THE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND ACADEMIC ACHIEVEMENT IN SENIOR SECONDARY SCHOOL STUDENTS

by

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A thesis submitted in conformity with the requirements for the degree of Master of Arts
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0-612-29178-2
The relationship between physical activity and academic achievement in senior secondary school students

Master of Arts
1997
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Abstract

The problem investigated in this study is to determine if there is a significant relationship between physical activity and academic achievement in senior high school students. More specifically, does a moderate level of physical activity facilitate higher academic grades than those students who maintain relatively low or high levels of physical activity?

An original questionnaire was created and administered to 126 grades 11, 12, and 13 students from one secondary school representative of the Greater Toronto Area. The data collected reflects the sample's academic achievement and physical activity level from their previous academic semester, roughly a five month period. Other variables which may have an influence in the study, such as gender, citizenship, and socioeconomic status are measured and accounted for within the parameters of the questionnaire.

Tests of hypotheses are conducted from a variety of statistical procedures. Multiple regression analysis and bivariate correlations at an alpha level of .05 are the tests used to analyze the data, note trends, and act as a foundation for interpreting the results.
All four of the hypotheses tested indicate no statistically significant results. The majority of the sample (46%) is measured to be in the moderate physically active range or level. The study's results confirm the conclusions of other studies, that physical activity does not hinder or deter a student's ability to succeed academically. However, a slight non-significant negative linear relationship between academic achievement and physical activity is noted.

Recommendations for future studies focus on issues of methodology. Increasing the sample size by including all grade 11, 12, and 13 classes of one or more secondary schools, and most importantly, observing and measuring low, moderate, and high physically active students in a 1:1:1 ratio within the sample may provide more conclusive evidence. A longitudinal study of the same sample within a 3 year period representative of the senior grades may offer the most challenging yet ideal conditions for future inquiries in this research area.
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Chapter I

Purpose

The purpose of this study is to determine if a relationship exists between physical activity and academic achievement in senior secondary school students. In determining such a relationship, the study’s results will attempt to clarify whether the positive findings in numerous primary/elementary school studies can be similarly concluded for senior secondary school students.

According to Jerome and Phillips (1981) and Keays and Allison (1995), there has been very little research studying the effects of physical activity upon secondary school students’ academic achievement, particularly in a Canadian context. Will the results from a Canadian secondary school parallel those of American schools? Much of the research literature in this pedagogical domain appears to focus primarily on American secondary schools. Research findings in this study will focus upon a Canadian, and more specifically, a Torontonian perspective; this may create further knowledge in a relatively new area of study and further enhance, on a comparative scale, the research literature to include students from Ontario’s educational system.

This research inquiry will involve creating an original instrument to measure secondary school students’ physical activity levels, academic achievement, and other variables which may have an effect on the study, such as socioeconomic
status (SES), gender, self esteem and parental motivation. By measuring and controlling for these variables, valid and reliable results may be determined.

Future implementation of school policy should inherently and theoretically meet and/or exceed the needs of children and youth. Vickers (1992) suggests that many North American states and provinces have gradually reduced or removed the physical education curriculum from secondary schools. Appropriate curriculum changes based upon past and current studies analyzing physical activity and academic achievement may be necessary to proceed confidently in two potential courses of action: 1) maintaining or limiting the current level of time the curriculum provides students to participate in physical education and related extracurricular pursuits—thereby placing more emphasis upon enhancing traditional academic subjects, such as math, science and the emerging field of technology—ensuring all students are competitive in the new of age of information and global competition, or 2) include an increased emphasis on physical and health education classes, extracurricular activities and interscholastic sports in secondary schools to empower students holistically—both mind and body, thereby facilitating health and knowledge acquisition.

Justification of the Study

The study of the relationship between physical activity and academic achievement according to Howe (1978) has been a “frustrating attempt” (p. 1).
Many of the findings involved in these types of studies have led to contradictory results; varied ideologies and conclusions amongst educational researchers have emerged after approximately fifty years of research.

Educational researchers such as Coleman (1961) and Henry (1963) believe there is a negative relationship between physical activity and academic achievement. They support the theory that various forms of physical activity, such as sports, lead to a decrease in time spent on homework and study, hence a decline in student achievement; this theory is referred to as the “zero-sum model” (Fejgin, 1994; Marsh, 1993). Further, some researchers recommend the partial or full elimination of extracurricular sports from the school curriculum (Mendez, 1985; Mireau, 1986). They recommend that hopeful participants should maintain a minimum standard of achievement before such activities may be pursued.

Conversely, there appears to be a significant amount of research that supports the benefits to being physically active or athletic in school (Holland & Andre, 1987; Keller, 1982; Marsh, 1993; Soltz, 1986). Research indicates that physically active students have higher educational and occupational aspirations, fewer discipline problems and perform equal to or better academically than non-physically active students (Fejgin, 1994; Marsh, 1993; Melnick, Vanfossen, & Sabo, 1991; Otto, 1982).

Social and cognitive scientists believe play, a subset of physical activity,
functions as the crucible for social development (Sage, 1992). Play is defined as the ability "to occupy oneself in amusement, sport, or other recreation" (The American Heritage Dictionary of the English Language, 1992). The term "play" stemming from the Greek word "paidia" meaning children, involves aspects of laughter, competition, mimicry, vertigo and/or chance. As these categories imply, non-traditional sports activities such as dance, charades and chess can all be applied and associated with the term 'play'. Hence, physical activity can involve movement of the body as it relates to sports, or in traditionally non-sporting or athletic activities which require physical movement, such as charades and dance.

Echoed from Piaget’s studies on play and cognitive function (1962, 1965), cited in Sage (1992), many socializing skills such as morals, values and consciousness of rules are learned and developed through play. Sports in particular are viewed as socializing agents, reinforcing the concepts of competition, determination, fair play and achievement in youth (Fejgin, 1994). Furthering these ideologies, many advocates of physical activity, such as secondary school physical education teachers and some educational researchers, believe participation in regular physical activity builds character and develops and enhances self-esteem, discipline and determination levels in students (Bradford, 1989; Green, 1992; Hale, 1988; Harris, 1991; Pangrazi, 1982; Picou & Howell, 1985).
Many physical activities and physical education classes have the potential to increase a child's sense of belonging, competence, self-worth and acceptance of one's uniqueness and limits (Pangrazi, 1982). These effects may be more prevalent during physical activity as opposed to other subjects because such activities often involve spontaneous, consistent feedback, and may create in some individuals strong feelings of exhilaration and satisfaction not readily experienced in other subjects:

Most experiences in our school lives do not involve immediate feedback and a gut felt sense of joy. We have to wait to find out whether we did it right. This is not the case with physical activities. These sensations of immediate joy are highly rewarding and very personal. They serve as the foundation for a strong and positive self concept.

(Green, 1982, p. 16)

Green's statement is not necessarily true for all participants. Some may experience the exact opposite feelings, such as frustration and humiliation participating in physical activity, while others may feel equally exhilarated by getting a perfect score on a test or doing a great job on an assignment. Though Green seems to speak in overly general terms, it would seem unwise to discount
his theory completely based on the information which very often supports his
claims from many types of studies (Pangrazi, 1982; Shephard et al. 1982).

Memory, spatio-temporal awareness and critical thinking may potentially
improve through conceptualization and repetitions of plays, patterns and rhythms
involved in many physical activities (Stroot, Carpenter, & Eisnaugle, 1991). These
skills may be transferred to the cognitive domain and practiced in other areas of
life, such as in school and society. For example, football players or dancers often
are required to memorize particular “plays” or “steps” and critically visualize and
analyze how this will effect their intended outcome(s). Some students who
develop these types of cognitive abilities through physical activity may have the
added advantage of transferring these types of abilities inside the classroom to aid
them in similar cognitive endeavours, such as memorizing historical facts and
figures, visualizing and conceptualizing geometric shapes or figures and critically
analyzing or critiquing a particular plot, character or theme from a novel.
Shephard (1984) believes an improvement in mathematical ability is a likely result
of psychomotor development, enhanced from added physical education classes in
elementary school.

Montessori (1965) and to a lesser extent Piaget (1926), cited in Howe
(1978), are supporters of the cognitive benefits developed in part through
participation within a multi-sensory environment. Cratty (1972, 1973) and
Humphrey (1970) indicate that a transfer of cognitive skills developed and enhanced through physical participation in play and sports result from participation in fun, enjoyable, and highly regarded activities; this motivates practice of skills that may not be enthusiastically practiced in generally passive and less regarded learning conditions. Creativity, in the forms of imagination and improvisation, may also become enhanced or further developed because of the barrage of spatio-temporal stimuli and patterns many physically active people are exposed to regularly; often, they are required to manipulate and create movement(s) in various unique forms, such as in a ‘broken’ play in a football game or creating modern dance movements.

A growing body of research stemming from the ancient Greek belief “a healthy mind in a healthy body” points to the physiology of learning. Daily physical activity and education is critical, potentially more so than English and Math because without a healthy body, the mind may not be able to work at its full capacity (Green, 1982; Hale, 1988). This Ancient Greek belief is supported through a physiological explanation:

Physical movement triggers extensive activity in the brain’s cerebral cortex and motor cortex. Stimulated by movement, the cerebral cortex acts as a perceptual feedback system that sends information to and receives information from the spinal
cord; the motor cortex sends signals to tell the body how to move...... In effect, researchers say, promoting this mind-body connection is a surefire way to increase students' attention and achievement.

(Houston, 1982; cited in Black, 1995, p. 34)

Kephart (1969) supports the physiological construct of learning within this theoretical tenet: physical movement or motor responses are the initial means by which an organism adapts and learns within its environment; therefore, movement is the basis of all future learning. Furthering his and other researchers and theorist's claims of the 1950's and 1960's, all spatial relationships are formed in reference to the body through space and posture; thus, skills such as reading and conceptual development are developed through perceptual-motor skills acquired via active participation in physical activity, particularly in the stages of early childhood.

The benefits of physical activity further indicate that physical fitness improves mood, sense of well-being and the ability to handle stress (Folkin, 1976). Physical activity and involvement in various competitive and non-competitive physical activities enhances, to various degrees, one's physical self-image and fitness, offers many people the opportunity to socialize and interact with others and the natural environment on a daily basis, and at the very least, acts as a form of
enjoyment or affordable entertainment which may be pursued in various forms throughout one’s lifetime.

However, only a small fraction of Canadians are maintaining a physically appropriate lifestyle in accordance with their beliefs and attitudes towards physical activity and fitness. Often, Canadian adults do not allot an appropriate amount of time in their lives to keep physically active (Shephard, 1986). The statistics for youth are similar in nature to their adult counterparts. Kemper (1995) notes “In many ways the lifestyles of children and adolescents will resemble those of adults” (p. 1). The Ontario Physical and Health Education Association (OPHEA) believes there is an inactivity epidemic among youth (Melbourne, 1996). Only 50% of males aged 15-19 and less than 24% of females of similar age reach the recommended level of fitness. At age 14, most females’ fitness levels are on the decline, and by 18, the males have joined them. Further, 40% of five to eight year old children are obese, and thus have very early in their lives developed a risk factor for heart disease: “The absence of sufficient physical activity is a direct or indirect cause of many pediatric diseases and an important risk factor for chronic behavioral diseases that appear in adulthood, such as cardiovascular and musculoskeletal diseases” (Bar-Or, 1983). Studies have also indicated that rises in obesity and coronary heart disease among children have been associated with
behavioural disorders, such as hyperactivity and teenage alcoholism (Shephard, 1977; Smart, 1976).

The opportunity to participate in physical education classes and athletic teams in schools, both extramurally and intramurally, has traditionally provided many students the opportunity to be physically active on a daily basis and achieve or maintain some level of daily physical fitness, thus promoting a healthy lifestyle choice. However, Vickers (1992) reports that enrollment in high school physical education has declined to 30% from 80% since the 1970’s. One of the main reasons why students drop out of physical education after grade nine is due to their beliefs that other subjects are more important (Service, 1991). Ironically, Vickers (1992) citing the statistics from a 1990 Canadian Gallop Poll, indicates that 78.5% percent of parents want their children involved in daily physical education in high school.

Statistics within the United States are similar. Less than 73% of students on average take physical education courses after grade nine. Perhaps Siedentop (1992) summarizes most succinctly the concerns of many advocates for maintaining quality physical activity and educational experiences within the school system:

At a time in American culture when sport, fitness, and physically active leisure experiences are increasingly valued, school physical
education is so often devalued, generally lacking in credibility within the secondary school culture, and often ridiculed by those outside the school (p. 69).

Keays and Allison (1995) believe most children do not exercise enough to establish a required level of physical fitness because of the lack of physical activity they occupy themselves with at home, in the community and on a daily basis at school. At present, both children and youth do 75% less exercise today than they did in 1980. Only 9% of males and 3% of females aged 10-19 play a sport once a week. Not surprisingly, only 6% of youth are active enough to reap the rewards of good health (Weiss, 1993).

There is a critical period in development which determines whether individuals will be physically active later on in life (Kemper, 1995). One of these periods of development occurs in adolescence, between the ages of 13-19. An increase in homework, a shift from bicycles to motorized vehicles as early as the age of 16, and the mechanization and automatization of work and other leisure activities may play a contributing factor in decreasing substantially the amount of time and enjoyment adolescents spend and receive in physical activities (Shephard, 1982). These lifestyle changes may play an important role in determining future physical activeness in adulthood. If adolescents in general have decreased their participation in physical education, sports and other physical activities in school,
and their lives outside of the school environment are less physically active than ever before, this seems to indicate that physical activity is playing a reduced role in society and may decline further as youth and the population as a whole ages.

Epistemological, philosophical and economic changes in recent years have created a transitional, and for some people, an uncertain educational environment for many concerned stakeholders within Ontario’s educational system. The importance and value of education has never appeared as great as it is considered today by society. Media, parents or government officials are often identifying, proposing and implementing new measures for higher standards of accountability and learning in education. The Ontario government has acted by calling for standardized testing of students, implementing de-streaming in grades nine and possibly grade ten, and initiating a common curriculum in most schools to attempt to make the educational system more accountable and equitable for all students (Report of the Royal Commission on Learning, 1995). However, educational programs are often evaluated based on many factors, such as their cost-effectiveness, achievement of intended educational outcomes and their ability to provide equal opportunities for all students (Bredekamp, 1992). The elimination of Ontario Academic Credits (OAC) in 1998, amalgamation and reduction in school boards and trustees, and the optional funding or complete elimination of junior kindergarten have been a few of the most notable changes since the Report
of the Royal Commission on Learning was released (though some of these policies specifically proceed contrary to the Royal Commission’s Report).

