Health-Related Physical Fitness, Knowledge, and Administration of the Canadian Physical Activity, Fitness, and Lifestyle Approach

by

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ABSTRACT

Research suggests that individuals who have increased fitness knowledge via health education are more likely to be physically active and fit. In addition, an individual's health literacy is suggested to play a substantial role towards the acquisition of health knowledge. However, literature delineating the relationship between health knowledge, health literacy, and the components of health-related physical fitness is scarce and inconsistent. The Canadian Physical Activity, Fitness and Lifestyle Approach (CPAFLA) represents a series of standardized fitness testing procedures developed by the Canadian Society for Exercise Physiology. In addition, the CPAFLA provides important health-related information to individuals intended to promote healthy lifestyle activities. To-date, the influence of the CPAFLA on health-related physical fitness knowledge and the components of the Theory of Planned Behaviour (TPB) regarding physical activity has yet to be examined. One large study examining two distinct sub-questions was conducted. The first question examined objectively the relationship between health-related physical fitness knowledge, health literacy, and health-related physical fitness in 34 participants (18 F, 16 M; 19-49 years). Knowledge was examined using the FitSmart, while health literacy and physical fitness were assessed via the Newest Vital Sign and the CPAFLA, respectively. Results indicated that knowledge was a significant correlate ($r=0.40$, $p<0.05$) to and the strongest individual predictor (standardized-B=0.59, $p<0.05$) of musculoskeletal fitness. In addition, health literacy was a significant correlate ($r = 0.63$, $p<0.05$) to and the strongest predictor (standardized-B=0.47, $p<0.05$) of knowledge. The second question examined objectively the influence of administering the CPAFLA on knowledge and the components of the TPB in relation to physical activity (via a 7-point bipolar adjective survey) in 40 participants (20 F, 20 M; 19-49 years). The results showed that the administration of the CPAFLA functioned to increase health knowledge [Wilks Lambda = 0.82, $F(1, 32) = 6.9$, $p = 0.013$], as well as important components of the TPB including: instrumental attitude [Wilks Lambda = 0.984, $F(1, 32) = 8.36$, $p = 0.007$], perceived behavioral control [Wilks Lambda = 0.861, $F(1, 32) = 5.18$, $p = 0.030$], and intention [Wilks Lambda = 0.667, $F(1, 32) = 15.96$, $p = 0.00$]. Taken together, these results demonstrate the important contribution of knowledge and health literacy to level of physical fitness, as well as the significant contribution of the CPAFLA to knowledge development and the promotion of regular physical activity participation in adulthood.

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OPERATIONAL DEFINITIONS

Aerobic Fitness: A measure of the combined efficiency of the lungs, heart, bloodstream, and exercising muscles in getting oxygen to the muscles and putting it to work (CSEP, 2003).

Body Composition: The relative amounts of muscle, fat, bone, and other anatomical components that contribute to a persons total body weight (U.S. Department of Health and Human Services, 1999).

Body Mass Index (BMI): The ratio of body weight divided by height squared (Kg/m^2) (CSEP, 2003).

Canadian Society for Exercise Physiology (CSEP): A voluntary organization composed of professionals interested and involved in the scientific study of exercise physiology, exercise biochemistry, fitness and health (for more information see www.csep.ca (national information) or www.csephealthfitnessbc.ca (BC information)).

Composite Body Composition: A health-related fitness measure of body composition which focuses on three specific indicators: body mass index (BMI), sum of (five) skinfolds (SO5S), and waist circumference (WC) (CSEP, 2003).

The Canadian Physical Activity, Fitness and Lifestyle Approach (CPAFLA): The CSEP Health and Fitness Program's 3rd Edition health-related appraisal and counselling strategy. It is a health-related fitness assessment protocol which incorporates measures of physical activity participation, body composition and metabolism, aerobic fitness, and musculoskeletal (including back) fitness. The CPAFLA is a client centered approach which focuses on the promotion of positive health behaviours, and is administered to over one million Canadians every year (CSEP, 2003).

Exercise: Planned and structured physical activity which incorporates repetitive bodily movement geared towards improving or maintaining one or more components of physical fitness (Caperson, Powell, & Christenson, 1985).

Flexibility: The range of movement in a joint or series of joints (CSEP, 2003).

Health: A construct that has physical, social, and psychological dimensions, each characterized on a continuum with positive and negative poles. Positive health is associated with a capacity to enjoy life and to withstand challenges; it is not merely the absence of disease. Negative health is associated with a decreased capacity to enjoy life and withstand challenges (CSEP, 2003).

Health Knowledge: A knowledge base that enables individuals to identify the symptoms and communicability of diseases, allows individuals to select and participate in appropriate preventative health strategies, and gives individuals and understanding of where to obtain health services (Freimuth, 1990). This knowledge base should encompass the basics of: aging, anatomy and physiology, drug use and abuse, illness, nutrition and metabolism, physical exercise and activity, health care utilization, as well as safety and first aid (Beier & Ackerman, 2003).

Health Literacy: The degree to which people have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions (Parker, Ratzan, & Lurie, 2003).

Health Promotion: The aggregate of all purposeful activities designed to improve personal and public health through a combination of strategies, including the competent implementation of behavioural change strategies, health education measures, risk factor detection, health enhancement and health maintenance (Ames et al., 1991).

Health-Related Physical Fitness: Encompasses the components of physical fitness that are related to health status, including cardiovascular fitness, musculoskeletal fitness, body composition and metabolism (Warburton et al., 2006b).

Health-Related Physical Fitness Knowledge (specific to this investigation): A knowledge base that encompasses basic fitness concepts, which is comprised of six sub-domain components including: concepts of fitness; scientific principals of exercise; components of physical fitness; effects of exercise on chronic disease risk factors; exercise prescription; as well as nutrition, injury prevention, and consumer issues (Zhu, Safrit, & Cohen, 1999).

Heart Rate Reserve (HRR): A method used to prescribe exercise intensities. HRR is calculated by subtracting resting heart rate from maximum heart rate (Powers & Howley, 2004).

Hypokinetic Disease: Disease states that are directly related to low levels of activity (e.g. heart disease, type II diabetes) (Kraus & Raab, 1961).

Intensity: The level of energy required to perform a specified physical activity. It is most commonly depicted in terms of maximal oxygen consumption

(VO_2max), percent of age predicted maximum heart rate (HRmax=220-age in years), percent heart rate reserve (HRR), or metabolic equivalents (METs) expressed in $ml \times kg^{-1} \times min^{-1}$ (1MET= 3.5 ml of oxygen consumption per kilogram of body mass per minute) (U.S. Department of Health and Human Services, 1999).

Metabolic Equivalent (MET): Used to describe the energy costs associated with exercise. One MET is equal to resting VO_2, which is approximately 3.5ml/kg/min (Powers & Howley, 2004).

Modified Canadian Aerobic Fitness Test (mCAFT): A predictive, submaximal, and progressive exercise test designed specifically for the general population. The test is employed in the CPAFLA health-related fitness assessment (CSEP, 2003) as an indicator of aerobic fitness.

Muscular Endurance: The ability of the musculoskeletal system to maintain or repeatedly develop force (CSEP, 2003).

Musculoskeletal Fitness: The fitness of the musculoskeletal system, encompassing muscular strength, muscular endurance, muscular power, flexibility, back fitness and bone health (Warburton, Whitney, & Bredin, 2006b).

Muscular Power: The combination of muscular strength and speed, which corresponds to the maximum rate of force that can be generated in a single rapid contraction (CSEP, 2003).

Muscular Strength: The maximum tension or force a muscle can exert in a single contraction (CSEP, 2003).

Obesity: A condition of excessive body fat that results from a chronic energy imbalance whereby intake exceeds expenditure (Katzmarzyk, 2002).

Physical Activity: Any bodily movement produced by skeletal muscles that results in energy expenditure (EE) and is positively correlated with physical fitness (Caperson et al., 1985).

Physical Fitness: A term that encompasses a set of attributes that people possess or achieve relating to their ability to perform physical activity. Physical fitness is comprised of five health-related components which include: (1) body composition, (2) cardiovascular endurance, (3) flexibility, (4) muscular endurance, and (5) muscular strength (U.S. Department of Health and Human Services, 1999).

Predicted Maximum Heart Rate (HRmax): An age based predication of maximum heart rate, referred to in beats per minute (bpm). Calculated by subtracting one's age from 220 (220-age = HRmax). Intensity can also be defined by utilizing percent of predicted HRmax. For example: 70% of HRmax = .7(220-age) (CSEP, 2003).

Skinfold: The thickness of the fold of skin plus the underlying fat determined by the use of a high quality Harpenden ™ skinfold caliper (CSEP, 2003).

Socioeconomic Status (SES): A complex phenomenon predicted by a broad spectrum of variables that is often conceptualized as a combination of financial, occupational, and educational influences (Winkleby, Jatulis, Frank, & Fortmann, 1992).

Sum of Five Skinfolds (SO5S): An estimate of subcutaneous fat which is determined by the addition of the triceps, biceps, subscapula, iliac crest, and medial calf skinfolds (CSEP, 2003).

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CO-AUTHORSHIP STATEMENT

Two manuscripts are presented in this document in Chapters 2 and 3, respectively:

1. Faktor, M.D., Warburton, D.E.R., Rhodes, R.E., & Bredin, S.S.D. The Relationship between Health Knowledge and Measures of Health-Related Physical Fitness. To be submitted in July/August 2009.
2. Faktor, M.D., Warburton, D.E.R., Rhodes, R.E., & Bredin, S.S.D. The Effects of Administering the Canadian Physical Activity Fitness & Lifestyle Approach (CPAFLA) on Health-Related Physical Fitness Knowledge as well as Beliefs, Attitudes, and Intentions towards Regular Physical Activity Participation. To be submitted in July/August 2009.

More specifically, Marc D. Faktor and Dr. Shannon Bredin were primarily responsible for the identification and design of the research program with input from Dr. Darren Warburton and Dr. Ryan Rhodes. Marc D. Faktor collected and analyzed all of the data presented in these manuscripts. The manuscripts in present form were also prepared by Marc D. Faktor with major contributions made by Dr. Shannon Bredin. Dr. Warburton and Dr. Rhodes made significant contributions following initial preparation of the manuscripts.

CHAPTER 1

Introduction to Thesis

There is incontestable evidence supporting regular physical activity participation (structured and unstructured) in the primary and secondary prevention of numerous chronic diseases and premature death (Warburton, Whitney, & Bredin, 2006a). Physical inactivity is a primary modifiable risk factor for cardiovascular disease and an increasing assortment of accompanying chronic hypokinetic (insufficient movement or activity) diseases, including: obesity, diabetes mellitus, cancer (breast and colon), bone and joint diseases (osteoporosis and osteoarthritis), depression, and hypertension (Katzmarzyk, 1998; Katzmarzyk, Gledhill, & Shephard, 2000; Katzmarzyk, Perusse, Rao, & Bouchard, 2000; Warburton et al., 2006a).

Recent research estimates that 53.5% of adult Canadians are physically inactive and 14.7% are obese (Katzmarzyk & Janssen, 2004). Within British Columbia, the physical inactivity prevalence is substantially lower (as low as 37%) in comparison to the rest of the average Canadian population. Five British Columbia health service regions are in the top ten for most physically active Canadian regions, with the top three all being British Columbia regions (Canadian Fitness and Lifestyle Research Institute, 2005). However, the average Canadian physical inactivity prevalence ranks higher than all other existing and modifiable chronic hypokinetic disease risk factors (Warburton et al., 2006a) and is predicted to rise along with current obesity rates. In 2001, 9.6 billon dollars were directly accredited to physical inactivity and obesity in Canada (Katzmarzyk & Janssen, 2004). These data confirm that physical inactivity and obesity are chief contributors to the Canadian public health care burden. Health promotion efforts, guided by relevant research, that function to increase physical activity and reduce obesity would significantly lower unnecessary health care spending and increase the health status of Canadians (Katzmarzyk & Janssen, 2004).

The assessment of health-related physical fitness is of major importance (Oja, 1995). The Canadian Society for Exercise Physiology (CSEP) health-related fitness appraisal and counselling strategy (the Canadian Physical Activity, Fitness & Lifestyle Approach (CPAFLA)) represents a series of standardized testing procedures. When administered by trained and certified CSEP health and fitness professionals, the results of the appraisal allow for the evaluation of current health status in accordance to Canadian normative data. Moreover and above all, the appraisal process and findings provide vital health-related information to individuals. A humanistic goal of this approach is to provide motivation to appraisal participants to develop healthier lifestyles and to increase their physical activity participation (Canadian Society for Exercise Physiology, 2003). However, previous scientific investigation has yet to explore whether or not the CPAFLA functions to increase health-related physical fitness knowledge or provide empirical evidence suggesting that it motivates individuals to participate in regular physical activity.

A number of theories have been used to explain and predict individual's health-related behaviours. Becker's Health Belief Model (1988) stipulates that an individual's health-related lifestyle is dictated by his or her perception of the consequences of a potential illness (e.g., cardiovascular disease) and the benefits of engaging in a behaviour (e.g., aerobics) that would eliminate the threat of such illness (Rosenstock, Strecher, & Becker, 1988; Seefeldt, Malina, & Clark, 2002). These perceptions are shaped in part by the knowledge base that one possesses. Prochaska and Diclimente's

Transtheoretical Model of Behaviour Change (1992) accentuates this notion. In order for a behavioural change to occur, the rudimentary step is to educate with the intention of increasing knowledge and awareness of the particular behavioural actions and reactions (Prochaska, DiClimente, & Norcross, 1992). Dominant among these is the Theory of Planned Behaviour (TPB, formerly the Theory of Reasoned Action (TRA) (Ajzen, 1988, 1991). The TPB proposes that the most immediate and significant forecaster of behaviour is an individual's intention to execute a behaviour. This behavioural intention is predicted by three major factors: attitude towards the behaviour, subjective norm, and perceived behavioural control. The knowledge base of an individual, in relation to the behaviour, is considered a background variable which influences the three variables that form behavioural intentions (Ajzen & Manstead, 2007). Accordingly, research suggests that individuals who understand the concepts of health-related physical fitness are more likely to be physically active and demonstrate higher fitness levels (Zhu, Safrit, & Cohen, 1999; Petersen, Byrne, & Cruz, 2003). Thus, important processes in becoming physically fit while endorsing constructive behaviours in relation to fitness are: obtaining, learning, and applying the concepts and principles of health-related physical fitness (Miller & Housner, 1998).

Health knowledge permits individuals to acknowledge the warning signs and propagation of diseases, select and partake in suitable preventative health strategies (e.g., physical activity), and provides individuals with an understanding of where and how to obtain health services and assistance (Freimuth, 1990). Health-related physical fitness knowledge is a knowledge base that encompasses basic fitness concepts related to health status as well as disease risk, prevention, and treatment (Zhu et al., 1999). The examination of health knowledge has important policy implications as health knowledge and its dependants are major utilities to public health promotion agencies (Nayga, 2001). Empirical evidence regarding the influence of health knowledge on health-related physical fitness, as well as variation in health knowledge across socio-demographic groups should be utilized in the development of future health promotion and education programs. However, literature delineating the relationship between health-related physical fitness knowledge and health-related physical fitness is scarce and inconsistent. Investigations have suggested a positive relationship between knowledge base and health-related fitness in adolescence (Keating, 2007), adulthood (Petersen et al., 2003), as well as in older adulthood (Fitgerald, Singleton, Neale, Prasad, & Hess, 1994). Conversely, investigations have also shown no relationship between fitness knowledge and components of physical fitness (e.g., physical activity) (Morrow, Krzewinski-Malone, Jackson, Bungum, & and FitzGerald, 2004).

A significant factor associated with the acquisition of health knowledge is health literacy. Health literacy is defined as the degree in which people have the competence to obtain, process, and understand basic health information and services needed to make appropriate health decisions (Parker, Ratzan, & Lurie, 2003). It is a contemporary and well warranted topic of concern for the advancement of high quality health care. Health literacy is pivotal to numerous health care system initiatives including quality assurance, cost maintenance, safety, and patient's active involvement in health care decisions (Parker, Ratzan, & Lurie, 2003). Inadequate health literacy is associated with several health-related consequences, as literacy is correlated to numerous aspects of health including: health knowledge, health status, and use of health services (Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association, 1999). Patients with low literacy are generally 1.5-3 times more likely to experience inferior health outcomes inclusive of health knowledge, transitional disease indicators, morbidity measures, utilization of health resources, and general health status (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004). In terms of health-related knowledge, there exists a positive and significant relationship between literacy levels and knowledge of health services or health outcomes (DeWalt et al., 2004). Studies indicate that individuals with low literacy and chronic or infectious diseases such as diabetes (Williams, Baker, & Parker, 1998), hypertension (Williams et al., 1998), asthma (Williams, Nurss, Baker, Honig, Lee, & Nowlan, 1998), or HIV/AIDS (Kalichman, Benotsch, Suarez, Catz, Miller, & Rompa., 2000) have inferior knowledge concerning their disease and its recommended treatment. Furthermore, research has indicated that poor health literacy alone is the most significant predictor of disease prevention knowledge when compared to ethnicity or education (Lindau, Tomori, Lyons, Langseth, Bennett, & Garcia, 2002). Nevertheless, to the best of our knowledge, the relationship between health literacy and health-related physical fitness knowledge has yet to be examined.

