remain overweight adults (Misra). Lifestyle and behaviour factors that influence cardiovascular risk are learned and begin
early in life. Healthy lifestyles should be adopted in childhood because they are critical to modulation of risk later in life (Misra).

Cholesterol levels track well from 2-3 years of age to adulthood (Garcia & Moodie, 1989). Increased total plasma cholesterol levels in children often lead to adults with increased likelihood of CHD development (Garcia & Moodie). The beneficial qualities of screening all children have developed controversy: It has been suggested that only children with family history (FH) of premature CHD or known hyperlipidemia should be tested (Garcia & Moodie). Albeit, half of children with hyperlipidemia do not have a FH of CHD or dyslipidemia. This assertion thereby suggests programs should provide cholesterol testing to all children (Garcia & Moodie).

Cost of CHD in Canada

Cardiovascular disease (CVD), excluding childbirth, is the leading cause of hospitalization for men and women and the leading cause of death for over one-third of Canadians (Heart and Stroke Foundation of Canada, 1993). In 1993, the cost of CHD in Canada was $7.78 billion; the cost of CVD, direct and indirect costs, was $19.72 billion (Table 1; Canadian Institute for Health Information, 2002). According to the Advisory Board of the International Heart Health Conference (1992), cardiovascular disease is largely preventable. "We have the capacity to virtually eliminate this world-wide epidemic by applying what we know and working together" (Advisory Board of the International Heart Health Conference, p. 5).
Rationale

Although not culturally and socially perceived, there is minimal difference between the physical abilities of boys and girls during childhood (Brustad, 1997). Conversely, by grade 9, there are many differences between the male and female biophysical composition. During adolescence (normally 10-11 for girls and 12-13 for boys), the release of hormones develops height, lean body mass, and overall physical maturation—increased testosterone levels will often provide an increase of strength in boys. A precursor outline of CHD risk factors, followed by an analysis of these risk factors for Niagara Region’s adolescent population, will help to provide an understanding of the future health care needs, portray the efficacy of the current school system, and demonstrate the necessity of daily vigorous physical activity in the school setting.

There are many diverse physical, psychological, and social influences in movement settings. Individuals are constantly receiving unhealthy options such as smoking, drinking alcohol, and overeating (Colquhoun, 1990). The role of the media, perspectives on work and play, and age- and gender-related stereotypes add cultural influences; physical ability, race, gender, social economic status (SES), and economic and political climates also greatly influence movement settings (Brustad, 1997).

Considerations should also be made for the socially and culturally determined messages and assumptions regarding the meanings, beliefs, values, and presentation of health (Colquhoun, 1990). Health is a symbolic representation and association of daily experiences (Colquhoun). Physical ability has many gender-linked and cultural influences for males and females. Physical activity is more highly valued within male peer groups
(Brustad, 1997) while females perceive increased barriers to physical activity (Sheridan, Bedoya, Papadakis, & Reid, 2003).

People are often judged by their image (Colquhoun, 1990). Appearance and weight loss are the primary motives for women to participate in physical activity, but the same does not hold true for men (Brustad, 1997). Correspondingly, women experience considerable social disapproval in movement settings based on their body size, which then contributes to a heightened negative self-concept and inhibited and restricted involvement and willingness to participate in physical activity (Brustad).

The sole generation of new knowledge in human movement is no guarantee that we will enhance the amount or value of movement experiences for individuals (Brustad, 1997). Rather, to increase the quantity and quality of physical activity, there is a need for integrative, inclusive, and dynamic approaches to physical activity (Brustad). An analysis of Ontario’s Health and Physical Education curriculum will provide an understanding of the governmental view regarding the outline of expectations for physical activity. The analysis will also help assess, acknowledge, and recognize the role of the curriculum in the formation of students’ health profiles.

Overview

The literature review has defined risk factors and has developed an understanding of Ontario’s Health and Physical Education curriculum. The literature review also provides an understanding of CHD with its current research limitations and the basic development for this and future research. The methodology provides structure for the analysis of the principles and procedures regarding this inquiry into the grade 9 health
risk profile for CHD development. The results section includes descriptive and
correlational statistics to provide a risk factor value for this population. Conclusions are
inferred regarding the general health status of these adolescents and curricular persuasion
to healthy community development. Further to this, a sample lesson plan provides
teachers a resource to help communicate and facilitate a heart healthy lifestyle in the
classroom.
CHAPTER TWO: LITERATURE REVIEW

Risk Factors

Most risk factors are associated with behavioural characteristics—learned facets of life developed from the social networking of family and peers (Weidner et al., 1992). There are many biochemical and physiological factors that contribute to, encompass, and affect the potential risks of CHD development (Kardia et al., 1998). Biochemical and hormonal abnormalities are already apparent in a subset of patients (children and adolescents) before atherosclerotic lesions develop. Approximately 50% of CHD patients do not have any of the established risk factors detected in routine evaluation (Misra, 2000). Although the relationship is unclear, people with depressive disorders and anxiety have an increased mortality from CHD (Fava, Abraham, Pava, Shuster, & Rosenbaum, 1996).

Socioeconomic status (SES) and sociodemographic factors pattern CHD morbidity and mortality (Hunt, Davison, Emslie, & Ford 2000; Leino, Raitakari, Porkka, Taimela, & Viikari., 1999). Education is the most frequently used measure for SES (Leino et al.). There is an inverse relationship among education and other risk factors for CHD (Leino, et al.). The influence of SES variables found that education was in general inversely associated with hypertension, cigarette smoking, serum cholesterol, and body mass index (BMI) and is directly associated with physical activity (Cirera, Tormo, Chirlaque, & Navarro, 1998). This may partly explain the inverse relations observed between SES and both general and ischemic heart disease mortality (Cirera et al.).
An adverse environment in utero and low birth weight have been shown to be associated with increased prevalence of glucose intolerance, insulin resistance, and atherosclerosis in adult life (Misra, 2000). The adverse effect on the body's metabolism, partially mediated by genotype, will increase the likelihood of atherosclerosis earlier in life (Misra). Low birth weight may affect subsequent growth including the cardiovascular system; infant development hindered by one kilogram is equal to approximately 4.5 cigarette pack years—the equivalent of smoking one pack of cigarettes per day for 4.5 years (Leeson, Kattenhorn, Morley, Lucas, & Deanfield, 2001).

Men with diabetes have double the risk of nondiabetic men to develop CHD; diabetic women have three times the likelihood of nondiabetic women (Vaccaro & Mahon, 1989). Insulin resistance may cause hypertension through alterations in the cation transport. Hyperinsulinemia may result in vascular smooth muscle hypertrophy and narrowing of the lumen of resistant vessels, ultimately leading to hypertension (Rocchini, 1992).

Clustering of risk factors may be important. Many risk factors are closely interlinked and may have synergistic qualities. The effects of certain risk factors may be multiplicative rather than additive in nature (Akerblom, Viikari, Raitakari, & Uhari, 1999; Misra, 2000). There are very early gender differences in the metabolic interactions for body mass, lipoproteins, and blood pressure. The prevalence of risk factor clustering occurs more so in boys than girls (Akerblom et al.). Genetic coding, smoking, blood pressure, diet, percent body fat and body mass index (BMI), and activity level including aerobic power are the focused variables throughout this study.
Genetic Coding

Genetic coding has changed and adapted to make people "civilized" beings. Genetic inheritance has significant control for many functions and dysfunctions in our bodies (Heart Niagara Inc., 2002). Genes will describe the colour for hair and eyes, body stature, and have major impact on disease processes that may develop. Body size and lipid profile are discriminators of children with and without a family history (FH) of CHD (Kardia et al., 1998).

Genetic risk factors are nonmodifiable and include a diverse group: age, sex, heredity, and race. Approximately 80% of individuals who die of CHD are 65 years of age or older (American Heart Association, 2001). Men have a greater risk of a heart attack than do women; however, at older ages women have a greater risk of mortality from similar causes (American Heart Association). Children of parents with heart disease are at a greater risk of CHD development. African Americans, Mexican Americans, American Indians, native Hawaiians, and Asian Americans are at a higher risk than Caucasians to develop CHD (American Heart Association). People having a FH of premature CHD, who are elderly, and are hyperlipidemic have maximum aggravation (Misra, 2000).

Genetic disposition may enhance the possibility of CHD development. CHD is known to aggregate in pedigrees and is a significant predictor for disease development (Kardia et al., 1998). There is evidence of increased risk for people with first-degree relatives being patients of premature CHD (Misra, 2000); if a first-degree relative, prior to the age of 55 for males and 65 for females, has a myocardial infarction, the likelihood of developing CHD is greatly increased for the child (Vaccaro & Mahon, 1989).
Generally, children with elevated low-density lipoproteins (LDL) will have a familial cause (Reece, 1995).

A FH of hypercholesterolemia is transmitted as an autosomal dominant characteristic that has a gene-dosage effect (Kwiterovich, 1993). Family genetic traits that cause dyslipidemia occur in 1:200 to 1:500 of the population; this in turn increases the risk of CHD development: 1:20 by 30 years of age and 1:5 by 40 years of age (Garcia & Moodie, 1989). Family hypercholesterolemia is the most commonly recognized disorder of lipoprotein metabolism in children. One half of children with a parent with CHD will have some form of dyslipidemia; one third of children with a positive family history of CHD will have hyperlipidemia. A FH of hypercholesterolemia heterozygotes (1:500) produces plasma levels of total cholesterol and LDL that are elevated 2-3 times; homozygotes (1:1,000,000) are elevated 5-6 times greater (Kwiterovich). Although seemingly genetic, secondary hypercholesterolemia can be caused by diabetes, hyperthyroidism, diseases of the liver, medications (including oral contraceptives and anabolic steroids), alcohol abuse, obesity, and anorexia nervosa (Reece, 1995).

People with a perceived FH of CHD are more likely to ascribe lifestyle to be very important in limiting risk factors (Hunt et al., 2000). People do not usually have a fatalistic attitude towards CHD regardless of the presence of a perceived FH. Decisions about smoking may be understandable only in the context of an array of other perceived risks that are weighed and balanced against this perception (Hunt et al.).

Risk factors in children are generally increased if their parents' risk factors are greater (Vaccaro & Mahon, 1989). Dietary habits, smoking, and physical activity are learned within families (Klesges, Mallot, Boschee, & Weber 1986). Offspring in high
CHD-risk families favour saltier meals, have more adverse smoking behaviours, and have lower physical activity levels (Koski, Laippala, & Kivela, 2000). As well, family stress may be associated with unfavourable plasma lipid profiles; a definitive mechanism is unknown but may be due to poor eating behaviours (Weidner, Hutt, Connor, & Mendell, 1992) and cortisol levels (Granata, Bancroft, & Del Rio 1995). However, there are some individuals that can eat poorly, smoke, and lead a hypoactive lifestyle and not develop symptoms of CHD.

Lesser known genetic disorders also exist, including the rate of healing after trauma. The healing process is generally rapid in people. Coagulation is an essential part of the healing process. Without the necessary formation of blood clots, the slightest cut would be lethal. In earlier times, blood clotting would have been more vital as first aid kits were not readily available. Keloid tissues, more commonly known as scars, are also a normal facet of healing and are caused by an inflammation. Unfortunately, keloid tissue development can be detrimental if occurring in arteries; endothelial dysfunction exists early in life even without any known risk factors (Misra, 2000). The loss of endothelium-dependant dilation tissue will deplete and damage the elasticity of the artery (Heart Niagara Inc., 2002). Polymorphisms of adhesion molecules are associated with further risk—producing more severe atherosclerosis development (Misra). This process is most likely to occur in the preclinical phase of atherosclerosis and often occurs in men over 40 and women over 50 years of age (Misra).

It is possible to screen family members to determine if there is an individual problem or hereditary problem for a child with hypercholesterolemia (Reece, 1995). Atherosclerosis does not usually reach the clinical horizon until the fifth decade, at which
point prevention has been lost (Kardia, et al., 1998), but secondary intervention may provide assistance to people with developed risk factors (Berenson, 2002). Health promotion strategies need to be targeted at children and adolescents. This strategy will be effective when based on a clear understanding of cultural norms, health beliefs, attitudes, and practices (Hunt et al., 2000) and can be developed into school curricula.

**Smoking**

Cigarette use is the most preventable cause of morbidity and mortality (Purath et al., 1995). Smoking has been termed the most important risk factor for increased atherosclerosis development, independent of race and geography (Misra, 2000). Cigarette smoking is closely associated with the development and progression of CHD, premature mortality (Dallongeville, Marecaux, Fruchart, & Amouyel 1998; Kwiterovich, 1998), stroke, peripheral vascular disease, and aneurysm (Study Group, 1987).

Smoking is a modifiable risk factor that more than doubles the risk of CHD development and is the biggest risk factor for sudden cardiac death (American Heart Association, 2001). Smoking is a synergist with other risk factors to more greatly affect CHD incidence. All-cause mortality is twice more likely in smokers than in nonsmokers; as well, morbidity is also greatly increased (Vaccaro & Mahon, 1989). Cigarette smokers are two times more likely to die before the age of 65 and two times as likely to be hospitalized or off work because of sickness, including respiratory disease, cancer, and CHD (Study Group, 1987).

Smoking has ill-affecting consequences on many people: 39% of people 23 years of age, 36% of people 43 years of age, and 33% of people 63 years of age are current
smokers (Hunt et al., 2000). Smoking dysregulates lipid levels by altering lipoprotein metabolism (Dallongeville et al., 1998). Chronic smokers are more likely to be hypertensive and dyslipidemic (Misra, 2000). There is often an increase in triglycerides, total cholesterol, very-low-density lipoprotein (vLDL), and low-density lipoproteins (LDL) but a decrease in high density lipoproteins (HDL; Kwitterovich, 1993). Smoking also increases the amount of carboxyhemoglobin, clotting factor concentrates, and blood viscosity (Kwitterovich). There is an inverse relationship between cigarette smoking and blood pressure, particularly with the systolic reading (Boreham et al., 1999). Body fatness is inversely related to smoking, creating a paradox because smoking is regarded as atherogenic while reduction of body fat is cardioprotective (Boreham et al.).