As the curriculum evolves to improve the standards and performance of educating children in literacy, mathematics, science and technology, and socializing students to participate and compete in a multicultural and global society, apparently there are some school courses which may have lost their importance within the curriculum despite the research. Traditional subjects in school curriculum such as music, drama, visual arts and physical education seem to be these areas which may be reduced or eliminated in Ontario secondary schools to conserve funds or allocate more curricular time for more traditional core subjects, often referred to as the “three r’s”—reading, ‘riting, and ‘rithmetic.

As indicated previously, many children and youth are not maintaining a healthy level of physical activity. A more careful analysis as to the equity, quality and ideology of school physical education and extramural programs, from the points of view of policy makers, educators and students alike, seems to be required to determine why students are not generally participating in physical activity. Yet, with impending changes to the curriculum slated for the new school year in 1998, it remains to be seen what level of accountability Ontario’s schools will have to ensure the future promotion and development of quality courses and programs aimed primarily at stimulating and improving the overall health and academic
achievement of children and youth in Ontario schools as the twenty-first century approaches.

The discourse evolving from the study of the relationship between physical activity and academic achievement appears to indicate the relevance for further research into this pedagogical domain. The relative importance and value of physical education and activity in the school curriculum apparently has yet to be conclusively determined. Contradictory evidence from the literature, and a re-emphasis of more traditional academic courses in the school calendar at the potential expense of other subjects, such as physical education, have led to a split in philosophies between concerned stakeholders in the educational system. There apparently remains much to be determined in considering how various forms of physical activity, such as physical education, extra-curricular activities and interscholastic sports affect how our children and youth learn and socialize in schools.

Research Question

The research question in this study highlights the following inquiry: "Do physically active students achieve higher academic averages than relatively non-physically active students?"
Hypothesis

The study's hypothesis or premise believes that senior secondary school students who are moderately physically active will receive academically higher grades on average than those students who maintain high or low physical activity levels.

Hypotheses 2-4 have been designed to measure the relationship between physical activity and academic achievement while concurrently measuring the potential effect(s) of other variables in this study:

1. Students who are physically active on a moderate level achieve higher grades than students who are considered to have high or low physical activity levels.

2. Students who are moderately active and participate in a wide range of activities in school, such as physical education classes, intramural athletic activities, and/or extramural teams, achieve higher grades on average than students who have equal or different physical activity levels but participate in these activities outside of the school environment.

3. Students who are moderately active spend more time studying or doing homework than students who have high or low physical activity levels.

4. Students who are moderately physically active select healthier lifestyle choices; these choices are manifested by not smoking or drinking alcohol.
Definitions

1. **Academic achievement**: last semester's overall average stated as a percentage.

2. **Physical activity**: As supported by Shephard (1986), physical activity will be considered as "any bodily movement requiring significant energy expenditure over time." Interscholastic sports, athletic extracurricular activities, either recreationally or competitively, and participation in physical education classes will be considered as forms of "physical activity".

   According to Ismail (1992), physical activity is a broad term with a very unlimited scope. It is virtually impossible for a student not to be physically active in some type or manner; therefore, it would be inaccurate to categorize physical activity as an "all-or-none phenomena":

   It does not distinguish between, nor does it eliminate, either motor learning or performance. It may occur in a very formal setting such as a highly organized professional sport contest or it may occur in an informal setting such as a group of children playing in a sandpile... Thus physical activity, including sport, generally conveys the notion of observable human movement occurring in a wide variety of settings (p. 7).
The criteria measuring physical activity will also apply to students who experience physical challenges. Many students who require the assistance of a wheelchair or cane/walking device for daily activities quite often participate in athletic events and are enrolled in adaptive physical education programs. Physically challenged students who do not participate in organized physical activities are still required to exert physical energy to move their bodies via the facilitation of manual wheelchairs and other movement devices mentioned previously. Hence, according to the operative definitions of the study, they may be categorized as having a low level physical activity, yet they would be physically active nonetheless.

3. **High level of physical activity**: A high level of physical activity will be defined as participating in one or more physical activities, totaling more than 5 days per week, for more than 5 hours per week, and establishing a high level of physical exertion during these activities.

In this study, subjects will be classified in the "high" "moderate" or "low" physically active range in accordance with the number of days and hours per week they partake in physical activity. This criteria will indicate the level or degree of involvement in physical activity for the purpose of measuring the relationship between physical activity and academic achievement in senior secondary students.
Research indicates that people of all ages benefit from physical activity when it is pursued 3-5 days per week, done at a moderate or high intensity (50-85% of maximum heart rate), and is sustained for 15-60 minutes each session (American College of Sports Medicine, 1988; Fitness Ontario Leadership Program, 1989; Keays & Allison, 1995; The Canada Fitness and Lifestyle Research Institute, 1993). Thus, a high level of physical activity will require that each participant exceed the guidelines set for physical activity participation as suggested by the research.

4. Moderate level of physical activity: Participation in a physical activity 3-5 days per week, for 45 minutes to 5 hours per week, and maintain a moderate or high level of physical exertion during these activities.

This criteria meets the recommended average guidelines for a physically active lifestyle conducive to physical well-being as outlined above. The minimum timelines for participation in sports is fifteen minutes per session and three days per week. Therefore, 15 min. x 3 days = 45 min. per day of physical activity.

Similarly, the maximum guidelines require sixty minutes per session, five days per week. Therefore, 60 x 5 days = 300 minutes or 5 hours per week.

5. Low level of physical activity: less than 3 days and 45 minutes per week of physical activity.
6. **Physical exertion**: the physiological effects of exercise measured by changes in heart rate, breathing rate and sweat levels during participation in physical activity(ies).

Physical exertion will be measured to provide additional insight into the absolute energy expenditure level of each student during physical activity. One’s level or degree of physical exertion may also play a factor in determining the benefit that each person acquires from daily physical activity. To measure physical exertion ideally, it would be more accurate to observe the maximal oxygen uptake (VO2 max.) or heart rate of an individual during and after physical activity. In the absence of these measures, estimated breathing, heart and sweat rates can be formulated, as well as the reported muscle soreness or fatigue during and after physical activity. In the present study, the participants who circle options 3 or 4 in questions 15-18 will be considered to have a moderate to high level of physical exertion during physical activity (see appendix I, pp. 105-106).

The Canada Fitness Survey (CFS) cited in Shephard (1986) uses a self-reported exertion scale to determine the population’s physical fitness level. A scale adopted from the CFS will be used in the present study to measure the exertion and physical activity levels of senior secondary school students within one academic semester of approximately five months. The questions measuring exertion levels from the CFS will not be used precisely in the present study
because the CFS measures physical activity and related criteria for a period of nine months or more.
Chapter II
Review of Related Research

Introduction

The following review analyzes a broad array of studies in considering the relevant literature pertaining to the study of the relationship between physical activity and academic achievement. Hence, various quantitative and qualitative studies, spanning various countries and time periods throughout the past fifty years have been included in the review of related research. Various samples or populations, such as elementary and secondary school children, pre-school infants and homogeneous gender and racial populations have been studied and reviewed in order to highlight the multi-faceted approach or analysis to this type of study.

Much of the literature focuses primarily on elementary school children and infants. In considering studies of various populations, it may be prudent to analyze the various controls, research measures and conclusions such studies generate; this may assist in determining whether such controls and conclusions can be transferred and effect, in a similar nature, the secondary school student.

Enhanced physical education in the elementary school curriculum

An alternative elementary school in Columbus, Ohio, Westgate Alternative School of Academic and Physical Excellence, has endorsed and implemented a curriculum-based physical education and health program to achieving academic
The school offers physical education three times per week, designs daily structured physical movement activities, as well as integrates into the curriculum the study and research of multicultural games and dances, health and fitness characteristics of people from various cultures, and develops critical thinking skills through analysis of sport strategies (Stroot, Carpenter & Eisnaugle, 1991). The school’s philosophy is based on the holistic development of the child—physical, mental, and emotional. As a result, attendance is consistently high (94% daily attendance on average) and test scores on reading and math tests are higher than the average of other schools in their district. According to the administrator and teachers of the school, the program has positively benefited their students: “the integrated curriculum and positive atmosphere result in developing confident, well-rounded, physically and academically fit students—students capable of making healthy, wise, and responsible life choices” (Stroot et al., p. 50).

In essence, physical activity seems to stimulate both the affective and effective domains of learning, or the socioemotional and technical/cognitive abilities necessary to learn and achieve. As mentioned previously in this study, these skills and emotions may be transferred over to enhance the academic performance of students (Jerome & Phillips, 1981; Piaget, 1952; Sage, 1992).

Shephard et al. (1982) conducted the “Trois Rivière Regional Experiment” to prove physical education programs in schools lead to enhanced academic skills
and do not disadvantage students by decreasing their time spent on classroom studies. The study's foundation was based upon the classic primary school experiment in 1951 in Vanves, France. The "Vanves Experiment" studied primary school children throughout a period of nine years. It indicated experimental groups of students partaking in increased daily physical education classes performed better academically, matured more quickly and were more independent and less susceptible to stress than the control groups who had little or no physical education in their school program.

The Trois Rivière Study charted the impact of added or decreased physical activity upon the academic achievement of 546 French Canadian students throughout six years of primary school. According to the researchers, not enough time is devoted in the school day to teaching physical education because of the belief that physical education classes would interfere with academic learning because of curriculum, time and budget constraints. Three study groups were formed: one group of children had no physical education classes, another group kept their traditional schedule of physical education, while the last group increased their daily schedule of physical education by 48 minutes per day, instructed by a physical education specialist. This last group generally performed better academically than the other two groups, based on student reports and their performance in province-wide examinations that were held in their final year of
elementary school. From a follow-up report to "The Trois Rivière Regional Experiment in 1982, Shephard et al. (1984) note:

Perhaps more important than apparent gains in academic achievement is the proof that the primary school child can devote a substantial segment of curricular time to physical development with no disadvantage to the learning process. The fact that there is much to teach is no longer a valid argument against allocating a reasonable proportion of the school day to physical education (p. 63).

Limitations to Shephard et al.'s study (1982) include teachers being more prepared and energetic towards the group with added physical education because they were relieved by physical educational specialists for 48 minutes per day. Further, the results may be attributed to a Hawthorne or 'halo' effect; the children with added physical education time instructed by a physical education specialist realized they were given special treatment, and as a result, they may have been more enthusiastic and energetic towards the curriculum.

In consideration of these limitations, the present study will not include test and control groups. This may help eliminate the influences of varied teacher energy levels and the Hawthorne Effect. Of further interest to this study will be to determine whether the secondary school student may also devote a significant
amount of time to physical activity without disadvantaging his/her learning and academic achievement.

Biernacki (1993) studied two third grade elementary schools in rural Southeastern Louisiana over a three year period to determine if there was a relationship between physical activity and academic achievement. The first school took part in a 50 minute daily physical fitness program, stressing aerobics and large muscle movements, while the other school was used as a control. Academic achievement was measured at both schools through test scores in mathematics, reading and scores from a national standard test. Results indicate a statistically significant difference in the academic achievement of the students who receive the physical fitness program to those not receiving the program. Multiple regression analysis indicates a significantly positive relationship between academic achievement and physical activity, as well as other predictor variables, such as self-esteem and school attitude. A two-way ANOVA test indicates no significant individual differences in academic achievement over the three year period of the study.

Biernacki's (1993) study, similar to Shephard et al.'s study (1982), does not account or measure for other variables, such as each participant's physical activity levels outside of the school environment. This may have created a 'false-positive' result. Further research controlling for such variables, and ideally
measuring senior secondary school students, may produce more conducive results to the research question.

**Physical activity and extracurricular involvement**

Another perspective in the study of physical activity and academic achievement focuses upon the effects of varying amounts or degree of involvement in physical activity within the school environment. Contradicting Mendez's (1985) findings regarding the curtailment of extracurricular activities in schools, both Slocum (1986) and Soltz (1986) determined that extracurricular athletic activities in school enhances the academic achievement of students. Therefore, a minimum grade point average should not be used as a basis to discriminate on which students may be involved in extracurricular activities.

Slocum (1986) studied 180 male sophomore, junior and senior students from three large American high schools. Slocum determined that students who were involved in one school-based extracurricular activity had significantly higher academic averages than students who did not participate at all. Furthering his findings, he notes that students who participate in two extracurricular activities achieved higher academically than students who participate in one extracurricular activity. Therefore, the more involved students are in interscholastic sports and extracurricular activities, the greater they will achieve academically. However, Slocum acknowledges a limitation to the research investigating the degree of
student involvement in school physical activities and academic achievement: "no study was found that discussed specific levels of interscholastic involvement at the point of three activities a year in school" (p. 5).

A related observation based upon Slocum's study is highlighted by Soltz (1986). After studying 6,000 high school students in Colorado, Soltz found that both male and female athletic participants have a higher grade point average (2.67) when compared to non-athletic participants (2.12). Slocum further observed that athletic students were more apt to receive failing grades during times of non-athletic participation than when they were involved in sports.

After an extensive literature review, Holland and Andre (1991) observed that extracurricular activities assist secondary school students with learning and socializing in schools. Students who participated in extracurricular activities had higher career aspirations, more self-esteem, higher academic achievement and better race relations with peers. The researchers believe extracurricular activities are an integral part of the school curriculum and all students should have the opportunity to partake in them:

While the research on participation has many limitations, it clearly demonstrates a positive relationship between the extracurriculum and academic curriculum. . . . Overall, these results suggest that the academic and extracurriculum are partners, not antagonists, in the
quest to help students develop personally, socially, and academically. These results suggest that so-called ‘extracurricular’ activities are an integral and necessary part of the curriculum (p. 8).

**Literature review meta-analyses**

Keays and Allison (1995) conducted an extensive literature review from 1980-1994 examining the impact of regular to moderate vigorous physical activity (MVPA) on student outcomes, such as mood, self-esteem, fitness and academic achievement. Regular MVPA was defined as including the elements of measured intensity, duration, and frequency in modified physical education programs---requiring the addition of an aerobic program (running). The studies involved students from grades five to nine. The time frame for the studies in review ranged from six weeks to four years, with most of the studies (10 out of 24) lasting on average between six to fifteen weeks. Subject size ranged from 10-2,000 students. A greater number of studies (9), contained subjects sizes of 40-150 students. The majority of these studies indicate positive effects from moderate to vigorous physical activity, including improved memory, problem-solving, reading and mathematics achievement (Sinclair, 1983; Tomporowski, 1986).