Overview of Thesis Investigation

One large study examining two distinct sub-questions was conducted. The first research objective was to examine the relationship between health-related physical fitness knowledge and health-related physical fitness in young and middle adulthood. A secondary purpose of this sub-question was to examine the relationship between health literacy and health-related physical fitness knowledge. Knowledge was assessed via the FitSmart, a standardized health-related physical fitness knowledge examination. Health-related physical fitness was assessed and interpreted using the Canadian Physical

Activity, Fitness and Lifestyle Approach (CPAFLA); while health literacy was assessed via the Newest Vital Sign, a brief yet formal standardized health literacy assessment. We hypothesized that individuals who scored higher on the FitSmart would also demonstrate higher levels of health-related physical fitness in comparison to individuals who scored lower on the FitSmart examination. This hypothesis was based on the idea that knowledge is considered a critical factor in establishing human behaviour (Andrade, 1999). Furthermore, people who understand the concepts of physical fitness are also more likely to incorporate physical activity and exercise into their everyday life (Zhu et al., 1999). Therefore, we predicted that individuals with increased fitness knowledge would display higher levels of health-related physical fitness because regular physical activity participation is often assumed as a significant predictor of health-related physical fitness (Katzmarzyk, 1998). We also hypothesized that there would be a positive and significant correlation between health literacy and health-related physical fitness knowledge. It was expected that individuals who scored higher on the Newest Vital Sign would also demonstrate higher scores on the FitSmart (in comparison to individuals who scored lower on the health literacy assessment). Given that health literacy has been shown to be a positive and significant correlate to and predictor of health-related knowledge as well as health outcomes (DeWalt et al., 2004; Lindau et al., 2002), it is reasonable to postulate a positive and significant relationship between health literacy and health-related physical fitness knowledge. In summary, our findings showed that health-related physical fitness knowledge was positively and significantly correlated to health-related physical fitness in adulthood. Specifically, knowledge was a significant correlate to and the strongest individual predictor of musculoskeletal fitness. In addition, health literacy was found to be a significant correlate to and the strongest predictor of knowledge. These findings have been compiled into a manuscript titled, "The relationship between health knowledge and measures of health-related physical fitness", which is presented in Chapter 2 of this thesis document.

The second research objective of this investigation was to examine objectively the effects of administering the CPAFLA on health knowledge and the Theory of Planned Behaviour components (i.e., attitude, subjective norm, perceived behavioural control, and intention) concerning regular physical activity participation in adulthood. The Theory of Planned Behaviour constructs were assessed via a written survey containing a series of 7-point bipolar adjective scales concerning regular physical activity participation. We hypothesized that individuals receiving the CPAFLA would demonstrate improved scores on the post-test FitSmart knowledge examination. More specifically, individuals would demonstrate higher scores on the 'Components of Physical Fitness' section of the test in comparison to baseline measures. This hypothesis was generated because the administration of the CPAFLA strategically identifies major physical fitness components in a sequential order and highlights their individual and aggregative impacts on health and well being. Furthermore, the CPAFLA strategy emphasizes education and counselling concerning appropriate evidence based tactics designed to augment fitness through a variety of exercises and activities. These tactics are based on the interpretation of fitness results (CSEP, 2003). As such, we predicted that participants will demonstrate improvements on the FitSmart examination following administration of the CPAFLA on questions specific to the health-related physical fitness component of the examination. We also predicted that the theory of planned behaviour components (i.e., individual beliefs, attitudes, and intentions) related to physical activity participation would improve in comparison to baseline measures following the administration of the CPAFLA. The CPAFLA appraisal process is designed to increase knowledge and awareness concerning health-related physical fitness while highlighting the health benefits of physical activity in an attempt to motivate individuals to develop healthier lifestyles and increase physical activity participation (CSEP, 2003). As such, improvements in the relevant Theory of Planned Behaviour components were expected following the administration of the CPAFLA. Our results supported these hypotheses, whereby administration of the CPAFLA functioned to increase health knowledge, as well as important components of the TPB. These effects were demonstrated via increases in instrumental attitude, perceived behavioural control, and intention. The findings have been compiled into a manuscript titled, "The effects of administering the Canadian Physical Activity Fitness & Lifestyle Approach (CPAFLA) on health-related physical fitness knowledge as well as beliefs, attitudes, and intentions towards regular physical activity participation", which is presented in Chapter 3 of this thesis document.

Overview of Document

This thesis is comprised of four Chapters. Chapter 1 serves as a general introduction to the thesis. The findings of the thesis investigation are then presented in the form of two manuscripts. The purpose of the first manuscript is to examine the relationship between health knowledge and health-related physical fitness; while, the second manuscript focuses on the effects of administering the CPAFLA on health-related physical fitness knowledge, as well as beliefs, attitudes, and intentions towards regular physical activity participation. These manuscripts are presented in Chapters 2 and 3, respectively. The conclusion is then presented in Chapter 4. This thesis also includes Appendices A through M. More specifically, the Appendix section includes: A) an extended review of literature directly pertinent to the investigation B) the required certificate of research ethics, C) a sample of the FitSmart health-related physical fitness knowledge examination questions, D) the health-related physical activity belief and attitude assessment, E) the Newest Vital Sign (NVS) health literacy assessment, F) the CPAFLA preliminary instruction template, G) the Physical Activity Readiness Questionnaire (PAR-Q), H) the Physical Activity Readiness Medical Examination (PARmed-x) template, I) the CPAFLA consent form, J) the Physical Activity Participation Questionnaire used in the CPAFLA, K) the detailed CPAFLA anthropometric protocols, L) the detailed modified Canadian Aerobic Fitness Test (mCAFT) procedure, and M) the detailed CPAFLA musculoskeletal fitness assessment protocols.

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CHAPTER 2

The Relationship between Health Knowledge and Measures of Health-Related Physical Fitness[1]

Knowledge is considered to be a major determinant of human behaviour (Andrade et al., 1999). Health-related knowledge permits individuals to acknowledge the warning signs and propagation of diseases, select and partake in suitable preventative health strategies (e.g., physical activity), and provides individuals with an understanding of where or how to obtain health assistance (Freimuth, 1990).

A number of theories have been used to explain and predict individual's health-related behaviours. Becker's Health Belief Model (1988) stipulates that an individual's health-related lifestyle is dictated by his/her perception of the consequences of a potential illness (e.g., cardiovascular disease) and the benefits of engaging in a behaviour (e.g., aerobics) that would eliminate the threat of such illness (Rosenstock, Strecher, & Becker, 1988; Seefeldt, Malina, & Clark, 2002). These perceptions are shaped in part by the knowledge base that one possesses. Prochaska and Diclimente's Transtheoretical Model of Behaviour Change (1992) accentuates this notion. In order for a behavioural change to occur, the rudimentary step is to educate with the intention of increasing knowledge and awareness of the particular behavioural actions and reactions (Prochaska, DiClimente, & Norcross, 1992). Dominant among these is the Theory of Planned Behaviour (TPB, formerly the Theory of Reasoned Action (TRA)) (Ajzen, 1988, 1991). The TPB proposes that the most immediate and significant

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forecaster of behaviour is an individual's intention to execute a behaviour. This behavioural intention is predicted by three major factors: attitude towards the behaviour, subjective norm, and perceived behavioural control. The knowledge base of an individual, in relation to the behaviour, is considered a background variable which influences the three variables that form behavioural intentions (Ajzen & Manstead, 2007). Accordingly, research suggests that individuals who understand the concepts of health-related physical fitness are more likely to be physically active and demonstrate higher fitness levels (Zhu, Safrit, & Cohen, 1999; Petersen, Byrne, & Cruz, 2003a). Thus, important processes in becoming physically fit while endorsing constructive behaviours in relation to fitness are obtaining, learning, and applying the concepts and principles of health-related physical fitness (Miller & Housner, 1998).

Health-related fitness encompasses the components of physical fitness that are related to health status, including physical activity participation, cardiovascular fitness, musculoskeletal fitness, body composition, and metabolism (Warburton, Whitney, & Bredin, 2006b). Additionally, it is regularly assumed that health-related physical fitness is a product of habitual physical activity participation (Katzmarzyk, Malina, Song, & Bouchard, 1998). Thus, a positive correlation is expected between participation in physical activity (i.e., any bodily movement produced by skeletal muscles that results in energy expenditure (EE)) and measures of physical fitness (e.g., body composition, aerobic fitness, and musculoskeletal fitness) (Caspersen, Powell, & Christenson, 1985). Another quantifiable component of physical fitness is cardiovascular or aerobic fitness. It is commonly defined as a measure of the combined efficiency of the lungs, heart, bloodstream, and exercising muscles in getting the oxygen to the muscles and putting it to work (CSEP, 2003). Individuals must then rely on the musculoskeletal system for movement and to perform work. Musculoskeletal fitness refers to the fitness of the musculoskeletal system, encompassing muscular strength, muscular endurance, muscular power, flexibility, back fitness and bone health (Warburton, Whitney, & Bredin, 2006b). Based on this definition, it is apparent that musculoskeletal fitness is essential to maintain as it provides the basis for our activities of daily living and determines our ability to perform a wide variety of physical challenges. Finally, body composition is an essential component of health-related fitness. The relative amounts of muscle, fat, bone and other anatomical components that contribute to a person's total body weight (U.S. Department of Health and Human Services, 1999) are what make up an individual's body composition and contribute to metabolic capacity.

To-date, the literature examining the relationship between health knowledge and health-related physical fitness remains limited and inconsistent. Evidence supporting a positive relationship between health-related physical fitness knowledge and the components of health-related physical fitness has been suggested in adolescence (Keating, 2007), and limitedly shown in adulthood (Avis, McKinlay, & Smith, 1990; Liang et al., 1993) and within elderly populations (Fitgerald, Singleton, Neale, Prasad, & Hess, 1994). Moreover, investigations have also shown no significant relationship between fitness knowledge and components of physical fitness (e.g., health-related physical activity) (Morrow, Krzewinski-Malone, Jackson, Bungum, & FitzGerald, 2004). More specifically, the research literature has shown that cardiovascular risk factor knowledge is positively related to level of education, being female, and amount of exercise (Avis, McKinlay, & Smith, 1990). In addition, exercise beliefs and knowledge have been suggested to influence exercise habits of healthy females (Fitgerald et al., 1994). Liang et al. (1993) have shown that health knowledge influenced medical student's fitness levels; however, attitudes concerning health promotion and disease prevention were stronger predictors of fitness levels. In contrast, Morrow et al. (2004) showed that knowledge of exercise recommendations had no effect on exercise behaviours; yet, ethnicity, education level, and age were significantly correlated to health knowledge.

A significant factor associated with the acquisition of health knowledge is health literacy. Health literacy is defined as the degree in which people have the competence to obtain, process, and understand basic health information and services needed to make appropriate health decisions (Parker, Ratzan, & Lurie, 2003). It is a contemporary and well warranted topic of concern for the advancement of high quality health care. Specifically, health literacy is pivotal to numerous health care system initiatives including quality assurance, cost maintenance, safety, and patient's active involvement in health care decisions (Parker et al., 2003).

The International Adult Literacy and Skills Survey (IALS) is the primary and current source of literacy measures of the general population in Canada and in other countries (Rootman, 2005). Most recently, the IALS highlighted major deficiencies in the literacy levels of the Canadian population (Statistics Canada, 2005). Almost half of the Canadian adult population fell into the lowest 2 of 5 literacy levels with regards to their ability to read and comprehend prose (48%) and documents (49%). The majority of the population fell into the two lowest levels concerning problem solving ability (72%) and numeracy (55%). Correspondingly, 22% of the Canadian adult population were shown to be seriously challenged in terms of literacy and another 26% displayed skills considered to be inadequate for the successful participation in today's "knowledge economy" (Rootman, 2005; Statistics Canada, 2005).

There are several consequences of inadequate levels of health literacy. Literacy is related to numerous aspects of health including health knowledge, health status, and use of health services (Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association, 1999). When related to health outcomes, patients with low literacy are generally 1.5-3 times more likely to experience inferior health outcomes inclusive of knowledge, transitional disease indicators, morbidity measures, utilization of health resources, and general health status (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004). In terms of knowledge, there exists a positive and significant relationship between literacy levels and knowledge of health services or health outcomes (DeWalt et al., 2004). Research indicates that individuals with low literacy and chronic or infectious diseases (e.g., diabetes, hypertension, asthma (Williams et al., 1998), or HIV/AIDS (Kalichman et al., 2000)) have inferior knowledge concerning their disease and its recommended treatment. Furthermore, research has indicated that poor health literacy alone is the most significant predictor of disease prevention knowledge when compared to ethnicity or education (Lindau et al., 2002). To-date, health literacy has not been examined in relation to health-related physical fitness knowledge.

The examination of health knowledge in relation to physical fitness (as well as health literacy in relation to health-related physical fitness knowledge) has important policy implications for preventative health care schematics. This is especially applicable to health promotion programs that employ education as a primary objective. Currently, the prevalence of physical inactivity (51% of adult Canadians) ranks higher than all other existing and modifiable hypokinetic (insufficient movement) disease risk factors (Statistics Canada, 2003; Warburton, Whitney, & Bredin, 2006a). Moreover, overweight and obesity within Canada has reached epidemic measures (Katzmarzyk, Perusse, Rao, & Bouchard, 2000; Katzmarzyk, 2002a; Katzmarzyk, 2002; Katzmarzyk, & Janssen, 2004) . Direct health care expenditures and indirect costs associated with physical inactivity and obesity in Canada are conservatively estimated to provide an economic burden totalling 9.6 billion: 5.3 billion for inactivity (1.6 and 3.7 billion in direct and indirect costs, respectively), and 4.3 billion for obesity (1.6 and 2.7 billion in direct and indirect costs, respectively) (Katzmarzyk, & Janssen, 2004). Provincially, the health care productivity losses and obesity costs associated with inactivity are conservatively estimated to cost British Columbia between $730 and $830 million per annum (Deacon, 2001). Given these data and the notion that health knowledge and its dependants are major utilities to public health promotional agencies (Nayga, 2001), the generation of empirical evidence regarding the influence of health knowledge on health-related physical fitness is clearly warranted.

The primary purpose of the present investigation was to examine the relationship between health-related physical fitness knowledge and objective measures of health-related physical fitness in young and middle adulthood. Health-related physical fitness knowledge was assessed via the FitSmart, a standardized health-related physical fitness knowledge examination, whereas, health-related physical fitness was assessed and interpreted using the Canadian Physical Activity, Fitness and Lifestyle Approach (CPAFLA). We hypothesized that individuals who scored higher on the FitSmart would also demonstrate higher levels of health-related physical fitness as determined by the CPAFLA in comparison to individuals who scored lower on the objective assessment of health-related physical fitness knowledge. Knowledge is a critical factor for establishing human behaviour (Andrade, 1999); and, moreover, people who understand the concepts of physical fitness are also more likely to incorporate physical activity and exercise into their everyday life (Zhu et al., 1999). Regular physical activity participation is often assumed as a significant predictor of health-related physical fitness (Katzmarzyk, 1998), therefore, we postulated that individuals with increased fitness knowledge would display higher levels of health-related physical fitness.

The secondary purpose of this investigation was to examine the relationship between health literacy and health-related physical fitness knowledge in young and middle adulthood. Health literacy was assessed via the Newest Vital Sign. We hypothesized a positive and significant correlation between health literacy and health-related physical fitness knowledge. That is, individuals who scored higher on the Newest Vital Sign would also demonstrate higher scores on the FitSmart in comparison to individuals displaying lower scores on the health literacy assessment.

Methods

Participants

Written informed consent was received from 18 female and 16 male participants. Participants were recruited according to two age groups: (a) 19 to 29 years (young adulthood, n = 9 F, 9 M; mean age = 24.3 ± 2.6), and (b) 39 to 49 years (middle adulthood, n = 9 F, 7 M; mean age = 42.6 ± 3.7). Individuals that were pregnant, were in poor health (illness or fever) at time of data collection, or were unable to provide documented physician clearance for physical activity in accordance with the CPAFLA pre-appraisal screening process were not permitted to participate. This investigation was executed in exact accordance with the ethical guidelines set forth by the University of British Columbia's Clinical Research Ethics Board for research involving human participants (see Appendix B for certificate of research ethics).

Assessment of Health-Related Physical Fitness Knowledge

The FitSmart written examination (Form 1) was used to assess the health-related physical fitness knowledge of each participant. Developed by Zhu, Safrit, and Cohen (1999), the FitSmart consists of 50 multiple choice items, measuring six sub-domain components: concepts of fitness; scientific principles of exercise; components of physical fitness; effects of exercise on chronic disease risk factors; exercise prescription; as well as nutrition, injury prevention, and consumer issues. Concepts of fitness make up 20% of the FitSmart examination and incorporate questions pertaining to fitness definitions, and the relationship(s) between fitness, physical activity, and health. The scientific principles of exercise component also makes up 20% of the exam and includes questions relating to the acute/chronic physiological and psychological adaptations to exercise. Questions associated with cardiovascular, respiratory and pulmonary function; muscular strength and endurance; flexibility; and body composition are addressed in the components of physical fitness section and comprise 20% of the exam. Five percent of the exam includes questions relating to the effects of exercise on chronic disease risk factors. Exercise prescription makes up 20% of the exam and takes into account the concepts of frequency, intensity, duration, mode, self-evaluation and exercise adherence. Last, 15% of the FitSmart examination consists of items pertaining to nutrition, injury prevention and consumer issues. Participants were allocated 45 minutes to complete the examination. Raw scores out of 50, overall percentages, and categorical percentage scores for each fitness component were generated via the FitSmart software for data analysis.