Smokers have unhealthy patterns of nutrient intake compared to nonsmokers. There is a positive relationship between increased alcohol consumption, fat, saturated fatty acids, and cholesterol intakes (Dallongeville et al., 1998). Smokers consume more fat: increased amounts of saturated fat and lower amounts of polyunsaturated fat. Smokers also consume more alcohol, less fibre, less vitamin C and E, and less β-carotene, all conducive to an increased risk of CHD (Dallongeville et al.). Ironically, smoking increases the need for antioxidants, further compounding the risk (Dallongeville et al.).

Cigarette smoke exposure is associated with a marked decrease in monoamine oxidase, an enzyme associated with mood function that may dysregulate appetite and attitudes toward food. Also, modification of taste sensation may lead smokers to prefer certain types of food (Dallongeville et al., 1998).
Nicotine is a highly toxic alkaloid that is a ganglionic stimulant and depressant. Nicotine effects are mediated by the release of catecholamines (Dallongeville et al., 1998). Cigarettes contain nicotine and other toxic substances that adversely influence blood pressure, heart rate, lipid levels, insulin resistance, and other metabolic parameters, thus accelerating the development of atherosclerosis (Misra, 2000).

There is currently no evidence supporting nicotine metabolism as a major determinant of an individual's smoking behaviour and exposure to tobacco smoke (Tricker, 2003). However, experimentation with smoking does occur in elementary school-age children and is influenced by peers and adults (Purath et al., 1995). Modest cigarette smoking in late adolescence may have long-term atherogenic consequences (Boreham, Savage, Primrose, Cran, & Strain 1993). Those in a poorer SES are more than twice as likely to smoke (Hunt et al., 2000). Current smoking habits are inversely related to perceptions of FH of CHD. Health promotion initiatives need to address these attributes and perceptions (Hunt et al.).

Young smokers are more often physically hypoactive and are greater users of alcohol than nonsmokers (Misra, 2000). The amount and duration of smoking is inversely related to activity and participation in regular vigorous exercise (Raftopoulos, Bermingham, & Steinbeck, 1999). Early use of tobacco, alcohol, and other recreational drugs are associated with subsequent abuse of those products later in life (Purath et al., 1995).

The compounding risk factors associated with smoking are gravely detrimental to the health of children, adolescents, and adults. Further health promotion strategies targeting children and adolescents are crucial. Confronting smoking is essential in order
to reduce deaths from cancer and heart disease (Hunt, 2000) and can be addressed in school curriculum.

Hypertension

In 2001, there were 3.25 million people with hypertension in Canada (Canadian Institute for Health Information, 2002). Blood pressure is determined by the amount of blood pumped, by the actions of the heart, and by the size and condition of the arteries. Hypertension is a risk factor in CHD development as it may cause distress throughout the body’s vasculature. Greater forces and pressures within the vasculature may cause disturbances and damage to internal organs and be potentially life threatening. Usually hypertension produces silent symptoms; however, consequences predominantly to the eyes and kidneys are regularly observed. Occipital headaches, dizziness, lightheadedness, vertigo, tinnitus, dimmed vision, and atherosclerotic lesions in the kidneys are some of the more common complications associated with hypertension. It is important to detect and treat hypertension before considerable organ damage occurs (Vaccaro & Mahon, 1989).

Blood pressure (BP) in children is lower than adults, dependent on their body height and weight (Berenson et al., 1988). Hypertension in children is defined as having a systolic blood pressure (SBP) greater than 135 millimeters of mercury (mmHG) or a diastolic blood pressure (DBP) greater than 85 mmHG (Kwiterovich, 1993); in adults, SBP of 140 mmHG and DBP of 90 mmHG are considered hypertensive.

Hypertension is potentially an inherited trait. Hypertension and FH of hypertension represent legitimate risk factors for CHD; however no evidence can directly
link CHD mortality to hypertension in childhood (Vaccaro & Mahon, 1989). Essential hypertension may begin at a young age; early detection is important (Vaccaro & Mahon). Tall or obese children are more likely to be hypertensive individuals (Kwiterovich, 1993). Hypertension is an important complication of childhood obesity and adult obesity (Kien, 1990).

Diet and activity level are related to BP. Sodium sensitivity seems to be an inherited trait, and incidence of hypertension is increased where FH is prevalent (Kien, 1990). However, there is a correlation between sodium intake and BP; obesity may enhance the sensitivity of BP to sodium intake (Kien). Aerobic activity has been found to produce little change in the blood pressure of children who are normotensive at the onset of training (Vaccaro & Mahon, 1989). Obese and hypertensive children who lost weight with diet and exercise were able to lower their blood pressure (Vaccaro & Mahon).

Some lifestyle patterns developed in childhood may predispose adults to developing CHD (Purath et al., 1995). Diet, smoking, obesity, and physical activity are risks that influence blood pressure (Purath et al.). It is essential to engage teachers to promote a healthy lifestyle. Delivery of appropriate curriculum and providing teachers with the appropriate tools will promote the necessary knowledge about healthy living and will purport healthy perceptions regarding the susceptibility and severity of CHD.

**Lipid Profiling**

Blood lipids are insoluble in blood plasma and must combine with protein molecules (lipoproteins) to be transported (Vaccaro & Mahon, 1989). Lipoproteins are essential in many bodily processes, including sexual maturation, but are biochemical risk
factors for atherosclerotic development (Misra, 2000). There is controversy surrounding the efficacy of lipid profiling for all children (Garcia & Moodie, 1989). If the diagnosis of hypercholesterolemia is to be sought, it is essential to have at least two consecutive elevated readings; it is also important to define total cholesterol (TC) and high-density lipoprotein levels (Kien, 1990).

Risk-related behaviours initiated in childhood and tracking to adulthood contribute to CHD (Raftopoulos, et al., 1999). Moreover, within populations, individuals tend to stay at a similar level of total serum cholesterol for long periods of their lives. An individual in the 90th percentile has 40% likelihood to still be in the 90th percentile 10-20 years later in life (Francis, 1996).

Early coronary artery lesions can be seen in an autopsy in at least 17% of infants (Paç et al., 1992). Grossly visible fatty streaks can be seen in the aortas of children after age 3 and are found in the coronary arteries beginning in the second decade of life (Berenson, 2002; Bereson & Srinivasan, 2001). Fatty streaks have been frequently observed in the coronary arteries of children as young as 10 years of age and are associated with arteriosclerosis in adults (Francis, 1996). Approximately 75% of obese children have three or more risk factors for CHD (Paç et al.).

Young adults with a low TC have a decreased risk for atherogenicity and a diminished capacity to supply cholesterol to cells (Iribarren et al., 1996). Dyslipidemia and obesity are the primary risk factors from childhood that often carry over into adulthood (Misra, 2000). Hyperlipidemia is a major risk factor for CHD development (Garcia & Moodie, 1989; Vaccaro & Mahon, 1989).
Lipoprotein complexes are classified by size and density of the molecule: high-density lipoprotein (HDL), low-density lipoprotein (LDL), and very-low-density lipoprotein (vLDL). There is a cardio-protective effect with increased levels of HDL. Apolipoprotein A-1 is the primary HDL molecule in the metabolism of cholesterol. The function of HDL is to transfer cholesterol away from the cells in the peripheral vasculature, to the liver, to be metabolized and excreted. This process helps to decrease cholesterol accumulation in arterial walls and aids the reduction of CHD incidence (Crook, Godsland, & Wynn, 1991; Gutierrez-Fuentes, 1996; Iribarren et al., 1996; Shikany & White, 2000; Vaccaro & Mahon, 1989). HDL can be genetically conditioned, but diet and physical activity are large determinants: A 0.025 mmol increase of serum HDL will decrease CHD risk by 2-3% (Shikany & White). LDL is a transport mechanism bringing essential cholesterol and nutrients to cells and is the particle responsible for increasing total cholesterol. Apolipoprotein B is the primary LDL molecule; it has a high affinity to liver cells and vascular beds (Gutierrez-Fuentes; Iribarren et al.). Increased levels of LDL and vLDL will cause an increased risk for CHD development.

There is an inverse relation with HDL levels and CHD development (Vaccaro & Mahon, 1989). Increased plasma LDL is a major risk factor for the attainment of CHD (Crook et al., 1991); however, non-HDL cholesterol may be a better predictor of CHD risk (Srinivasan, Myers, & Berenson, 2002). There is a good correlation between LDL levels in childhood and adulthood (Misra, 2000). Lowering TC will lower the incidence of CHD (Garcia & Moodie, 1989). Respective to the aforementioned risk, the ratios of TC : HDL and LDL : HDL may be more important.
Many biochemical and biophysical relations may adversely or beneficially affect lipoprotein values. The reduction of LDL in middle-aged men reduces incidence of CHD, although it does not affect mortality (Crook et al., 1991). White males with increased TC levels demonstrate a greater risk of attaining CHD (Iribarren et al., 1996). Insulin is strongly and positively correlated to serum triglyceride and vLDL levels; however is negatively associated with HDL levels (Misra, 2000). Obesity is commonly associated with decreased levels of HDL (Gutierrez-Fuentes, 1996).

Lipid concentrations change throughout the menstrual cycle. There is an increase in TC and LDL before ovulation and an increase in HDL at ovulation. There are more favourable TC : HDL and LDL : HDL during periovulatory and midluteal phases that are likely due to the fluctuation in sex steroid concentrations (Merz-Demlow et al., 2000). Oral contraceptives may modulate and alter lipid and insulin metabolism. As well, postmenopausal women show a 50% reduction in CHD by increasing HDL levels (Crook et al., 1991). For women, readings may not clearly reflect cholesterol levels; as such, reevaluation of samples may be necessary before diagnosis is specified.

Physical activity is consistently reported to be inversely related to TC: HDL in adolescents (Raftopoulos et al., 1999). Activity level may be the primary effect on plasma lipid levels in physically fit individuals involved in regular, high volume, endurance activities (Sternfeld et al., 1999). Active adolescents have significantly lower serum insulin and triglyceride concentrations, more beneficial TC : HDL levels, and are less likely to smoke (Akerblom et al., 1999).

More active and fit people have higher HDL. People with lower fitness levels have increased TC, LDL, and triglycerides as well as a reduced HDL. Effects of exercise
on plasma lipoproteins depend on intervening variables: body weight, amount and type of exercise, as well as gender; however, a decrease in LDL is rarely observed except with substantial body weight decreases (Sternfeld et al., 1999). There is conflicting information on the effects that experimental manipulation of exercise has on blood lipid levels in children (Vaccaro & Mahon, 1989).

Exercise and increased amounts of dietary fat are known to increase plasma HDL while increasing carbohydrate intake lowers plasma HDL (Sternfeld et al., 1999). Dietary fat causes an increase in serum cholesterol (Kien, 1990): Saturated fatty acids increase serum LDL but do not alter HDL levels; trans (hydrogenated) fatty acids increase LDL and decrease HDL; monounsaturated fatty acids decrease levels of LDL when substituted for saturated fatty acids but have no effect on HDL; polyunsaturated fatty acids have a lowering effect for LDL and HDL (Gutierrez-Fuentes, 1996; Shikany & White, 2000).

Saturated fatty acids, carbohydrates, and alcohol increase serum cholesterol levels. Carbohydrates lower the HDL levels if substituted for polyunsaturated and monounsaturated fatty acids (Gutierrez-Fuentes, 1996). Increased triglyceride levels caused by increased carbohydrate diets suggest that diet has a primary effect on cholesterol levels (Brown & Cox, 1998). In children, an increased level of total serum cholesterol may be lowered solely by dietary changes (Reece, 1995).

Healthy cholesterol profiling is important for children and adults alike. It is essential to engage students in a curriculum that promotes healthy lifelong behaviours. Integration of various heart health topics will promote the necessary knowledge regarding healthy living and will purport autonomy in lifestyle choices.
Diet

Nutrition encompasses growth, weight change, biochemistry, and metabolism. It impacts on the cardiovascular system, ensuring adequate delivery and circulation of nutrients (Kien, 1990). Diet is not a risk factor for CHD development, but rather a risk factor modifier—it does impose on and influence many other risks. The breadth of this topic extends beyond the horizons of this paper and is greatly limited to a brief outline.

Alcohol effects on mortality and CHD is a J-shaped curve (Shikany & White, 2000). Ethanol intake has been associated with both physiologic changes in the cardiovascular system and with cardiovascular risk factors (Braun, Wagenaar, & Flack, 1995). Low and moderate levels of alcohol have an unclear relation; however, more than three drinks per day are associated with hypertension (Braun et al.). As a result of excessive intake, increased heart rate, atrial and ventricular arrhythmias, and structural changes in the heart have been recognized (Braun et al.).

Fat is essential in a well-balanced diet: It provides satiety in meals, carries high amounts of energy in small volumes, and is vital for children with limited intake capacity but extraordinary energy needs. Essential fatty acids (FA) help mature the central nervous system including visual development and intelligence. A low intake of essential FAs may cause abnormal platelet aggregation, hypertension, abnormal glucose metabolism, atherosclerosis, and hyperlipidemia (Lifshitz & Tarim, 1996). Low fat diets, less than 25% of calories per day, may lead to inadequate nutrient intake and stunted growth. However, mild to moderate clinically supervised restrictions in dietary fat can be encouraged to achieve health benefits without impairing growth or nutrient deficiencies (Lifshitz & Tarim).
In general, visual assessment is adequate for detecting clinically important obesity: 80% of children who appear obese will have triceps skin fold measures greater than the 85th percentile (Kien, 1990). Obesity, often caused by excessive food consumption, in adults is an important risk factor for chronic diseases and increases the mortality of CHD. Obese children have abnormally high levels of lean body mass and fat mass; the increased risk of CHD may be caused by high levels of circulating LDL, total cholesterol, triglycerides, and lower HDL (Kien).