Black (1995) compiled a series of qualitative and quantitative research studies. The research indicates an overall positive relationship between physical
activity and improved academic performance due to increased and improved
d physical education programs in elementary and secondary schools. The emphasis
on improved physical education programs is based largely on Howard Gardner's
research on multiple intelligences. According to his theory, each person contains
seven different types of intelligence; one being a 'bodily/kinesthetic intelligence.
As a result of Gardner's study, educational researchers in Canada have placed a
cognitive development emphasis in the K-12 curriculum of physical education
programs (Black, 1995). Their focus pertains to the following three areas in
particular:
1. the psychomotor domain, where students learn fitness and games;
2. the cognitive domain, where students learn the principles and theory of
   movement; and,
3. the affective domain, focusing on behaviours, such as cooperation, self-esteem,
   and respect.

Howard Gardner's theory of bodily/kinesthetic intelligence and Jean
Houston's (1982) theory of motor cortex stimulation leading to improved
academic ability, appear to act as the founding principles of the physiological and
social constructs of the K-12 curriculum. With the physical education program's
focus on these three domains, acquired physical skills should improve academic
achievement in other disciplines (Vickers, 1990).
A final area of Black’s investigation highlighted the importance of developing physical education programs involving thinking and thoughtful movement, creating “educational experiences” as opposed to the more traditional or stereotypical leisure experiences assumed to be part of most physical education classes, such as sports. These educational experiences take into account a three step process of learning and moving, where students become sensitized to space and time in movement strategy and execution. This occurs before, during and after the activities have been performed, thus establishing critical thinking skills and transferring this type of mental skill over to more traditional academic subjects (Buschner, 1990; cited in Black, 1995).

With respect to Black’s (1995) and Keays and Allison’s (1995) literature reviews, it is unclear whether other variables, such as student motivation and socioeconomic status were controlled for in the various studies they reviewed. Further, it remains uncertain how various amounts of physical activity may effect academic achievement, particularly in senior secondary students, and whether a Hawthorne Effect, similar to Shephard et al.’s study (1982), may have occurred.

The present study will measure all types of physical activity rather than implementing a single aerobic component, or creating an improved physical education program in a controlled school environment as the primary measure of physical activity. This should eliminate a Hawthorne Effect and give a broader
perspective on how various forms of physical activity are related to academic achievement.

Kirkendall (1986) conducted a literature review based upon five approaches to measuring physical activity levels and academic achievement throughout the period between 1950-1970. He discusses the findings of experimental, motor-performance and neurological studies in this field of research. Kirkendall also discusses and compares the effects of physical activity and academic achievement between student athletes and non-athletes, and between mentally challenged students and mainstreamed students. Results based on the comparison between student athletes and non-athletes indicate conflicting reports. According to Kirkendall, most of the literature supports a “modestly positive” relationship between the two variables, though little evidence has been found to indicate physical activity directly increases academic achievement. To highlight the conflicting evidence, Eidsmoe (1951) and Lehsten (1964) found student athletes perform better academically than non-student athletes, whereas Slusher (1964) and Thorpe (1967) found evidence supporting no significant difference between academic achievement and physical activity.

Motor performance and experimental studies indicate similar mixed results. In terms of motor performance measures, positive relationships are found between measures of muscular strength, flexibility and coordination with academic and
intelligence scores. However tests involving somatotype, body size and endurance are negatively related to academic achievement and intellectual scores.

Experimental studies referenced in Kirkendall's literature review manipulate participation levels of students in physical education classes. Many studies find no significant relationship between subjects who participate in physical education classes to those who do not partake in physical education classes. However, Ismail (1967) found a significantly positive relationship between academic achievement and physical activity in the form of an organized physical education class for 5th and 6th graders.

According to Kirkendall (1986), very few neurological studies have been found in the literature, and hence there are too few studies to make any significant observations in this area. Studies involving a comparison between mentally challenged and mainstreamed students indicate that a positive relationship exists between motor and intellectual performance for both mentally challenged and mainstreamed children (Francis & Rarick, 1959; Sloan, 1951). Kirkendall believes the relationship between motor and intellectual performance is strongest in the very earliest stages of life and gradually disappears with age. He reiterates there is no conclusive evidence on the actual effects that exercise has on intellectual development. In Kirkendall's opinion, the entire area of study has yet to be seriously studied. He concludes his review by stating: "there is generally a
moderate positive relationship between motor performance and intellectual achievement, especially with motor performance involving cognitive processes such as coordination and balance tasks, rather than with strength, cardiovascular endurance, or flexibility tasks" (p. 58).

Howe (1978) conducted a literature review between the periods of 1950-1978 to enable him to develop a model demonstrating the interrelationship between sport, physical activity and academic achievement, and the factors involved which have led to contradictory results in this area of study. He scans various theoretical models whose primary focus is on the psychological, neurological and social reinforcement theories directly related to the development of children. Though much of Howe's literature review indicates a positive relationship between physical activity, sport and academic achievement, he later notes that follow-up studies are unable to duplicate the same results. He cites the lack of stringent controls, analysis and the Hawthorne Effect as possible explanations why inconsistent results are produced. Studies reviewed include measuring imaginative play and cognitive development in kindergarten children, a comparison of grades between athletes and non-athletes, and athletic participation as a predictor of educational aspirations. Having considered the research work, Howe constructed a dynamic model of the interrelationship of physical activity, sport and academic achievement as a dual level of needs, physical and social,
initiated and developed in the primary stage of a person's development by physical activity. As development occurs, extrinsic motivators such as social acceptance, self-esteem and expectation of success influence and effect the outcomes of each individual. Though responses to these effects become more refined and increasingly independent of each other in time, the model indicates the conditions which need to be present before such relationships can exist and when achievement in any area is the result (p. 34).

As more research has been undertaken within the past decade, Howe's literature review and model and Kirkendall's (1986) review function as solid theoretical foundations to incorporate many factors into future research which may help to identify a relationship between physical activity and academic achievement in senior secondary school students.

The effects of gender and race

Research in the domain of physical activity and academic achievement has led to postulations on the effects that gender and race may play in discovering a significant relationship in this area of study. Melnick, Vanfossen, and Sabo (1988) measure the effects of athletic participation on academic achievement, focusing exclusively on a female sample. The researchers administered questionnaires and standardized tests to 5,669 female U.S. high school students in 1980, and subsequently followed up in 1982, allowing for both cross-sectional and
longitudinal analysis. The sample was selected from a two-stage stratified sample, with a 90% response rate in 1982 from the initial survey date in 1980. Multiple regression analysis measured changes in scores over the two year period. Academic achievement was found to have no effect on the independent variable of athletic participation. There was, however, a slight positive effect between athletic participation and educational aspiration. According to the researchers, the more girls were involved in school athletics, the more they perceived themselves as being popular with other students and "thus the higher their perceived status within the school system" (p. 31). This effect may enhance their self-esteem and motivate them to perform better academically in school.

The present study will attempt to expand upon Melnick, Vanfossen, and Sabo's (1988) study by including both males and females in the target population. Including both genders will be more reflective towards the greater population, and as a result, may provide more relevant conclusions.

Harris (1991) studied two male high school summer basketball leagues in Washington DC to determine whether sport reinforces or detracts from academic performance, and whether the race of students involved plays a role in their academic performance. The sample consisted of 187 black and white high school male basketball players from grades nine through twelve, from both public and private schools. Questionnaires were the primary method of data collection. The
content in the questionnaires pertained to determining academic achievement, personal and significant others' values through a series of structured and open-ended questions. Harris separated the data into categories to determine the effects of sport and academic achievement, and what role, if any, race and the type of school attended play. This resulted in the following comparisons:

1. black/white comparisons for the entire sample;
2. black/white comparisons for public schools and for private schools; and
3. public/private school comparisons for blacks and for whites.

The results indicate a slight negative correlation (r = -.13) between academic and athletic performance for the entire sample. However, these findings were not statistically significant. All of the subsequent comparisons of physical activity and academic achievement, as noted in the second and third comparisons above, indicate some positive correlations (whites in private schools, r = .16), and some negative correlations (blacks in public schools, r = -.01). As an overall conclusion to the study, Harris noted that most students felt it was important to do well in both school and sports, and that race is not a strong indicator in determining the compatibility or incompatibility of sport and academics.

A qualitative study by James (1995) on 29 black youth (18 males and 11 females) between the ages of 17-22 in Metropolitan Toronto secondary schools examined the beliefs, problems and rewards working class black youth experience
through their involvement in school sports. Most participants were supportive of 
sport involvement in school because it made them feel popular, allowed them to 
communicate and in some cases, cope with teachers and classmates better, and it 
gave them a reason to stay in school and get an education. Most males believed 
they could use sport in school to help them cope with the low expectations and 
negative stereotypes they are subjected to in school and society. Some participants 
felt proud of themselves and their heritage with the added positive recognition of 
sport success. As a result, they felt their teachers supported them more, both 
athletically and academically. For some respondents, sports were used as a means 
to bridge the "cultural gulf" of being new to the country. Many of the respondents 
were motivated to achieve academically and were concerned with the label of 
"dumb jock" and racism associated with blacks in sports.

Picou, McCarter, and Howell (1985) conducted a literature review to 
assess the effects that high school athletic participation has on educational, 
 occupational and income achievements of male and female, white and black 
students eleven years after graduation, from five southern states in America. Data 
from 8,000 high school students were taken in 1966, 1968, four years after 
completing high school (1972), and eleven years after completing high school 
(1979). Multiple regression techniques were used to determine the effects of 
parental education, socioeconomic status and athletic participation on educational
attainment, occupational status and earnings. Athletic participation had a positive impact on the educational attainment of white males (beta = .150); however, the educational attainment for black females was negatively correlated (beta = -.165). Participation in high school athletics had a small negative effect of black males and conversely, a small positive effect on white females. The effect of participation in high school sports on occupational status and earnings indicated a statistically positive relationship for white males. White males with a high school athletic background averaged $252 per month more than white males who were non-athletes. Black male high school athletes earned an additional $166 per month, while white female athletes earned $71 per month. No reported earnings for black female athletes were listed, though black female high school athletes had significant negative effects on occupational prestige (beta = -.163). The study concludes that adult earnings of black athletes of both genders are more affected by measures of background than athletic participation, while the opposite is true for white males: high school athletic participation has more impact than social background or social origin. According to the researchers, they feel the effects of discrimination and social origin on black males “outweighs sports participation as a determination of status attainment” (p. 76). Further, though white females participating in high school athletics earn more than their non-athletic counterparts, their earnings are considerably less than the male gender of both races; athletic
participation for black females has a negative effect on educational attainment and possibly their future earnings as a result.

Unclear in their study are the effects of athletic participation on academic achievement of both race and gender groups. Though the measure of educational attainment acts as a rudimentary measuring device, it remains to be proven how each group performed academically in high school while concurrently participating in school athletic events; what effects does gender, race or citizenship have on academic achievement for both athletic and non-athletic students?

Picou, McCarter, and Howell's study (1985) provides an interesting framework for analyzing the effects of gender on educational and occupational attainment. Stereotypical gender biases appear to have a determining effect on the effects of high school athletic participation. These results may indicate that the athletic environment continues to remain a patriarchal 'strong-hold', enhancing male prestige and attainment while minimizing or undermining the value of athletics and physical activity for females.

The studies by Harris (1991), James (1995), Melnick, Vanfossen, and Sabo (1988), and Picou, McCarter, and Howell (1985) indicate that variables of gender and race have significant effects on the social and educational achievement of physically active students. Their findings indicate that further research and inquiry is necessary to determine specific results concerning students' actual academic
achievement during participation in physical activities and their social and emotional development within the high school context. How do their findings and the prevailing ideologies concerning gender and race reflect in other environments, particularly within Ontario’s educational system?

Motor learning and academic achievement

Some studies analyzing physical activity and academic achievement focus on the effects of academic and intellectual results based upon developing rudimentary physical skills in infants and elementary school children, otherwise referred to as “motor learning” (Diem, 1982; Harris & Jones, 1982). These studies are measured over a period of many years throughout childhood.

Harris and Jones (1982) studied 1767 boys and girls in a stratified random sample of 18 schools in the state of Georgia. Eight motor performance measures ranging from jump-and-reach tests to the flexed-arm hang and a 600 yard walk-run are compared to the subjects’ performance on the Georgia Criterion Referenced Test, indicating reading and mathematical ability. The results indicate that one or more motor variables, such as eye-hand coordination activities and “shape-o-ball”, a perceptual motor activity, are found to be statistically significant with relation to reading and mathematical ability in the second, fourth, and sixth grades.

Diem (1982) studied the longitudinal effects of early motor stimulation in four to six year old children. Infants exposed to swimming and moving in water
from their third month of life were compared to infants who received limited or no stimulation in this environment. Subjects who began swimming during their third month of life showed higher intelligence scores (Wechsler Preschool, Primary Scale of Intelligence, and Hamburg Wechsler Intelligence Test for children) at four and six years of age in comparison with four and six year olds who began their swimming program at 2.4 years of age, or not at all.

The above studies by Diem (1982), and Harris and Jones (1982) seem to indicate physical activity beginning from infancy or early childhood accelerates neural function in various undetermined capacities. However, these studies do not observe whether this “accelerated” neural benefit, derived in part from physical activity, positively effects academic performance past elementary school. Other potentially influencing variables, such as family environment and physical activity levels not accounted for outside of the study, may have played influential roles in the conclusions the researchers determined. By measuring and controlling for these variables in the present study more valid results may be concluded, isolating to a greater extent the variables of social, economic, motivational and physical activity levels.

Non-deleterious effects of physical activity towards academic achievement

Though all studies do not conclude a significant positive relationship between physical activity and academic achievement, the results that are measured
often show no significant negative relationship between the two variables; this would indicate that physical activity does not detract from academic performance as some research has suggested (Henry, 1963; Mendez, 1985; Mireau, 1986).

Fejgin (1994) conducted a longitudinal study of nationally representative eighth graders on the effects of athletic participation on student outcomes over a two year period in the United States. The study is based on data obtained from the National Educational Longitudinal Study (NELS) in 1988. The sample is created from a clustered, stratified national probability sample of 1,052 schools and 26,432 eighth graders. Fejgin’s study examines the original group of eighth graders in 1990, currently in their grade ten year and consisting of 22,696 students. Academic achievement, self-concept, locus of control and educational aspirations are the variables measured. The study further creates measures to control for student background or race, and other dependent variables such as IQ and socio-economic status via questionnaires and standardized tests. Student data is obtained from four questionnaires given out to students, parents and teachers. Multiple regression analysis examines the relationship between athletic participation and various dependent variables: grade 10 academic achievement, self-concept, locus of control, discipline problems and educational aspirations.

Student athletic participation shows positive effects on all the dependent variables, yet a positive relationship between physical activity and academic
achievement is not statistically significant. Although not statistically significant in her study, Fejgin highlighted the fact that other studies have found that sport participation does not negatively affect academic performance (Jerome & Phillips, 1981; Marsh, 1993).