According to Zhu et al. (1999), the FitSmart is an established, valid, and reliable test to measure knowledge of the fundamental health and fitness concepts at the high school level of education. As such, the FitSmart written examination was used in this investigation to establish whether young and middle-aged adults possess the level of health-related knowledge expected at a high school level. The FitSmart has been implemented as the primary measure of health-related physical fitness knowledge in well educated adult populations (Losch & Strand, 2004; Petersen, Byrne, & Cruz, 2003b). Researchers have also utilized sections of the FitSmart as adjuncts to series of self report measures to incorporate health knowledge (Zizzi, Ayers, Watson, & Keeler, 2004).

Assessment of Health Literacy

The Newest Vital Sign was used to assess level of health literacy (Weiss et al., 2005). The Newest Vital Sign was administered to measure essential general literacy constructs (prose literacy, numeracy and document literacy) applied to health information in under five minutes. The Newest Vital Sign assessment is based on a nutritional label from an ice cream container, whereby participants were provided the label and asked to read, comprehend, and apply the available information to answer six content based questions. The six questions were asked orally and participant responses were recorded on a specialized score sheet. Time constraints were not placed on participants when answering the six questions. The number of correct responses (0-6) was used to estimate the participant's level of health literacy, with higher scores indicating superior health literacy.

Assessment of Health-Related Physical Fitness

Health-related physical fitness was assessed and interpreted using the CPAFLA. The CPAFLA represents a series of standardized testing and counselling procedures developed by the Canadian Society for Exercise Physiology (CSEP). The assessment is commonly used as a measure for the health-related fitness of the general population and is administered on over a million Canadians each year by trained CSEP health and fitness professionals (CSEP, 2003).

The CPAFLA appraisal included pre-appraisal screening and objective measures of physical activity participation, metabolic fitness, body composition, aerobic fitness, musculoskeletal fitness, and back fitness. The administration of the CPAFLA took an average of 1-1.5 hours to complete.

Pre Appraisal Screening: Each participant was screened in accordance to the CPAFLA pre-appraisal screening protocol which includes: the Physical Activity Readiness Questionnaire (PAR-Q), subjective observation (e.g., is the participant pregnant? or exhibiting difficulty breathing at rest?), measurement of resting heart rate (bpm) and resting blood pressure (mmHg). Resting heart rate and blood pressure were measured after five minutes of seated rest. Resting heart rate was evaluated via the use of a Polar ™ heart rate monitor. Resting blood pressure was manually assessed with a standard sphygmomanometer and stethoscope (Almedic) on the left arm.

Individuals were momentarily prohibited from participating in the appraisal if they answered yes to one or more of the questions on the PAR-Q, were ill or had a fever, had difficulty breathing at rest, coughed persistently, were currently on certain medications contraindicated with the assessment, had lower extremity swelling, retained a resting heart rate ≥ 100 bpm, or a resting blood pressure ≥ 144/94 mmHg. Participants who were screened out in the pre-appraisal were referred to their physician for a medical examination and clearance before proceeding with the appraisal. These participants were given a CPAFLA Physician Summary and a Physical Activity Readiness Medical Examination (PARmed-X) form. Participants who required physician clearance and did not receive it were excluded from the investigation.

Healthy Physical Activity Participation: Current physical activity levels were measured via the Healthy Physical Activity Participation Questionnaire. The questionnaire examines three characteristics of participation: frequency, intensity, and perceived fitness. For each of these characteristics there is a statement followed by a list of options. Participants were instructed to choose the option that most closely described them. Based on the participant's answers to the three questions they were given a score ranging from 0-11, which was then converted into a one of five health benefit ratings/zones from 0-4 pertaining to their current level of physical activity participation. These health benefit zones are standardized throughout the CPAFLA composite measures and are translated as follows: 0 = Needs Improvement (considerable health risks); 1 = Fair (some health benefits but also some health risks); 2 = Good (many health benefits); 3 = Very Good (considerable health benefits); and 4 = Excellent (optimal health benefits).

Healthy Body Composition: Composite body composition was calculated by combining Body Mass Index (BMI, kg/m^2), Waist circumference (WC, cm), and the sum of five skin folds (SO5S, mm) according to the CPAFLA fitness assessment protocol.

Height (cm) was measured to the nearest 0.5 cm with a wall mounted stadiometer (SECA). Weight (kg) was recorded to the nearest 0.1 kg using an electronic scale (SECA). The participant's shoes were removed and light clothing (e.g., shorts and a T-shirt) was worn for both of these measures. The ratio of body weight in kilograms divided by height in meters squared was used to determine BMI.

Waist circumference was determined by positioning the anthropometric tape horizontally mid-way between the iliac crest and the bottom of the rib cage to the nearest 0.5 cm. All measurements for the sum of five skinfolds were landmarked according to CPAFLA protocol and made on the right side of the body to the nearest 0.2 mm with Harpenden™ calipers. The five skinfolds in order of measurement were: Triceps, Biceps, Subscapular, Iliac Crest and Medial Calf. The mean of two measurements for each skinfold was recorded.

Each participant received a score ranging from 0-4 pertaining to their body composition. This score was converted into a health benefit rating ranging from Needs Improvement (0) to Excellent (4).

Healthy Aerobic Fitness: Cardiovascular fitness was assessed using the modified Canadian Aerobic Fitness Test (mCAFT). The mCAFT is a valid and reliable, predictive, submaximal, and progressive exercise test designed specifically for the general population (CSEP, 2003). The test consists of one or more sessions of three minutes of stepping at predetermined speeds based on gender and age. At the end of each three minute stage, immediate post-exercise heart rate was recorded via the use of a high quality Polar ™ heart rate monitor. If the individual's heart rate was below their predetermined post-exercise ceiling heart rate [85% of predicted maximum (220-age)] at the end of the three minute stage they continued onto the next stage at a more intense cadence. The test was terminated once the participant reached their predetermined post-exercise ceiling heart rate. Other criteria for test termination can include: complaints of dizziness, noticeable staggering, inability to maintain cadence, extreme leg pain, nausea, chest pain, or signs of facial pallor. An aerobic fitness score was then generated via the following equation: *10 x [17.2+ (1.29 x O2cost) - (.09 x wt. in Kg) – (.18 x age in years)]* (CSEP, 2003, pg.7-31). This score was converted into a health benefit score/rating ranging from Needs Improvement (0) to Excellent (4).

Healthy Musculoskeletal Fitness: Composite musculoskeletal fitness was calculated by combining weighted scores from a set of 6 measures: grip strength, push-ups, sit and reach, partial curl-ups, leg power, and back extension. Maximum grip strength was determined in kilograms (kg) by summing the maximum score from the greater of two trials of the right and left hand with the use of an Almedic hand dynamometer. Individuals were asked to complete as many push-ups as possible. Females followed the same push-up procedure as males except their knees were used as the fulcrum. Sit-and-reach scores were determined with the use of a standard flexometer by the maximum distance (cm) reached (forward trunk flexion) over two trials. Prior to the sit-and-reach participants were instructed to stretch their hamstrings (modified hurdler stretch) and remove their shoes. For partial curl-ups, participants lay supine with their knees bent at a 90° angle with both feet on the floor and performed as many 10 cm partial curl-ups, at a 50 beat/min cadence, as possible in one minute to a maximum of 25. Vertical jump was assessed from the maximum of 3 trials with the use of the Vertec ™. The jump height (cm) was determined by the participant jumping as high as possible from a semi squat position (knees bent at 90°, arms and shoulders maximally extended). Peak leg power, in watts (W), was then determined with the use of the

Sayers Equation (Peak Leg Power (W) = [60.7 x jump height (cm)] + [45.3 x body mass (kg)] - 2055). Due to the amount of stress the back extension measure places on the back, a screening test was performed prior to administration. If participants felt any discomfort during the screening test, the back extension was not completed. For the test, participants were asked to support their upper torso (iliac crest and above) in a horizontal position from a 46 cm elevation with no rotation or lateral shifting for as long as possible to a maximum of 180 seconds. The number of seconds the horizontal position was maintained was recorded.

Each participant received a score ranging from 0-4 relating to their musculoskeletal fitness. This score was then converted into a health benefit rating ranging from Needs Improvement (0) to Excellent (4).

Healthy Back Fitness: Weighted scores for the following CPAFLA components: physical activity participation, waist circumference, sit-and-reach, partial curl-ups, and back extension, were combined to provide an indication of composite back fitness. These components are the best discriminators for healthy or unhealthy back fitness (CSEP, 2003). Each participant received a score ranging from 0-4 relating to their back fitness. This score was then converted into a health benefit rating ranging from Needs Improvement (0) to Excellent (4).

Procedure

Participants took part in two data collection days. On day 1, health-related physical fitness knowledge was assessed via the FitSmart, as well as general and health literacy using the Newest Vital Sign. Day 1 also functioned to familiarize the participants with the CPAFLA health-related fitness assessment protocols and preliminary instructions as per CPAFLA protocol. On day 2, participants completed the CPAFLA assessment of health-related physical fitness. Recommendations and guidance pertaining to each CPAFLA measure were provided by a Canadian Society for Exercise Physiology - Certified Exercise Physiologist (CSEP-CEP) at the end of the fitness appraisal as required by standardized CPAFLA protocols. The CSEP-CEP is the most advanced health and fitness practitioner certification in Canada allowing members to work with high performance athletes, the general population (across the lifespan), and varied clinical populations. A CSEP-CEP is sanctioned to perform assessments/evaluations, prescribe conditioning exercise, provide exercise supervision/monitoring, counseling, healthy lifestyle education, and outcome evaluation for "apparently healthy" individuals and/or populations with medical conditions, functional limitations or disabilities through the application of physical activity/exercise, for the purpose of improving health, function and work or sport performance (CSEP, 2007).

Statistical Analysis

Statistical significance was set *a priori* at $p < 0.05$ for all analyses. All figures and tabular values are reported as the mean ± standard deviation. Each variable was tested for normal distribution (i.e., skewness or kurtosis) and was transformed if necessary. A general linear model (GLM) univariate analysis of variance (ANOVA) was implemented to examine the differences between age groups (young adulthood, middle adulthood) and gender (female, male) for each dependant variable. Regression analyses, incorporating age, gender, income, and education, as well as bivariate correlations were employed to examine the relationship(s) between health-related physical fitness knowledge (FitSmart) and health-related physical fitness (CPAFLA) scores. The same analyses were performed to examine the relationship(s) between health literacy (Newest Vital Sign) and health-related physical fitness knowledge scores.

Health-related physical fitness knowledge percentage scores (x/100) were used as the primary indicators of health knowledge. Indicators of physical fitness were analyzed as composite scores (Healthy Physical Activity Participation (x/4), Healthy Body Composition (x/4), Healthy Aerobic Fitness (x/4), Healthy Musculoskeletal Fitness (x/4), Healthy Back Fitness (x/4)) and compartmentalized (e.g., Healthy Musculoskeletal Fitness (grip strength (x/4), push-ups (x/4), sit and reach (x/4), partial curl-ups (x/4), leg power (x/4), and back extension (x/4)) if significance was identified. Lastly, the Newest Vital Sign scores (x/6) were used as the primary indicators of health literacy.

Results

Participants

All participants resided in Vancouver, British Columbia or the Greater Vancouver Region. Most participants (79.4%) were currently enrolled in or had completed post secondary education (8.8% college diploma, 47% undergraduate degree, 23.5% graduate degree). The remaining one fifth (20.6%) of the participants were currently enrolled in or had completed a secondary level of school education. With respect to ethnicity: 47.1% were Caucasian, 8.8% were Mid Eastern, 14.7% were East Indian, 23.5% were Asian, and 2.9% were Aboriginal Canadian. For income: 61.8% grossed ≤ $ 39000/year (32.35% ≤ $ 20000; 29.4% = $ 20-39000), and 32. 3% grossed ≥ $ 40000/year (11.76% = $ 40-59,000, 17.6 % = 60-79000, 2.9% = $ 80-90000). The remaining 6% did not disclose their income. Participant physical characteristics (e.g., height, weight, body mass index, waist circumference, heart rate, and blood pressure) are outlined in Table 2.1 as a function of age and gender.

No adverse effects were exhibited by any of the participants during the physical fitness appraisal. However, three individuals (1 young female adult, 1 middle-aged female adult, and 1 middle-aged male adult) were not permitted to participate in this investigation due to contraindications with exercise that could not be cleared by a physician in a timely fashion (i.e., unknown severe chronic abdominal pain, surgery of the eye musculature causing bleeding during exertion, and undiagnosed yet reoccurring chest pains). In addition, a total of 4 participants were screened out of select physical fitness measures due to the CPAFLA protocol and the professional discretion of the CSEP-CEP during testing. One female middle-aged adult was excluded from the vertical jump test and the back extension test due to a previous yet treated lumber nerve impingement. Another female middle-aged adult was excluded from the aerobic, vertical jump, partial curl-up, and back extension tests due to complaints of transient light headedness. A young adult male was screened out from performing the back extension test due to noticeable pain sensed during the back extension pre-screening test. A second young adult male did not perform the vertical jump test due to a previous ankle injury. With regard to the health-knowledge assessment, participants demonstrated no problems completing the FitSmart within the allotted timeframe.

Health-Related Physical Fitness Knowledge

Table 2.2 lists the FitSmart overall raw scores, overall percentage scores, as well as the sub-domain component percentage scores for the total sample and according to age group and gender. The average test score out of the maximum 50 was 35.9 ± 5.8.

The lowest score achieved on the test was 25 while the highest score was 46. Figure 2.1 displays the FitSmart overall percentage scores by age and gender. Analysis of the sub-domain components showed that participants scored highest on the Concepts of Fitness section (mean = 78.9%) and lowest on the Scientific Principles of Exercise component (mean = 67.9%) and the Effects of Exercise on Chronic Disease Risk Factors (mean = 66.0%). No significant differences were found between males and females or young and middle adult groups for overall, as well as sub-component health-related physical fitness knowledge FitSmart scores.

Health-Related Physical Fitness Assessment

The composite mean scores (out of 4) were: Healthy Physical Activity Participation (1.9 ± 1.2), Healthy Body Composition (2.6 ± 1.1), Healthy Aerobic Fitness (2.1 ± 0.9), Healthy Musculoskeletal Fitness (1.8 ± 1.0), and Healthy Back Fitness (2.0 ± 1.0).

Table 2.3 shows the CPAFLA composite scores for the total sample, as well as by age and gender. Significant differences were found for healthy physical activity participation as well as healthy musculoskeletal fitness as a function of gender. Males engaged in significantly greater levels of physical activity when compared to females in both young and middle adulthood (Figure 2.2). In contrast, female's musculoskeletal fitness levels were superior to males in both age groups (Figure 2.3). Female resting heart rate was significantly higher in comparison to males (Figure 2.4), while there was no main effect for age. Analysis also revealed no significant difference for systolic and diastolic blood pressure as a function of age and gender (refer to Table 2.1 for sample and group values).

The body composition measures of height, weight, body mass index, waist circumference, and sum of five skinfold values are reported in Table 2.1 as a function of age and gender. Significant differences were shown for height, weight, and waist circumference between males and females. Waist circumference was the only measure to demonstrate a significant difference between young and middle adulthood. Characteristically, all male values for height, weight, and waist circumference were significantly elevated in comparison to females (refer to Figures 2.5, 2.6, and 2.7 respectively). In terms of age, middle-aged adults showed significantly larger waist circumference measures in comparison to young adults (Figure 2.7).

The mean aerobic fitness score was 413.5. Based on mean age group values, aerobic fitness raw scores significantly declined (19.8 %) from young adulthood to middle adulthood, 454.3 to 364.6 respectively (Figure 2.8). In addition, male's raw aerobic scores were significantly greater than females in both age groups (Figure 2.8). No significant differences were found between age and gender for composite aerobic fitness health benefit ratings.

Grip strength values were significantly higher for males in both young and middle adulthood (Figure 2.9). Flexibility was significantly different between males and females in both young and middle adulthood with females having increased scores across age (Figure 2.10). Vertical jump measurements significantly decreased (23.8 %) from young (38.0 cm) to middle (29.0 cm) adulthood, with an aggregate sample mean equal to 34.2 cm (Figure 2.11). Moreover, female vertical jump measurements were significantly lower than males in both young and middle adulthood (Figure 2.11). Significant differences were found as a function of gender for leg power, with males generating more power then woman (Figure 2.12). No significant differences were found for age group or gender for push-ups, abdominal endurance, and back extension measures.