Macronutrient and type of food intake have vast implications on CHD risk. A high-carbohydrate diet can increase LDL and lower HDL, therefore increasing the risk of developing CHD (Lin et al., 2000). A high complex carbohydrate and high fibre diet is effective in reducing plasma cholesterol levels and blood glucose concentration (Study Group, 1987). The intake of dairy and animal products is likely to increase fatty plaques, causing atherosclerosis, and vasoconstriction (Heart Niagara Inc., 2002). Fat intake during childhood is related to the incidence of fatty streaks in the aortas of children and adolescents (Francis, 1996). Margarines and vegetable shortenings are sources of trans-fatty acids and are associated with an increase in CHD risk (de Roos, Schouten & Katan, 2000).

Consumption of dietary fat, especially saturated fat, is highly associated with obesity, insulin resistance, and dyslipidemia (Misra, 2000). Recommended values are exceeded by many children. If excess consumption of dietary fat is clustered with smoking, hypoactivity, and obesity, the risk of developing dyslipidemia and hypertension in adolescence is 5.5 times greater (Misra).
Instilling healthy eating behaviours in children is essential. Providing education to allow for comprehension in quantity and quality of food is important. People are not inherently knowledgeable regarding macronutrient sustenance, nor the type and amount of fat that is required for hormone processes to function adequately, nor the essential balance of micronutrients. Curriculum should be focused, allowing children some autonomy in food choices while instilling adequate comprehension of healthy choices.

**Body Composition**

Obesity is a serious nutritional problem contributing to increasing CHD morbidity and mortality (Rocchini, 1992; Saw & Rajan, 1997). The prevalence of obesity has dramatically increased, especially in childhood and adolescence (Kwiterovich, 1993). Excess weight in adolescents correlates significantly with excess weight during adult life; childhood obesity leads to 30% of adult obesity (Saw & Rajan). Obese adolescents have a lower life expectancy than leaner individuals, with a greater incidence of CHD (Raftopoulos et al., 1999).

The aetiology of childhood obesity is complex. Obese adults are more likely to have been heavy children; however, many overweight children are normal weight as adults (Kwiterovich, 1993). Up to 40% of body fatness can be attributed to genetic inheritance (Saw & Rajan, 1997) but metabolic disturbances contribute significantly (Vaccaro & Mahon, 1989). Environmental factors influence childhood obesity: Cultural background, SES, and overeating are primary concerns, albeit fat children are less active than lean children (Vaccaro & Mahon). Moreover, obesity is often influenced by
prolonged increased dietary calories and a reduced amount of physical activity—an unbalanced energy intake and output (Joseph et al., 1996).

Percent body fat and body mass index [BMI—weight (kg) divided by height (m²)] are related to obesity and being overweight. BMI is widely used and has a correlation of 0.7-0.8 with body fat measure by body density (Saw & Rajan, 1997); it has a high specificity with variable sensitivity (Tremblay & Willms, 2000) and allows for comparisons between different populations while being independent of height (Saw & Rajan). Since 1966, a systematic and substantial increase in BMI has been observed for boys and girls aged 11-19 years: BMI has increased at a rate of 0.1 m·kg·m⁻² from 1981 to 1996, with obesity more than doubling (Tremblay & Willms).

Canada does not have a system to monitor the prevalence of obesity among its children and youth (Tremblay & Willms, 2000). The World Health Organization (WHO) determines obesity by BMI: Adolescents less than 14 years of age should be less than 20 kg·m⁻²; 15 years of age should be less than 25 kg·m⁻²; 16 years of age and up should be less than 28 kg·m⁻² (Joseph et al., 1996; Shikany & White, 2000). Unfortunately, BMI is confounded by frame size, which accounts for up to 20% of weight for children the same height, and BMI cannot distinguish between lean body mass and fat mass (Saw & Rajan).

Obese children who become obese adults have a more severe obesity than those adults whose obesity started in adulthood. The former of the individuals have a higher proportion of body fat with an increased fat cell size (Saw & Rajan, 1997). Obesity is more common in males with a low SES (Joseph et al., 1996) and black females (Berenson, Srinivasan, & Bao, 1997).
Obese adolescents have an increased number of risk factors for CHD (Becque, Katch, Rocchini, Marks, & Moorehead, 1988); 97% of obese adolescents have four or more risk factors (Rocchini, 1992). As well, obesity serves many consequences: increased adipose tissue distribution, hypertension, poor lipid profile, glucose intolerance leading to non-insulin-dependant diabetes, decreased pulmonary function, and lower levels of physical activity and physical fitness (Kwiterovich, 1993; Matsuzawa et al., 1995; Rocchini; Saw & Rajan, 1997; Sternfeld, et al., 1999; Vaccaro & Mahon, 1989) are regularly associated with excessive body fat.

In adults, centrally deposited fat in the abdominal cavity seems more harmful to cardiovascular health than fat stored in other parts of the body (Gutin et al., 1994; Matsuzawa et al., 1995). In children, the relationship of fat distribution to risk factors seems to become apparent only in the late adolescent years (Gutin et al.). Obesity, particularly in people with high abdominal fat, generates more adverse metabolic profiles, especially glucose intolerance and dyslipidemia (Misra, 2000).

People with excess body fat are more likely to develop CHD even if they have no other risk factors. Excess weight increases the strain on the heart, raises blood pressure, and elevates blood cholesterol and triglyceride levels (American Heart Association, 2001). Losing 10 to 20 pounds may significantly lower CHD risk (American Heart Association).

Excess body weight and fatness relate both to adverse changes in serum lipoproteins and to higher blood pressure (Berenson et al., 1988). Girls with a BMI above the 90\textsuperscript{th} percentile had significantly higher TC : HDL ratio (Raftopoulos et al., 1999). Increased TC, LDL, vLDL, and triglyceride levels, as well as decreased HDL levels are
often observed in obese individuals (Vaccaro & Mahon, 1989). Maintaining healthy diet and exercise programs will aid in the reduction of weight and has been shown to be effective in providing a healthier risk profile and normalizing cholesterol values (Becque et al., 1988; Vaccaro & Mahon).

Obesity acts as a gauge of overall physical condition, nutritional state, and activity level (Berenson et al., 1988). As well, there are social and psychological consequences related to being overweight. Obese individuals are less likely to be married and are likely to complete fewer years of school (Saw & Rajan, 1997). Caloric restriction, increased amounts of physical activity, and spending less time watching television are modifiable behaviour patterns that need to be addressed. The involvement of parents and schools through education and behaviour modification is also very important (Saw & Rajan). Health promotion programs directly focused on children and adolescents are society’s best hope to reduce the incidence of obesity-related CHD.

**Physical Activity**

Hypoactive lifestyle is a consequence of technological development and is a risk factor associated with increased incidence of CHD (Adamopolous, et al., 1993). Physical activity is beneficial, often producing a decreased morbidity and mortality through direct influence on the cardiovascular system—active people have lower risk profiles (Raitakari et al., 1994). There is an inverse relation with physical activity and obesity, cigarette smoking, low HDL levels, high TC and triglyceride levels, hypertension, and glucose intolerance (Adamopolous et al.). These relations are established for adults and provide
weak and nonsignificant values for children; however, they can be used to establish risk to evaluate the potential protection against future CHD development (Anderson, 1996).

**Definitions For Physical Activity**

Physical activity is any bodily movement produced by skeletal muscles that results in increased energy expenditure. Exercise is planned, structured, and repetitive bodily movements done to improve or maintain one or more components of physical fitness. Physical fitness is a set of attributes that people have or achieve that relates to the ability to perform physical activity (Anderson, 1996; Francis, 1996) and includes aerobic power—the body's utilization of oxygen during exercise.

**Physical Activity Research**

Regular physical activity protects against CHD in both males and females (Blair, 1993; Kwiterovich, 1993; Morris, 1994; Pate et al., 1995; Riddoch, Savage, Murphy, Cran, & Boreham 1991). It is important for already active individuals to prescribe to a maintenance program to preserve reduced morbidity (Abbott et al., 1989; Ekelund et al., 1988). The relative risk of mortality from a myocardial infarction is approximately twofold greater for hypoactive compared to regularly active men and women. More specifically, there are many benefits of regular aerobic exercise: improvement of myocardial circulation, including vascularization (Laughlin, Overholser, & Bhatte, 1989); improvement of mechanical efficiency of the heart, including beneficial changes of heart rate, blood pressure, and ejection-fraction (Paffenbarger, Hyde, Wing, & Hsieh, 1986; Scheuer, 1982); maintenance of favorable homeostatic blood-clotting mechanisms
(McArdle, Katch, & Katch, 1996); normalization of blood lipid profiling for individuals (Fang, Sherman, Crouse, & Tolson 1988); and achievement of a more desirable body composition, including fat distribution (Walter et al., 1988).

CHD is seldom seen in childhood, but risk factors have been observed in children (Freedson, 1992). Hypoactivity in childhood is a determinant of the frequency of physical activity in adulthood (Francis, 1996; Misra, 2000). Children should be regularly physically active so they can carry this characteristic throughout their life (Freedson).

Overall, premature mortality is substantially less common in active people than in sedentary people (Study Group, 1987). The protective effect is related to total energy expenditure during regular bouts of physical activity, more so than sporadic bouts of high intensity activity (Riddoch et al., 1991). Participation in vigorous physical activity for at least 30 minutes per day, 3 days per week, is recommended for cardiorespiratory fitness. However, physical activity below this level can be beneficial in decreasing the risk of CHD but may not develop maximal aerobic power (Francis, 1996). With respect to the guidelines, it should be noted that exercise is not without hazard. Musculoskeletal dysfunction and CHD events, including sudden death, are more common during and immediately after exercise than at rest (Study Group). It is essential to consider preexisting factors: age, physical fitness, musculoskeletal problems, cardiorespiratory conditioning, and vascular health.

Physical activity can be considered a health-related behaviour in adults (Freedson, 1992). Hypoactive lifestyle has been reported to be the most prevalent modifiable risk factor, followed by cigarette smoking (Francis, 1996). Blood lipids, blood pressure, body mass, and physical fitness have physiological interrelations with physical activity patterns
(Walter et al., 1988). It is not known whether physical fitness exerts an independent effect on CHD risk beyond its effect in reducing the aforementioned risk factors (Gutin et al., 1994).

Physical activity seems to modify biological risk factors including lipid profile, insulin resistance, and adiposity (Raitakari et al., 1994). In adults, greater physical activity is associated with decreased CHD risk profiles (Misra, 2000). This phenomenon is believed to be mediated through its effects on other risk factors, especially the lipid profile and glucose tolerance (Raitakari et al.).

In young subjects, increased physical activity will aid in the development of a beneficial lipid profile. As well, physical activity will decrease serum insulin levels and reduce blood pressure (Misra, 2000). Also, increasing leisure-time physical activity can be used to predict an increased HDL (Misra). With three 30-60 minute sessions of exercise per week at 60-70% of maximum heart rate, nonobese children had increased HDL and TC : HDL more than their obese counterparts (Vaccaro & Mahon, 1989). Physical activity and sport participation aid healthier lipid profiles and are associated with lower SBP, reduced fatness, and more efficient cardiorespiratory fitness (Boreham et al., 1997).

Greater physical activity is associated with lower blood pressure (Misra, 2000). Hypertension and diabetes often require medication, but most other risk factors can be improved with behaviour modification in diet and increased physical activity. Evidence suggests regular physical activity alone may alter all risk factors, including hypertension and diabetes (Vaccaro & Mahon, 1989).
Physical activity is an important determinant of obesity in childhood and adult life (Misra, 2000). There is observably less leisure-time physical activity by young, obese students with hypertension than in normotensive individuals (Misra). Obese children have a very low level of physical activity and are less active than lean children (Vaccaro & Mahon, 1989). An increase in physical activity will help to decrease body fatness. The later into adolescence a person remains obese, the more likely they will remain obese as an adult: This warrants interventions based in childhood development to encourage healthy lifestyles (Vaccaro & Mahon).

Hypoactivity is likely to increase levels of obesity and decrease longevity in otherwise healthy people. Lean men have increased longevity only if they are physically fit; obese-fit men are less likely to die from CHD than lean-unfit men; obese and unfit individuals have the highest risk of CHD development (Lee, Blair, & Jackson, 1999).

Physical activity is important in obesity and insulin resistance in childhood and adult life (Misra, 2000). Body fat is inversely correlated with peak maximum aerobic power and glucose levels and positively correlated to triglyceride levels (Gutin et al., 1994). It is important to develop and evaluate regular exercise and diet interventions to help obese children (Gutin et al.).

**Physical Fitness**

In adults, cardiorespiratory fitness is now accepted as a strong independent risk factor for CHD; higher cardiorespiratory fitness levels are associated with favourable risk profiles in children, adolescents, and young adults (Boreham et al., 1997). Aerobic activity is well accepted as a preventative action in CHD development but, 71% of
children fall below the aerobic endurance standard (Vaccaro & Mahon, 1989). Regular exercise by children will produce many effects: increase ventilatory threshold, decrease myocardial oxygen demands, promote the formation of collateral coronary circulation, increase coronary vessel diameter, improve myocardial function, and increase maximal aerobic power, but it does not result in increases in dimensional and functional components of the cardiorespiratory system (Adamopolous et al., 1993; Vaccaro & Mahon).

Physical activity is beneficial for developing positive physiological attributes; however, maximal aerobic power is largely inherited (Freeman, et al., 1990). Genetic factors represent 25% of aerobic power and may limit the upper level that an individual may achieve by training (Anderson, 1996). A decrease in physical activity, an increase in body weight, an increase of disease development, and a decrease of maximal heart rate (biological aging—approximately one beat per year) negatively affect maximal aerobic power (Anderson).

Increased physical activity and physical fitness are inversely related with most risk factors. Endurance athletes have decreased plasma triglycerides and increased HDL compared with an untrained counterpart (Hurley, 1989). Although aerobic training is successful in lowering triglyceride levels and increasing HDL in healthy male and female CHD patients, there is not a consistent TC or LDL lowering effect reported from aerobic training (Hurley). The mechanisms of change may be relative to a change in sex hormones, increased insulin sensitivity, and increased lipoprotein lipase level (Hurley).