Marsh (1993) studied the effects of sport participation in the last two years of high school in a longitudinal study based on a nationally representative U.S. high school sample of the HSB study (High School and Beyond). Four thousand four hundred and twenty two randomly selected students from an original probability sample of 14,825 were chosen out of 1,015 U.S. high schools. Twenty-two outcome variables, such as educational aspirations, self-esteem, academic achievement and reduced absenteeism are tested in this study using multiple regression analysis. The results find that school sports have a significantly positive effect on 14 of the 22 outcome variables. However, academic achievement and seven other outcome variables are not found to significantly improve nor decrease. Marsh concludes that higher educational and occupational aspirations are one of the most significant results of sport involvement in high schools and that high school sports do not negatively affect any of the eight outcome variables, including academic achievement.

Diringer (1993) studied 300 randomly selected grade 10-12 students from four high schools in Ohio. Multiple linear regression is used to determine a
potential relationship between extra-curricular participation, in the form of
interscholastic athletics, and academic achievement beyond what can be concluded
from each student’s standardized test scores. There is no significant difference
between male and female grade point averages compared to their degree of
involvement in interscholastic activities. However, interscholastic athletes have
higher grade point averages than non-participants on average.

Summary

As argued by Shephard et al. (1982), much of the empirical research
completed in studying the relationship between physical activity and academic
achievement has consistently shown that physically active students have higher
grades in direct comparison with students who have very limited levels of physical
activity in their lives (Diem, 1982; Hale, 1988; Harris & Jones, 1982; Pangrazi,
1982). Performance improvements in academic subjects and behaviours such as
math, reading, higher educational aspirations and greater self-esteem are some of
the more consistent findings of physically active students throughout many studies.

Qualitative research offers another perspective when analyzing the effects
of physical activity and sports upon academic achievement. Researchers such as
Black (1995) and Pangrazi (1982) strongly support the hypothesis that physical
activity improves students’ academic achievement based on interviews and
personal observations of students, whereas studies conducted by James (1995) and
Green (1992) indicate that improved self-concept and educational aspirations are results of athletic participation in high school.

However, many studies showing a positive relationship between physical activity and academic achievement are performed on young children, often in the elementary school setting. Thus, can the results from elementary student samples accurately infer that secondary schools students will be similarly positively effected? Further, can the conclusions of studies occurring in foreign settings, such as in the United States or Europe, be considered valid when measured within the Canadian, Ontario, or Toronto geographic regions?

Many studies focusing on the relationship between physical activity and academic achievement of students use questionnaires as their principal method of data collection (Fejgin, 1994; Keays & Allison, 1995; Marsh, 1993; Melnick, Vanfossen, & Sabo, 1988). Data analysis includes multiple regression of the variables involved in the study: motivation, parental support, educational aspirations and self-esteem. Gender, SES, and IQ of the subjects are controlled for in some studies.

Limitations to the research, in some cases, are due to a lack of measurement or control for extraneous variables such as SES, physical activity participation outside of the school context and the Hawthorne or Halo Effect. Valid conclusions and generalizability to the greater population appears to be most
challenging when studies focus exclusively on one particular gender and geographic region.

Building upon previous research may enable this study to further measure and control for more variables which may have played an influential role in past research designs but were otherwise ignored or overly manipulated. For example, sampling a mixed gender population and taking into account many types of physical activity occurring naturally in various settings may allow for more generalizable conclusions and potentially be more representative of the Greater Toronto Area.

This research area appears to require further pertinent questioning and analysis to determine the cognitive benefits of physical activity that has traditionally been promoted for health reasons alone and may be in danger of being reduced in the school curriculum in the future. Echoing Shephard et al.’s (1982) and Kirkendall’s (1986) conclusions, more research measuring and controlling for extraneous variables inherent in the study of the relationship between physical activity and academic achievement seems needed to clarify and broaden the validity and scope of this pedagogical research domain.
Chapter III

Methods and Procedures

Subjects

The target population consists of grades 11, 12 and O.A.C. (grade 13) students from one secondary school in an overall middle-class region within the GTA (Greater Toronto Area), though families from lower and upper-middle class socioeconomic groups populate the area. Within the school’s geographic region, the average family income is $2,000 dollars higher than the provincial average, the immigrant population is 45%, and low income residents account for 13% of all residents.

Out of 150 students who participated in the study, 126 sample data are used in this study (male=65, female=61). The age of the participants ranges from 16-20 years; the mean age of the subjects is 17.30 years. The ages of 16-18 occur most often in the study (109 times) and consist of 86.6% of all cases.

Representative of the school population, the subjects are chosen based on a convenience sample; hence two sets of grades 11, 12 and O.A.C. classes (one arts/humanity and one math/science/technology class) of approximately 20-35 students whose teachers granted permission for the study to proceed during class time are the criteria involved in selecting the sample.
Research Design

The theoretical tenet of the study is dually based on the foundations of correlational and survey research. The correlational design involves the investigation of possible relationships between variables without manipulating them; this however does not indicate or imply causation. Various statistical analyses described in detail in chapter IV indicate the strength of the relationship between various levels or amounts of physical activity and academic achievement while taking into account the potential influences of other variables.

The study also contains characteristics inherent to survey research, such as asking questions as the main method of data collection, determining specific abilities and knowledge of the sample, and collecting information from a sample rather than from every member of the population (Fraenkel & Wallen, 1993).

The research design takes into account threats to internal validity by measuring and controlling for other variables which may have a significant impact on this study; these variables include parental motivation, self esteem, study or homework habits, SES, age, citizenship and gender.² Potentially, all of these variables may play a significant role in determining whether moderately physically

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1 Due to grade and age restrictions, 18 cases were deleted because these participants had done most of their course work in grade 10 the previous semester or were over the age of 20.
2 Due to restrictions by the "xxx" Board of Education where the study was conducted, citizenship rather than race will be measured in the present study.
active students achieve higher academic averages than secondary school students with high or low levels of physical activity.

Data collection is based exclusively on a questionnaire that all participants complete during class time. The information gathered is specifically from the previous semester's accomplishments and activities. In this study, data collection occurs during the second semester. Thus, the data generated from the sample is determined from the first semester in the 1996-1997 school year. First semester begins in September, 1996 and is completed at the close of January 31, 1997, approximately a five month period of study.

The design of the study attempts to minimize variability in IQ, grade, and course difficulty levels within the sample. Thus, the following controls based on administration/teacher and student/parent permission, are taken:

1) all participants are in the advanced stream of learning;

2) an equal number of grade 11, 12, and O.A.C. classes are selected; and

3) the number of courses taken in the past semester by each participant are recorded and grouped accordingly within similar categories of course load or number.

To eliminate discrepancies in terms of course load, the participants will be grouped according to the number of courses they have taken in the past semester. Hence, student academic achievement will be categorized and compared based on
each participant’s course load in two, three, four or five academic courses from the past academic semester. Variability in course load may result in skewed or inconsistent results when determining students’ academic achievement with relation to their past academic performances in school.

It is often tricky to measure the perceived and actual difficulty levels of student course loads. For example, a student may have a course load comprised entirely of traditionally difficult subjects such as math and sciences, yet s/he may find the particular course load relatively easy because his/her strengths lie in this area. Thus, the same student may find the traditionally “easier” course load of languages and arts more challenging based on individual preferences and strengths.

Materials

Very little research has been done in this particular area (Keays & Allison, 1995). Hence, a questionnaire measuring high school students’ levels of physical activity and academic achievement was originally created by the researcher for the purposes of this study, and as indicated previously, provides the only method of data collection (see Appendix I, p. 101).

The questionnaire serves a dual purpose: a) to determine and categorize the varying amounts of students’ physical activity levels and their academic average, and b) to control for other variables which may hinder internal validity.
**Questionnaire design**

No specific name or title was considered necessary for the instrument in this study. The instrument of measure was simply titled, “Questionnaire”. The author or creator of the instrument is the principal researcher in this study; however much collaboration in designing the instrument was provided by the ‘xxx’ board of education’s research department, the principal researcher’s thesis and expert committees, and by the statistical consulting services group at the Ontario Institute for Studies in Education of the University of Toronto.

The instrument predominantly involves quantitative responses from the sample, such as grade average and family income levels, and indicates involvement in various physical activities from the past academic semester. The final two questions of the questionnaire, (see Appendix I, page 110) involve qualitative measures, thereby allotting the sample an opportunity to express personal beliefs in reference to the research question. These two short-answer questions may provide a ‘window of opportunity’ for future qualitative study—as an alternative form or follow-up to the present study, and may also add some insight into current senior secondary school student’s ideologies and values as they pertain to physical activity in the high school curriculum.

The response format to the questions of the instrument involves a multi-faceted approach. Multiple-choice replies, yes or no answers, circling categories
or scale measures to indicate physical activity and exertion levels, and filling-in blanks to indicate such items as academic average, age, and number of hours worked in the past semester comprise the technique or methodology used in the design of the instrument. Though multifaceted, the questionnaire appears to be straightforward and relatively accessible to the sample as indicated by the ease of completion and lack of clarification of the questions from the sample groups during the pilot-study and data collection (see p. 57).

There are 44 questions in the questionnaire measuring 15 items or variables. These items pertain to: grade level, type and amount of physical activity participated in (whether it is extramural, intramural or extracurricular, and the number of days and hours per week), parental motivation, self-esteem in athletics and academics, number of courses taken, overall academic average, homework or study habits, gender, birthplace, age, SES, employment, health choices, and opinions about the value of physical activity within the secondary school context.

Some of the items, such as physical activity levels, academic averages and family income require two or three types of measures to indicate as accurately as possible each subject’s true status for these variables. For example, to determine whether students are ‘high’ ‘moderate’ or ‘low’ physically active, 6 types of questions or measures are used, although each measure pertains to or is categorized according to only one item, that being physical activity level in this
instance. Specifically, questions 8, 9, 11, and 15-17 in the questionnaire are the primary determinants of physical activity level. Questions 2-7 are used as a guide to facilitate, sensitize, associate and potentially ‘trigger’ the sample’s memories of the amount and type of physical activity each student had accumulated throughout the past semester. When coding the data from the questionnaire, these questions further act as a basic measure of consistency or honesty, indicating for example, whether the responses to questions 8 and 9 are consistent or in keeping with the replies from questions 2-7.

Validity

Validity is very important in any research design because the more valid a particular research instrument is, the more confident researcher(s) can be when they make inferences based upon the data they have collected. According to Bertrand and Cebula (1980) a test or instrument is valid if it measures what it is supposed to measure. Thus, for example, if a researcher wishes to determine the socioeconomic level of a participant in a study, does the question “please state the average annual income of your family in a given year” accurately measure the socioeconomic status of the participant?

The validity of the questionnaire in this study will be determined from content-related evidence. Content-related evidence determines the relevance of the questions to the study, and also examines the usability of the instrument for
such items as page layout, size of the print, margins, clarity of instructions and the appropriateness of language (Martin, 1980).

A common way of determining the suitability of an instrument is to acquire the services of suitable judge(s), otherwise referred to as an “expert committee”:

How does one obtain content-related evidence of validity? A common way to do this is to have someone look at the content and format of the instrument and judge whether or not it is appropriate. The 'someone', of course, should not be just anyone, but rather an individual who can be expected to render an intelligent judgement about the adequacy of the instrument—in other words, someone who knows enough about what is to be measured to be a competent judge.

(Fraenkel & Wallen, 1993)

The judges in this study’s committee are comprised of an associate professor, Dr. Larry Leith, and an assistant professor and career scientist, Dr. Ken Allison. Both professors have doctoral degrees, are actively publishing in this research area, and practise currently at The School of Physical and Health Education, University of Toronto. In accordance with the expert committee’s knowledge and experience, the questionnaire was considered a valid measure for the purpose of this study. The expert committee determined that the questions and
format of the questionnaire provided useful information about the topic or variable being measured; this is also known as content validation.\(^3\)

The study of physical activity and academic achievement involves determining relationships not causation. Research where the variables are not manipulated is referred as "ex post facto" research. Newman and Newman (1977) highlight that causal-comparative or ex post facto research has very low levels of internal validity yet contains high levels of external validity. To increase internal validity, alternative hypotheses need to be formulated and subsequently eliminated:

Alternative hypotheses. These are hypotheses that propose other explanations for the effect other than the stated ones. These explanations are competing or rival hypotheses to the one the researcher is interested in verifying. The more of these rival hypotheses that can be eliminated, the greater the internal validity of the design.

(Cited in Diringer, 1993, p.62)

The type of research to be conducted in the present study examines the effect an event has on an outcome (Kerlinger, 1973; cited in Diringer, 1993). Causation in causal-comparative or ex-post facto research cannot be determined nor can the researcher(s) manipulate the variables that are being studied (Fraenkel

\(^3\) However, content validity can not be quantitatively judged (Gay, 1981; cited in Diringer, 1993).
& Wallen, 1993; Newman & Newman, 1977). By manipulating the amount of time students partake in physical activities during school, such as in the experiments by Biernacki (1993), Shephard et al. (1982), and Stroot et al. (1991), the validity of the results may be questioned. However, if studies such as the present one are to involve only a measurement and not a manipulation of the variables, educational research may have a more reliable indicator of the relationship between physical activity and academic achievement as it normally occurs in the larger social context.

The questionnaire in this study is based upon the foundations of other studies, such as Diringer (1993) and The Canada Fitness Survey (1983), as cited in Shephard (1986). In measuring physical activity levels, Shephard (1986) indicates the Canada Fitness Survey uses the criteria of active, moderately active and sedentary. Similarly, Diringer (1993) uses a rating scale of 0, 1, 2, 3 to measure the level of extracurricular involvement in students. Thus, comparable to other research, this study uses a three-tiered rating scale of low, moderate and high to measure physical activity.

Controlling for extraneous variables will require that each type of variable be categorized appropriately within the portion of the sample size that is of a similar quality. For example, when analyzing the data, all students of a similar gender will be categorized together to eliminate any discrepancies in interpreting
the results of the data according to gender. This type of control may enhance to
some degree the questionnaire's internal validity.

**Reliability**

The questionnaire was pilot-tested during the first semester, preceding the
actual data collection in the second semester. One grade eleven physics class of
twenty students in the same secondary school chosen for this study completed the
pilot study. The response rate was 100%. Pilot-testing the questionnaire provided
feedback regarding the student response rate. The overall indication of the ability
to comprehend the questions was positive---only 2 participants were unsure of
how to answer one question on the questionnaire. The exact method outlined in
the procedures section was followed during the preliminary study. The average
time taken to complete the questionnaire during the pilot study was twelve
minutes.