Health-Related Physical Fitness Knowledge and Health-Related Physical Fitness

Pearson correlations for each CPAFLA composite measure and the overall Health-related Physical Fitness Knowledge score are listed as a matrix in Table 2.4. Our analysis showed that composite musculoskeletal fitness was significantly correlated ($r = 0.40$) with knowledge (FitSmart score). Additionally, when controlling for socio-demographic variables (age, gender, income, and education) in the regression analysis, results indicated that health-related physical fitness knowledge was the strongest unique contributor to musculoskeletal fitness (standardized $B = 0.59$, $p < 0.05$). Upon further inspection within musculoskeletal fitness, health-related physical fitness knowledge was significantly correlated to musculoskeletal fitness measures of muscular endurance (refer to Table 2.5). Specifically, there was a positive and significant correlation between health-related physical fitness knowledge and push-ups ($r = 0.37$), as well as knowledge and partial curl-ups ($r = 0.41$).

Health Literacy and Health-Related Physical Fitness Knowledge

Table 2.6 lists the Newest Vital Sign health literacy scores for age group, gender, and the total sample. No significant differences were found between age group or gender for health literacy. With respect to knowledge, our analysis demonstrated that health literacy was positively and significantly correlated to health-related physical fitness knowledge ($r = 0.63$). Moreover, when controlling for sociodempgraphic variables (age, gender, income and education), our regression analysis indicated that health literacy was the strongest individual predictor of health-related physical fitness knowledge (standardized B = 0.47, $p < 0.05$). Upon FitSmart sub-domain component analysis health literacy was significantly correlated, in increasing order, to scientific principles of exercise ($r = 0.44$), components of physical fitness ($r = 0.45$), concepts of fitness ($r = 0.49$), nutrition injury prevention and consumer issues ($r = 0.62$), and effects of exercise on chronic disease risk factors ($r = 0.67$). Refer to Table 2.7 for Pearson correlations of health literacy for overall and sub-domain component health-related physical fitness knowledge scores.

Discussion

Currently, the literature delineating the relationship between health-related physical fitness knowledge, measures of health related physical fitness, and health literacy is limited as well as inconsistent. As such, the purpose of this investigation was to examine the relationship between: 1) health-related physical fitness knowledge and objective measures of health-related physical fitness in young and middle adulthood, and 2) health literacy and health-related physical fitness knowledge in young and middle adulthood. Strength of the present investigation was the utilization of objective measures of both health knowledge and physical fitness. First, a holistic and standardized measure of health-related physical fitness knowledge (the FitSmart) was administered as opposed to open ended/lobbied questions (Avis et al., 1990), bimodal surveys (Liang et al., 1993), telephone interviews (Morrow et al., 2004) or a single question (Fitzgerald, Singleton, Neale, Prasad, & Hess, 1994). In addition, we used a health-related physical fitness assessment systematically developed and standardized for use within the general Canadian population. To examine health literacy, the Newest Vital Sign was employed, which is a brief yet valid and reliable measure of the general literacy constructs applied to health information.

Health-Related Physical Fitness Knowledge

Results from the FitSmart examination illustrate that participants were most capable at identifying the basic definitions of fitness and the positive relationship between physical activity and health (Concepts of Fitness (x = 79%)); however, they were least capable at correctly answering questions related to acute/chronic physiological/psychological processes and bodily adaptations to exercise (Scientific Principles of Exercise (x = 68%) as well as Effects of Exercise on Chronic Disease Risk Factors (x = 66%)). These results support findings in the current literature, whereby physical education majors demonstrated the lowest scores on Scientific Principles of Exercise (x = 68%) (Peterson et al., 2003). These results are not surprising as the content matter of the scientific principles component of the FitSmart is generally more complex, requires a fundamental base of knowledge, and fits into a higher taxonomic educational category (i.e., application) (Bloom & Krathwohl, 1956). For example, to successfully answer the question,

> "Which of the following is a characteristic of the blood of highly fit individuals?
> A) Greater blood volume and more red blood cells,
> B) Greater blood volume and fewer red blood cells,
> C) Less blood volume and more red blood cells, and
> D) Less blood volume and fewer red blood cells",

individuals are required to apply previously acquired knowledge (e.g., blood components, and the haematological or physiological adaptations to exercise) in four different ways (options A-D) to correctly choose the one best answer. This is clearly more challenging and complex than being asked a question that falls into a lower taxonomic educational level (e.g., knowledge) which requires the exhibition of previously memorized basic concepts, facts and or terminology to identify the correct answer.

Peterson et al. (2003) collected data regarding previous academic experiences (i.e., number of exercise physiology courses taken) to substantiate their findings. Physical education majors who participated in more than one exercise physiology course were more likely to score higher on the knowledge exam. Practically, in-depth exercise physiology courses are not an option for most individuals, regardless of education. In addition, only 10% of the physical education majors in Peterson's investigation opted to take more than the one required exercise physiology course. A solid foundation of exercise physiology content knowledge is essential for all health care practitioners and educators to ensure the appropriate translation to students, clients, patients, and/or participants (Bulger, Mohr, Carson, Robert, & Wiegand, 2000). Thus it is important to consistently encourage and provide the opportunity for all individuals to learn foundational and higher-order concepts by publishing them repeatedly via creative and comprehendible media vehicles, as well as integrating them into appropriate educational curricula (Bulger et al., 2000).

Health-Related Physical Fitness

It is clear that most participants in this investigation failed to achieve levels of physical fitness associated with optimal health status (i.e., achieving an excellent rating of 4.0) on the components of the CPAFLA. This is consistent with other data that shows that the majority of Canadians are failing to meet the physical activity requirements set forth by Health Canada (Statistics Canada, 2003; Warburton, Whitney, & Bredin, 2006a). Moreover, based on the low socio-economic status of this sample, as indicated by income (61% earned ≤ $39000/yr), and the documented relationship between low socioeconomic status, poor health behaviours (e.g., malnutrition, physical inactivity, inadequate health care utilization) and poor health outcomes (increased morbidity and mortality), our results are consistent with previous literature (Adler et al., 2002; (Feinstein, 1993).

With respect to age, significant differences were revealed for measures of body composition (waist circumference), aerobic fitness (mCAFT score), and musculoskeletal fitness (vertical jump). For each of these measures the middle adulthood group demonstrated significantly worse health-related scores in comparison to the young adulthood group. Waist circumference was significantly larger (12 %), aerobic fitness scores were significantly lower (20 %), and vertical jump measurements were significantly less (24 %). These results provide insight into the relationship between age and health-related physical fitness. Decrements in fitness that result as a function of increasing age are common and have the ability to produce substantial and detrimental effects towards health and wellbeing if not mediated appropriately during the aging process (WHO, 2002). Thus, there is an imperative need to stress the importance of regular physical activity participation and healthy lifestyle behaviours (e.g., nutrition, stress relief, personal hygiene) to middle and older adulthood cohorts (Galloway & Jokl, 2000). Moreover, given that physical activity behaviours track from childhood to adolescence and into adulthood, preventative health promotion measures that target children are strongly recommended (Malina, 1996). A suggested primary action should be to increase people's health-related knowledge base. Knowledge is a background factor which contributes to the formation of behavioural intentions (Ajzen & Manstead, 2007), as well as a recommended first step in the Transtheoretical model of behaviour change (Prochaska, DiClimente, & Norcross, 1992). Importantly, our results suggest that knowledge is a significant correlate to and predictor of health-related physical fitness measures. Therefore, health care practitioners at all levels should aim to increase people's health-related knowledge. Unfortunately, many primary care physicians (who care for middle-aged adults) frequently overlook the importance of prescribing physical activity and/or educating patients on the benefits of regular health-related physical activity participation (Galloway & Jokl, 2000). Insufficient physical fitness knowledge and lack of time are two major barriers physicians report when discussing their lack of exercise counselling (Abramson, Stein, Schaufele, Frates, & Rogan, 2000).

In addition, the 39-49 age range is one where individuals generally endure extreme levels of stress (e.g., work, family, finances, and first occurrences of health problems). Likewise, this is a recognized age range where past negative health behaviours (e.g., smoking, poor diets, physical inactivity) start to take a more substantial role in health degradation. In extreme cases this is an age where the previous negative health behaviours cause severe debilitation (e.g., cardiovascular disease, musculoskeletal impairments) leading to impinged quality of life until death (WHO, 2002). In summary, the findings of this investigation support the need to provide children, adolescents, and adults with knowledge concerning health-related physical fitness. We recommend health promotion initiatives that highlight the relationship between health knowledge, physical fitness, and health outcomes.

Health-Related Physical Fitness Knowledge and Health-Related Physical Fitness

Based on our results, musculoskeletal fitness was shown to be a significant correlate to health-related physical fitness knowledge and health-related physical fitness knowledge was the strongest individual contributor to musculoskeletal fitness. Within musculoskeletal fitness, health-related physical fitness knowledge was correlated to muscular endurance measures: specifically, push-ups and partial curl-ups. These findings are very compelling, applicable, and important given the documented indirect and direct relationship(s) between musculoskeletal fitness and health status. Indirectly, musculoskeletal fitness is related to health status via body composition as well as cardiovascular fitness (Warburton, Gledhill, & Quinney, 2001a). In terms of body composition, musculoskeletal strength and endurance training is known to result in significant improvements in fat free mass attributable to muscular hypertrophy. The increases in fat free/muscle mass have the ability to augment metabolic capacities (i.e., increased resting metabolic rates (RMR)) which, in turn, contribute to a healthier body composition via increased fat oxidation and energy expenditure (Ballor & Poehlman, 1992; Poehlman et al., 1992). Significant improvements in cardiovascular/aerobic fitness (maximal oxygen consumption, VO_{2max}) are rarely documented due to improvements in musculoskeletal fitness alone (Warburton, Gledhill, & Quinney, 2001a). However, it is important to acknowledge that improvements in the functionality of the musculoskeletal system operate to enhance an individual's capability to engage in physical activity pursuits and active lifestyle behaviours. Additionally, these improvements in functional status are of significant importance to the elderly, disabled, and or diseased populations as they serve to increase the capacity to execute activities of daily living (e.g., household cleaning, shovelling snow, carrying shopping bags) and therefore, provide functional independence (Warburton, Gledhill, & Quinney, 2001a; Warburton, Gledhill, & Quinney, 2001b).

Directly, improvements in musculoskeletal fitness (strength and endurance) may have a positive and significant impact on the risk factors for cardiovascular disease; namely, blood based lipid and lipoprotein profiles, hypertension, abdominal obesity, RMR, and glucose homeostasis (Warburton, Gledhill, & Quinney, 2001a). This is of major importance given that chronic diseases, including cardiovascular disease (CVD), cancer, and diabetes, are the leading causes of morbidity and death in Canada (Stone & Arthur, 2005). Cardiovascular disease was the single greatest cause of death in 2001 (men and woman combined, all ages), accounting for one in three (36%), or approximately 75,000 total deaths (Stone & Arthur, 2005). Additionally, the economic burden of cardiovascular disease is exorbitant. Cardiovascular disease remains the single most expensive diagnostic category on the health care budget, and the direct and indirect CVD related costs in Canada currently exceed $18 billion/annum (Stone & Arthur, 2005). In addition to the physiological benefits, improved musculoskeletal fitness may improve multiple components of psychological well being, including self efficacy, mood state, anxiety, perceptions of anger, and tension (Warburton, Gledhill, & Quinney, 2001a).

In summary, "high levels of musculoskeletal fitness are associated with positive health status and health, and low levels of musculoskeletal fitness are associated with lower health status" (Warburton, Gledhill, & Quinney, 2001b, p. 217). Correspondingly, perceived health has also been associated with levels of musculoskeletal fitness in both men and women. In general, lower levels of musculoskeletal fitness are associated with reduced perceptions of health and higher levels of musculoskeletal fitness are associated with elevated perceptions of health (Suni et al., 1998). It is essential for preventative health practitioners to highlight the musculoskeletal fitness to health and health-related physical fitness knowledge to musculoskeletal fitness relationships in an attempt to educate individuals to adopt healthy and active lifestyles that function to increase health status.

The following points should be considered to discuss why musculoskeletal fitness was the only composite fitness measure to be significantly correlated with health-knowledge. Firstly, other components (e.g. aerobic fitness) were close to reaching significance. Given that this investigation only utilized 34 participants, it is reasonable to assume that we were slightly underpowered. A study examining this relationship with a much larger sample is recommended to enhance the current findings. Secondly, another potential contributor to these findings is the actual measurements being taken. For example: musculoskeletal fitness is a composite measure devised from six challenging measurements (i.e., grip strength, push-ups, curl-ups, flexibility, vertical jump, and back extension). Provided that musculoskeletal fitness incorporates the greatest amount of testing elements, the composite scores should be more reflective of fitness levels and as a result may have been more indicative of health knowledge. Moreover, musculoskeletal fitness may be a better determinant of current physical fitness levels as other measures (e.g. aerobic fitness) are known to show large detraining and consistent aging effects in comparison (CSEP, 2003).

When looking into how an individual's knowledge of health-related physical fitness translates into behaviours that promote the development, maintenance, and improvement of fitness, the Theory of Planned Behaviour is a viable framework. The theory suggests a model stipulating how human action is generated given that the active behaviour is intentional. Behavioural intentions are assumed to result sensibly from beliefs (behavioural, normative, and control) about performing the behaviour (Ajzen & Fishbein, 2005). It is important to note the beliefs people possess regarding the performance of a particular behaviour are influenced by a broad assortment of situational, cultural, and personal background factors (knowledge being one of them). These beliefs can be accurate, inaccurate, biased, and even illogical. Nevertheless, this set of beliefs is the cognitive foundation that guides human action, which is influenced by three major factors: a positive or negative assessment of the behaviour (attitude regarding the behaviour), perceived societal influence to execute or not execute the behaviour (social norm), and perceived ability to execute the behaviour (perceived behavioural control). Thus, accurate knowledge pertaining to the behaviour at hand is essential in guiding human action. The amalgamation of attitude towards the behaviour, subjective norm, and perception of behavioural control leads to the formation of the behavioural intention (strongest predictor of human behaviour). In general, the more favourable the attitude and subjective norm, in combination with increased perceived behavioural control, a person's intention to perform the desired behaviour will be greatest. Lastly, given a significant degree of actual control over the behaviour, individuals are expected to execute their intentions when presented with an opportunity.

Health Literacy and Health-Related Physical Fitness Knowledge

To the best of our knowledge, this is the first investigation to incorporate the assessment of health literacy in relation to physical fitness knowledge. Our results suggest that health literacy is a significant correlate to and predictor of health-related physical fitness knowledge. These results are in line with previous health literacy research looking at the relationship between health literacy and other subsets of health knowledge (e.g., disease prevention, disease treatment and management, and health care utilization) (Weiss et al., 2005; DeWalt et al., 2004; Lindau et al., 2002; Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association, 1999; Williams et al., 1998). Given that health literacy is broadly defined as an individual's ability to obtain, process, and understand basic health-related information in order to navigate the health care system and make appropriate health-related decisions, its relevance is of much importance to the health-care practitioners in all disciplines (Parker et al., 2003). Individuals with limited literacy have less knowledge concerning their health problems, elevated health care costs, more hospitalizations, and inferior health status than those with sufficient literacy (Weiss et al., 2005). These relationships are uniform across studies and continually exist when adjusting for possible confounding socio-demographic factors (Weiss et al., 2005). In light of our results and the supporting literature, the value of health literacy assessment within the health and fitness discipline should be acknowledged. Health literacy assessments (such as the Newest Vital Sign) are generally brief (e.g., 3-5 minutes) and provide the ability to increase knowledge translation in an individually tailored fashion (Weiss et al., 2005). This in turn, has the potential to result in increased client to practitioner communication leading to increased client knowledge retention. This increased retention then has the capacity to translate into improvements of essential health constructs specific to the knowledge being provided.

Conclusion

Given the empirical evidence relating musculoskeletal fitness to health status and the findings from the present investigation relating health-related physical fitness knowledge to musculoskeletal fitness, it is imperative that individuals are provided opportunities to access and acquire knowledge pertaining to health-related physical fitness. It is important to integrate education of this knowledge into multidimensional health promotion and education initiatives whenever possible. Additionally, it is essential for the advanced concepts relating to the scientific principles of exercise (acute/chronic physiological and psychological changes that our bodies endure via exercise) to be addressed in educational materials to the general population. Moreover, the relationship between health literacy, health outcomes, and health knowledge is one of much value and should be promoted throughout the health and fitness industry. Health care practitioners should make use of brief standardized assessments like the Newest Vital Sign in order to individually tailor the communication and guidance provided to clients, patients, and students.

Table 2.1. Participant Physical Characteristics (mean ± SD)

Physical Measurements	Female (n =18)		Male (n = 16)		
	Young (n = 9)	Middle-Age (n = 9)	Young (n = 9)	Middle-Age (n = 7)	Total (n = 34)
Height (cm)*	161.3 ± 7.9	162.3 ± 6.98	174.9 ± 6.2	176.3 ± 7.8	168.3 ± 9.8
Weight (kg)*	59.5 ± 20.0	67.4 ± 11.9	75.6 ± 13.7	87.3 ± 16.5	71.6 ± 18.1
BMI ($kg \cdot m^{-2}$)	22.7 ± 6.4	25.5 ± 3.0	24.7 ± 4.0	28.0 ± 5.2	25.1 ± 5.0
Waist Circumference (cm) **	71.6 ± 11.8	83.3 ± 9.4	87.9 ± 15.1	96.0 ± 13.0	84.0 ± 14.8
Resting Heart Rate (bpm) *	76.4 ± 7.2	73.1 ± 10.8	64.7 ± 7.6	63.7 ± 8.8	69.8 ± 10.0
Resting Systolic Blood Pressure (mmHg)	101.8 ± 12.8	110.9 ± 15.4	110.2 ± 9.8	113.1 ± 11.8	108.8 ± 12.9
Resting Diastolic Blood Pressure (mmHg)	68.9 ± 5.6	72.9 ± 8.8	74.2 ± 8.4	77.1 ± 8.3	73.1 ± 8.0

Note. *significant difference for gender ($p < 0.05$); ** significant difference for age and gender ($p < 0.05$).