Physical fitness other than aerobic endurance may also guard against CHD (Hagan, Parrish, & Liccardone 1991). Improvements in strength, muscle endurance, body
composition, flexibility, self-image, and longevity can result from levels below the recommended requirements for cardiopulmonary fitness (Riddoch et al., 1991). Anaerobic capacity and muscular endurance also protect against CHD (Hagan et al.).

There is a decreased incidence of CHD in males who engage in intense muscular activity. Resistive training, two sets, 12 exercises, 10-15 repetitions, three times per week for 20 weeks, improves CHD risk factors by lowering LDL from 5-39% and increasing HDL 10-15%; these values are similar for aerobic training. As well, resistive and aerobic training provide similar improvements in glucose tolerance and insulin sensitivity (Hurley, 1989). CHD risk is often similar for endurance- and strength-trained athletes: Controlling for age, body fat, and anabolic-androgenic steroid use, body-builders have similar lipid profiles to runners; however, power-lifters have a lower HDL and increased LDL, possibly caused by varying diets, training regimens, and genetics (Hurley).

A hypoactive lifestyle clusters adverse behavioural risk (Raitakari et al., 1994). There is uncertainty about the relationship that risk factors have to each other and which risk factors are most important (Vaccaro & Mahon, 1989); however, hypoactivity worsens metabolism, especially in sedentary individuals. Obese and unfit individuals have the highest risk of CHD development (Lee et al., 1999). The metabolic effect of physical activity may be also influenced by genetics and diet (Misra, 2000).

**Educational Link**

Grade 9 provides the last mandatory component of curricular influence in regards to physical activity and lifestyle habits. Maintenance of a physically active lifestyle is not an easily modifiable behaviour. Long-term, multidimensional curricular and public health
campaigns directed at increasing quality daily physical activity may be required to
significantly impact the activity level of children, adolescents, and adults. “Although such
efforts are not without cost, they have potentially greater social benefits in terms of
disease reduction and health promotion” (Sternfeld et al., 1999, p. 27).

**Pedagogical Foundations**

The best inroads are developed when autonomy in the students develops, and self-
selection is the motivating vehicle for healthy lifestyle decisions—to be free from eating
disorders and the use of illicit drugs, including cigarettes, is crucial. Healthy lifestyle
choices, including regular physical activity, are important foundations for adolescent
development because of the relationship with adult risk factors (Anderson, 1996; Riddoch et al., 1991). Given that children are no more likely to learn from or act upon health
information than adults, it is necessary to utilize intrinsic motivation and encourage
positive attitudes in children to become physically active and to create positive
experiences for children in health education, physical education, sports, and exercise
(Riddoch et al.). Part of the development should include learning rules and skills
necessary to play sports and games, creating new games by altering primary aspects
within already developed activities, and establishing a desire to participate by allowing
fun with and without competition. Increasing self-efficacy within children for sport and
play is also essential. Lifestyle education, within an advanced curriculum, will help to
provide skills and knowledge to incorporate healthy diet and exercise patterns into daily
life (Gutin et al., 1994).
Ontario's Health Physical Education Curriculum

"Movement participation does not occur in a cultural vacuum" (Brustad, 1997). Gender appropriateness of various forms of physical activity is predominant even during childhood and adolescence; male and female participatory involvement is clearly influenced by cultural beliefs. Physical activity needs to be recognized as a purposeful and personally meaningful experience (Brustad).

Curriculum is a foundational component of the educational system. It is the basis for classes throughout primary and secondary schooling, at the college and university level, in graduate level courses, and for most recreational courses. Curriculum represents the political bias of learning needs—sometimes more obvious than other times. Hidden curriculum can be determined by critical analysis and only with the entire program implicated in the process.

The Ontario Health and Physical Education curriculum, grades 1 through 9 (Ministry of Education and Training, 1999a; 1999b), seems to maximize an altruistic pedagogical foundation to support healthy populations. These curricula support daily vigorous physical activity and provide a multitude of means to maximize students' chances to incur a healthy lifestyle. Analyses of the curriculum will provide a means to qualify educational standards, address the roles of responsibility, and infer possible supports to teachers.

Grade 9

Ontario's grade 9 Health and Physical Education curriculum, implemented in September 1999, encompasses a wellness concept. It incorporates a varying degree of the
social, emotional, mental, spiritual, and physical components of health. Kirk and Tinning (1990) provide the resources to aid in the critical examination of this curriculum. Dominance of scientism, motor elitism, and competitiveness, and the political nature of education are of primary concern within the curriculum because of the impetuous belief system derived from society.

The grade 9 curriculum is comprised of four distinct but related strands—physical activity, active living, healthy living, and living skills. This curriculum is developed to provide "an understanding of the importance of physical fitness, health, and well-being and the factors that contribute to them" (Ministry of Education and Training, 1999a, p. 4). This idealized suggestion represents the scope and nature of the curriculum, but in doing so problematizes the overall health and well-being of the participants. This curriculum does not seem to incorporate the numerous conditions that could impede the ideal situations as represented throughout the document.

Healthy, active living has many positive influences on society. It increases productivity, improves morale, decreases absenteeism, reduces health care costs, and heightens personal satisfaction (Ministry of Education and Training, 1999a). Decreasing productivity related to illness impacts the society and accelerates health care costs. "Within such technocentric ideology people are viewed as ‘human resources’ who are educated so as to maximize their productivity, especially their economic productivity” (Bain, 1990, p. 29). Healthy individuals can provide a capitalistic gain to society; thus they are important to develop the economic flow.

The dominance of scientism is a strong issue within this curriculum development. The consolidation of theory and practice needs to be addressed to balance the growth of
pedagogical requirements for the participants. “Physical education has finally been able to demonstrate its scientific basis and so its worth as a respectable intellectual pursuit” (Kirk & Tinning, 1990, p. 3). Ontario’s current physical education curriculum does allow a specifically defined component for theory and practice of knowledge; scientism seems to be prevalent in the four streams. This science base helps to legitimize the new curriculum as a genuinely important subject within the high school setting, especially as it relates to healthy productive members of society.

Ontario’s grade 9 Health and Physical Education curriculum provides, at least, superficial promotion of mind and body unity, rather than the dualism that is often conjured in society. Teachers are encouraged to educate the students regarding healthy lifestyle choices. For example, discussions addressing responsible sexual relationships, decision-making and assertiveness skills, and descriptions of physical and nonphysical abuse are mandated in the curriculum (Ministry of Education and Training, 1999a). The living skills strand addresses "appropriate decision-making skills to achieve goals related to personal health" and "appropriate social skills when working collaboratively with others" (Ministry of Education and Training, p. 9). There is still an obvious link to these objectives with the notion of health and well-being.

Physical activity focuses on the learning of motor skills. Within the curriculum, there is opportunity for students to participate in individualized physical activity as well as develop positive social relations. The curriculum suggests activities the adolescents can be exposed to for a variety of leisure pursuits, any number of which they could take up throughout their life; however the real endeavours primarily address sport-specific activities through which the objectives of the program could be achieved.
Assuming sport is the principle mechanism for activity, individual and social competitiveness as well as motor elitism will often dominate within the social relations and structure of the class. Attainment of a level four, for the movement skills component, requires the individual to perform “a movement skill with a high degree of competence” (Ministry of Education and Training, 1999a, p.19). Leadership and dominance channel similar energies. The ideology within the curriculum lends itself to inter- and intraparticipant competition and conflict. As well, the skill component does not include provisions for progression—especially related to people with disabilities.

There are many well-planned and -versed ideas throughout the Ontario grade 9 curriculum. It encompasses a plethora of theoretical and practical skills that are beneficial to the health and well-being of its affected adolescent population. To appreciate the Grade 9 curriculum, it is necessary to also address its natural foundation.

**Grades 1-8**

Ontario’s Grade 1 through 8 curriculum is integral of all grades but is dissected for the populations that it will affect. The curriculum advocates that the students themselves, their parents, and their teachers all have vital roles in the development of healthy lifestyle. The curriculum tends to follow the primary tenets of the Health Belief Model. Throughout the curriculum, guidelines for learning applications are instilled to enforce the susceptibility and severity of illness for hypoactive people, while taking action will control for and reduce ill health. Also, the promotion of benefits while reducing barriers and costs, and development of self-efficacy and competence through
guidance and training is also strongly infused (Ministry of Education and Training, 1999b; Strecher and Rosenstock, 1997).

The curriculum is presented so that the role of the parents and students is as integral as the role of the teachers. However, the primary responsibility seems to be appropriated to the teachers. Teachers have the inherent accountability for student development, and there is minimal responsibility and liability for the parents. As well, teachers are required to provide students with many encompassing activities to fully develop the physical and social elements required to succeed throughout life. However, there are minimal examples of non-sport-related activity, and some of the other examples are not befitting. For example, a bake sale has minimal relativity to healthy eating, especially in grade 1—perhaps making an indoor garden would be more appropriate.

Similarly to the grade 9 program, achievement levels are attained through successful completion without regard to progression of skill. Unlike the grade 9 program, there is credit awarded for participation and effort. Within the curriculum, instruction acknowledges that movement skills must be taught and are not innately ingrained in motor behaviour patterns. Activities need to be taught with a task-specific breakdown of skills to lead to a successful outcome. The curriculum is supportive of physical activity routine in childhood to promote healthy, lifelong physical activity endeavors. Teachers are to encourage “flexibility, agility, coordination, strength, balance and especially cardiovascular respiratory exercise” (Ministry of Education and Training, 1999b, p. 30) among students.

The grade 1-8 Ontario Health and Physical Education curriculum honours and purports many healthy lifestyle behaviours, including the repeated instruction for
vigorous daily physical activity. The curriculum instructs teachers to incorporate inclusive behaviours; it is supportive of informal and less competitive activities in class while endorsing students’ competitive nature in extracurricular, interschool programs. As well, many gender-sensitive issues have been encompassed: equality in male and female leadership roles and responsibilities; encouraging interests and abilities of all male and female participants; and ensuring topics can be communicated in coeducational and same-sex classes.

**Summary**

The literature review examined a multitude of CHD risk factors: genetic coding, smoking, hypertension, lipid profiling, diet, body composition, and physical activity. Genetic inheritance, primarily influenced by age, sex, heredity, and race, is a nonmodifiable contributor to CHD risk. Smoking is the most important risk factor and is the most preventable cause of morbidity and premature mortality. Hypertension is a life-threatening risk factor that may cause distress and damage to arteries. Blood lipids are essential in many bodily processes; however, excess LDL, vLDL, and triglycerides, or low HDL or a low TC : HDL can be a cause of fatty streaks that can lead to complicated plaque build-up. Diet is a risk factor modifier; a high complex carbohydrate and high fibre diet with moderate dairy and animal product consumption is important in reducing incidence of CHD. Obesity acts as a gauge of overall physical condition, nutritional state, and activity level. Incidence of childhood obesity has dramatically increased and is correlated with increased morbidity and premature mortality. Physical activity is the most modifiable risk factor and protects against CHD development. It is recommended to be
physically active for 60-90 minutes daily, but essential to be active for 30 minutes at least three times per week for cardioprotective effects.

Grade 9 seems to be the turning point in adolescents’ lives; students are developing an established lifestyle that may become difficult to change. Grade 9 entails the last mandatory year of physical education. The class does not always provide physical activity, nor is daily physical activity an enforced component of curriculum. As well, recess has been omitted from the daily routine of the adolescent lives during this year. Intervention via primary school curriculum mandates into lifestyle risk modification should be fundamental.

Education relating to the categorical distinctions between biophysical and lifestyle gender differences for CHD development is essential. Promoting students’ understanding regarding the susceptibility and severity of CHD and communicating its importance to children and adolescents living in the Niagara Region requires much tact and diplomacy. As educators, portraying the belief of the benefits outweighing the costs is important and can be achieved through curricular implementation.
CHAPTER THREE: RESEARCH DESIGN

Overview

The current study did not proceed to classify any prognostic nor synergistic value of any of the risk factors; rather it was designed to increase individual and communal knowledge regarding personal CHD risk factors through prevention awareness. CHD is a growing paediatric problem. Although the extrapolation of risk to children is speculative, learned behaviours affect the lifestyle habits and biophysical characteristics later in life. Public policy assisted by integrative curriculum in the primary and secondary school levels may help positively influence development from childhood to adolescence and to adulthood via positive lifestyle habits thus, curtailing the development of disease.

Methodology

This chapter outlines the methodology and procedures that were used for this study. Firstly, a description of participant selection, variables and instrumentation will profile the study. Subsequently, data collection and data analysis dictate the processes involved for investigation. Finally, the limitations of the study and a summary conclude the chapter.

Participant Selection

With the co-operation of the principals and health and physical education teachers, participants ($N = 2,291$) were recruited from all of the Niagara Catholic District
School Board and the District School Board of Niagara schools. These self-selected participants included 1,032 male and 1,153 female students (106 participants failed to indicate their sex). Participants ranged from 13 to 17 years, with a mean age of 14 years.

**Variables**

Grade 9 students in the mandatory physical education unit were tested for several biophysical risk factors: serum cholesterol, body composition, body mass index and percent body fat, blood pressure, and aerobic power—$\dot{V}O_2$ max (Appendix A). In addition, participants completed questionnaires designed to collect information pertaining to FH of CHD (Appendix B), lifestyle measures: physical activity and eating habits; using the Habitual Activity Estimation Scale (HAES; Appendix C), and smoking behaviour (Appendix D).

**Instrumentation**

A self-report survey was used to determine family history of CHD risk factors, smoking behaviours, as well as physical activity patterns and eating habits. The family history questionnaire was developed to illustrate familial incidence of diabetes, hypertension, dyslipidaemia, angina, and heart attack. The smoking behaviour questionnaire was developed to address lifetime cigarette use and secondhand smoke abuse. For this study, only smoking status was be analyzed.

The HAES was used to determine physical activity patterns. HAES was initially developed to monitor children with acute lymphoblastic leukemia (Hay, 1997) and has demonstrated test-retest reliability greater than 0.80 when assessing at least 2 days (Hay, Atkinson & Halton, 1995). The questionnaire segregates an individual day into four
periods and ranks activity according to intensity. The adolescents completed the scale, and the results were compared to clinical and anthropometric measures, providing the high reliability (Hay et al.).