To further enhance reliability, more than one question is used in the
questionnaire to measure physical activity and academic achievement. This may
improve the comparative value of the results, indicating the rate of consistency
between questions measuring the same item, such as student physical activity levels
and academic averages, and this may also provide a broad and encompassing
measure of the primary variables in this study.
Procedures

The principal researcher of this study conducted and supervised the administration and procedures of all data collection. This involved a two-step or two-meeting interaction with all the participants or sample during their regularly scheduled class time in their classrooms. Initial contact occurred at the beginning of class, consisting of a 5-10 minute briefing about the purpose of the research, the procedures necessary to be taken (completing the questionnaire), and distribution of parental permission forms to the participants. The participants were made aware that they could not participate in the study unless they return the permission forms indicating written consent from their parents/guardians (see Appendix IV—Parental Consent Form, p. 113). Questions or concerns regarding any aspect of the study were actively encouraged and answered. No data collection of any kind occurred in the initial meeting.

The second meeting with each class occurred 2-5 days after the initial meeting. The gap in time allowed the participants enough opportunity to receive permission from their parents/guardians and return the signed permission forms to their classroom teacher or to the principal researcher. Further, a 2-5 day period was necessary based on the availability of each class’s schedule; some classes were preparing for and writing tests, submitting lab reports or projects, or were involved in class presentations and/or field trips. This gap in time also enables the principal
researcher to schedule within a school week the necessary time to go individually to each class and administer the questionnaire.

During the second meeting, after all permission forms were submitted to the principal researcher from the students, and the class currently participating in completing the questionnaire was attentive and seated, the principal researcher distributed the questionnaires face-down on each student’s desk while indicating that no one could begin answering any questions. Once each student had a questionnaire, instructions concerning the introductory page of the questionnaire (see Appendix I, page 101) were exactly read aloud as typed at the beginning of the questionnaire. Highlighted points included such items as definitions of terms, the time period that each student would be basing his/her answers on, maintaining confidentiality by not writing one’s name or school on the questionnaire, and a reemphasis that questions might be left blank or unanswered if they seem too intrusive or personally troubling. Once again, questions from the participants were encouraged and answered.

At this point data collection began. The participants were asked to complete the questionnaire on an individual basis. The principal researcher invigilated the entire process, answering participant’s questions as the need arose for each class.
The questionnaire took approximately 20 minutes on average to complete. No student from any of the six classes involved in the study took less than 12 minutes or longer than 30 minutes to complete the questionnaire. As the students completed the questionnaires, they returned them to the principal researcher where they were immediately placed in a folder indicating the grade level and subject area of each class.
Chapter IV

Data Analysis and Results

The Statistical Package for the Social Sciences (SPSS, version 7.0) was used to analyze and interpret the data. Similar to other studies (Diringer, 1993; Fejgin, 1994), multiple regression analysis and various Anova procedures were conducted to determine within-group and between-group variance estimates (Welkowitz, Ewen, & Cohen, 1986). More specifically, one-tailed t-tests comparing statistical significance of the hypotheses were done at the .05 alpha level. These measures were used to determine the presence of a significant difference between two or more variables simultaneously, and to limit the chance of Type I error: “...rejecting the statement that says there is no relationship or no significant difference between groups when that statement really is true” (Diringer, 1993, p. 79).

Main Hypothesis

The hypothesis of this study states that moderately physically active students achieve higher academic averages than low or high physically active students. Multiple regression is the primary statistical procedure used to determine the statistical relationship. This is a valuable method to use because it controls for influencing variables which may skew the results of the study. Controlling the variables of gender, citizenship, number of courses taken, SES, age, parental
motivation, self esteem, and the average amount of homework done, a Pearson Correlation Coefficient of \( r = -.051 \) at an observed significance of .293 is produced. The one-tailed significance test of .293 indicates that the null hypothesis cannot be rejected. In this study, the null hypothesis indicates there is no significant difference in academic achievement with varying levels of physical activity for senior secondary school students. Table 1 presents the Pearson Correlation between the variables without using controls for extraneous variables. A larger negative correlation of \(-.063\) is produced with a one-tailed observed significance of .245, indicating once again no significant relationship between the variables.

Table 1: Correlation of academic average and physical activity levels.

<table>
<thead>
<tr>
<th></th>
<th>ACAAVG</th>
<th>ACTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation ACAA VG</td>
<td>1.000</td>
<td>-0.63</td>
</tr>
<tr>
<td>ACAA VG</td>
<td>ACTIVE</td>
<td>0.63</td>
</tr>
<tr>
<td>Sig. (1-tailed) ACAA VG</td>
<td>.</td>
<td>.245</td>
</tr>
<tr>
<td>ACAA VG</td>
<td>ACTIVE</td>
<td>.245</td>
</tr>
<tr>
<td>N ACAA VG</td>
<td>ACTIVE</td>
<td>122</td>
</tr>
</tbody>
</table>

To clarify the results further, descriptive statistics, in the form of frequencies, means, standard deviations, and a one-way Anova procedure are produced. The sample sizes for each category of physical activity is as follows: low physically active, \( n = 26 \) (22.2% of the total sample), moderately physically
active n = 54 (42.9% of the total sample), and high physically active n =42 (34.9% of the total sample).

The mean academic averages of low physically active students are slightly higher (mean=74.81) than those for moderate (73.72) and high (72.81) physically active students. Figure 1 below illustrates there is a slight negative linear relationship between academic achievement and physical activity in this study.

**Figure 1: Relationship between academic achievement and physical activity level.**

![Graph showing the relationship between academic achievement and physical activity level.](image)

Standard deviation values are higher in the low physical activity category (12.81) as compared with the moderate (11.09) and the high physical activity category (11.57). The variability or range of marks is greater in the low physically active category as Figure 2 demonstrates, though more than twice the number of participants are in the moderate range.
Figure 2: Physical activity levels and variance in academic performance.

The error-bar in figure 2 indicates that the low physically active students' marks range between 69.61- 80%, the moderate physically active students marks range between 70.69- 76.75%, and the high physically active marks range between 69.20- 76.41% ; all ranges of marks are within a 95% confidence interval. All three of the confidence intervals overlap. This indicates that some of the values or academic averages for one group or level of physical activity are also plausible in other levels of physical activity.
Table 2: One-way Anova table of academic achievement and physical activity levels

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACAAVG Between Groups</td>
<td>64.783</td>
<td>2</td>
<td>32.392</td>
<td>.239</td>
<td>.788</td>
</tr>
<tr>
<td>ACAAVG Within Groups</td>
<td>16145.348</td>
<td>119</td>
<td>135.675</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACAAVG Total</td>
<td>16210.131</td>
<td>121</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The one-way Anova procedure using academic average (acaavg) as the dependent variable and physical activity level (active) as the independent variable produces an f value of .239 at the observed significance of .788 with a 95% confidence interval; this result further clarifies that the null hypothesis cannot be rejected.

The various statistical procedures and analysis of the data indicates that there is no observed statistical significance between the variables of physical activity and academic achievement in senior secondary school students in this study.

Hypothesis #2

"Students who participate in a wide range of physical activities in school, such as extramural activities, intramural activities, and physical education class, achieve higher grades on average than other students who have equal or different physical activity levels but participate in these activities outside of the school environment."
Comparing the academic averages for students who participate in physical education class to those who do not, students who do not take a physical education class perform better (an academic average of 74.25%, n=91) than those who do (academic average=71.84%, n=31). However, when conducting a one-way Anova test, an f value of 1.00 at an observed significance of .318 indicates that there is no statistical difference in academic achievement with the presence or absence of physical education of these students in the sample.

The absolute number of students participating in school extramural activities is 28 compared to 89 students who chose to be physically active outside of school. By calculating the mean academic average for students who participate in school extramural activities ranging in the moderate to high levels of activity, the result is an academic average of 76.74% as compared to an average of 72.065% for students who participate in physical activities outside of the school environment with the same activity levels.

Comparing the mean academic averages of students who participated in intramural physical activities between the ranges of moderate and high physically active levels with students who did not participate in intramural activities, the academic averages are very similar. Those who did not participate in intramural activities receive an average of 73.68%, n=103, while those who do participate in the two highest categories of activity levels (moderate and high) receive an
average of 73.34%, n=18. The moderate and high physically active students are
grouped together for comparative purposes because of the relatively low
cumulative numbers that are within these categories.

Frequency tests indicate 77% of the sample does not participate in
extramural or school teams. Similarly, 84.1% do not participate in intramural
teams. However, participation involving extracurricular activities, (those outside
of the school environment) are much more popular within the sample. 31% of the
sample are moderately physically active (an average 3-5 days for 45 minutes-5
hours per week), while cumulatively, 57.2% of the sample are considered to be in
the moderate or high physically active level extracurricularly.

A two-way Anova test with academic average as the dependent variable,
and participation in both extramural and extracurricular physical activities as the
independent variables produces an f value of .554 at the observed significance of
.792, indicating that there is no interaction between these variables. Thus, there is
no significant effect on academic average when combining the effects of
extramural or extracurricular physical activity on academic achievement.
Hypothesis #3

“Students who are moderately physically active spend more time studying or doing homework than students who have high or low physical activity levels.”

Table 3: Crosstabulation of physical activity levels and the amount of homework done last semester.

<table>
<thead>
<tr>
<th>HMWKSEM</th>
<th>3+ hrs./week</th>
<th>Count</th>
<th>% of Total</th>
<th>2-3 hrs./week</th>
<th>Count</th>
<th>5% of Total</th>
<th>1-2 hrs./week</th>
<th>Count</th>
<th>8% of Total</th>
<th>less than 1 hour/week</th>
<th>Count</th>
<th>% of Total</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 low physical activity</td>
<td>3</td>
<td>2.4%</td>
<td>9</td>
<td>7.2%</td>
<td>8</td>
<td>6.4%</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 moderate physical activity</td>
<td>9</td>
<td>7.2%</td>
<td>16</td>
<td>12.8%</td>
<td>7</td>
<td>5.6%</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 high physical activity</td>
<td>11</td>
<td>8.8%</td>
<td>18</td>
<td>14.4%</td>
<td>16</td>
<td>12.8%</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 1 hour/week</td>
<td>5</td>
<td>4.0%</td>
<td>11</td>
<td>8.8%</td>
<td>12</td>
<td>9.6%</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>22.4%</td>
<td>54</td>
<td>43.2%</td>
<td>43</td>
<td>34.4%</td>
<td>125</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A comparison of means for each category measuring the amount of homework done in the last semester for low, moderate and high physically active students demonstrates that in all categories, except for the students who average less than 1 hour per week of homework, moderately active students do more homework than their counterparts (see Table 3). Moderately active students who
study or do their homework from 2-3 hrs./week in combination with the 3+ hours/week account for approximately 50% of all students within those groups. A one-way Anova test indicates that there is a statistical difference in academic achievement dependent upon the amount of homework or study time students do. However, a two-way Anova calculation produces an f value of .428 at an observed significance of .859, indicating that the null hypothesis cannot be rejected—the effects of low, moderate, or high physical activity levels on academic achievement is the same regardless of the amount of homework or studying done.

**Hypothesis #4**

"Students who are moderately physically active choose healthier lifestyle alternatives. These choices are manifested by not smoking or drinking alcohol."

One hundred and one respondents of the questionnaire or 80.2% of the sample do not smoke. Similar to these results, 96 respondents or 76.2% of the sample reported that they do not drink alcohol.

A one-way Anova procedure between the dependent variable of physical activity and the independent variable of smoking demonstrates that there is no difference in the populations of various physical activity levels when one chooses to smoke or not (f value=.688 at an observed significance level of .408). The same procedure is used to replace the independent variable of smoking with drinking alcohol. An f value of .958 at the observed significance level of .330 indicates
results similar to smoking: there is no significant difference in the population means of various levels of physical activities when the independent variable of drinking alcohol is accounted for.

The two-way Anova procedure, measuring for the population influence on activity levels when incorporating the effects of alcohol and smoking, produces an f statistic of 2.72 at an observed significance of .102. This result further clarifies that there is no statistically significant effect on whether choosing to smoke or drink is influenced by the amount of physical activity within this sample.

Other Variables

Sixty-six per cent of the sample responded to question 44a of the questionnaire: “Please comment on whether you think students receive higher grades in school when they are physically active.” 41 students agreed with the statement, while 42 students disagreed with the statement. A one-way Anova test comparing student response to question 44a and academic achievement produced an f statistic of .016 at an observed significance of .901. Hence, there appears to be no statistically significant effect in this sample on academic achievement when considering the sample’s personal beliefs on the effects that physical activity has on academic achievement.

Responses from the sample to question 44a indicate three prevailing types of ideologies: 1) a belief that physical activity positively effects academic
achievement because it reduces one's stress levels and improves self esteem; 2) physical activity negatively effects academic achievement because of a lack of time for study; and 3) in some cases, physical activity may act positively or negatively on academic achievement; according to the respondents, this depends on the abilities and desire of each student to succeed. The following are exact quotes from the sample, representative of the three types of philosophies:

1) I believe high physical activity increases academic success. I find it releases stress and helps me concentrate more clearly on school work. It has also increased my attention span. Along with effective time-management, sport provides personal satisfaction, confidence, valuable experiences and valuable life skills.

2) It helps keep you focused on what you have to do; helps maintain goals. I don't believe though physical activity makes a difference on grades in general. If you want the grades you'll get them.

3) Some way, some students might receive higher grades when they are confident themselves, but some might not, because they pay too much attention on physical activities not on school work.

The first student response reflects the majority of the research literature, reflecting on the positive benefits of physical activity (Bradford, 1989; Green, 1982; Hale, 1982; Harris, 1991; Pangrazi, 1982; Shephard et. al. 1982). The
second response is more reflective of an existentialist philosophy, where the power to achieve lies within the individual, regardless of personal circumstances and environment. The third student response supports the “zero-sum model” of Coleman (1961) and Henry (1963): sport and activity decrease the amount of time spent on homework and study, hence decreasing the opportunity for students to succeed academically.

The majority of the sample (62%) believed that physical activity programs, such as extramural sports teams and physical education, are a very important part of the high school curriculum. Only 14% of the sample believed they were unimportant, while the remaining 24% did not respond to the question.

**Gender**

Females within this sample scored a mean average of 76.81% as compared to the males’ academic average of 70.77%. A one-way Anova produces an f statistic of 8.836 at an observed level of .004 of significance. This indicates that there is a statistically significant difference in the academic averages between males and females in this study. In all three categories of physical activity, the females’ academic averages were higher than the males’ (see Appendix V, page 115). Males outnumber females in all categories of participation in extramural physical activities. Eighty-two percent of females in this sample are not involved in extramural or school teams/sports as compared to the male value of 72.3%. In
general, males spend more days and hours than females involved in school physical activity. When comparing physical activity levels outside of the school environment, or extracurricularly, both genders are much more active. Only 32.8% and 24.6% of the female and male samples respectively do not participate in any type of sports or recreational activities outside of the school environment, though males on average spend more days and hours involved than females (see Appendix V, page 116).