Table 2.2. FitSmart Health-Related Physical Fitness Knowledge Scores (mean ± SD)

	Female (n =18)		Male (n = 16)		
Measurement	Young (n = 9)	Middle-Age (n = 9)	Young (n = 9)	Middle-Age (n = 7)	Total (n = 34)
Overall Score (x/50)	36.8 ± 7.2	35.6 ± 4.5	35.6 ± 5.4	35.6 ± 6.8	35.9 ± 5.8
Overall Score (%)	74.1 ± 14.3	71.1 ± 9.0	71.1 ± 10.9	71.1 ± 13.6	71.9 ± 11.6
Concepts of Fitness (%)	77.7 ± 14.0	77.2 ± 18.1	79.9 ± 15.2	81.6 ± 12.9	78.9 ± 14.7
Scientific Principals of Exercise (%)	69.9 ± 20.1	61.3 ± 10.5	68.6 ± 14.7	72.9 ± 10.8	67.9 ± 14.7
Components of Physical Fitness (%)	74.4 ± 20.4	78.6 ± 13.7	67.9 ± 11.7	63.7 ± 18.3	71.6 ± 16.5
Exercise on Chronic Disease Risk Factors (%)	72.3 ± 21.0	59.2 ± 19.7	69.4 ± 18.2	62.0 ± 26.6	66.0 ± 20.9
Exercise Prescription (%)	72.2 ± 44.1	72.2 ± 44.1	55.6 ± 52.7	100 ± 0.0	73.5 ± 43.1
Nutrition Injury Prevention and Consumer Issues (%)	68.8 ± 17.7	69.6 ± 15.3	70.4 ± 16.6	70.1 ± 26.8	69.7 ± 18.2

Table 2.3. CPAFLA Health-Related Physical Fitness Composite Scores (mean ± SD)

Composite Measurement	Female (n =18)		Male (n = 16)		
	Young (n = 9)	Middle-Age (n = 9)	Young (n = 9)	Middle-Age (n = 7)	Total (n = 34)
Healthy Physical Activity Participation *	1.4 ± 1.0	1.2 ± 1.1	2.6 ± 1.1	2.7 ± 0.8	1.9 ± 1.2
Healthy Body Composition	2.9 ± 1.3	2.4 ± 1.0	2.8 ± 1.2	2.1 ± 1.1	2.6 ± 1.1
Healthy Aerobic Fitness †	2.1 ± 1.2	2.1 ± 1.4	2.1 ± 0.8	1.9 ± 0.7	2.1 ± 1.0
Healthy Musculoskeletal Fitness *	1.9 ± 0.9	2.4 ± 1.2	1.1 ± 0.6	1.7 ± 0.95	1.8 ± 1.0
Healthy Back Fitness	1.9 ± 0.9	2.0 ± 1.5	1.9 ± 0.8	2.1 ± 0.7	2.0 ± 1.0

Note: * significant difference for gender ($p < 0.05$; † n = 33 (1 female middle-aged adult did not complete aerobic fitness test due to light headedness).

Table 2.4. Health-Related Physical Fitness Knowledge and Physical Fitness Correlations

Measure		Healthy Physical Activity Participation	Composite Body Composition	Healthy Aerobic Fitness	Composite Musculoskeletal Fitness	Composite Back Fitness
	P C	-.063	.169	.249	.395*	.178
FitSmart Score	Sig.	.725	.340	.162	.021	.313
	N	34	34	33	34	34

Note: PC Pearson Correlation. * Correlation is significant at the 0.05 level (2-tailed).

Table 2.5. Health Knowledge and Musculoskeletal Component Correlations

Measure		Grip Strength	Push-ups	Flexibility	Partial Curl-ups	Vertical Jump
FitSmart Score	P C	.329	.368*	.291	.413*	.238
	Sig.	.057	.035	.100	.019	.198
	N	34	33	33	32	31

. Note: [PC] Pearson Correlation. * Correlation is significant at the 0.05 level (2-tailed).

Table 2.6. The Newest Vital Sign Health Literacy Scores (mean ± SD)

Measurement	Female (n =18)		Male (n = 16)		Total
	Young (n = 9)	Middle-Age (n = 9)	Young (n = 8)	Middle-Age (n = 7)	Total (n = 34)
The Newest Vital Sign	5.7 ± 0.7	4.8 ± 1.1	5.3 ± 1.0	4.9 ± 1.9	5.2 ± 1.2

Table 2.7. The Health Literacy and Health-Related Physical Fitness Knowledge Correlations

Measure		Overall Score (%)	Concepts of Fitness (%)	Scientific Principals of Exercise (%)	Components of Physical Fitness (%)	Effects of Exercise on Chronic Disease Risk Factors (%)	Exercise Prescription (%)	Nutrition Injury Prevention and Consumer Issues (%)
Newest Vital Sign Score	PC	.632**	.491**	.491**	.451**	.674**	-.008	.173
	Sig.	.000	.004	.004	.008	.000	.964	.337
	N	33	33	33	33	33	33	33

Note: PC Pearson Correlation. * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Figure 2.1. Health Knowledge Scores as Determined by the Fitsmart

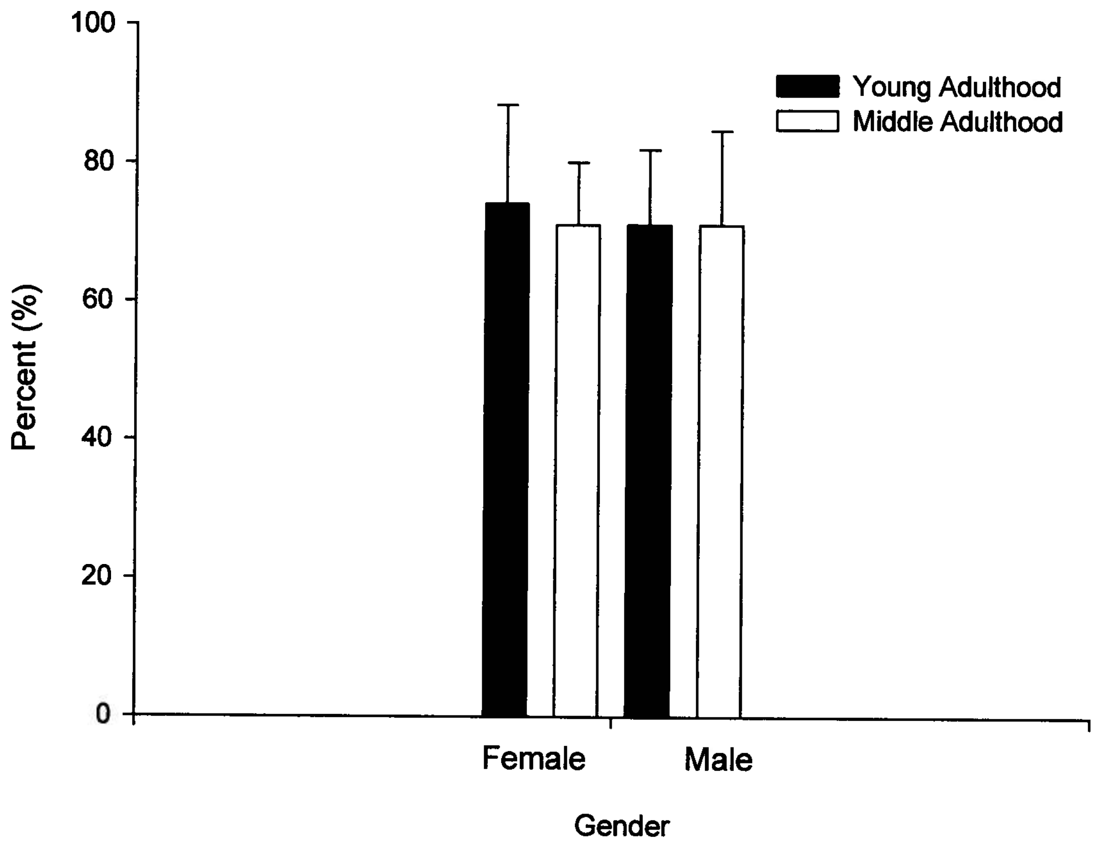
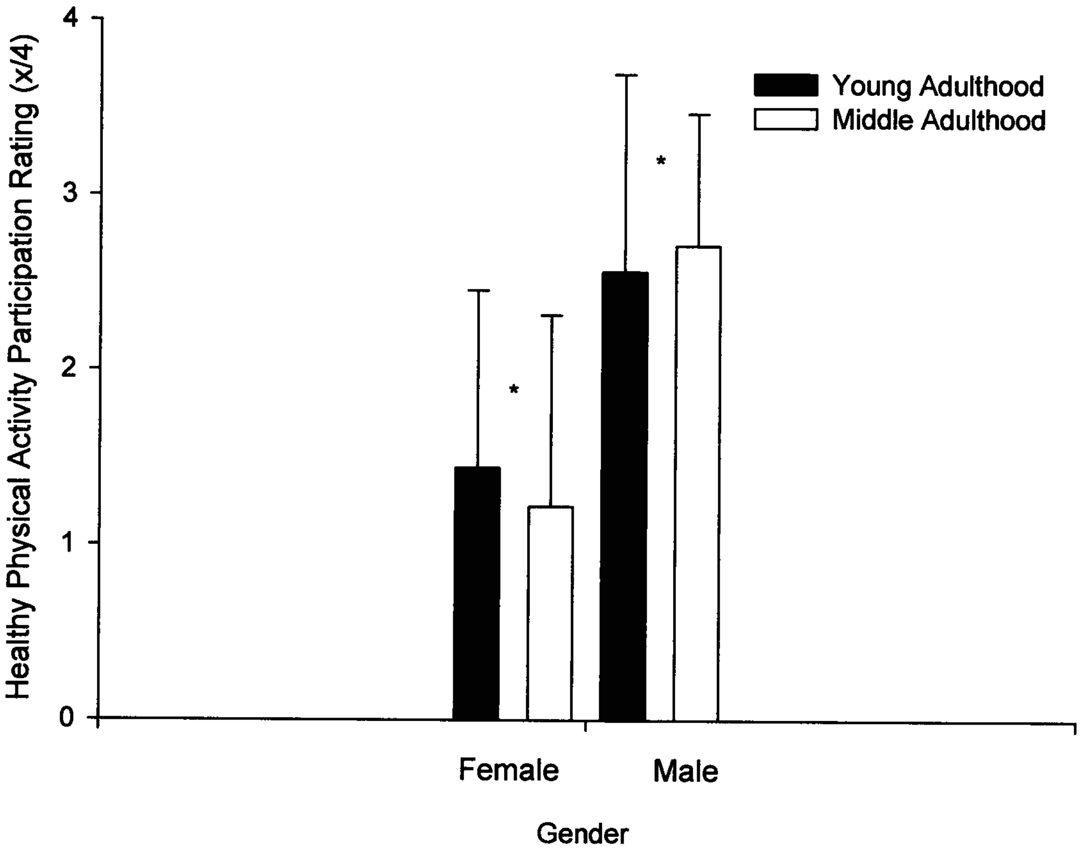
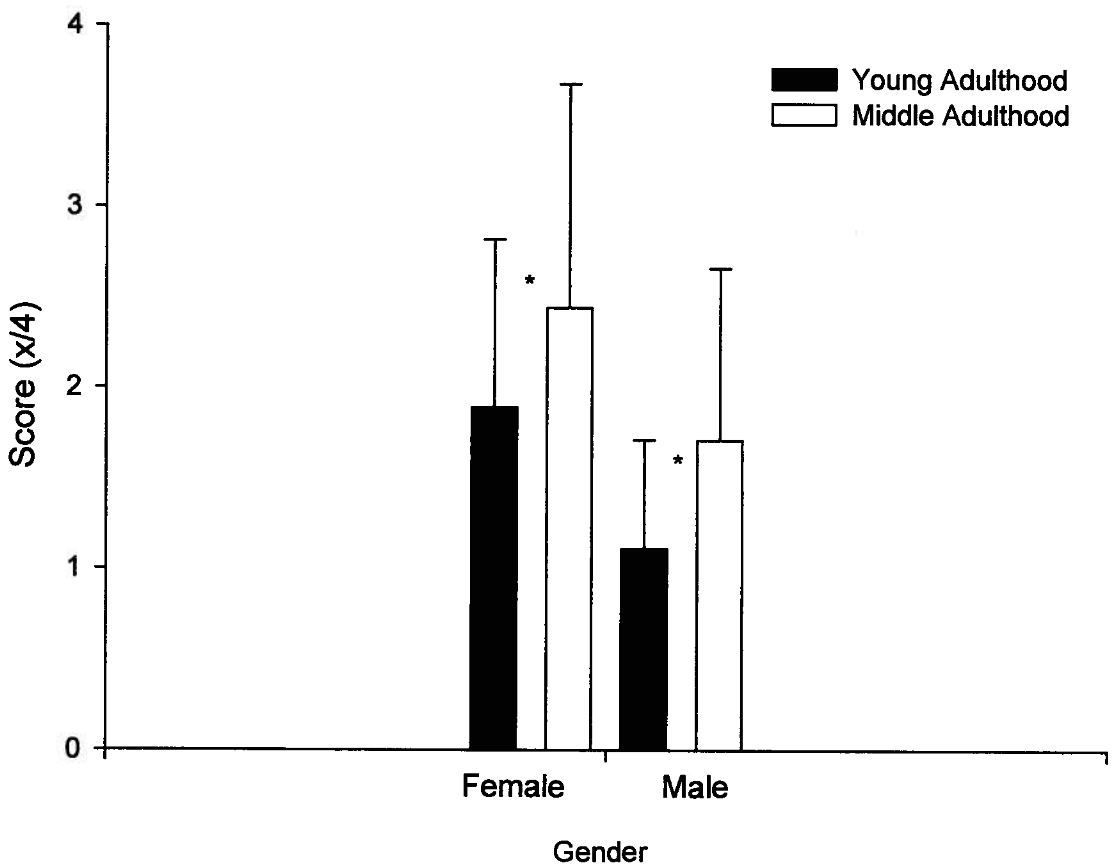


Figure 2.2. Physical Activity Participation Scores as a Function of Age and Gender



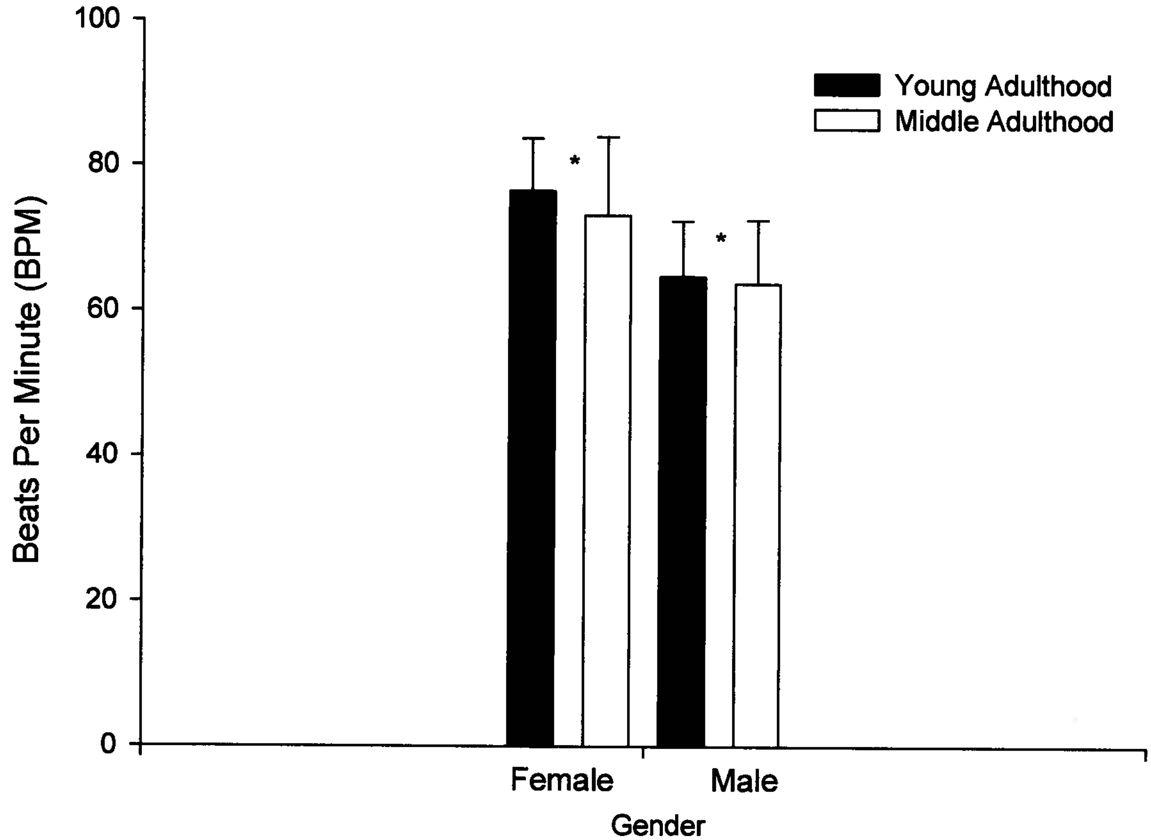
Note: * Significant Difference ($p < 0.05$).