Lipid testing is a rapidly growing area of clinical chemistry, but there is still much controversy about which groups of the population it is desirable to test (Hobbs et al., 1997). The Reflovet® Plus is designed for quantitative determination of undiluted specimen (whole blood, blood serum, and blood plasma) material using Reflotron® reagent strips. "It works on the principle of reflectance photometry and ensures rapid and reliable results while being simple to use" (Roche, 2000, p. 4). The accuracy (± 0.5%) and precision (≤ 0.2%) are respective to the mean for the tests delivered (Roche) and are accurate in community-based settings when compared with laboratory testing (Guibert et al., 2001). The minimum and maximum total cholesterol values programmed into the machine are 2.586 mmol/L and 25.86 mmol/L respectively (Roche).

Percent body fat was measured using a Quantum bioelectrical impedance analyzer. Bioelectrical impedance analysis (BIA) is a rapid, noninvasive, and relatively inexpensive method for evaluating body composition in field and clinical settings (Heyward, 2001). It is highly viable in field settings and has the capacity for describing the distribution of water based on the conductive and nonconductive properties of various biological tissues—fat-free mass is more conductive then fat mass (Lukaski & Bolonchuk, 1988; Ward & Cornish, 2000a). Being that water has a constant fraction of fat-free mass, about 73%, the volume of specified tissues can be estimated from the drop in impedance or the measurement of the resistance to the applied electric current, usually about ¼ volt, flowing through the body (Sowers, 1997; Ward & Cornish, 2000b).
Although BMI, anthropometric measures, and BIA are all regularly used in body composition assessment, BIA has been proven more effective in estimating obesity (Roubenoff, 1996). Furthermore, BIA provides valid estimates of body fat with no significant difference from dual energy X-ray absorptiometry (DEXA; Fubiano, Nuñez, & Heymsfield, 1999). BIA may be used as a tool in health assessment of persons varying in age and fitness levels, including children (Nuñez, Fubiano, Horlick, Thornton, & Heymsfield, 1999).

\[ \dot{V}O_2 \text{ max was estimated using Léger's 20-meter shuttle run (Léger, Mercier, Gadoury, & Lambert, 1988). Léger's test requires subjects to run at increasing speeds on a 20-meter shuttle course. Subjects run back and forth and must touch the 20-meter line; at the same time a sound signal is emitted from a prerecorded tape. Prior to testing, subjects warm up with a 5-minute jog and 5 minutes of static stretching. The start speed of the test is 8.5 km/hr-1 and increases by 0.5 km/hr-1 each minute. The test is terminated when the subject cannot maintain the required pace; the last stage number announced is used to predict } \dot{V}O_2 \text{ max (Y, ml·kg}^{-1}·\text{min}^{-1}) \text{ from the speed (X, km·h}^{-1}) \text{ corresponding to that stage (speed } = 8 + 0.5 \text{ stage number), and age (A, year): Y = 31.025 + 3.238 X - 3.248A + 0.1536AX, r = 0.71 (Léger et al.).} \]

**Protocol**

This study used Heart Niagara's public database.

Heart Niagara Board of Directors, the Niagara Catholic District School Board, and the District School Board of Niagara approved the research project and all protocols, and permission was obtained from school officials. In conjunction with Heart Niagara,
the Health and Physical Education Teacher explained the purpose and potential risks of the study to participants before obtaining consent. All grade 9 students enrolled in the health and physical education curriculum were provided with a project package containing a study description, a parental consent form (Appendix E), and FH of CHD questionnaire (Appendix B). Since the participants were under the age of 18, approval was required from their parents/guardians, who were asked to sign the form after receiving the information package describing the research.

The purpose of the study and methods involved in the research project were explained to the volunteer participants. At the onset of testing, all subjects were split into separate groups, according to gender, in order to maintain a manageable size of test group. Each group was then separately given instructions regarding the 20 metre (m) shuttle run (Léger et al. 1988) and given opportunities for practice and to ask questions regarding the activity.

**Data Collection and Recording**

Data collection took place in the schools' gymnasiums by public health nurses and a team of researchers, accompanied by the school nurse. Height (m) and weight (kg) were measured, and body mass index (BMI; kg·m⁻²) was thereby calculated. To ensure exercise did not have an effect, systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured prior to performing the shuttle run test. Mean arterial pressure (MAP; DBP+ [⅓ (SBP - DBP)]) was calculated.
Data Analysis

Descriptive frequency analysis was used to compare whole population, male and female genetic inheritance, smoking, hypertension, lipid profiling, diet, body composition, and physical activity. *t* tests and Pearson correlational analysis were used to detect possible relationships among all the variables. All data analyses were conducted using SPSS 11 for Windows. A *p* value of ≤ 0.05 was accepted to indicate a significant result.

Summary

This chapter provides a description of the methodology and procedures that were used in this research protocol. Data collection consisted of administering the family history questionnaire, the HAES questionnaire, and a smoking questionnaire, as well as the research team collecting the biophysical characteristics of students. This study provides valuable insight regarding the Ontario Health and Physical Education curriculum’s contribution to the CHD risk profile of Niagara Region’s grade 9 population.
CHAPTER FOUR: RESULTS

Introduction

The data analysis provides an opportunity to examine the cross-sectional health status of the Niagara Region adolescent population. This chapter examines and interprets the self-reflective and clinically retrieved data provided by the participants and nurses. Descriptive and correlational values are used to examine and outline the risk factor analysis. Further to this, this chapter compares the regional outcomes with national and provincial statistics. Tables and figures have been inserted and should be used to complement the interpretations.

Descriptive Statistics

Descriptive statistics, tables, and figures are used to describe the basic features of the risk profiles of the Niagara Region adolescents in this study. Descriptive statistics help to simplify large amounts of data in a sensible way and provide a powerful summary that may enable comparisons across the grade 9 group.

Family History

Table 2 represents the FH profile of the Niagara Region’s adolescent population. Less than one fifth of the responsive group has first-degree relatives with a FH of CHD. Dyslipidemia and hypertension are the primary risk factors affecting this group.
Table 1

*Niagara Region: Family History of CHD for Students*

<table>
<thead>
<tr>
<th>Disease</th>
<th>Father %</th>
<th>Mother %</th>
<th>Uncle/Aunt %</th>
<th>Grandparents %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>3.57</td>
<td>3.52</td>
<td>22.03</td>
<td>47.32</td>
</tr>
<tr>
<td></td>
<td>(1,344)</td>
<td>(1,335)</td>
<td>(1,203)</td>
<td>(1,289)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>13.73</td>
<td>9.42</td>
<td>23.10</td>
<td>60.86</td>
</tr>
<tr>
<td></td>
<td>(1,304)</td>
<td>(1,306)</td>
<td>(1,147)</td>
<td>(1,321)</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>17.92</td>
<td>8.64</td>
<td>21.14</td>
<td>47.48</td>
</tr>
<tr>
<td></td>
<td>(1,317)</td>
<td>(1,320)</td>
<td>(1,159)</td>
<td>(1,270)</td>
</tr>
<tr>
<td>Heart attack</td>
<td>3.62</td>
<td>1.50</td>
<td>6.36</td>
<td>22.12</td>
</tr>
<tr>
<td></td>
<td>(1,355)</td>
<td>(1,396)</td>
<td>(2,578)</td>
<td>(2,685)</td>
</tr>
</tbody>
</table>
Secondary and tertiary relatives show a great increase in risk factor value. These populations are not as closely related and therefore do not provide as threatening a danger to the development of disease; nonetheless, they influence risk. Dyslipidemia (3 : 5), hypertension (1 : 2), diabetes (1 : 2), and MI (1 : 4) are all attributed risk factors for this population.

**Smoking**

The Niagara Region adolescent participants ($n = 2,031$) provide no significant differences in patterns of male and female smoking habits. Figure 1 represents the smoking status of the adolescents. Only 10% ($n = 1,988$) have smoked 100 cigarettes or more (4+ packs) in their life. Students' self-perception ($n = 1,989$) suggests that 82% are occasional or nonsmokers, 8% are regular smokers, and 8% are ex-smokers. However, 40% of the grade 9 students ($n = 2,031$) have tried a cigarette at least once in their lifetime.

**Blood Pressure**

Prior to exercise, 97% of the sample ($n = 2,195$) had a nonclinically hypertensive blood pressure. Only 53.2% of the male population and 69.3% of the female population had a SBP lower than 120 mmHG; 75.1% and 74.1% of the males and females respectively had a DBP less than 80 mmHG. However, as calculated, 77% of the group ($n = 852$) had healthy MAP and 99% had nonhypertensive MAP.
Figure 1. Niagara Region: Smoking status among students (n = 1989)
Cholesterol

Table 3 represents the cholesterol percentiles of the Niagara Region adolescent population. Although there is a significant mean difference in the male-female intergroup analysis ($p < 0.001$), the male ($n = 366$) and female ($n = 361$) subgroups had a healthy total cholesterol. Intergroup results may be seen in Table 8.

Body Composition

Figure 2 represents the BMI of Niagara Region’s adolescents as defined by Canadian and international standards. Between standards, there is a discriminating difference in the acceptable and underweight categories; however, primary risk of CHD development happens in the excess weight and obese categories. Although there are differences, the Canadian and international standards agree to classifying the distribution of overweight populations.

Table 4 represents the BMI of the Niagara Region’s male and female adolescents, per Canadian standards. The male participants have a significantly lower BMI ($p < 0.01$), compared to the female participants. The difference is primarily related in the acceptable and underweight categories; this does not provide an increased risk of CHD development.

In terms of relative body fat, the boys had a significantly lower relative body fat (% BF) than the girls ($p < 0.01$). Less than 10% of the boys were above 25% BF, while an overwhelming 56% of the girls were above 25% BF; 34% of the girls had 30% BF or greater. In accordance with the American Council on Exercise, figure 3 represents the gender-related distribution for body fat classifications: 10% of boys and 30% of girls are considered obese.
Table 2

*Niagara Region: Cholesterol Values (mmol·L⁻¹) Among Students*

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>All</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>(n = 1,935)</em></td>
<td><em>(n = 366)</em></td>
<td><em>(n = 361)</em></td>
</tr>
<tr>
<td>5th</td>
<td>2.5900</td>
<td>2.5900</td>
<td>2.5900</td>
</tr>
<tr>
<td>10th</td>
<td>2.7300</td>
<td>2.5900</td>
<td>2.5900</td>
</tr>
<tr>
<td>25th</td>
<td>3.1600</td>
<td>2.8575</td>
<td>3.1975</td>
</tr>
<tr>
<td>50th</td>
<td>3.6300</td>
<td>3.2300</td>
<td>3.7950</td>
</tr>
<tr>
<td>75th</td>
<td>4.3300</td>
<td>3.8900</td>
<td>4.4800</td>
</tr>
<tr>
<td>90th</td>
<td>5.0440</td>
<td>4.5830</td>
<td>5.0970</td>
</tr>
<tr>
<td>95th</td>
<td>5.4600</td>
<td>5.0055</td>
<td>5.4540</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statistic</th>
<th>All</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.8055 ± 0.02031</td>
<td>3.4289 ± 0.041</td>
<td>3.8544 ± 0.04702</td>
</tr>
<tr>
<td>Median</td>
<td>3.6300</td>
<td>3.2300</td>
<td>3.7950</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.8932</td>
<td>0.7850</td>
<td>0.8947</td>
</tr>
<tr>
<td>Minimum</td>
<td>2.0000</td>
<td>2.0000</td>
<td>2.0000</td>
</tr>
<tr>
<td>Maximum</td>
<td>8.5300</td>
<td>6.3700</td>
<td>6.9500</td>
</tr>
<tr>
<td>Range</td>
<td>6.5300</td>
<td>4.3700</td>
<td>4.9500</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>1.1700</td>
<td>1.0325</td>
<td>1.2825</td>
</tr>
</tbody>
</table>
Figure 2. Niagara Region: BMI as defined by Canadian and international standards (n = 850).
Table 3

*Niagara Region: Gender Difference in BMI (%)*, Canadian Standards

<table>
<thead>
<tr>
<th>Canadian Standard</th>
<th>Male $(n = 459)$</th>
<th>Female $(n = 391)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight (&lt; 18.5)</td>
<td>44.9</td>
<td>32.0</td>
</tr>
<tr>
<td>Acceptable (18.5 - 24.9)</td>
<td>38.8</td>
<td>49.6</td>
</tr>
<tr>
<td>Excess weight (25 - 27)</td>
<td>7.1</td>
<td>9.2</td>
</tr>
<tr>
<td>Obese (&gt; 27)</td>
<td>9.2</td>
<td>9.2</td>
</tr>
</tbody>
</table>
Figure 3. Niagara Region: Body fat percentages of male \((n = 855)\) and female \((n = 912)\) adolescents.
**Cardiorespiratory Fitness**

Table 5 represents the \( \dot{V}O_2 \) max percentiles of the Niagara Region adolescent population. Although there is a significant mean difference in the male-female intergroup analysis \( (p < 0.001) \), the male \( (n = 366) \) and female \( (n = 361) \) subgroups achieved the expected aerobic power for sedentary individuals within their respective groups.

**Correlational Statistics And Gender Differences**

Bivariate analysis shows a significant relation between BMI and cholesterol \( (p < 0.05) \) for all subjects, as shown in Table 6. As well, cholesterol was significantly correlated with percent BF, SBP, and DBP \( (p < 0.01) \). Percent BF, BMI and MAP were significantly related to \( \dot{V}O_2 \max \) \( (p < 0.01) \). Refer to Table 7 (Males) and Table 8 (Females) for specific relationships by gender.

Compared to all subjects, the male adolescents had many of the same correlations. However, cholesterol and percent BF, as well as cholesterol and DBP, did not have a significant association. Furthermore, cholesterol and DBP did not have the significant correlation as is shown for the female participants.

As shown in Table 8, females’ MAP was not related with relative BF or \( \dot{V}O_2 \) max, and cholesterol was not related to BMI. Conversely, female subjects had a significant correlation between cholesterol and \( \dot{V}O_2 \max \) (Table 8) whereas this relationship was not significant in the total cohort or within males (Tables 6 and 7).