Table 4: Two-way Anova procedure of the effects of physical activity and gender on academic achievement.

<table>
<thead>
<tr>
<th>ANOVA*</th>
<th>Hierarchical Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sum of Squares</td>
</tr>
<tr>
<td>ACAAVG</td>
<td>Main Effects</td>
</tr>
<tr>
<td></td>
<td>ACTIVE</td>
</tr>
<tr>
<td></td>
<td>GENDER</td>
</tr>
<tr>
<td>2-Way Interactions</td>
<td>ACTIVE * GENDER</td>
</tr>
<tr>
<td>Model</td>
<td>1556.633</td>
</tr>
<tr>
<td>Residual</td>
<td>14653.498</td>
</tr>
<tr>
<td>Total</td>
<td>16210.131</td>
</tr>
</tbody>
</table>

However, a two-way Anova procedure testing for 2-way interactions between the variables of gender and physical activity level produces a statistically non-significant f value of 1.677 at an observed significance level of .191. This indicates that there is no interaction between the variables of gender and physical
activity. The effect of physical activity on academic achievement seems to be similar for males and females, although there is a statistically significant difference between gender and academic achievement.

Citizenship

The majority of this sample (57.9%, n=73) were born outside of Canada.

Of those, the majority of students have spent six or fewer years in Canada.

Figure 3: The number of years spent in Canada for the sample born outside of the country.

The mean academic averages of students in this sample who were born in Canada compared to those students born from a different part of the world are very similar. Students born in Canada received an academic average of 73.76% (n=50), and students born in another part of the world received an academic average of 73.40% (n=70). A one-way Anova produces an f statistic of .028 at an
observed significance of .868, indicating no statistically significant difference in the academic achievement between Canadian or foreign born students in this study.

Table 5: A comparison of the mean academic averages and their level of physical activity of Canadian and foreign born students.

<table>
<thead>
<tr>
<th>Cell Means*</th>
<th>ACAA AVG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>ACTIVE</td>
<td>BIRTH</td>
</tr>
<tr>
<td>1 low physical activity</td>
<td>Canada</td>
</tr>
<tr>
<td></td>
<td>2 other</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>2 moderate physical activity</td>
<td>Canada</td>
</tr>
<tr>
<td></td>
<td>2 other</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>3 high physical activity</td>
<td>Canada</td>
</tr>
<tr>
<td></td>
<td>2 other</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>Total</td>
<td>Canada</td>
</tr>
<tr>
<td></td>
<td>2 other</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
</tbody>
</table>

a. ACAA AVG by ACTIVE, BIRTH

b. Grand Mean

Foreign born students appear just as physically active as Canadian born students, as table 5 indicates. In all categories, except for the high level of physical activity, foreign born students receive higher academic averages. Further, greater percentages of foreign born students participate more in all categories of physical activity, except for the high level of physical activity; 40% of Canadian born
students as compared to 30% of foreign born students achieve a high level of physical activity.

**SES or socioeconomic background**

The majority of the sample (57.9%) were unaware of their family income. Of the remaining sample, 14% had a family income of $25-50,000, 13% had a family income of greater than $60,000, 9% had a family income between $40-60,000, and 3% had a family income between $10-25,000. The majority of father and mother education levels in this sample were university educated (43% and 35% respectively).

The largest mean academic average within this sample occurred in the greater than 60 thousand dollar category; this group averaged 75.38%, as compared to the overall mean academic average of 73.32%. The lowest achieving group had a mean academic average of 66.75%; this group was in the lowest income category of 10-25 thousand dollars (see Appendix V, page 118). A one-way Anova procedure analyzing academic achievement and family income levels produced an f statistic of .462 at an observed significance of .763. Further, a one-way Anova procedure analyzing physical activity levels and family income produced an f statistic of .799 at an observed significance of .528. Both Anova tests indicate that family income does not have a statistically significant effect on academic achievement or physical activity levels. Similarly, separate one-way
Anova procedures analyzing the education levels of mother and father respectively with the academic achievement of their children within the sample produced no statistically significant results.
Chapter V

Discussion of Results and Conclusion

Hypothesis #1 or the main hypothesis that moderate physically active senior secondary school students perform better academically on average than low or high physically active senior secondary school students is not proven to be statistically significant in this study. Students with low levels of physical activity perform slightly better academically on average than moderate or high physically active students.

The results of this study are in keeping with the quantitative research findings of other studies in the secondary school setting (Diringer, 1993; Fejgin, 1994; Marsh, 1993). There are no statistically significant data or findings to indicate that physical activity positively effects or increases academic achievement of secondary school students. A variety of tests, such as one-way Anova tests, Pearson correlation coefficients and multiple regression analysis controlling for extraneous variables were used to determine this relationship. The results parallel the previously cited ones above by indicating that physical activity, though not increasing academic achievement, does not cause a statistically significant decrease or decline in academic achievement.

These results appear to negate or contradict the zero-sum model supported by Coleman (1961) and Henry (1963): the more physically active a student is, the
less he or she will be able to achieve academically. According to this theory, it should then be expected in this study that low physically active students would have significantly higher academic averages than moderate or high physically active students, since they spend more time on studying or completing homework.

Overall, this has been proven false in this sample, specifically within-group comparisons of extramural, intramural, and extracurricular activities; the mean averages are very similar within all groups (see pages 66-67). Interestingly, students who participate in non-physical activities and clubs within the school environment, such as Student Academic Council (SAC), chess club, math/science club, yearbook committee, etc. perform better academically when they are involved in two of these types of clubs. Students who participate in three clubs perform worse academically than those who are involved in 1 and/or 2 clubs, but they perform better than students who are not involved in any clubs at all, (72.80% compared to 71.77% for those not in any clubs). These results further indicate student involvement in school activities at a moderate level (whether of a physically or non-physically active nature) may not be a direct cause in detracting from students' academic achievement within this study.

Moderate physically active students double in absolute numbers the low physically active students and also outnumber the high physically active students. The sample size of moderate to low physically active students is approximately a
2:1 ratio which may explain to some degree the results of the study. The portion of the sample size of low physically active students may be too small to accurately compare with the sample of moderate physically active students. Ideally, a 1:1:1 of low, moderate, and high physically active students may be the most appropriate ratio to use when assessing how various levels of physical activity effect academic achievement.

The standard deviation or variability in academic averages is much less for moderately active students than low or high physically active students. This result may be interpreted as a significant finding because it may indicate that moderately physically active students may consistently perform at a certain standard of achievement while low or high physically active students have much more variability in grades, resulting in much more volatile predictors of academic achievement. However, this theory has not been statistically proven, and is only one of possibly many interpretations. Another explanation might be because the sample sizes of low and high physically active students are smaller, this is why they have the greater variability, whereas if the sample size were to increase for these groups, the range of variability may be smaller, similar to the moderate physically active category. It remains unknown how the mean academic averages of the low and high physically active groups would be effected.
Can one infer from this study that most senior secondary school students are moderately physically active in the GTA? Can this reflect that many high school students are growing up into healthy, well-rounded students? The result that 42.9% or the majority of the sample is moderately physically active may be an interesting finding in itself when studying demographic characteristics and trends of various age groups with relation to the amount of physical activity youth commit to on a regular basis. This seems to contradict the statistics on child and youth involvement in physical activity (Keays & Allison, 1995). A larger sample size may provide a greater understanding in the present trend of youth physical activity levels in high school.

The alternate hypotheses in this study, indicated by hypotheses 2-4, are all proven to be statistically not significant. Participating in physical activity programs or events within the school environment does not enhance a senior secondary school student's academic achievement in this sample when compared to participating in physical activity outside of the school environment. This result is similar to the results by Diringer's (1993) sampling of 300 Ohio secondary school students' participation in school teams. In all cases, students who performed less physical activity in various school and out of school environments, including partaking in a physical education class, performed slightly higher academically than their counterparts. However, the statistics in this sample indicate a wide
discrepancy in participation levels as the results section indicates. A 4:1 ratio of
non-participants to participants is observed in the categories of extramural and
intramural physical activities. These results may indicate that students do not like
or find varied enough the activity opportunities in the school environment. It may
also indicate that students choose to spend their in-school time focusing on their
courses while their leisure time outside of the school-environment is occupied with
physical activity.

A moderate level of physical activity does not appear to enhance or
improve the amount of study or homework students in this sample commit
themselves to on a regular basis within a school semester, nor promote specific
health-related lifestyle choices based on smoking and drinking. In terms of
absolute percentages, however, moderately physically active students performed
more homework and smoke and drank less on average than their low and high
physically active counterparts.

The more a student studies in this sample, the higher their academic
average. This result is consistent with many popular beliefs related to study and
success. Yet, when including the effect(s) of physical activity, there is no
statistical evidence that study time/homework and moderate amounts of physical
activity produce higher academic averages. However, the measure of homework
or study done from the past semester must be more carefully scrutinized. How,
where and when students do their homework/study may play an influential role in the results. Some students study in quiet places, have consistent times when they do their homework and complete their work on time. Other students may procrastinate and have exorbitant amounts of homework to catch-up, they do not work in an environment conducive to learning and do not practice good study or homework strategies, such as studying first items or concepts that are more difficult. Hence, variability in study/homework skills of the participants may also influence the results; these were not accounted for in this study.

Though the majority of the sample is moderately physically active, most of the sample chooses not to smoke and drink, 81.5% and 77.4% respectively, though males smoke and drink more than females. It is interesting to note that high physically active students smoke and drink more than other students who are in the low and moderate active categories. This may indicate that high physically active students are not seriously pursuing careers in sports but do so for social reasons; within these social parameters, smoking and drinking may play influential roles for high physically active youth.

The effects of gender upon this study reflect the popular stereotype that females tend to perform better than males in school, particularly in high school. Females scored significantly higher on average academically than males within all categories of physical activity. Although there were more males to females
recorded in this question (64 males-58 females) more females were measured to be either low or moderately physically active; the males almost double the females in the high physically active category.

From the three categories of physical activity, the males' mean academic average is the lowest in the high physically active range yet highest in the moderate range. However, there is no statistical evidence indicating that moderately active males perform significantly better than low or high physically active males (see Appendix V, pages 120-121). Though not statistically significant, this may indicate a trend within this study; future studies may want to consider analyzing further the effects of moderate physical activity on specifically a male population to determine more conclusively how moderate levels of physical activity effect academic achievement in high school males.

For the females, their academic average is highest in the low physically active range and lowest in the moderately active range. However, twice the number of females in this sample are moderately active as compared to the low and high active categories; the resulting unequal distribution of females within the three categories may play an influential role with these results.

The findings for the males in this study may indicate that high physical activity may be detrimental to academic success. It would seem that the male population of this sample may not have acquired the requisite skills to balance
one's activity and academic calendar or maintain the appropriate motivation necessary to sustain high standards in both areas. Yet, when the males moderate their physical activity schedule, they perform more than 3 percentage points higher on average than if they were to maintain or drastically reduce their high levels of physical activity.

These results may indicate that males within the sample lack the necessary maturity or have too many distractions to stay focused on achieving high academic averages, concentrating on being popular as supported by the statistics on smoking and drinking; if they were to maintain more of a balance in the areas of smoking, drinking and physical activity, it is possible that their marks might improve. It is unclear in this study how basic or general level male students may benefit from moderate levels of physical activity. The females in this sample seem to be able to balance and maintain their motivation to succeed academically while at the same time leading a moderately active lifestyle.

The measure and effects of socioeconomic status were hampered because of the majority of the sample's inability to determine or disclose their family's income level. As the results demonstrate, the sample within the highest income bracket achieved the highest mean academic average; yet, no statistically significant data were produced. However, these results based on SES may be
questioned because of the relatively poor response to the question from the sample.

The information gathered concerning father’s and mother’s education were used to enhance the measure of SES. The sample was more able or willing to share this information as indicated by the higher percentage of responses to these questions. In contrast to the result of family income above, students whose mother’s and father’s had elementary or technical school training had higher academic averages (see Appendix V, page 119). This result may indicate that these parents are of ‘blue-collar’ background and hence value more the opportunities that good grades may provide in life. This assumes that higher incomes are related to ‘white-collar’ jobs and possibly higher educational attainment, and lower incomes or educational attainment are related to ‘blue-collar’ jobs of the parents within this sample. Further, it assumes that ‘white-collar’ parents value educational attainment less than blue-collar parents, which seems to be an over-generalization. Clearly, SES must be measured with other variables to achieve more valid measures in attempting to determine the effects of physical activity on academic achievement.

The country of one’s birth or origin does not have a significant effect when studying the relationship between academic achievement and physical activity. Though the majority of the sample born outside of Canada have lived in this
country fewer than six years, they have achieved academically higher in all categories of physical activity, except for the high level of physical activity, where the mean academic average of students born outside of the country falls more than three percentage points below their overall average. These results may indicate that relatively new arrivals to the country in this sample adapt quickly to the different academic and activity climates.

However, a high level of physical activity appears to be more of a detriment to foreign born students than it is to Canadian born students in this sample. Interestingly, high physically active Canadian born students score approximately 1.5 percentage points higher than their overall academic average. Yet, as the results in this study have indicated, high physically active students perform less well academically overall than low and moderately active students.

Though somewhat innovative in a predominantly quantitative study, the inclusion of two qualitative measures within this study provides a unique perspective into the minds of today’s youth. Interestingly, the samples’ responses to these questions were quite articulate and they supported their theory(ies) with facts from the research literature, presumably unaware that such knowledge has ever been published.

The samples’ responses mainly support the two prevailing and contrasting ideologies within the research literature to date: 1) the positive effects of physical
activity—improving academic achievement by helping one to concentrate more, budget one’s time better, and improve one’s self-esteem, or 2) the zero-sum model—decreasing academic achievement by spending too much time in other pursuits.

Regardless of which prevailing ideology each student within the sample chose to support, (and in some cases, students wavered between both ideologies), many of the respondents believed that it was very important to maintain and continue to offer within the curriculum opportunities for students to participate in physical activities, underscoring the values of physical activity this sample holds and has become aware of, possibly from various educational and media-driven institutions.

Limitations

The sample’s poor response to the question pertaining to family income highlights one of the limitations of this study—the memory and knowledge of the sample. Since the questionnaire was based on information from the samples’ previous semester, their ability and willingness to accurately recall and know the pertinent information to some of the questions on the questionnaire may detract from the validity and reliability of this study.

Further, one semester may not be enough time to determine whether physical activity may play an influential role in students’ academic achievement.
An extended or longitudinal study, ranging from 1 year to 3-4 years throughout a student's high school life, may indicate significant trends and data during the absence or presence of various physical activity levels on academic achievement.