Figure 2.3. Composite Musculoskeletal Fitness



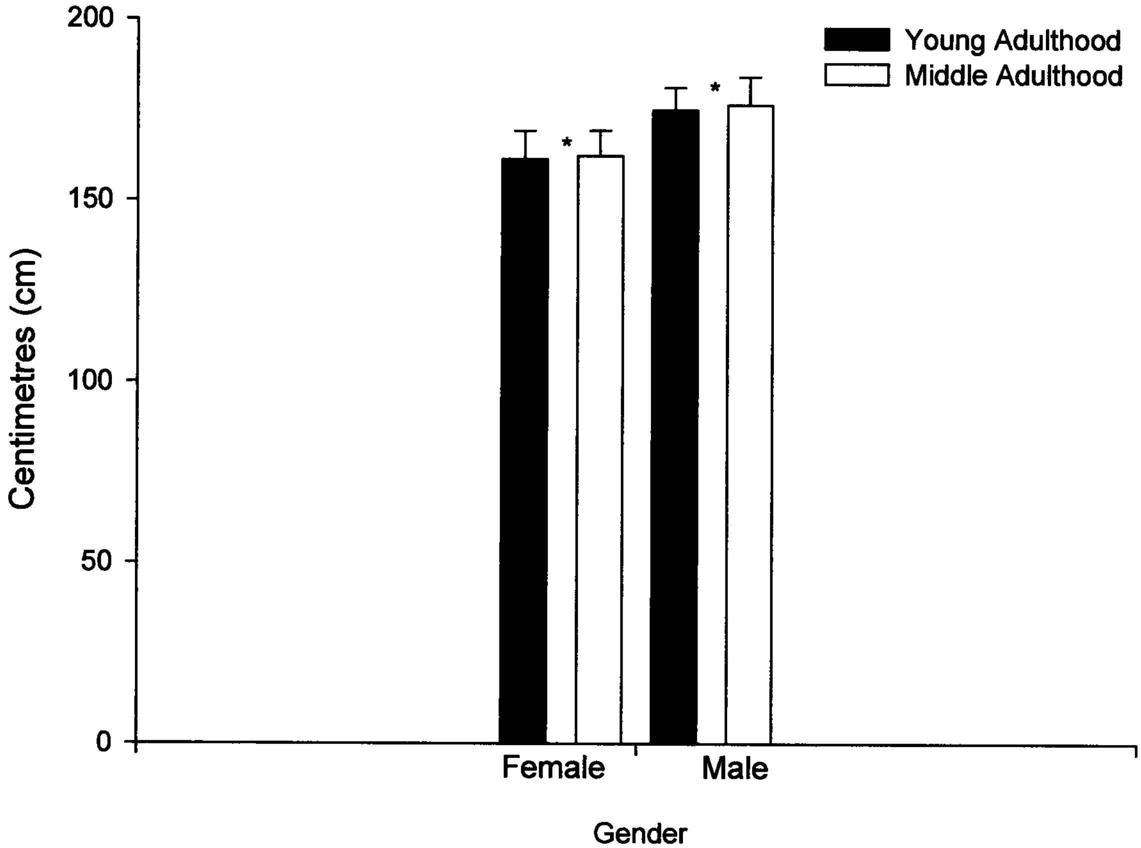
Note: * Significant Difference ($p < 0.05$).

Figure 2.4. Resting Heart Rate as a Function of Age and gender



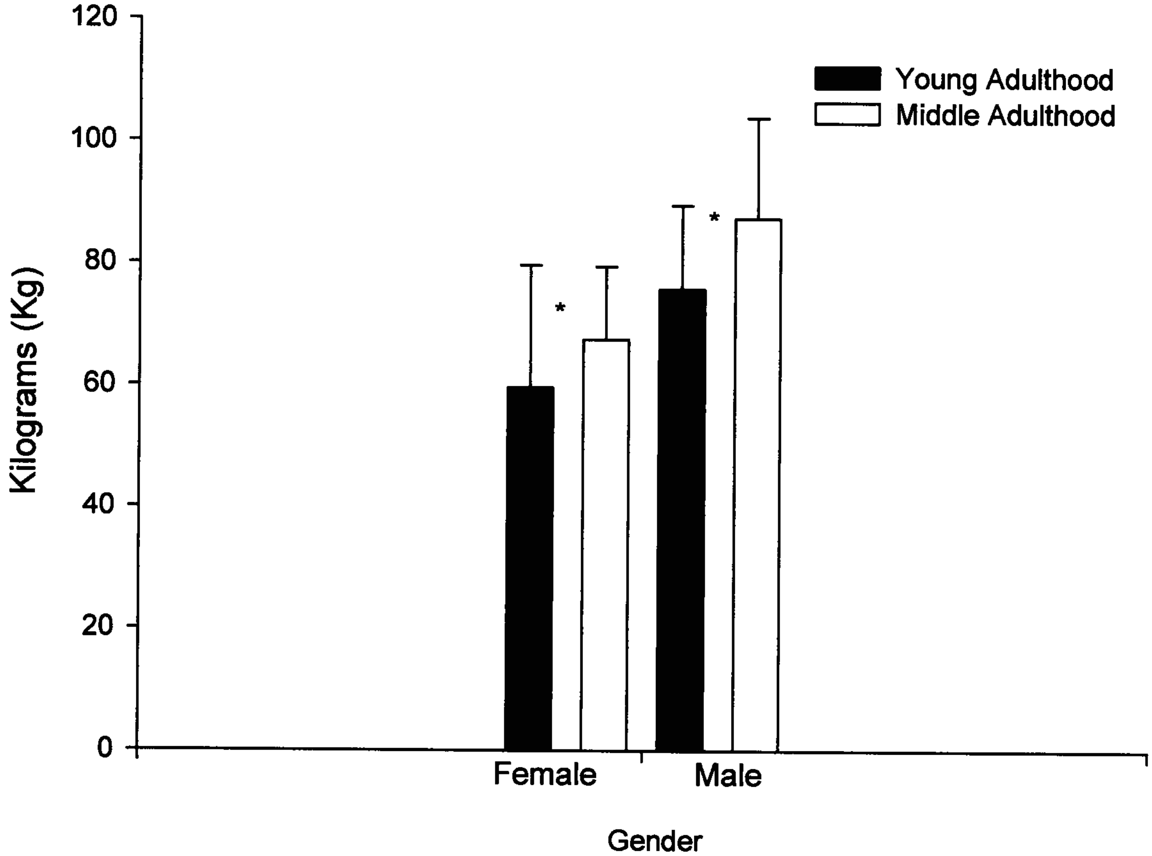
Note: * Significant Difference ($p < 0.05$).

Figure 2.5. Height as a Function of Age and Gender



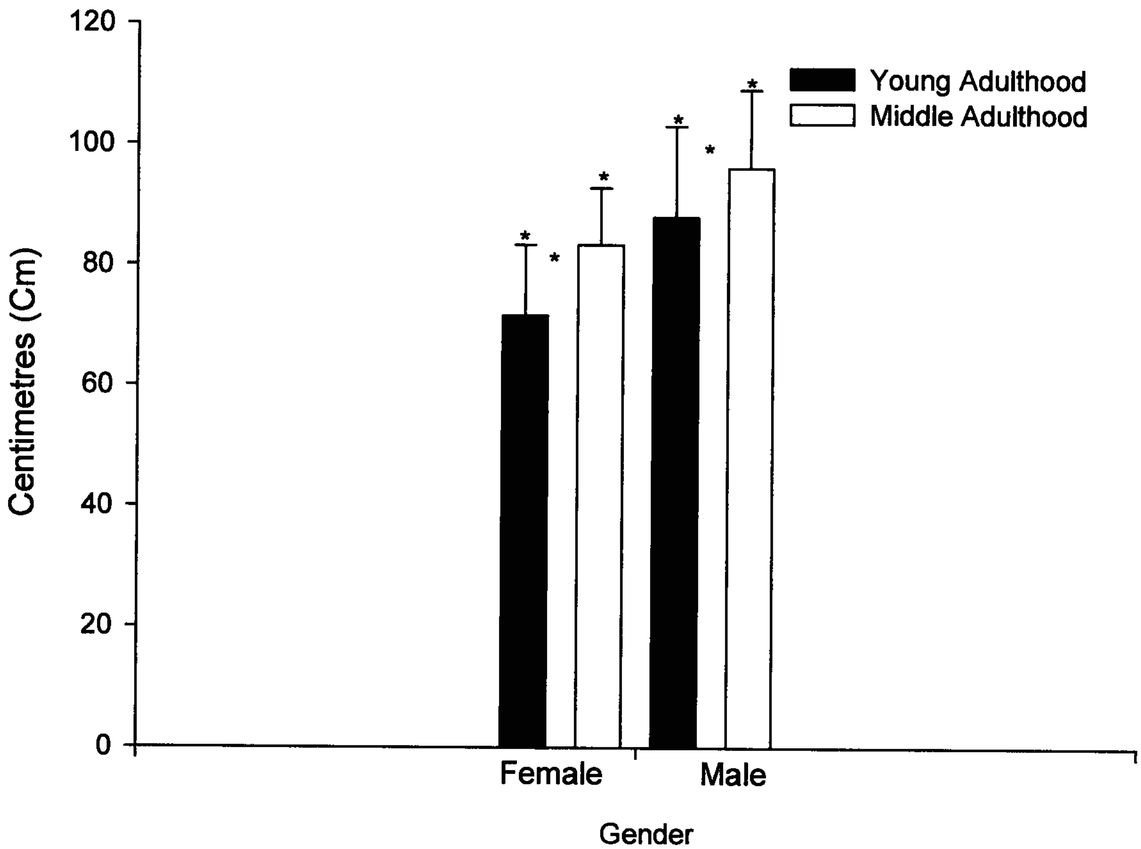
Note: * Significant Difference ($p < 0.05$).

Figure 2.6. Weight as a Function of Age and Gender



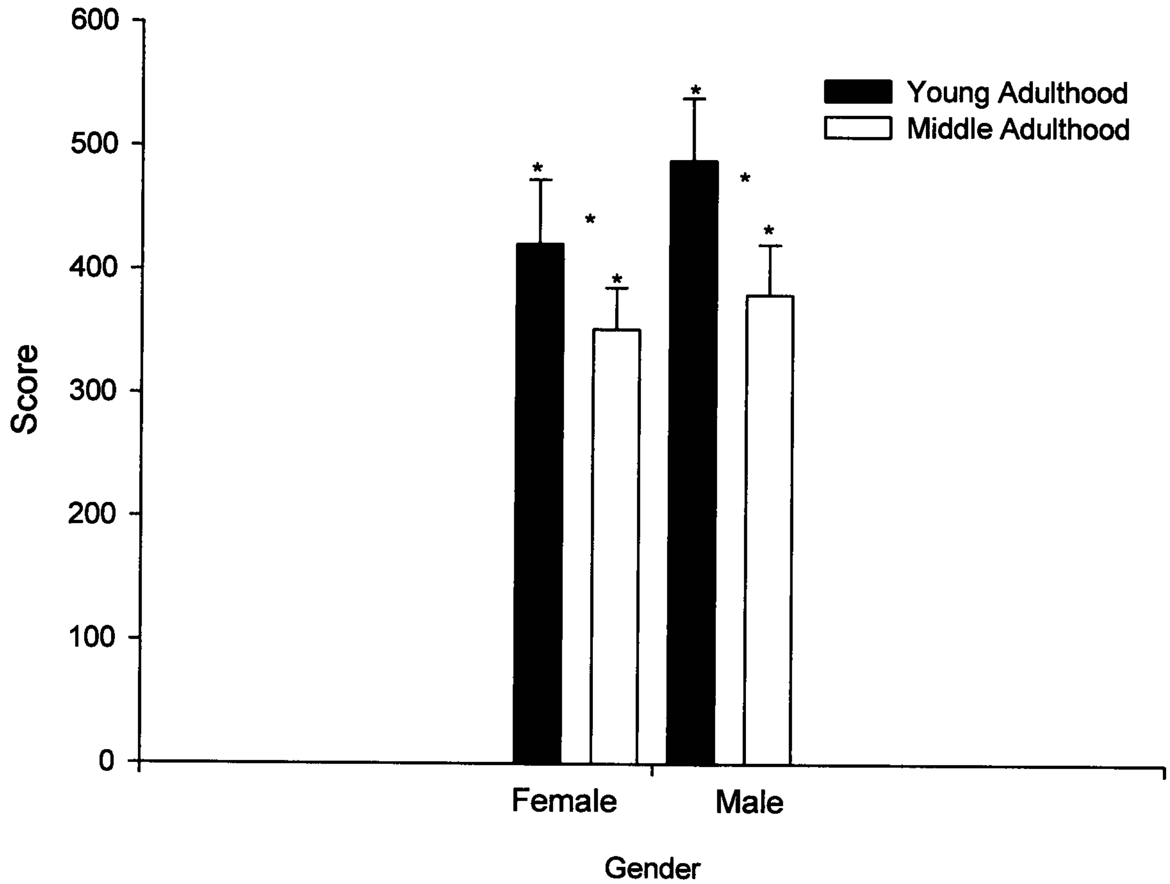
Note: * Significant Difference ($p < 0.05$).

Figure 2.7. Waist Circumference as a Function of Age and Gender



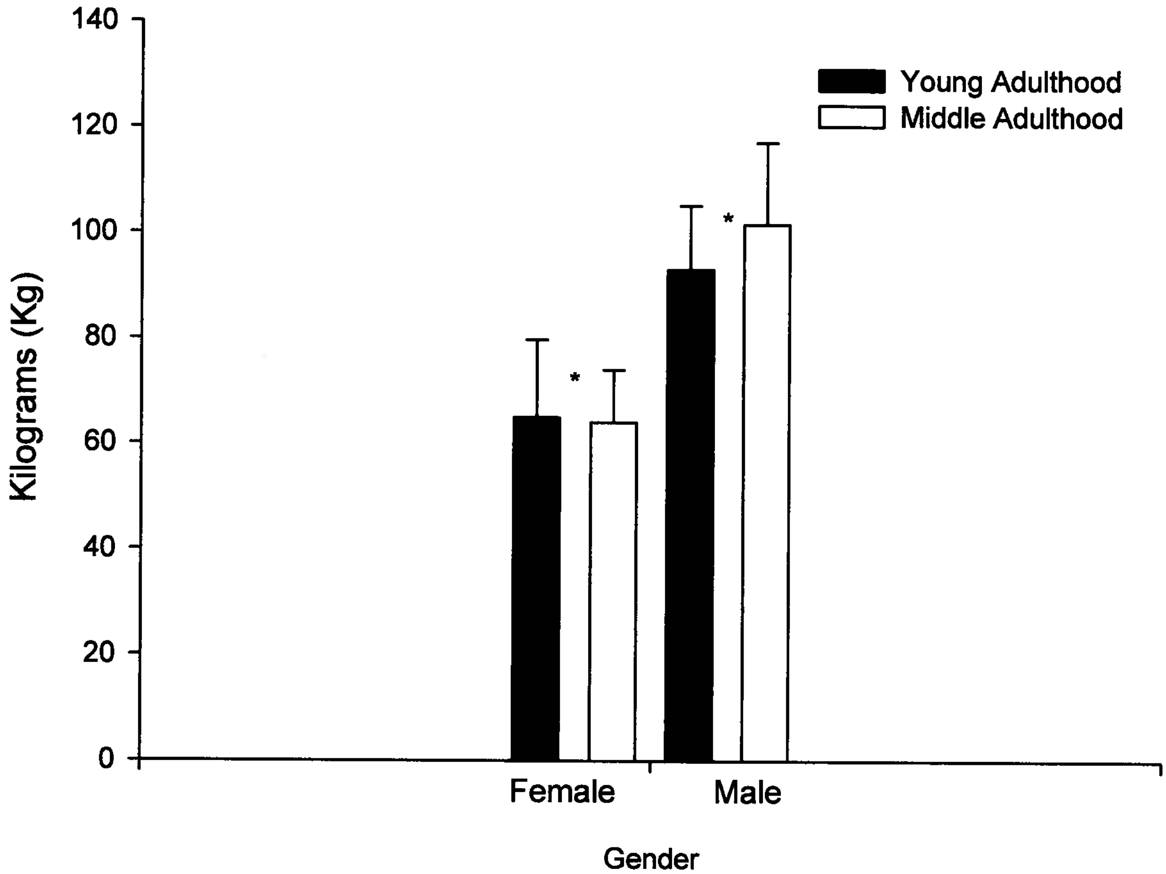
Note: * Significant Diference ($p < 0.05$).