Male and female adolescent risk factors provide many significant intergroup differences, as shown in Table 9. The male participants had a significantly healthier.
Table 4

Niagara Region: Cardiorespiratory Fitness (ml·kg⁻¹·min⁻¹) Among Students

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>All  ((n = 894))</th>
<th>Male  ((n = 366))</th>
<th>Female  ((n = 361))</th>
</tr>
</thead>
<tbody>
<tr>
<td>5th</td>
<td>26.600</td>
<td>26.600</td>
<td>26.600</td>
</tr>
<tr>
<td>10th</td>
<td>26.600</td>
<td>29.600</td>
<td>29.600</td>
</tr>
<tr>
<td>25th</td>
<td>34.100</td>
<td>37.100</td>
<td>32.600</td>
</tr>
<tr>
<td>50th</td>
<td>38.600</td>
<td>44.600</td>
<td>37.100</td>
</tr>
<tr>
<td>75th</td>
<td>46.100</td>
<td>50.600</td>
<td>41.600</td>
</tr>
<tr>
<td>90th</td>
<td>52.100</td>
<td>53.600</td>
<td>45.650</td>
</tr>
<tr>
<td>95th</td>
<td>53.600</td>
<td>56.600</td>
<td>48.875</td>
</tr>
<tr>
<td>Mean</td>
<td>39.673 ± 0.284</td>
<td>43.279 ± 0.473</td>
<td>37.445 ± 0.335</td>
</tr>
<tr>
<td>Median</td>
<td>38.600</td>
<td>44.600</td>
<td>37.100</td>
</tr>
<tr>
<td>Maximum</td>
<td>62.600</td>
<td>62.600</td>
<td>61.100</td>
</tr>
<tr>
<td>Range</td>
<td>53.100</td>
<td>53.100</td>
<td>34.500</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>12.000</td>
<td>13.500</td>
<td>9.000</td>
</tr>
<tr>
<td>Risk factor</td>
<td>SBP</td>
<td>DBP</td>
<td>MAP</td>
</tr>
<tr>
<td>----------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>SBP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBP</td>
<td>0.400*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAP</td>
<td>0.773*</td>
<td>0.919*</td>
<td></td>
</tr>
<tr>
<td>Cholesterol</td>
<td>0.110*</td>
<td>0.063*</td>
<td>-0.013</td>
</tr>
<tr>
<td>BMI</td>
<td>0.363*</td>
<td>0.246*</td>
<td>0.174*</td>
</tr>
<tr>
<td>% BF</td>
<td>0.077*</td>
<td>0.193*</td>
<td>-0.227*</td>
</tr>
<tr>
<td>$\dot{V}O_2_{\text{max}}$</td>
<td>0.029</td>
<td>0.016</td>
<td>0.148*</td>
</tr>
</tbody>
</table>

*Note.* $^* p < 0.01$ $^{**} p < 0.05$
Table 6

*Niagara Region: Correlations, Male Subjects*

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>SBP</th>
<th>DBP</th>
<th>MAP</th>
<th>Cholesterol</th>
<th>BMI</th>
<th>% BF</th>
<th>VO2 max</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBP</td>
<td>0.342*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAP</td>
<td></td>
<td>0.738*</td>
<td>0.913*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholesterol</td>
<td>0.124*</td>
<td>-0.008</td>
<td></td>
<td>-0.056</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>0.385*</td>
<td>0.193*</td>
<td>0.140*</td>
<td>0.160*</td>
<td>0.056</td>
<td>0.317*</td>
<td></td>
</tr>
<tr>
<td>% BF</td>
<td>0.104*</td>
<td>0.186*</td>
<td>-0.0349*</td>
<td>0.056</td>
<td>0.317*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VO2 max</td>
<td>-0.016</td>
<td>0.023</td>
<td>0.179*</td>
<td>-0.052</td>
<td>-0.280*</td>
<td>-0.366*</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* *p < 0.01 **p < 0.05;
Table 7

**Niagara Region: Correlations, Female Subjects**

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>SBP</th>
<th>DBP</th>
<th>MAP</th>
<th>Cholesterol</th>
<th>BMI</th>
<th>% BF</th>
<th>( \dot{V}O_{2} \text{max} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBP</td>
<td>0.451*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAP</td>
<td>0.808*</td>
<td>0.933*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholesterol</td>
<td>0.163**</td>
<td>0.108*</td>
<td>0.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>0.404*</td>
<td>0.305*</td>
<td>0.222*</td>
<td>-0.013</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% BF</td>
<td>0.196*</td>
<td>0.218*</td>
<td>-0.03</td>
<td>-0.006</td>
<td>0.377*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \dot{V}O_{2} \text{max} )</td>
<td>-0.056</td>
<td>-0.002</td>
<td>0.091</td>
<td>0.105**</td>
<td>-0.295*</td>
<td>0.344*</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* *p < 0.01** **p < 0.05;
Table 8

*Niagara Region: Comparison of Male and Female CHD Risk Factors*

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Males</th>
<th>Females</th>
<th>Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\bar{x} \pm SE$</td>
<td>$\bar{x} \pm SE$</td>
<td>($p$ value)</td>
</tr>
<tr>
<td>SBP</td>
<td>117.30 ± 0.40</td>
<td>113.20 ± 0.40</td>
<td>$p &lt; 0.001$</td>
</tr>
<tr>
<td>DBP</td>
<td>71.60 ± 0.30</td>
<td>71.80 ± 0.30</td>
<td>Not significant</td>
</tr>
<tr>
<td>MAP</td>
<td>83.70 ± 1.00</td>
<td>82.70 ± 0.90</td>
<td>Not significant</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>3.42 ± 0.04</td>
<td>3.84 ± 0.05</td>
<td>$p &lt; 0.001$</td>
</tr>
<tr>
<td>BMI</td>
<td>21.30 ± 0.20</td>
<td>22.10 ± 0.20</td>
<td>$p &lt; 0.01$</td>
</tr>
<tr>
<td>Body fat</td>
<td>18.10 ± 0.70</td>
<td>29.90 ± 0.60</td>
<td>$p &lt; 0.001$</td>
</tr>
<tr>
<td>$\dot{V}O_2$ max</td>
<td>43.30 ± 0.50</td>
<td>37.20 ± 0.40</td>
<td>$p &lt; 0.001$</td>
</tr>
</tbody>
</table>
cholesterol, body fat, and \( \dot{\text{V}}O_2 \) max \((p < 0.001)\), and BMI \((p < 0.01)\). Females had a healthier SBP \((p < 0.001)\).

**CHD Risk Factors: Canada, Ontario, And Niagara Region**

The health and welfare of people in the Niagara Region frequently and grossly falls below that of the province and country. Tables 10, 11, and 12 depict the relationships for life expectancy (Canadian Institute for Health Information, 2002), circulatory disease deaths (Canadian Institute for Health Information, 2003), and potential years of life lost (Canadian Institute for Health Information, 2003) for Canada, Ontario, and the Niagara Region.

*Comparing CHD Risk Factors In Adolescents*

Smoking is the primary modifiable determinant for CHD development. In 2001, over 1 million Canadians initiated their smoking habits between the ages of 12 and 19 years; 53.8% of them started between 12 and 14 years (Canadian Institute for Health Information, 2002). There were 1.2 million 12- to 14- year-old males and females and an overwhelming 3.2 million 12- to 19-year-olds that smoked. Almost one half million adolescents smoked daily (Canadian Institute for Health Information). The present results revealed that 8% of adolescents in the Niagara Region smoke, a proportion that hasforgone the 3% Canadian average for 12- to 14-year-olds who smoke daily.
Table 9

*Canada, Ontario, and Niagara Region: Gender Comparison of Life Expectancy, 1996*

<table>
<thead>
<tr>
<th>Region</th>
<th>Both sexes (Years)</th>
<th>Male (Years)</th>
<th>Female (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>68.6</td>
<td>66.9</td>
<td>70.2</td>
</tr>
<tr>
<td>Ontario</td>
<td>68.0</td>
<td>66.6</td>
<td>69.4</td>
</tr>
<tr>
<td>Niagara Region</td>
<td>67.3</td>
<td>65.9</td>
<td>68.8</td>
</tr>
</tbody>
</table>

(Canadian Institute for Health Information, 2002)
Table 10

Canada, Ontario, and Niagara Region: Gender Comparison of All Circulatory Disease Deaths, 1997

<table>
<thead>
<tr>
<th>Region</th>
<th>Both sexes /100,000</th>
<th>Male /100,000</th>
<th>Female /100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>239.2</td>
<td>307.9</td>
<td>186.5</td>
</tr>
<tr>
<td>Ontario</td>
<td>239.0</td>
<td>305.2</td>
<td>187.6</td>
</tr>
<tr>
<td>Niagara Region</td>
<td>268.2</td>
<td>338.7</td>
<td>214.4</td>
</tr>
</tbody>
</table>

(Canadian Institute for Health Information, 2003)
Table 11

*Canada, Ontario, and Niagara Region: Gender Comparison of Potential Years*

*Life Lost from Circulatory Disease, 1997*

<table>
<thead>
<tr>
<th>Region</th>
<th>Both Sexes /100,000</th>
<th>Male /100,000</th>
<th>Female /100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>988.0</td>
<td>1375.9</td>
<td>597.3</td>
</tr>
<tr>
<td>Ontario</td>
<td>944.3</td>
<td>1323.6</td>
<td>565.8</td>
</tr>
<tr>
<td>Niagara Region</td>
<td>1185.4</td>
<td>1667.1</td>
<td>708.4</td>
</tr>
</tbody>
</table>

(Canadian Institute for Health Information, 2003)
Further data from 2001 illustrated that hypertension gravely affected the Canadian population: 18.8% of 45- to 64-year-olds and 38.6% of people 65 years and older were considered hypertensive (Canadian Institute for Health Information, 2002). Although 0.6% of Canadian adolescents were considered hypertensive, the Niagara Region subjects did not fare as well—3% have a hypertensive reading. One reading, however, of irregular blood pressure does not constitute a diagnosis for hypertension, which must be afforded by a medical doctor. Furthermore, students participating in the study were expected to provide a blood sample for cholesterol testing, thus potentially increasing their anxiety level and skewing the data.

Cholesterol levels for the Niagara Region grade 9 population fared slightly better than the 10- to 14-year-old participants in the North American Lipid Research Clinic (LRC) Prevalence Study (National Cholesterol Education Program, 1991). Boys from the LRC project had a mean cholesterol level of 4.19 mmol\(\text{L}^{-1}\) and a 95th percentile of 5.38 mmol\(\text{L}^{-1}\), but the Niagara Region program had a 3.43 mmol\(\text{L}^{-1}\) mean and 5.01 mmol\(\text{L}^{-1}\) at the 95th percentile. Results from the girls were similarly based: a 4.24 mmol\(\text{L}^{-1}\) mean with a 5.35 mmol\(\text{L}^{-1}\) at the 95th percentile from the LRC project and 3.85 mmol\(\text{L}^{-1}\) mean with a 5.45 mmol\(\text{L}^{-1}\) 95th percentile in the Niagara Region program.

Canadian data from 2001 revealed that many 20- to 64-years of age were overweight: 55.6% of males, 39.1% of females, and 47.5% of the total cohort had a BMI exceeding 25—considered above normal range (Canadian Institute for Health Information, 2002). Statistics Canada did not cite data for adolescents. The Niagara Region adolescents, have a BMI below 22 kg\(\text{m}^{-2}\); however, this is still above WHO’s standard of 20 kg\(\text{m}^{-2}\).
The Niagara Region adolescents had a generally healthy body fat profile. Over 90% of the boys but only 66% of the girls had acceptable body fat levels. Relative body fat as measured per BIA is controversial in nature, and as such, there is not relevant comparison data available.

Aerobic power for the Niagara Region Grade 9 adolescents was lower than the established norms (Léger, Lambert, Goulet, Rowan, & Dinelle, 1984). Normal mean for boys 14 years of age is 48.2 ml\(\text{kg}^{-1}\text{min}^{-1}\) and the 95th percentile is 58.5 ml\(\text{kg}^{-1}\text{min}^{-1}\); however, the Niagara Region boys attained a mean of 43.3 ml\(\text{kg}^{-1}\text{min}^{-1}\) and a 95th percentile of 56.6 ml\(\text{kg}^{-1}\text{min}^{-1}\). Likewise, normal mean for girls 14 years of age is 42.2 ml\(\text{kg}^{-1}\text{min}^{-1}\) and the 95th percentile is 49.1 ml\(\text{kg}^{-1}\text{min}^{-1}\); however the Niagara Region girls attained a mean of 37.4 ml\(\text{kg}^{-1}\text{min}^{-1}\) and a 95th percentile of 48.9 ml\(\text{kg}^{-1}\text{min}^{-1}\).

Less than one half of Canadian adolescents are active on a daily basis (Table 13). Overall, 22% of the Niagara Region adolescents considered themselves to be inactive, and only 8.5% of the boys and 5.2% of the girls considered themselves to be very active. There are many determinants of physical activity that need to be addressed in order to instill healthy dynamic behaviours in children and adolescents. There is a need for every individual to enjoy physical activity; to be confident that the environment is safe but challenging in nature; to have their motor skills develop in a positive setting; to have parental encouragement and social support; and to develop self-efficacy in physical activity (Heart and Stroke Foundation of Canada, 1993). School officials, parents, and health promoters have the innate responsibility to ensure the aforementioned determinants occur, thus encouraging positive lifestyle values that are cultivated throughout development.
Table 12

*Canada: Gender Comparison of Physical Activity Level, 2001*

<table>
<thead>
<tr>
<th>Age group (Years)</th>
<th>Activity level</th>
<th>Both sexes (%)</th>
<th>Male (%)</th>
<th>Female (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-14</td>
<td>Active</td>
<td>41.5</td>
<td>45.5</td>
<td>37.1</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>21.5</td>
<td>20.1</td>
<td>23.1</td>
</tr>
<tr>
<td></td>
<td>Inactive</td>
<td>21.0</td>
<td>16.7</td>
<td>25.6</td>
</tr>
<tr>
<td>12-19</td>
<td>Active</td>
<td>38.4</td>
<td>44.2</td>
<td>32.3</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>21.1</td>
<td>19.7</td>
<td>22.5</td>
</tr>
<tr>
<td></td>
<td>Inactive</td>
<td>27.7</td>
<td>21.1</td>
<td>34.6</td>
</tr>
</tbody>
</table>

(Canadian Institute for Health Information, 2003)
Overview

Developing a healthy diet, valuing quality daily physical activity, and maintaining a nonsmoking behaviour are essential to healthy biophysical characteristics later in life. Controlling food intake, including increasing complex carbohydrates and reducing fat intake (below 30% of total daily kilocalories), is crucial for limiting CHD development (Study Group, 1987). Reducing saturated fatty acids (below 10% of total daily kilocalories) and reducing cholesterol intake (under 300 mg per day) will also aid in maintaining a healthy risk profile. Additionally, an increase in the consumption of fruits, vegetables, and legumes while moderating salt intake is needed (Study Group). These tasks are critical components that need to be implemented throughout the Health and Physical Education curriculum.