Measuring advanced level students may also have skewed the results of this study. An assumption vis-à-vis this theory would hold that advanced students have already acquired the necessary coping and studying skills, such as effective time management and high self-esteem; this may lead to higher academic achievement and not require the beneficial effects of physical activity to help achieve these results. However, general or basic level students may find that physical activity provides them with the positive effects of higher self-esteem, improved time-management and higher concentration levels that the advanced level students may have already used to their benefit.

Lastly, a relatively small, unequally distributed sample size of low, moderate and high physically active students within one school, representing only one of the many diverse geographic areas of The Greater Toronto Area may have similarly led to skewed results in this study.

Conclusion

The relationship between physical activity and academic achievement appears to be non-conclusive in the senior secondary school setting for this sample. There is no significant data to suggest a positive or negative relationship between
these variables, although there is no negative effect on academic achievement. The current study appears to agree with many of the American studies conducted in secondary schools—there is no significant relationship between physical activity and academic achievement (Fejgin, 1994; Holland & Andre, 1987; Houston, 1982; Marsh, 1993).

It seems results and conclusions from numerous studies based in the elementary school setting cannot be readily transferred to encompass this senior secondary school study. Most often, the elementary studies use experimental methods to produce their results (Biernacki, 1993; Shephard et al. 1982).

Future studies may be necessary to include the same type of research parameters from the elementary setting; hence, new studies may be based upon and measured using a standardized research design in secondary schools. This may not be easy, however. The average secondary school student is older and often has more leisure and physical activity opportunities within the school environment. Further, with regards to the secondary school student’s academic schedule, it is not as controlled as an elementary school student’s schedule; hence it is more challenging to control for the influencing variables of course load and difficulty level.

Further research and analysis of this hypothesis seems to lend itself ideally to a longitudinal study with a larger population chosen randomly. A three year
period of study throughout each student’s senior high school years may be more conducive to observing the long term effects of physical activity upon academic achievement. In comparison, a five month period within one semester of study may not be long enough to observe any significant effects or changes that may possibly occur. Also, it remains undetermined how basic and general level students might be effected by various levels of physical activity. Noting the trend in this study of moderately active males performing better academically than low or high physically active males, it would be very interesting to measure basic and general level male students in future studies and observe the results produced from such research.

A potentially interesting methodology to incorporate in future might be to parallel to some extent the elementary school experimental studies, such as Biernacki (1993) and Shephard et al. (1982). These studies could be simulated by measuring longitudinally the physical activity and academic achievement patterns of moderately physically active students within their last three years of high school, while using a control group of low and/or high physically active students for comparative purposes. Though the research design may be rather extensive because of the length of study, the variability of activity and academic programs/results, and the administrative challenges of frequent measurements of
the same sample within three school years, this type of study may enhance the 
external validity within this research domain.

Limitations to internal and external validity involve analyzing carefully the 
methodology of the study and whether the results can be generalized to subjects 
other than the subjects in the sample studied (Martin, 1980). One method to 
minimize the limitations in validity may be to increase the sample size. Two 
possible methodologies may be incorporated:

1) submit questionnaires to all grade 11, 12, and OAC teachers within the same 
school to give to their classes. This would be similar to a modified mail-in 
questionnaire and might enhance the sample size though ideally, the principal 
researcher and his/her assistant(s) would still be responsible to administer the 
questionnaires; or

2) select various secondary schools throughout a geographic region and apply 
method 1 above or incorporate the present research methodology. This may 
increase the generalizability of the results by increasing the population and 
hence be more representative of the geographic region (Martin, 1980).

These methodologies may simulate more closely the sample sizes of the 
majority of the research literature and allow for a closer, comparative analysis, 
thereby potentially increasing the generalizability, validity and reliability of the 
study and its findings to the general population.
However, this type of study would be time consuming and would require a healthy grant or scholarship to allocate the appropriate funds necessary to support the principal researcher(s) throughout this time and subsidize the appropriate human and material resources: “Since no research deals with the entire population of interests and tests the treatment(s) under all necessary conditions, it is a compromise and must deal with limitations of researcher time and money” (Martin, 1980).

With the proposed elimination of grade 13 or OAC in the fall of 1999, part of this study’s sample will no longer be in existence within Ontario secondary schools. Future studies, to account for this change, may wish to focus exclusively on grades 11 and 12, the new senior grades, or possibly follow-up the study to include first year university and college students, to measure how the effects of physical activity may influence post-secondary academic achievement.

Though the research literature in the study of the relationship between physical activity and academic achievement has been increased slightly to include a school setting in the demographic area of the Greater Toronto Area, this research area has once again demonstrated that a clear and conclusive answer to the research question remains within one’s grasp, but presently beyond this study’s reach.
Further testing and analysis of larger populations using various methodologies and procedures, such as experimental studies and/or qualitative analysis, in combination with isolating and examining other variables influential to such a study, such as SES and gender, may demonstrate that the value of physical activity should be appreciated for more than health reasons alone.
References

American College of Sports Medicine Position Statement on, The recommended quantity and quality of exercise for developing and maintaining fitness in healthy adults. vii-x.


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Appendix I: Questionnaire

Dear participant,

The following nine page questionnaire is for a Master's research project on the frequency and effects of physical activity on student achievement and other variables. The information gathered from the questionnaires is confidential; you or your school name will not be used in any publications; it will not affect your status in school in any way.

Keep in mind that your answers will be based upon your physical activity levels and other basic information from your last semester in school—not the current one. Most of the questions are multiple-choice. Unless otherwise indicated, please circle the number which most accurately applies to you.

Also, please note the difference between extramural and intramural school teams: Extramural school teams are teams that you try-out for, practice with regularly, and play with against teams from other schools. Intramural school teams are teams for which you need not try-out, don't usually involve regular practice, and only play with against teams from your own school.

At the end of the questionnaire there is one two-part question which asks for your personal feelings about physical activity and success in school. Feel free to give your honest opinions. If for any reason you feel uncomfortable answering a question, you may leave it unanswered.

Thank-you very much for your time and effort!
Questionnaire

1. At what grade level were you taking most of your subjects last semester?
   1.) Grade 10
   2.) Grade 11
   3.) Grade 12
   4.) O.A.C.

2. Did you play on a extramural school team last semester?  
   1. Yes  2. No

3. Please circle the number beside the extramural school team(s) you participated in last semester:
   1. Does not apply to me  8. Soccer
   2. Baseball  9. Swimming
   3. Basketball  10. Tennis
   4. Badminton  11. Track and Field
   5. Cycling  12. Volleyball
   6. Football  13. Waterpolo
   7. Hockey  14. Other sport _________________________

4. Did you play on any intramural school teams last semester?  
   1. Yes  2. No

5. Similarly as above, please circle the numbers beside the intramural school activity(ies) you participated in last semester:
   1. does not apply to me  8. soccer
   2. badminton  9. swimming
   3. baseball  10. tennis
   4. basketball  11. track and field
   5. field hockey  12. volleyball
   6. floor hockey  13. waterpolo
   7. football  14. other _________________________
6. Were you involved in any sports or recreational physical activities (such as skateboarding, rollerblading, dance, ultimate frisbee, etc.) outside of the school environment last semester?

1. Yes  
2. No

7. Please circle the number beside these sports or recreational activities you participated in outside of the school environment last semester:

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<tbody>
<tr>
<td>1</td>
<td>does not apply to me</td>
<td>10</td>
<td>field hockey</td>
</tr>
<tr>
<td>2</td>
<td>aerobics</td>
<td>11</td>
<td>football</td>
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<tr>
<td>3</td>
<td>archery</td>
<td>12</td>
<td>gymnastics</td>
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<td>4</td>
<td>aquafit</td>
<td>13</td>
<td>ice hockey</td>
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<tr>
<td>5</td>
<td>badminton</td>
<td>14</td>
<td>jogging</td>
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<tr>
<td>6</td>
<td>baseball</td>
<td>15</td>
<td>martial arts</td>
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<tr>
<td>7</td>
<td>basketball</td>
<td>16</td>
<td>rollerblading</td>
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<td>8</td>
<td>cycling</td>
<td>17</td>
<td>skateboarding</td>
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<tr>
<td>9</td>
<td>dance</td>
<td>18</td>
<td>soccer</td>
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<tr>
<td>19</td>
<td>swimming</td>
<td>20</td>
<td>tennis</td>
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<tr>
<td>21</td>
<td>track and field</td>
<td>22</td>
<td>volleyball</td>
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<tr>
<td>23</td>
<td>waterpolo</td>
<td>24</td>
<td>weightlifting</td>
</tr>
<tr>
<td>25</td>
<td>ultimate frisbee</td>
<td>26</td>
<td>other</td>
</tr>
</tbody>
</table>

8. Last semester, on average, how many days per week did you participate in physical activities? (Please circle the numbers below which apply to you)

TOTAL DAYS PER WEEK PARTICIPATING IN PHYSICAL ACTIVITY

<table>
<thead>
<tr>
<th>Does not apply</th>
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<tbody>
<tr>
<td>1-2 days</td>
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<tr>
<td>3-5 days</td>
</tr>
<tr>
<td>More than 5 days/week</td>
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</tbody>
</table>

a) in school *extramural* teams/sports

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<tbody>
<tr>
<td>a)</td>
<td>in school <em>extramural</em> teams/sports</td>
<td>1</td>
<td>2</td>
</tr>
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</table>

b) in school *intramural* teams/sports

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<th></th>
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<tbody>
<tr>
<td>b)</td>
<td>in school <em>intramural</em> teams/sports</td>
<td>1</td>
<td>2</td>
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</table>

c) in sports/recreational activities outside school

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<tbody>
<tr>
<td>c)</td>
<td>in sports/recreational activities outside school</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
9. Thinking back to your answers from question 8, last semester, on average, how much time per week did you participate in physical activities?

**TOTAL TIME PER WEEK PARTICIPATING IN PHYSICAL ACTIVITY**

<table>
<thead>
<tr>
<th>Does not apply to me</th>
<th>Less than 45 minutes per week</th>
<th>45 min. — 5 hours/week</th>
<th>More than 5 hours/week</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) on school <em>extramural</em> teams/sports</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>b) on school <em>intramural</em> teams/sports</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>c) sports/recreational activities outside school</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

10. Were the days and time you spent on sports and other physical activities last semester:

1. less than you spent on sports/physical activities in previous years
2. about the same as in previous years
3. more than you spent on sports/physical activities in previous years

11. Did you take a physical and health education class last semester? 1. Yes 2. No

12. If you were involved in any type of sport or physical activity last semester, why did you participate?

1. To get in shape
2. Have fun
3. I have dreams of becoming a professional athlete one day
4. I want to become an all-round student
5. I generally dislike everything in school but sports and activities
6. To lose weight
7. Another reason. Briefly explain: ____________________________________________
13. Do you consider yourself to be a:

1. non-athlete
2. below average athlete
3. average athlete
4. above average athlete
5. excellent athlete

14. Please circle the number beside the extracurricular activities you were involved in last semester which did not directly involve being physically active:

1. does not apply to me
2. student council
3. film club
4. chess club
5. athletic council
6. photography club
7. science/math club
8. other

** For questions 15- 17, please circle the appropriate number which best describes you in general DURING physical activity.

15. Does your heart rate increase.............................

1 2 3 4 5
Stays the same when I'm exercising
A bit higher when I'm exercising
Very high when I'm exercising
Extremely high when I'm exercising
I don't exercise

16. Does your breathing rate increase.........................

1 2 3 4 5
Stays the same when I'm exercising
A bit higher when I'm exercising
Very high when I'm exercising
Extremely high when I'm exercising
I don't exercise

17. Describe the amount you sweat during physical activity:

1 2 3 4 5
I don't sweat at all
I sweat a bit
I sweat very much
I sweat profusely
I don't exercise
18. In general, how sore do your muscles get after physical activity?

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<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Not sore at all</td>
<td>A bit sore</td>
<td>Very sore</td>
<td>Extremely sore</td>
<td>I don't exercise</td>
</tr>
</tbody>
</table>

19. Do you consider yourself to be a:

1. excellent student
2. very good student
3. average student
4. below average student

20. Please list all the courses you took last semester in the underlined spaces. Beside each course, please circle the appropriate number indicating your grade range received in that subject. (1= 0-50%, 2=50-60%, 3= 60-70%, 4= 70-80%, 5= 80-100%)

<table>
<thead>
<tr>
<th>Courses</th>
<th>0-50%</th>
<th>50-60%</th>
<th>60-70%</th>
<th>70-80%</th>
<th>80-100%</th>
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<td>c)</td>
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<tr>
<td>d)</td>
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</table>

21. Please state your overall academic average last semester: I achieved ____ % last semester.

22. Other than your last semester in school, what marks do you usually get on your report cards:

1.) 80%-100%
2.) 70-80%
3.) 60-70%
4.) 50-60%
5.) less than 50%
23. On average, how much time did you spend on homework or study per day last semester?

1.) more than 3 hours/day
2.) 2-3 hours/day
3.) 1-2 hours/day
4.) fewer than 1 hour/day

24. Were the days and time you spent on homework and/or studying in the last semester:

1.) less than you spent on homework in previous years
2.) about the same as in previous years
3.) more than you spent on homework in previous years

For the following questions, please circle the number which best describes your beliefs/attitudes:

25. How important is it for you to participate and excel in sports or other physical activities?

1 2 3 4
Not Somewhat Very Extremely
important important important important

26. How important is it to your parents that you do well or participate in sports or other physical activities?

1 2 3 4
Not Somewhat Very Extremely
important important important important

27. How important is it for you to be an excellent student?

1 2 3 4
Not Somewhat Very Extremely
important important important important
The following section asks a variety of personal background questions. Please keep in mind that neither your name nor the school’s will be published, and all information collected from the questionnaire WILL remain confidential.

28. Please circle the number that indicates your gender:

1.) Female 2.) Male

29. Were you born in Canada? Yes_____ No_______

30. If you were not born in Canada, how many years have you been living in Canada?

   a) I have lived_________ years in Canada.

31. How old are you? ________ yrs. old.

32. Please circle the number which most appropriately indicates your family’s income level:

1.) $10,000-25,000  4.) $60,000 and up
2.) $25,000-40,000  5.) Not sure
3.) $40,000-60,000

33. What is your mother’s highest level of education?

1.) Elementary school  4.) University
2.) High school  5.) Business or Technical School
3.) College  6.) Not sure

7.) Not applicable
34. What is your father’s highest level of education?
   1.) Elementary school  4.) University
   2.) High school  5.) Business or Technical School
   3.) College  6.) Not sure
   7.) Not applicable

35. How important is it to your parents that you do well in school?

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<th>3</th>
<th>4</th>
</tr>
</thead>
</table>
   1 | Not important | Somewhat important | Very important | Extremely important |

36. Did you have a part-time job last semester?  1. Yes  2. No

37. If yes, on average, how many hours per week did you work?
   1.) Does not apply to me  4.) 6-8 hours/week
   2.) fewer than 4 hours/week  5.) 8-10 hours/week
   3.) 4-6 hours/week  6.) more than 10 hours/week

38. Are you currently working part-time?  1. Yes  2. No

39. How many years throughout high school have you been working part-time?
   a) I have worked for _____ years throughout high school.