Figure 2.8. Aerobic Fitness Raw Scores as a Function of Age and Gender



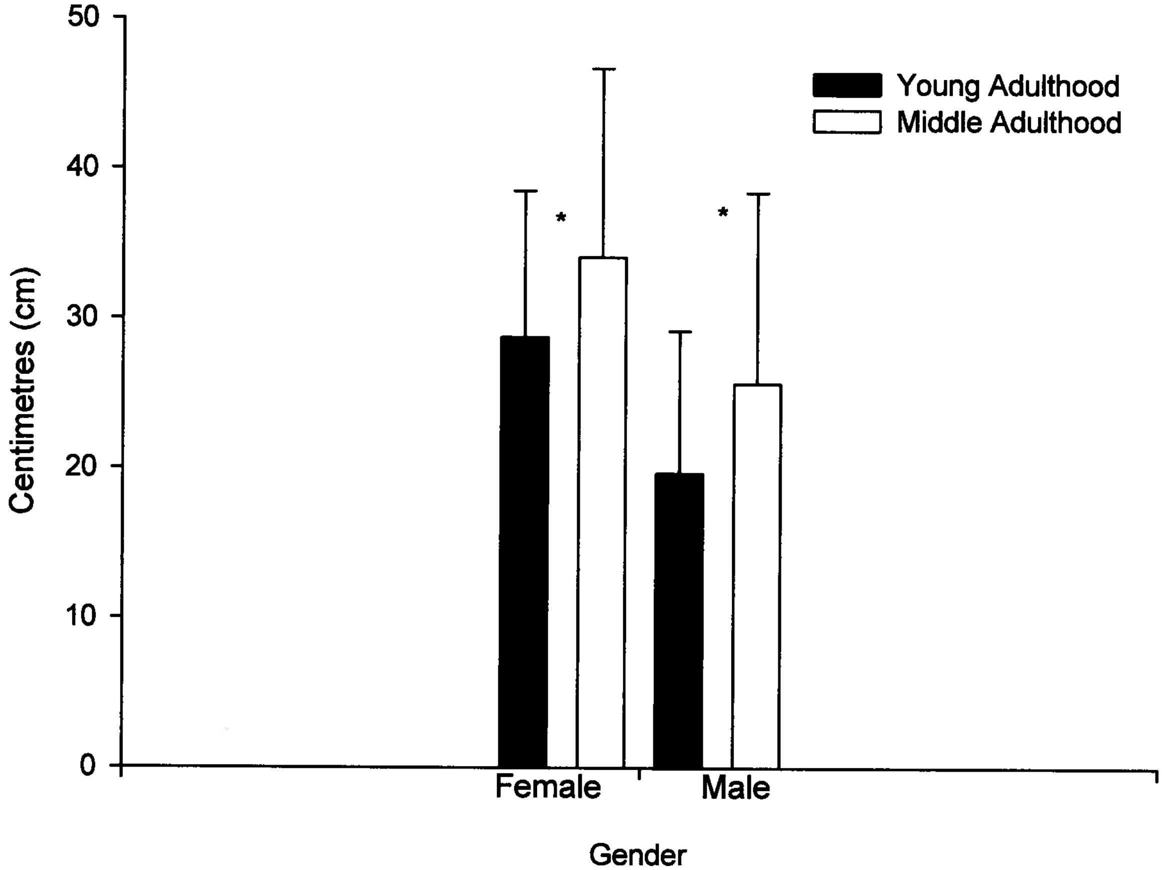
Note: * Significant Difference ($p < 0.05$).

Figure 2.9. Grip Strength as a Function of Age and Gender



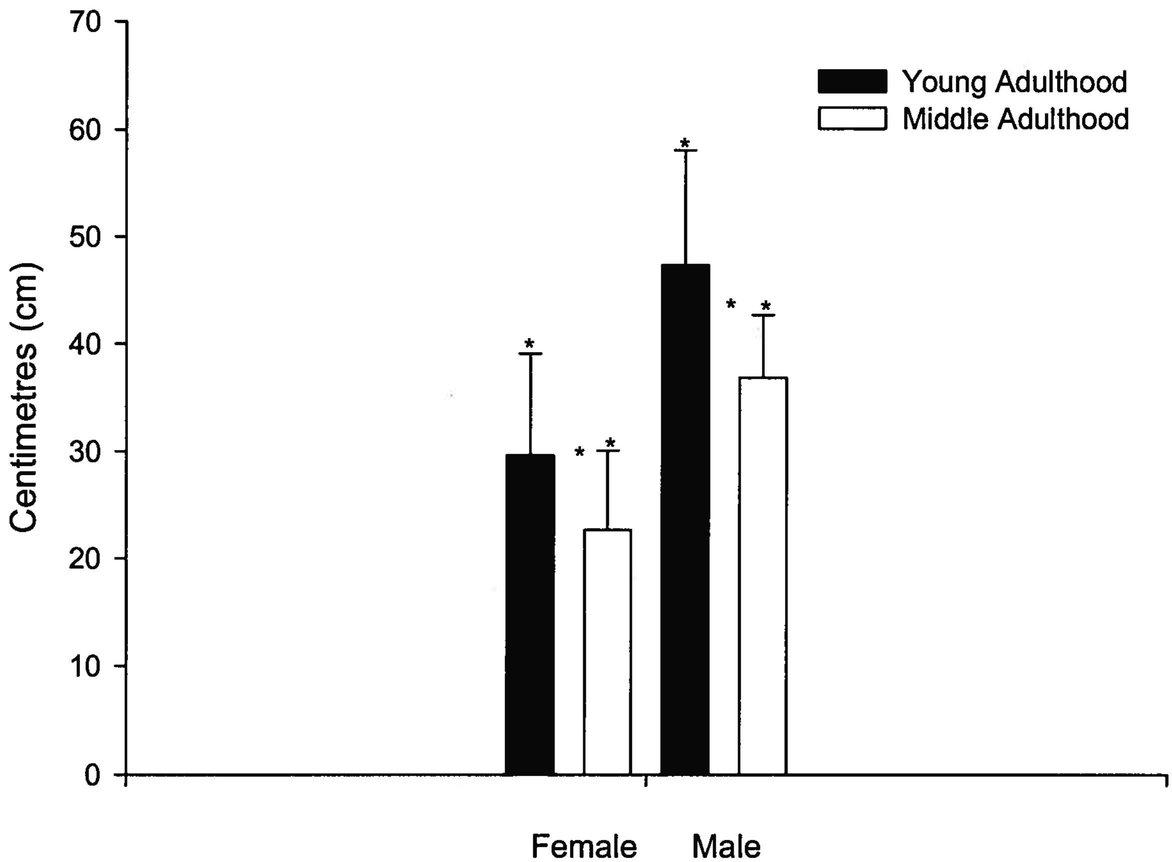
Note: * Significant Difference ($p < 0.05$).

Figure 2.10. Flexibility as a Function of Age and Gender



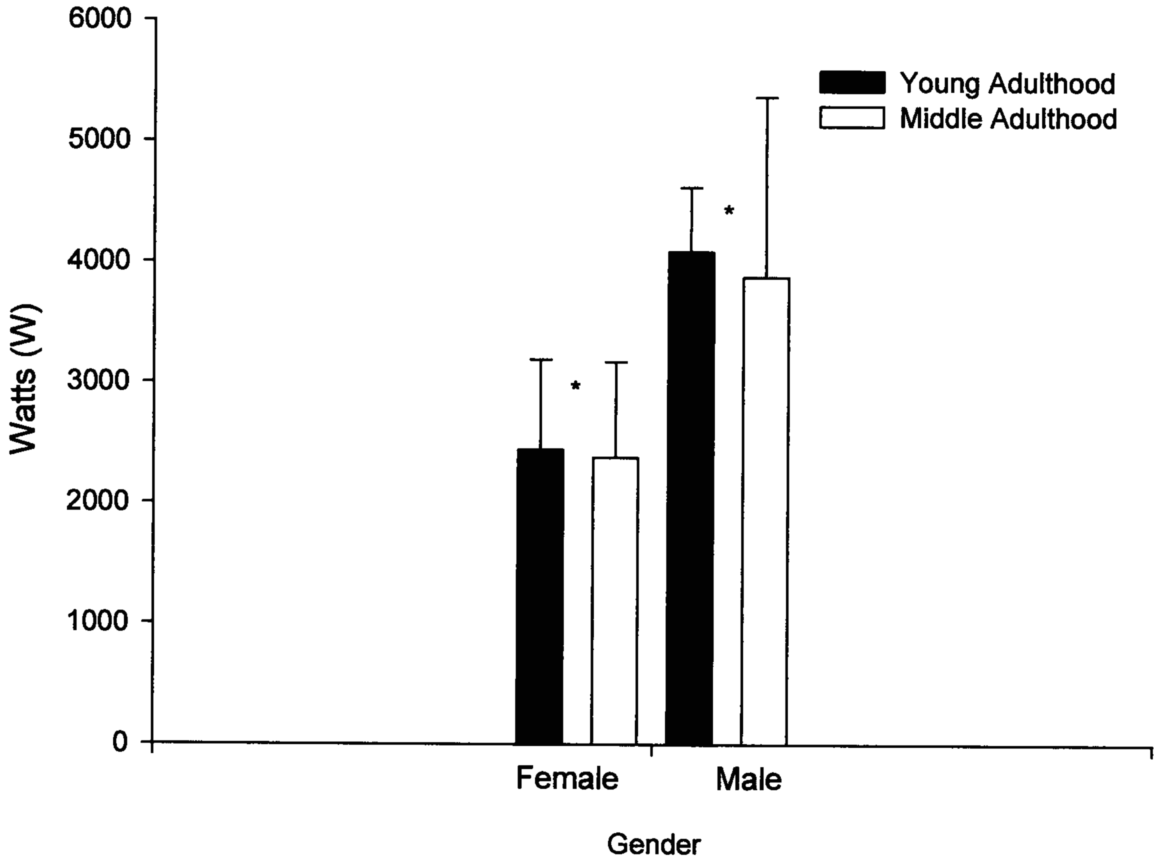
Note: * Significant Difference ($p < 0.05$).

Figure 2.11. Vertical Jump as a Function of Age and Gender



Note: Significant Difference ($p < 0.05$).

Figure 2.12. Leg Power as a Function of Age and Gender



Note: * Significant Difference ($p < 0.05$).

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CHAPTER 3

The Effects of Administering the Canadian Physical Activity Fitness & Lifestyle Approach (CPAFLA) on Health-Related Physical Fitness Knowledge as well as Beliefs, Attitudes, and Intentions towards Regular Physical Activity Participation [2]

The assessment of health-related physical fitness is of major importance (Oja, 1995). The Canadian Society for Exercise Physiology (CSEP) health-related fitness appraisal and counselling strategy, the Canadian Physical Activity, Fitness & Lifestyle Approach (CPAFLA), represents a series of systematic and standardized testing procedures designed to promote the health benefits of physical activity (CSEP, 2003). The assessment is commonly used as a measure for the health-related fitness of the general population and is administered on over a million Canadians each year by trained and certified CSEP health and fitness professionals (CSEP, 2003). When administered, the results of the appraisal allow for the evaluation of current health status in accordance to Canadian normative data. Most importantly, the appraisal process and findings provide vital health-related information to individuals. The appraisal is designed to educate, increase knowledge, and raise awareness of personal health indicators while highlighting the components of health-related physical fitness. During the appraisal, participants are provided with evidence based guidance aimed towards increasing current physical and mental wellbeing. Specifically, the goal of the appraisal and counselling session of the CPAFLA is to provide information as well as motivation

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to individuals to develop healthier lifestyles and to increase their physical activity participation (CSEP, 2003). However, previous scientific investigation has yet to examine the effectiveness of the CPAFLA. An aim of this investigation was to examine whether the CPAFLA contributes to the immediate promotion of physical activity and health-related physical fitness in young and middle adulthood.

The promotion of health-related physical activity as well as fitness are essential preventative public health measures (Suni et al., 1998), as inseparable relationship(s) exist between physical activity, physical fitness, and positive health status (Erikssen, 2001). An important development in recent years has been a change in the understanding of how much physical activity is required to derive health-related benefits (CSEP, 2003). There is now a distinction regarding physical activity as it relates to health versus fitness (American College of Sports Medicine, 1998). Previous fitness specialists recommended engaging in exercise (planned and structured physical activity) at vigorous intensities (60-84% of heart rate reserve (HRR), or 6-8 metabolic equivalents (METS)) to improve one's cardiovascular endurance. Health-related benefits of physical activity participation were only assumed if cardiovascular endurance, a performance related measure, was improved (CSEP, 2003). The dose dependent relationship between physical activity volume, health variables (e.g., blood pressure, triglycerides, lipoproteins), and fitness outcomes (e.g., VO2max) has aided in the shift from performance-based physical fitness activity guidelines and recommendations to health-related, for the general population (CSEP, 2003). Research has supported this shift by emphasizing the considerable health benefits of engaging in light to moderate intensity physical activity (Oja, 1995; Warburton et al., 2006b). Moreover, it has been stated that health benefits occur with weekly volumes of physical activity (energy expenditures) as low as 700kcal (2940kJ, light intensity activity on most days of the week), with additional benefits occurring at higher levels (American College of Sports Medicine, 1998).

There is undeniable evidence supporting regular physical activity participation (structured and unstructured) in the primary and secondary prevention of numerous chronic diseases and premature death (Warburton, Whitney, & Bredin, 2006a). Physical inactivity is a primary modifiable risk factor for cardiovascular disease and an increasing assortment of accompanying chronic hypokinetic (insufficient movement or activity) diseases, including: obesity, diabetes mellitus, cancer (breast and colon), bone and joint diseases (osteoporosis and osteoarthritis), depression and hypertension (Katzmarzyk et al., 1998; Katzmarzyk, Gledhill, & Shephard, 2000; Katzmarzyk, Perusse, Rao, & Bouchard, 2000; Warburton et al., 2006a). The most recent research estimates that 53.5% of adult Canadians are physically inactive and 14.7% are obese (Katzmarzyk & Janssen, 2004). This physical inactivity prevalence ranks higher than that of all other existing and modifiable hypokinetic disease risk factors (Warburton et al., 2006a). In 2001, 9.6 billion health care dollars were directly accredited to physical inactivity and obesity in Canada (Katzmarzyk & Janssen, 2004). This confirms that physical inactivity and obesity are chief benefactors of the Canadian public health care burden. Health promotional efforts, guided by relevant research, that function to increase physical activity and reduce obesity are essential mechanisms towards improving the health of all Canadians and significantly reducing health care expenditures (Katzmarzyk & Janssen, 2004).

Research suggests that individuals with increased health-related physical fitness knowledge are more likely to be physically active and fit (Zhu, Safrit, & Cohen, 1999).

Health-related knowledge permits individuals to acknowledge the warning signs and propagation of diseases, select and partake in suitable preventative health strategies (e.g., physical activity), and provides individuals with an understanding of where or how to obtain health assistance (Freimuth, 1990). According to Zhu et al., health-related physical fitness knowledge is a knowledge base that encompasses basic fitness concepts, which is comprised of six sub domain components including: concepts of fitness; scientific principles of exercise; components of physical fitness; effects of exercise on chronic disease risk factors; exercise prescription; as well as nutrition, injury prevention, and consumer issues (Zhu et al., 1999). Previous research has suggested a positive and significant correlation between health-related physical fitness knowledge and measures of health-related physical fitness in adulthood (See Chapter 3, Faktor, Warburton, Rhodes & Bredin, 2009). The first purpose of the present investigation was to empirically examine the influence of administering the CPAFLA health-related physical fitness appraisal and counseling strategy on health-related physical fitness knowledge in young and middle adulthood. Health-related physical fitness knowledge was assessed via the FitSmart, a standardized health-related physical fitness knowledge examination. As indicated by Zhu et al. (1999), the FitSmart is an established, valid, and reliable test to measure knowledge of the fundamental health and fitness concepts at the high school level of education. As such, the FitSmart written examination was used in this investigation to establish whether young and middle-aged adults possess the level of health-related knowledge expected at a high school level. The FitSmart has been implemented as the primary measure of health-related physical fitness knowledge in well educated adult populations (Losch & Strand, 2004; Petersen, Byrne, & Cruz, 2003b). Researchers have also utilized sections of the FitSmart as adjuncts to series of self report measures to incorporate health knowledge (Zizzi, Ayers, Watson, & Keeler, 2004). We hypothesized that participants would demonstrate improvements in the sub-domains of aerobic fitness, muscular strength and endurance, flexibility, and body composition for the assessment of health-related physical fitness knowledge in comparison to baseline measures. The administration of the CPAFLA strategically identifies these major physical fitness components and highlights their individual and aggregative impacts on health and well being. Furthermore, the CPAFLA strategy emphasizes education and counselling concerning appropriate evidence based tactics designed to augment fitness through a variety of exercises and activities. These tactics are based on the interpretation of fitness results (CSEP, 2003). As such, we hypothesized that participants will demonstrate improvements on the FitSmart examination following administration of the CPAFLA on questions specific to the health-related physical fitness component of the examination.