The Niagara Region grade 9 population had a healthy biophysical risk profile compared with Canada’s adolescent population. However, there is still an urgent need to improve physical activity levels and decrease levels of smoking. The male population did have a significantly healthier cholesterol level, BMI, relative body fat, and VO$_2$ max than did the female population; however, percent BF and VO$_2$ max were expected to have this difference. The female group had an excessive amount of body fat; the remaining mean scores for both groups were healthy values, at least compared against adult risk factor values. Maintenance of these values is of great importance; an increase in any risk factor may lead to a grave incidence of CHD development. Ontario’s Health and Physical Education curriculum does contribute to the health of our children and adolescents; however, there is a need to implement a stronger mandate for daily vigorous physical activity.
CHAPTER FIVE: CONCLUSIONS AND IMPLICATIONS

Introduction

This study was designed to determine if Ontario’s Health and Physical Education curriculum contributes sufficiently to ensure the health of our children and young adults. To answer this question, the following specific questions were posed and investigated: What is the health risk profile of Niagara Region grade 9 students? How do Niagara Region grade 9 students compare to Canada’s adolescent population? Descriptive and correlational analyses were assessed. Results of the grade 9 health risk profile in comparison with the national and provincial statistics provide valuable insight regarding the curriculum meeting the health needs of our population.

One of the most important findings was that cholesterol levels were not related to aerobic power, but cholesterol was positively associated with BMI and relative body fat in the total cohort analysis. Based on the findings that aerobic power is related to body composition and that cholesterol is related to blood pressure and body composition, it is important for Ontario to mandate increased importance regarding CHD knowledge and quality daily physical activity throughout all curricula. All students need to perceive the importance of CHD and perceive the severity of the disease. However, the nonoptimal risk factor profiles for these adolescents necessitate urgent intervention. Promoting teacher support and resources will help deliver healthier outcomes for children and potentially redisseminate necessary information to parents.
The knowledge gained from this research can aid physical education curriculum development by addressing the primary components of risk. There is a need for further “Heart Health” curricular mandates. Quality daily physical activity throughout all years of schooling and cardiopulmonary resuscitation (CPR) training will introduce the tools necessary to aid situations as required. School-based settings have prime ability to communicate to children. Health education activities motivate children to adopt healthier lifestyles and can be disseminated beginning in elementary school (McArthur, 1998). This is valuable social reinforcement because of the significant environmental and behavioural influences that children have amid school administrators, teachers, parents, and other adults (McArthur). Appendix F is a lesson plan that could be used by teachers or guest speakers to promote health education activities to children in grades 3 through 5 and supportive up to grade 8. It is designed to educate children regarding risk factors attributed to heart disease and the benefits of physical activity.

Limitations And Recommendations

The grade 9 Physical and Health Education classes were chosen for this study, in part because it is an encompassing population through many of the determinants of health: income and social status, social support networks, literacy, personal health practices and coping skills, lifelong development, biology and genetic endowment, health services, gender, and culture (Health Canada, 2003). Participation and communication seem to be the two dominant limitations within this study.

Heart Niagara’s Heart Health program is not a curriculum-mandated event within the scope of grade 9 Physical and Health education. Students may thereby perceive a lack
of importance of CHD or a lack of necessity to participate in the study. In part, teacher
time constraints and not being able to properly emphasize the importance of the
program's activities may be responsible. The 53% participation rate permits limited
generalizability.

Surveys that rely on self-reports of physical activity by children are often
unreliable (Heart and Stroke Foundation of Canada, 1993). The self-reported data may
have some exaggerated results, and it cannot be determined as to the accuracy of the
findings. Furthermore, due to the age of participants, the questionnaire distribution and
retrieval process eliminated some individuals from participation. For example, if a
student could not be in attendance for distribution or retrieval of the forms or if the
parental consent forms were not signed, elimination from the study was immediate.

As previously mentioned, dietary factors are risk modifiers, rather than risk
factors. As such, eating behaviours were not analyzed in the results section. However,
because there is direct impact on risk factors, and for the purpose of this study, it is still
plausible to suggest the efficacy of students' dietary choices.

There was potential ambiguity and misunderstanding for some of the questions.
Question 5 on the Smoking Questionnaire (Appendix D) addressed the individual's future
plans of smoking. Some of the nonsmoking participants indicated that they did not plan
to quit in the next 6 months; however, this question was intended only for the youths who
currently smoke. Many individuals had difficulty understanding or did not carefully read
the directions in filling out the “estimated percentage of time spent in each activity level”
on the Activity Level Questionnaire (Appendix C). As well, this survey had a
typographical error; “overall level of activity for the day” had two “very active” categories and did not have a “very inactive” component.

The 20m shuttle run provides easy group access to help timely measurement of \( \text{VO}_2 \text{ max} \). Due to the running-specific nature of the test, individuals who run avidly may produce higher results than individuals with other foci (biking, swimming, and rowing). It requires a highly motivated individual to achieve maximum effort and the provision of this sole test does not account for individuals with injuries or physical disabilities. Poor participation (about 40%) in the 20m shuttle run could be, in part, due to a lack of parental encouragement, social support, self-efficacy, or inspiration.

Continued support of projects such as this one will help develop primary prevention strategies, increase public awareness, and it is hoped, reduce the incidence of CHD development. Future research gathering information regarding students’ food choice and knowledge level of risk factors would be interesting. Further research should also uncover future trends of adolescent risk factors in the determination of CHD risk. It may also be interesting to address the prospective value (incidence) and determine the potential relation to paediatric and adolescent risk profiling.

**Ontario’s Physical Education Curriculum**

Ontario’s grade 9 Health and Physical Education curriculum appears to fulfill the multitude of objectives set forth by the government; however, it does not necessarily support the components of the HBM to facilitate self-efficacy or reduce barriers. With some modifications the curriculum may more adequately represent the requirements of the entire (affected) population. The following recommendations may not respect the needs of all populations; however, the (proposed) amendments provide greater autonomy
and onus on the students and parents while guiding teachers in their personal educational development.

Progress and achievement are integral components of theory and practice. Both are very important; however, achievement is the current measure for the quantifiable grading system set forth by the provincial government. Progress may be a segue to fairness as well as be a provisional mechanism to increase student self-efficacy and enhance motivation to participate.

Currently, to achieve a level four for personal physical fitness the student must “maintain a high level of personal physical fitness” (Ministry of Education and Training, 1999a, p. 19). People with disabilities and other health disorders may not be physically capable of achieving this standard. Again, this creates bias in the setup of the achievement levels. Allowance for progress and development of skills may adequately rebalance this conflict. Although this change may be seemingly unfair to other curricula for other courses, some justification can be developed from necessity; people of all abilities can benefit health wise from increased activity. The current de-grading system may unjustly demotivate (exercise) participants, causing a decrease in health, an increase in disease, and a decrease in life span—increasing the number of potential years life lost (PYLL).

Other primary concerns did not necessarily occur within the grade 9 curriculum, but rather the general setup of high school physical education curriculum. Currently, the physical education curriculum has integrated the four streams into one credit. Modification to segment this one credit into two half-credit courses, a theoretical and practical series, could allow individuals to be cognitively or physically engaged in
learning the health-related benefits and consequences of exercise and lack thereof, as per the specific needs and aspirations of individuals.

Without a theory and practical differential, students may be intimidated or apathetic to the information in the curriculum and choose not to incorporate physical education into their lifestyle. This would incur a twofold impediment to the students’ health: The lifestyle health benefits regarding importance in knowing the specific genetic profiles in regard to risk, the harmfulness of smoking and other drug use, and the qualitative aspects such as fun and well-being through physical activity would be missed. As well, the biophysical health benefits of physical activity, such as having a healthy blood pressure, BMI and body composition, lipid profile, and aerobic power, may not exude the necessary implications toward CHD development.

Engagement in the curriculum beyond the mandatory one year is often not feasible. Students regularly assume physical education classes are not educationally sound and a likely “waste” of time. In accordance with the misbelief of physical education as not being a scientifically reputable subject, many parents and students do not foresee any benefit to continue physical education beyond its minimal requirement. If diploma requirements were adjusted to accept physical education as more than just an elective credit, then it might improve attitudes and enhance future enrollment.

Physical Education Teachers need to accept responsibility for teaching physical activity and lead by example. Integrating many types of physical activity in the classroom is but one means to enhance children’s experiences. It should not be expected that teachers inherently know many types of activities, and more so, the necessary knowledge to teach activities. As such, graduation requirements adopting an educational system
including substantial physical activity portfolios for teachers-in-training will help to facilitate healthier activities for child-learning experiences.

**Conclusion**

Children and adolescents must associate physical activity with pleasure if they are expected to be regularly dedicated to physical activity throughout their life (Colquhoun, 1990). Subjective and affective dimensions of exercise are more central aspects of student participation in exercise (Brustad, 1997). Throughout a physical education program, children should have fun, some success, be able to learn to manage their bodies with some control, and develop self-confidence (Colquhoun). Using images of well-being, contentment, hedonism and narcissism, children need to be encouraged into healthy lifestyle patterns (Colquhoun).

Physical education can offer unique and essential aspects of motor competence and lifetime fitness to students. Physical education also provides a means to learn and control body movements and keep physically fit—which in turn aids in looking good, feeling good, and protecting ourselves against *modern* disease (Colquhoun, 1990). Adequate curriculum guidelines will help to enable teachers to disseminate the essential information, knowledge, and skills to empower students to develop autonomy in the critical analysis of personal, social, and cultural interests.


Advisory Board of the International Heart Health Conference. (1992). *The Victoria Declaration on heart health.* Victoria, BC.


http://www.hc-sc.gc.ca/hppb/phdd/determinants/


Heart Niagara Inc. (2002). *Cardiovascular risk management workshop series: What has brought us all here? The causes of arterial disease*. Symposium conducted at the Niagara Regional Cardiac Rehabilitation Program, Niagara Falls, ON.


Sheridan, E., Bedoya, E., Papadakis, S., & Reid, R. (2003, October). *Perceived barriers to physical activity in cardiac patients: Are there gender differences?* Poster session at the 13th annual conference and general meeting of the Canadian Association of Cardiac Rehabilitation, Toronto, ON.


http://www.macses.ucsf.edu/Research/Allostatic/notebook/body.html


http://pediatrics.aappublications.org/cgi/content/full/110/3/e29


Appendix A

Assessment Day Data

HEART NIAGARA

Assessment Day __________________________

Please Print

Month Day Year

Name: ___________________________ School: ___________________________

Student Address: ___________________________

The measurement data on your fitness, height, weight, blood pressure and cholesterol is confidential information that is shared only with the school nurse. In order to assess your personal risk of future heart disease, the information must be considered with the lifestyle information and family history information.

The primary purpose of the School Heart Health Project is to make all students aware that heart disease is preventable and to motivate students to choose a heart healthy lifestyle. However, any student whose risk factor combination appears to put them at high risk of future heart disease will be contacted by the school nurse and advised to seek a more in-depth assessment with their family physician and modify their lifestyle as necessary.

Please turn this form in to your school nurse and keep your questionnaires and other heart health information to use during the follow-up and risk factor class with your school nurse.

ASSESSMENT DAY DATA

1. Sex: Male Female

2. Date of Birth: ___________________________ Age: ______

   Month Day Year

3. Weight: ___________________________ pounds or ___________________________ kilograms

   Height: ___________________________ inches or ___________________________ centimeters

4. Blood Pressure:

   (Systolic/Diastolic) Sitting – Left: ________/_______ mm Hg

5. Cholesterol: Total ___________________________ mmol/L

6. Run-Stage: ___________________________

7. \( \text{VO}_2 \) = ___________________________

8. BIA: ___________________________

Revised June 20, 2001 – Assessment Day Doc.
CONFIDENTIAL STUDENT FAMILY HISTORY OF DAMAGE TO THE HEART AND ARTERIES

Please discuss the marking of this questionnaire with your parents or guardians. Coronary Artery heart Disease runs in families. Family history includes the medical history of your brothers/sisters, parents, uncles/aunts and grandparents. The positive answers you may uncover will probably come from your uncles/aunts and grandparents.

1. Have any members of your family been diagnosed with diabetes?
   a) Father  yes  no
   b) Mother  yes  no
   c) Uncle/Aunt  yes  no  more than 1?  yes  no
   d) Grandparent  yes  no  more than 1?  yes  no

2. Have any members of your family been diagnosed with high blood pressure (hypertension)?
   a) Father  yes  no
   b) Mother  yes  no
   c) Uncle/Aunt  yes  no  more than 1?  yes  no
   d) Grandparent  yes  no  more than 1?  yes  no

3. Have any members of your family been diagnosed with high cholesterol (dyslipidaemia)?
   a) Father  yes  no
   b) Mother  yes  no
   c) Uncle/Aunt  yes  no  more than 1?  yes  no
   d) Grandparent  yes  no  more than 1?  yes  no

4. Have any male members of your family had angina, or a ‘heart attack’ before the age of 55?
   a) Father  yes  no
   b) Uncle  yes  no  more than 1?  yes  no
   c) Grandfather  yes  no  more than 1?  yes  no

5. Have any female members of your family had angina or a ‘heart attack’ before the age of 65?
   a) Mother  yes  no
   b) Aunt  yes  no  more than 1?  yes  no
   c) Grandmother  yes  no  more than 1?  yes  no

If 4a, 4c or 5a, 5c have been ticked you should encourage all the other members of your family to have a RISK PROFILE for heart and artery disease completed by their family doctor.
Activity Level and Eating Behaviour Questionnaire

ACTIVITY LEVEL QUESTIONNAIRE

This form asks you to estimate your level of activity during different time periods throughout the day. For each period you will estimate the percentage of time that you spent in four different activity levels. These activity levels are described below. For each time period the total time spent in the activity levels must equal 100%.