40. Do you drink alcohol?  Yes_____  No_______

41. If yes, how many drinks on average do you have per week?
   1.) I don’t drink  3.) 2-4 drinks per week
   2.) 1-2 drinks per week  4.) more than 4 drinks per week
42. Do you smoke?  1.) Yes______  2.) No______

I am interested in your opinion about the effects and value of physical activity on high school students’ success in school. The following two-part question asks for your personal opinions about this subject. In the space provided below and on the next page, if necessary, please offer your insights towards the following:

44. a) Please comment on whether you think students receive higher grades in school when they are physically active.

b) How important is it to you that physical activity programs in schools, such as phys.ed. and extramural sports teams, continue to be offered as part of the school program (during and after school)?

Thanks once again for your participation! 😊
Appendix II: School Board Consent Form

Dear Sir/Madam,

My name is John Stathakos. I am a Master’s student studying at OISE/UT. It is my wish to conduct a one week research study within one secondary school in your board to fulfill my thesis obligation. The study focuses on the area of physical activity and academic achievement. Do physically active students achieve higher grades in school than non-physically active students?

Daily physical activity, as described by much of the literature, may enhance academic achievement. Thus, this area of research should be studied further to determine if physical education and extracurricular activities empower and facilitate student achievement and overall development.

The research study requires a sample of two grade eleven, twelve, and O.A.C. classes. The sample size should contain an approximate total of 160 students. The data collection method involves a questionnaire that all participants would be required to complete. The questionnaire will take approximately 25 minutes to finish.

Schools from your Board of Education have traditionally been known to support academic research. I realize many schools and administrators may currently be busy with other research interests. However, the main focus of my research would involve only a one week visit to one secondary school.

I am very hopeful that we can broaden our relationship and assist one another in developing and expanding upon an important aspect of pedagogical knowledge and research. Thank-you very much for your time and consideration.

Yours very truly,

John Stathakos
M.A. candidate
OISE/UT
(416) 443-9214
Appendix III: Administrative Consent Form

Nov. 28, 1996

Dear xxx,

My name is John Stathakos. I am a Master’s student studying at OISE/UT. It is my wish to conduct a one week research study within your school to fulfill my thesis obligation. The study focuses on the area of physical activity and academic achievement. Do physically active students achieve higher grades in school than non-physically active students?

Daily physical activity, as described by much of the literature, may enhance academic achievement. Thus, this area of research should be studied further to determine if physical education and extracurricular activities empower and facilitate student achievement and overall development.

The research study requires a sample of two grade eleven, twelve, and O.A.C. classes, for an approximate total of 160 students. The data collection method involves completing a brief questionnaire. The questionnaire will take approximately 25 minutes to complete.

Confidentiality will be ensured. Neither the school nor the students’ names will be used for any publication purposes. Parental and student approval will also be sought.

I hope that we may broaden our working relationship together as members of the educational community, and I look forward to having the opportunity to work with the school’s staff and students in the near future.

Sincerely,

John Stathakos
M.A. candidate
OISE/UT
(416) 443-9214
Appendix IV: Parental Consent Form

Dear parent:

I am a secondary school teacher and a part-time Master's student at the Ontario Institute for Studies in Education at the University of Toronto. I am conducting a study to determine whether physical activity in and outside of school influences academic achievement in our children.

The study is very straightforward. All that is involved is the completion of a brief questionnaire which will take about 25 minutes to complete. The questions mostly pertain to your child's physical activity level and academic achievement from the past semester.

The survey is anonymous and confidentiality WILL be insured. No names of students or schools will be published. The only persons with access to the questionnaire will be myself and my thesis supervisor.

The study has been approved by the Board of Education's Research Review Committee. This research is important because the results may enable students to achieve to their fullest potential, both academically and physically, in all aspects of life. Participation in this study is voluntary. If you do not wish to have your child involved, please indicate this in the form below. Your child may also withdraw from the study at any time or decline to answer specific questions without penalty.

I greatly appreciate your time and co-operation. If you would like to receive more information about any aspect of this study, please do not hesitate to contact me at (416) 443-9214.

Sincerely,

John Stathakos
Occasional Teacher
M.A. candidate, OISE/UT

******************************************************************

Please check appropriate line:

I give permission for my child to participate in the study

I do not give permission for my child to participate in the study

Signature of parent/guardian: __________________________ Date: __________

Signature of student: __________________________ Date: __________
Table 1: Physical activity levels

<table>
<thead>
<tr>
<th>Valid physical activity</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 low physical activity</td>
<td>28</td>
<td>22.2</td>
<td>22.2</td>
<td>22.2</td>
</tr>
<tr>
<td>2 moderate physical activity</td>
<td>54</td>
<td>42.9</td>
<td>42.9</td>
<td>65.1</td>
</tr>
<tr>
<td>3 high physical activity</td>
<td>44</td>
<td>34.9</td>
<td>34.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>126</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Physical activity levels

Bar Chart

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Low activity</th>
<th>Moderate activity</th>
<th>High activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Descriptive statistics of academic average and physical activity.

<table>
<thead>
<tr>
<th>Descriptives</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACAAVG ACTIV</td>
<td>1</td>
<td>low</td>
<td>physical</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>74.81</td>
<td>12.86</td>
<td>2.52</td>
<td>69.61</td>
<td>80.00</td>
<td></td>
<td>43</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>73.72</td>
<td>11.09</td>
<td>1.51</td>
<td>70.69</td>
<td>76.75</td>
<td></td>
<td>30</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>42</td>
<td>72.81</td>
<td>11.57</td>
<td>1.78</td>
<td>69.20</td>
<td>76.41</td>
<td></td>
<td>45</td>
<td>91</td>
</tr>
<tr>
<td>Total</td>
<td>122</td>
<td>73.64</td>
<td>11.57</td>
<td>1.05</td>
<td>71.56</td>
<td>75.71</td>
<td></td>
<td>30</td>
<td>95</td>
</tr>
</tbody>
</table>

Table 3: A comparison of mean academic average and level of physical activity between males and females.

<table>
<thead>
<tr>
<th>Cell Means</th>
<th>ACAAVG</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACTIVE</td>
<td>GENDER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 low</td>
<td>female</td>
<td>79.21</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>physical</td>
<td>male</td>
<td>69.67</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>activity</td>
<td>Total</td>
<td>74.81</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 moderate</td>
<td>female</td>
<td>74.59</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>physical</td>
<td>male</td>
<td>72.72</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>activity</td>
<td>Total</td>
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<td>54</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 high</td>
<td>female</td>
<td>78.87</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>physical</td>
<td>male</td>
<td>69.44</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>activity</td>
<td>Total</td>
<td>72.81</td>
<td>42</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>female</td>
<td>76.81</td>
<td>58</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>male</td>
<td>70.77</td>
<td>64</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>73.64</td>
<td>122</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. ACAAVG by ACTIVE, GENDER
b. Grand Mean
Table 4: Comparison of participation (*days/week*) in sports/recreational activities outside of the school environment and gender.

<table>
<thead>
<tr>
<th></th>
<th>GENDER</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 female</td>
<td>2 male</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>QESTN8C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 n/a</td>
<td>Count</td>
<td>20</td>
<td>16</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>% within GENDER</td>
<td>32.8%</td>
<td>24.6%</td>
<td>28.6%</td>
</tr>
<tr>
<td>2</td>
<td>Count</td>
<td>20</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>1-2</td>
<td>% within GENDER</td>
<td>32.8%</td>
<td>30.8%</td>
<td>31.7%</td>
</tr>
<tr>
<td>days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Count</td>
<td>13</td>
<td>20</td>
<td>33</td>
</tr>
<tr>
<td>3-5</td>
<td>% within GENDER</td>
<td>21.3%</td>
<td>30.8%</td>
<td>26.2%</td>
</tr>
<tr>
<td>days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Count</td>
<td>8</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>5+</td>
<td>% within GENDER</td>
<td>13.1%</td>
<td>13.8%</td>
<td>13.5%</td>
</tr>
<tr>
<td>days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>61</td>
<td>65</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>% within GENDER</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 5: Comparison of participation (*hours/week*) in sports/recreational activities outside of the school environment and gender.

<table>
<thead>
<tr>
<th></th>
<th>GENDER</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 female</td>
<td>2 male</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>QESTN9C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 n/a</td>
<td>Count</td>
<td>20</td>
<td>15</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>% within GENDER</td>
<td>32.8%</td>
<td>23.1%</td>
<td>27.8%</td>
</tr>
<tr>
<td>2</td>
<td>Count</td>
<td>11</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>less than 45 minutes per week</td>
<td>% within GENDER</td>
<td>18.0%</td>
<td>12.3%</td>
<td>15.1%</td>
</tr>
<tr>
<td>3</td>
<td>Count</td>
<td>19</td>
<td>20</td>
<td>39</td>
</tr>
<tr>
<td>45 minutes to 5 hrs. per week</td>
<td>% within GENDER</td>
<td>31.1%</td>
<td>30.8%</td>
<td>31.0%</td>
</tr>
<tr>
<td>4</td>
<td>Count</td>
<td>11</td>
<td>22</td>
<td>33</td>
</tr>
<tr>
<td>5+ hrs.</td>
<td>% within GENDER</td>
<td>18.0%</td>
<td>33.8%</td>
<td>26.2%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>61</td>
<td>65</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>% within GENDER</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Table 6: One-way Anova comparing the academic averages of Canadian and foreign born students.

ANOVA Table

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACAAVG Between (Combined)</td>
<td>3.780</td>
<td>1</td>
<td>3.780</td>
<td>.028</td>
<td>.868</td>
</tr>
<tr>
<td>* BIRTH Groups</td>
<td>16097.920</td>
<td>118</td>
<td>136.423</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>16101.700</td>
<td>119</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2: Family income levels.

![Bar Chart]

Family income (in thousands of dollars)
### Table 7: Mean academic averages of students and family income levels.

<table>
<thead>
<tr>
<th>Income Level</th>
<th>Mean GPA</th>
<th>N</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 10-25 thousand dollars</td>
<td>66.75</td>
<td>4</td>
<td>9.11</td>
</tr>
<tr>
<td>2. 24-40 thousand dollars</td>
<td>73.72</td>
<td>18</td>
<td>13.26</td>
</tr>
<tr>
<td>3. 40-60 thousand dollars</td>
<td>72.36</td>
<td>11</td>
<td>16.06</td>
</tr>
<tr>
<td>4. &gt; 60 thousand dollars</td>
<td>75.38</td>
<td>16</td>
<td>10.86</td>
</tr>
<tr>
<td>5. Not sure</td>
<td>73.28</td>
<td>69</td>
<td>10.77</td>
</tr>
</tbody>
</table>

### Table 8: One-way Anova procedure between physical activity levels and family income.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTIVE * FAINCOME</td>
<td>1.805</td>
<td>4</td>
<td>.451</td>
<td>.799</td>
<td>.528</td>
</tr>
<tr>
<td>Between Groups</td>
<td>1.547</td>
<td>1</td>
<td>1.547</td>
<td>2.739</td>
<td>.101</td>
</tr>
<tr>
<td>Deviation from Linearity</td>
<td>.258</td>
<td>3</td>
<td>.086</td>
<td>.152</td>
<td>.928</td>
</tr>
<tr>
<td>Within Groups</td>
<td>66.097</td>
<td>117</td>
<td>.565</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>67.902</td>
<td>121</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Table 9: The mean academic average of students compared with their father's level of education.

<table>
<thead>
<tr>
<th>Descriptives</th>
<th>95% Confidence Interval for Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>ACAMVG</td>
<td>EDUFATHI</td>
</tr>
<tr>
<td>elementary</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>high school</td>
<td>23</td>
</tr>
<tr>
<td>college</td>
<td>13</td>
</tr>
<tr>
<td>university</td>
<td>53</td>
</tr>
<tr>
<td>tech. school</td>
<td>8</td>
</tr>
<tr>
<td>not sure</td>
<td>15</td>
</tr>
<tr>
<td>n/a</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
</tr>
</tbody>
</table>

Table 10: The mean academic average of students compared with their mother's level of education.

<table>
<thead>
<tr>
<th>Descriptives</th>
<th>95% Confidence Interval for Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>ACAMVG</td>
<td>EDUMOTHE</td>
</tr>
<tr>
<td>elementary</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>high school</td>
<td>28</td>
</tr>
<tr>
<td>college</td>
<td>19</td>
</tr>
<tr>
<td>university</td>
<td>44</td>
</tr>
<tr>
<td>tech. school</td>
<td>6</td>
</tr>
<tr>
<td>not sure</td>
<td>18</td>
</tr>
<tr>
<td>n/a</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
</tr>
</tbody>
</table>
Table 11: Multiple regression of academic achievement, physical activity and other variables.

Model Summary<sup>a,b</sup>

<table>
<thead>
<tr>
<th>Model</th>
<th>Entered</th>
<th>Removed</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PERCEPTN, FAINCOME, COURSENO, ACTIVE, MOTIVAPA, EDUFATHE, BIRTH, GENDER, HMWKLESEM, AGE&lt;sup&gt;d&lt;/sup&gt;</td>
<td>.584</td>
<td>.341</td>
<td>.279</td>
<td>9.89</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Dependent Variable: ACAAVG

<sup>b</sup> Method: Enter

<sup>c</sup> Independent Variables: (Constant), PERCEPTN, FAINCOME, COURSENO, ACTIVE, MOTIVAPA, EDUFATHE, BIRTH, GENDER, HMWKLESEM, AGE

<sup>d</sup> All requested variables entered.

Table 12: Independent sample T-test of moderately active males and their academic average.

Independent Samples Test

<table>
<thead>
<tr>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>ACAAVG</td>
<td>Equal variances assumed</td>
<td>.347</td>
</tr>
<tr>
<td>ACAAVG</td>
<td>Equal variances not assumed</td>
<td>.880</td>
</tr>
</tbody>
</table>
Table 13: One-way Anova of moderately active males and their academic average.

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACAAVG</td>
<td>Between Groups</td>
<td>1</td>
<td>122.618</td>
<td>.779</td>
<td>.381</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>61</td>
<td>157.334</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>62</td>
<td>157.334</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>