Activity Level Description

These descriptions give you examples of the type of activities that are typical of each activity levels. You can refer to these as often as you need when completing your estimates.

a) Inactive - sleeping, lying down, resting, napping.

b) Somewhat inactive - sitting, reading, watching TV, playing video games, playing quiet games or activities which are mostly done sitting down.

c) Somewhat active - walking, climbing stairs, shopping etc.

d) Active - running, biking, swimming, doing aerobics, cutting grass, doing heavy physical labour, and other activities that make you sweat, breathe hard, and raise your heart beat faster.

The following is an example of how to complete this form:

For the time period between 12:00 noon until 2:00 in the afternoon, please estimate the percentage of time you spend in each of the following activity levels:

<table>
<thead>
<tr>
<th>Activity Level</th>
<th>Time Spent (in %)</th>
<th>Activity Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Inactive</td>
<td>5</td>
<td>(having a short nap)</td>
</tr>
<tr>
<td>b) Somewhat inactive</td>
<td>60</td>
<td>(watching TV, sitting down for lunch)</td>
</tr>
<tr>
<td>c) Somewhat active</td>
<td>30</td>
<td>(cleaning, going for a walk)</td>
</tr>
<tr>
<td>d) Active</td>
<td>5</td>
<td>(carrying some boxes from the car)</td>
</tr>
<tr>
<td>e) TOTAL</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

On the last page there are a number of questions that ask about when you eat meals and bedtimes. Please answer all the questions completely.

PLEASE START ON THE NEXT PAGE!
For each of the following time periods, please estimate the percentage of time that you spent in each activity level.

1. After getting out of bed until starting breakfast:
   a) Inactive
   b) Somewhat inactive
   c) Somewhat active
   d) Active
   e) TOTAL

2. After finishing breakfast until starting lunch:
   a) Inactive
   b) Somewhat inactive
   c) Somewhat active
   d) Active
   e) TOTAL

3. After finishing lunch until starting supper:
   a) Inactive
   b) Somewhat inactive
   c) Somewhat active
   d) Active
   e) TOTAL

4. After finishing supper until bedtime:
   a) Inactive
   b) Somewhat inactive
   c) Somewhat active
   d) Active
   e) TOTAL
Please answer the following questions as accurately as possible in the spaces provided. Answer these questions for the day you described on the previous page. (If you missed a meal, please enter the time you usually would eat that meal and put in 0 for the time spent eating).

When did you get out of bed this morning? _______ A.M.
When did you start eating breakfast? _______ A.M.
How long did you spend eating breakfast? _______ MIN
When did you eat lunch? _______
How long did you spend eating lunch? _______ MIN
When did you eat supper? _______ P.M.
How long did you spend eating supper? _______ MIN
When did you go to bed? _______ P.M.

For the day that this questionnaire has asked you about, how would you rate your overall level of activity?

I was:

a) Very inactive
b) Inactive
c) Somewhat inactive
d) Somewhat active
e) Active
f) Very active

Compared to your activity six months ago, would you rate yourself as?

a) Much less active than usual
b) A little less active
c) About the same
d) A little more active
e) Much more active than usual

THANK YOU VERY MUCH FOR COMPLETING THIS QUESTIONNAIRE!
Appendix D

Smoking Questionnaire

Smoking Questionnaire

1. Have you ever smoked a cigarette, even just a few puffs?
   A. Yes
   B. No

2. Have you smoked 100 or more whole cigarettes in your life?
   A. Yes
   B. No

3. Would you consider yourself a:
   A. Non-smoker who has never smoked
   B. Non-smoker who smokes sometimes
   C. Light smoker
   D. Medium smoker
   E. Ex-smoker who has totally quit

   If you are an ex-smoker, how long have you been totally smoke free?
   A. More than 1 year
   B. Between 6 months and 1 year
   C. Less than 6 months
   D. I still smoke

4. In the last week, how many cigarettes have you smoked? (Answer either number of cigarettes or number of packs?)
   ___________ cigarettes  ___________ packs

5. Think about the next 6 months, do you plan to quit smoking in the next 6 months?
   A. No
   B. Yes, when exactly do you plan to quit?
      □ Within the next 24 hours
      □ Within the next week
      □ Within the next month
      □ Within the next 3 months
      □ More than 3 months from now
6. Out of all the ways there are to quit smoking, choose all the ones you would use.
   - Use a ‘do-it-yourself’ program that gives tips about how to quit
   - Use the internet to get information on quitting
   - Read pamphlets about the dangers of smoking
   - Make a deal with a friend to quit together
   - Call a telephone hotline for help quitting
   - Get a group of friends to quit with me
   - Ask a teacher, nurse, counselor, coach etc. for help
   - See a doctor to get a prescription for Zyban
   - Use (pay for) acupuncture, laser, or hypnosis
   - Use (pay for) nicotine gum
   - Quit totally on your own, without telling anyone or using anything at all
   - School Smoke Cessation Program

7. Does anyone smoke in your home?
   a. Yes
   b. No – but guest do
   c. No – our house is a smoke-free zone
Appendix E

Letter of Consent

[School letterhead]

Dear Parent:

Currently grade nine physical education students are involved in health education around the issues of Tobacco Use, Healthy Eating and Active Living.

We now know that arteriosclerotic heart disease caused by "hardening of the arteries" begins in adolescence and that many teenagers already demonstrate significant plaque formation in their arteries. This is often associated with those teenagers who are inactive or who smoke or whose nutrition includes large amounts of saturated fat. The testing procedures that are involved in the Schools' Heart Health Program may identify those students who have genetic risk and who should make significant lifestyle choices. It may also demonstrate in those children who do have a suggestion of genetic risk that their parents should go for testing themselves if this has not been done at an earlier age.

The Niagara Regional Public Health Department and Heart Niagara Inc. in conjunction with the District School Board of Niagara and the Niagara Catholic District School Board have expanded the existing grade nine-heart health program. The revised package includes classroom teaching around heart healthy lifestyle choices, a personal assessment of his/her own fitness, an Awareness Day including blood pressure and cholesterol testing and two sessions on CPR training. Students will have the opportunity to review their current lifestyle choices and test results with the nurse and may be referred to their family physician for further assessment and advice.

We ask that you assist your son/daughter in completing the family history questionnaire on the back and sign and return the consent form.

Sincerely,

__________________________________________________________
Youth Connection Nurse
Niagara Regional Public Health Department

__________________________________________________________
Physical Education Teacher

_________ has my consent to participate in a finger prick cholesterol test.

☐ I would like more information on heart disease

☐ I would like to be involved in heart health programming

__________________________________________________________
Parent/Guardian Signature

Heart NIAGARA
207 – 5673 North Street, Niagara Falls, ON L2G 1J4 (905) 358-5552
Appendix F

Grade 4 Lesson, with Handouts and Quiz

Slide 1

Grade 4 Presentation
Why am I here?

Who knows why I am here today?

Answer: Talk to you about heart disease and physical activity.

What is heart disease?

Answer: A sickness of the heart that kills a lot of people. Being physical activity (playing, having fun, and doing sports) can help to prevent you from developing problems.

What does this mean to you?

Answer: I want you to understand that being physically active can and should be fun! It does not have to be a sport (soccer, baseball, hockey, etc.), but it definitely does not include watching TV (including the game) or playing a video game.
Stand up
Stretch
Move

Stretch and move body for 1-2 minutes then sit down.
Discuss reasons why we are doing this... increase heart rate, oxygen flow, and energy
Start by reaching for the ceiling and down to the floor.
Rotate the neck and shoulders.
Flexion, extension and rotation of the trunk.
Move and stretch legs.
Who knows what Heart Disease is?

- Your heart, arteries and veins do not work as well as they should.
- Arteries have fat build-up that stops blood from flowing freely.
  - Then you end up in the hospital with a heart attack
  - Then, if you are lucky, you come and see the staff at Heart Niagara.

I said that CHD is a sickness of the heart, but what is really happening?
Answer: Your heart, arteries and veins do not work as well as they should.
Your arteries develop fat build-up that slows blood down.
Then you end up in the hospital with a heart attack
Then, if you are lucky, you come and see the staff at Heart Niagara.
Draw this picture on the board.

Explain it such that:
A hose that is pinched does not let all the water through.

However, physical activity acts like a zamboni driver... it smooths everything out

Fun activity:
Everyone gets a cold drink and licorice.
What happens to the licorice when the cold drink is passed through the licorice?
We don't want that to happen... so what causes it?
What is a risk factor?
Answer: it is the 'things' (characteristics) that get us in to trouble. But, if we do the right things, everything is easier... How much easier is it when you do what your parents ask of you. You pick up your clothes, eat all your dinner, when you don't fight with your brothers and sisters, and when you do your homework.

Smoking and 2nd hand smoke increase your risk of dieing from heart disease... so don't start, and tell people not to smoke around you!
Diet
The nurse came and talked to you about diet last week, so I’m not going to talk to much about it.
Decreasing your fat and salt intake (less McDonalds), and increasing fruits, vegetables, beans, oatmeal, etc.

Physical Activity is very a very important risk factor
Components of Physical Activity?

- 3 components
  - Strength
  - Endurance
  - Flexibility

3 components (just explain, do not use the term)
Strength—the ability to lift, pull, or push weight—weight lifting
Endurance—the ability to do something for a long time—long-distance running
Flexibility—ability to bend and stretch easily—stretching
What are we going do?

- **Physical Activity**
  - Every day for at least 30 minutes
    - HNI recommends 60-90 minutes daily
  - Will also help you
    - More energy
    - Remove the wiggles
    - Feel better about yourself
    - Sleep better and less tired
    - Eat healthier and control your appetite
    - Be happier

Physical activity is very important... it should be done every day for at least 20 minutes, but 60-90 minutes every day is recommended.

Physical activity will help you to:
- More energy
- Remove the wiggles
- Feel better about yourself
- Sleep better and less tired
- Eat healthier and control your appetite
- Be happier
Games, Sports, Play, Fun!

- Physical activity does not have to be a sport.
  - Some examples from class
- Physical activity will increase
  - Your heart rate (pulse)
  - Your breathing
  - Flow of blood through your body—increasing the nutrients (vitamins from food)
  - Co-ordination

Physical activity does not have to be a sport.

What are some examples of physical activity?

What does physical activity do to you?
Physical activity will increase
Your heart rate (pulse)
Your breathing
Flow of blood through your body—increasing the nutrients (vitamins from food)
Improves co-ordination
What is your pulse?
   Answer: The flow of blood from your heart beating

Why is your pulse important?
   Answer: Blood helps to deliver essential nutrients throughout your body

How do you find your pulse?
   Feel a slight movement or pulsing. Each pulse you feel, represents 1 heart beat.
   Radial pulse: 3 fingers set at the base of the thumb with hand in supination
   Listen with a stethoscope: place over your heart.

What is my Maximum and Target Heart Rate?
   Answer: MHR = 220 – age. THR = MHR * 65% up to 85%
Exercise Effect on HR

• How does it respond to exercise?
  – Your heart is a muscle, the more you exercise the stronger it becomes.
  – Short term
    • The harder you exercise, the higher it goes.
  – Long term
    • Lower resting HR
    • Increased strength and endurance

How does your heart respond to exercise?
Your heart is a muscle, the more you exercise the stronger it becomes.
While performing activity—Short term
The harder you exercise, the higher it goes.
Effects after activity—Long term
Lower resting HR
Increased efficiency and performance
Just Doing It!

- Pulse check
- Warm-up
  - Stretch and move body from head to toe
- Pulse check

Pulse check
Warm-up
Stretch and move body from head to toe
Pulse check
Now We Are Having Fun!!

- Predict rebound with a soccer ball
- Skipping sequences
- Calisthenics and Strength Training
  - Jog on the spot
  - Push-ups (from knees)
  - Squats (ski sits)
  - Arm circles
  - Abdominal crunches
  - Swinging Gate
- Walking or jogging around perimeter of gym

Divide group into 4. All activities to be done in partners, but both people must participate:

NO BODY CONTACT

Predict rebound with a soccer ball (*develop co-ordination and speed*)
Kick ball off wall. How does the ball react with different kicks? (integrate mathematics focus on triangles)

Skipping sequences (*develop CV health and power*)
Develop a skipping routine with as many different steps as possible. How many times can you go without stopping the rope?

Calisthenics (*develop Strength*)
Jog on the spot
Push-ups (from knees)
Squats (ski sits)
Arm circles
Abdominal crunches
Swinging Gate (hold wall for balance swing leg in forward and back directions)

Walking or jogging around perimeter of gym (*develop endurance*)
Just Did It!!

- Pulse check
- Cool down
  - Stretch and move body from head to toe
- Pulse check
Integrating Activities

- Write about your experience with the activities.
  - How did your pulse change?
  - How did your breathing change?
  - How did you feel performing each of the activities?
- Plot your resting and exercise heart rate on a graph
  - Get 4 friends heart rates to add to your graph.

Write about your experience with the activities. (Language Arts)
How did your pulse change through the 4 activities?
How did your breathing change through the 4 activities?
How did you feel performing each of the activities?
Plot your resting and exercise heart rate on a graph (Math)
Get 4 friends heart rates to add to your graph.
Fill out the daily fitness log for 1 week of activities.
The licorice experiment (Science and Technology?)