The Theory of Planned Behaviour elements are significant predictors (some stronger than others) towards the initiation, alteration, and or maintenance of a vast array of behaviours. Developed by Ajzen (1988, 1991) as an evolution of the Theory of Reasoned Action (Fishbein, 1967), this theory has successfully provided a greater understanding of diverse health-related behaviors such as exercising, adhering to low-fat diets, contraceptive use, illicit drug use, and numerous more (Ajzen & Fishbein, 2005). It is the most prominent conceptual model for thinking about the determinants of particular behaviours to date (Ajzen, 2007). The Theory of Planned Behaviour suggests a framework about how human action is generated. It estimates the incidence of a particular behavior given that the behavior is intentional. It is suggested that behavioral intentions are assumed to result sensibly from beliefs (behavioral, normative, and control) about performing the behavior (Ajzen & Fishbein, 2005). It is important to note that the behavioral, normative and control beliefs people possess regarding the performance of a particular behavior are influenced by a broad assortment of situational, cultural, and personal background factors. These beliefs can be accurate, inaccurate, biased, and even illogical. Nevertheless, this set of beliefs is the cognitive foundation that guides human action, which is influenced by three major factors: a positive or negative assessment of the behavior (attitude regarding the behavior), perceived societal influence to execute or not execute the behavior (social norm), and perceived ability to execute the behavior (perceived behavioral control). The amalgamation of attitude towards the behavior, subjective norm, and perception of behavioral control leads to the formation of a behavioral intention (the strongest predictor of human behavior).

Traditionally, the attitude, subjective norm, and perceived behavioral control components are measured as single concepts; however, Ajzen (2002) suggests that each concept comprises two subcomponents each of which are hypothesized to be influenced by a single general factor. This is referred to as a second order model (Rhodes & Courneya, 2003). However; Rhodes & Courneya (2003) believe that this second order model is more likely to be conceptualized as a "sub compartment" model whereby the individual theory of planned behavior subcomponents are capable of having direct effects on the general factor and any relationship between each subcomponent may arise from external common causes. Attitude is said to be composed of affective (e.g., unpleasureable/ pleasurable) and instrumental (e.g., harmful/beneficial) evaluations concerning a behavior. This two component attitude structure has been supported across various attitude measurement methodologies and conceptual modeling's (Rhodes & Courneya, 2003). Likewise, subjective norm research has indicated that the distinct components of self efficacy (e.g. ease. difficulty, confidence) and controllability (e.g., personal behavioral control and or assessment of whether or not the behavior is volitionally determined by the actor). Lastly, subjective norm is thought to include the more traditional measurement of the injunctive component (e.g., does one believe that their social network wants them to perform a specific behavior?) as well as a descriptive component (e.g. does ones social network perform a specific behavior?).

The second purpose of this investigation was to examine the influence of administering the CPAFLA health-related physical fitness appraisal and counseling strategy on the components of the Theory of Planned Behavior (i.e., attitude, subjective norm, perceived behavioural control, and intention) in relation to regular physical activity participation in young and middle adulthood. The Theory of Planned Behaviour constructs were assessed via a written survey containing a series of 7-point bipolar adjective scales concerning regular physical activity participation. The instrument used in the present investigation was developed by Rhodes and Courneya (2003) and is an established, valid and reliable method to assess the Theory of Planned Behaviour constructs. Rhodes and Courneya utilized this instrument to investigate the components of attitude, subjective norm, perceived control, and intention in clinical and healthy populations with relation to exercise. We postulated that individual beliefs, attitudes, and intentions towards participating in regular health-related physical activity would also improve in comparison to baseline measures following the administration of the CPAFLA. This hypothesis is based on the premise that the CPAFLA appraisal process is designed to increase knowledge and awareness concerning health-related physical fitness while highlighting the health benefits of physical activity in an attempt to motivate individuals to develop healthier lifestyles and increase physical activity participation (CSEP, 2003).

Methods

Participants

Written informed consent was received from 20 female and 20 male physically inactive participants. Physically inactive was defined as engaging in 20-30 minutes of vigorous or 30-60 minutes of moderate physical activity less than 3 times per week. The Godin leisure time exercise questionnaire functioned as the screening instrument (Godin & Shephard, 1985). Participants were recruited according to two age groups: (a) 19 to 29 years (young adulthood, n = 10 F, 10 M; mean age = 24.3 ± 2.5), and (b) 39 to 49 years (middle adulthood, n = 10 F, 10 M; mean age = 42.7 ± 3.9). Participants were randomly assigned to either the control group (n = 20; 10/age group) or the experimental group (n = 20; 10/age group). Individuals that maintained a regular physical activity regimen (i.e., 20-30 minutes of vigorous or 30-60 minutes of moderate physical activity at least 3 times per week during leisure time over the past month), were pregnant, were in poor health (illness or fever) at time of data collection, or were unable to provide documented physician clearance for physical activity upon being screened out in the CPAFLA pre-appraisal screening process were not permitted to participate. This investigation was executed in exact accordance with the ethical guidelines set forth by the University of British Columbia's Clinical Research Ethics Board (CREB) for research involving human participants (see Appendix B for certificate of research ethics).

Procedure

Participants took part in two data collection days with a one week interval between days. The purpose of the one week delay was to decrease the carry over effects associated with psychological, educational, and cognitive assessments (e.g., knowledge retention) (Portney & Watkins, 2000). Additionally, since physiological fatigue is a common consequence of fitness testing and fatigue is known to have detrimental effects on cognitive function (Afari & Buchwald, 2003), the day 2 (post-test) was scheduled to occur one week following the collection of baseline measures. Each of the two testing sessions consisted of: 1) an assessment of health-related physical fitness knowledge (FitSmart), and 2) an assessment of beliefs, attitudes and intentions (TPB components) towards regular health-related physical activity participation. On Day 1, participants randomly assigned to the experimental group were also administered the Canadian Physical Activity, Fitness & Lifestyle Approach health-related physical fitness assessment and counselling strategy. Recommendations and guidance pertaining to physical activity participation, body composition, aerobic fitness, musculoskeletal fitness (muscular strength, muscular power, muscular endurance, and flexibility) and back fitness were provided by a Canadian Society for Exercise Physiology-Certified Exercise Physiologist (CSEP-CEP) directly following the fitness assessment according to standardized CPAFLA protocol. The CSEP-CEP is the most advanced health and fitness practitioner certification in Canada allowing members to work with high performance athletes, the general population (across the lifespan), and varied clinical populations. A CSEP-CEP is sanctioned to perform assessments and evaluations, prescribe conditioning exercise, provide exercise supervision/monitoring, counselling, healthy lifestyle education, and outcome evaluation for "apparently healthy" individuals and/or populations with medical conditions, functional limitations or disabilities through the application of physical activity/exercise, for the purpose of improving health, function and work or sport performance (CSEP, 2007). Additionally, Health Canada physical activity and nutrition guides were provided to the participants during the appraisal and consultation session. Refer to Figure 3.1 for a schematic of the research design.

Assessment of Health-Related Physical Fitness Knowledge

The FitSmart written examination was used to assess the health-related physical fitness knowledge of each participant. Developed by Zhu, Safrit, and Cohen (1999), the FitSmart written examination consists of two equivalent examinations (Forms 1 and 2) containing 50 multiple choice items, measuring six sub-domain components: concepts of fitness; scientific principles of exercise; components of physical fitness; effects of exercise on chronic disease risk factors; exercise prescription; as well as nutrition, injury prevention, and consumer issues. The content based equivalency of the two examinations was carefully dictated by a panel of experts in the health-related physical fitness discipline (Zhu et al., 1999). All participants were required to complete both forms of the FitSmart, one for each test day based on random assignment. Concepts of fitness make up 20% of the FitSmart examination and incorporate questions pertaining to fitness definitions, and the relationship(s) between fitness, physical activity, and health. The scientific principles of exercise component also makes up 20% of the exam and includes questions relating to the acute/chronic physiological and psychological adaptations to exercise. Questions associated with cardiovascular, respiratory and pulmonary function, muscular strength and endurance, flexibility, as well as body composition are addressed in the components of physical fitness section and comprise

20% of the exam. Five percent of the exam includes questions relating to the effects of exercise on chronic disease risk factors. Exercise prescription makes up 20% of the exam and takes into account the concepts of frequency, intensity, duration, mode, self-evaluation, and exercise adherence. Last, 15% of the FitSmart examination consists of items pertaining to nutrition, injury prevention and consumer issues. Participants were allocated 45 minutes to complete the examination. Raw scores out of 50, overall percentages, and categorical percentage scores for each fitness component were generated via the FitSmart software for data analysis.

Assessment of the Theory of Planned Behavior Components Concerning Regular Physical Activity

We modified the instrument developed by Rhodes and Courneya (2003) by replacing the word and definition of "exercise" with "physical activity" and its corresponding definition to reflect the aims of the present investigation. Regular health-related physical activity was defined as leisure-time activity performed at least 3 times per week for at least 20-30 minutes in duration at a vigorous intensity (e.g., hard breathing, heart beats rapidly, heavy sweating); or leisure-time activity performed at least 3 times per week for at least 30-60 minutes in duration at a light-moderate intensity (e.g., increased breathing, faster than normal heart beat, light sweating, can keep a conversation going). Participants were provided with common examples of activities corresponding to these definitions of regular physical activity and were asked to use these definitions and examples when answering all physical activity related questions. The same assessment was provided to both experimental and control participants during both (pre, post) testing sessions.

Attitudes towards regular physical activity participation: Seven-point bipolar adjective scales were used to assess regular physical activity participation attitudes. Two components of attitude were assessed, instrumental and affective attitude, via three items each. The three items used to investigate instrumental attitude were: beneficial-harmful, useful-useless, and important-unimportant. The three items used to assess the concept of affective attitude were: enjoyable-unenjoyable, fun-boring, pleasurable-painful. The stem preceding these bipolar adjectives was: 'for me, participating in regular physical activity over the next month would be…'. Participants received a score out of 21 for each attitude component with increased scores indicative of favourable attitudes towards participation in regular health-related physical activity.

Subjective Norm: Two components of subjective norm were assessed, injunctive and descriptive norm, via the use of 7-point bipolar adjective scales. Three items were used for each component of subjective norm. For injunctive norm, the following preceding stem was utilized: 'I think that if I were to participate in regular physical activity over the next month, most people who are important to me would be…'. This stem was followed by the following adjective pairs: approving-disapproving, supportive-unsupportive, encouraging-discouraging. For the concept of descriptive norm, participants were asked to rate, on 7-point bipolar adjective scales, how active important people in their lives were likely to be over the next month. The following three question stems were used: (1) 'I think that over the next month, most people who are important to me will be…', (2) 'I think that over the next month, most people who are important to me will participate in regular physical activity…', and (3) 'I think that over the next month, the regular physical activity participation levels of most people who are important to me will be…'. These stems were followed by the following pairs of adjectives in their respective order: extremely active-extremely inactive, extremely agree-extremely disagree, and extremely high-extremely low. Participants received a score out of 21 for each subjective norm component with increased scores suggestive of favourable subjective norms towards participation in regular health-related physical activity.

Perceived Behavioural Control: The concept of perceived behavioural control was measured by six items, each of which consisted of a stem and a 7-point bipolar adjective scale. The following six question stems were used: (1) 'If you were really motivated, how controllable would it be for you to participate in regular physical activity over the next month?', (2) 'If you were really motivated, how easy or difficult would it be for you to participate in regular physical activity over the next month?', (3) 'If you were really motivated, do you feel that whether or not you participate in regular physical activity over the next month would be completely up to you?', (4) 'If you were really motivated, how confident are you that you could participate in regular physical activity over the next month?', (5) 'If you were really motivated, do you feel you would have complete control over whether or not you were physically active over the next month?', and (6) If you were really motivated, how certain or uncertain would you be that you could participate in regular physical activity over the next month?'. These stems were followed by the following pairs of adjectives in their respective order: extremely controllable-extremely uncontrollable, extremely easy-extremely difficult, extremely agree-extremely disagree, extremely confident-extremely unconfident, extremely true-extremely untrue, and extremely certain-extremely uncertain. Participants received a score out of 42 for perceived behavioural control, with increased scores indicative of higher levels of perceived control towards participation in regular health-related physical activity.

Intention: Intention to participate in regular physical activity was measured with five items; three question stems followed by 7-point bipolar adjective scales, and 2 open ended questions. The three question stems were as follows: (1) 'How motivated are you to participate in regular physical activity over the next month?' (2) 'I strongly intend to do everything I can to participate in regular physical activity over the next month…', and (3) 'How committed are you to participating in regular physical activity over the next month?'. The corresponding bipolar adjectives were: extremely motivated-extremely unmotivated, extremely true-extremely untrue, and extremely committed-extremely uncommitted. Participants received a score of out of 21 for the first three questions concerning intention to participate in regular physical activity with higher scores suggestive of increased intention to partake in physical activity over the next month. The two open ended questions asked the participants to stipulate the number of days per week (0-7) as well as minutes per session (0-60) that they intended to participate in; (1) vigorous intensity physical activity, and (2) light-moderate intensity physical activity over the next month.

CPAFLA Assessment

The CPAFLA appraisal included pre-appraisal screening and objective measures of physical activity participation, metabolic fitness, body composition, aerobic fitness, musculoskeletal fitness, and back fitness. The CPAFLA appraisal was conducted using the exact procedures as described in Chapter 2, with the inclusion of an individually tailored physical activity participation counselling session that focused on the results of the CAPAFLA assessment. The counselling session functioned to : (1) educate participants regarding the health-related importance of each and every component within the CPAFLA and the health benefits associated with physical activity participation, (2) provide participants with Canadian standardized health-related interpretations of their personal fitness results, and (3) set specific measurable attainable realistic and time oriented (SMART) health-related goals based on individual measurements with reference to: (i) Canadian normative fitness data, (ii) Canada's physical activity guide, (iii) Canada's food guide, and (iv) personal issues (e.g., income, activity preference) and personal daily/weekly schedules. The administration of the CPAFLA assessment and counselling session took an average of 1.75 hours to complete.

Statistical Analysis

Statistical significance was set *a priori* at $p < 0.05$ for all analyses. All figures and tabular values are reported as the mean ± standard deviations (SD). Each variable was tested for normal distribution (i.e., skewness or kurtosis) and was transformed if necessary. A multivariate repeated measure analysis (mixed between-within subjects ANOVA) was employed to look at the individual and aggregative effects of time (pre-test, post-test), treatment group (control, experimental), gender (female, male), and age (young adulthood, middle adulthood) on each dependant variable. To answer the hypotheses of this investigation, the interaction effect of time by group was utilized as the primary indicator of the CPAFLA assessment's effect(s) on the dependant variables of interest. Health-related physical fitness knowledge (overall and sub domain component) percentage scores (x/100) were used as the primary indicators of health knowledge. The theory of planned behaviour component scores/responses (instrumental attitude (x/21), affective attitude (x/21), injunctive norm (x/21), descriptive norm (x/21), perceived behavioural control (x/42) and intention (x/21, days per week and minutes per session)) were used as the main indicators of beliefs, attitudes and intentions towards participation in regular physical activity.

Results

Participants

All participants resided in Vancouver, British Columbia or the Greater Vancouver Region. The control group consisted of 20 participants: 10 young adulthood (5F, 5M; mean age = 24.2 ± 2.1) and 10 middle adulthood (5F, 5M; mean age = 43.4 ± 3.9). The experimental group was also comprised of 20 participants: 10 young adulthood (5F, 5M; mean age = 24.3 ± 2.9) and 10 middle adulthood (5F, 5M; mean age = 42 ± 3.9). Table 3.1 lists physical activity participation as a function of intensity (vigorous, moderate, and light), duration (times/week, and minutes per session), age (young, middle adulthood), gender (male, female), and treatment group (control, experimental). Half the participants (50.0%) were Caucasian, 22.5% were Asian, 12.5% were East Indian, 10.0% were Mid Eastern, 2.5% were Pilipino, and 2.5% were Aboriginal Canadian. Most participants (80.0%) were currently enrolled in or had completed post secondary education (12.5% college diploma, 47.5% undergraduate degree, 20% graduate degree). The remaining one fifth (20.0%) of the participants were currently enrolled in or had completed a secondary level of school education. For income: 67.5% grossed ≤ $ 39000/year (37.5% ≤ $ 20000; 30.0% = $ 20-39000), and 27.5% grossed ≥ $ 40000/year (10% = $ 40-59,000, 15% = 60-79000, 2.5% = $ 80-90000). The remaining 5.0% did not disclose their income. During the CPAFLA, two male experimental participants (1 young adult, 1 middle-aged adult) were screened out from performing the back extension measurement during the standardized back extension pre-screening assessment.

Health-Related Physical Fitness Knowledge

The means and standard deviations for the FitSmart health-related physical fitness knowledge, overall and component, scores are presented in Table 3.2 as a function of time and treatment group. There was a statistically significant interaction effect for time and group for the Components of Physical Fitness section of the FitSmart [Wilks Lambda = 0.82, $F(1, 32) = 6.9$, $p = 0.013$]. The average score for the control group declined over time while the mean score for the experimental group increased (Figure 3.2). The time by group interaction effects for overall FitSmart score [Wilks Lambda = 0.91, $F(1, 32) = 3.14$, $p = 0.086$], Concepts of Fitness [Wilks Lambda = 0.91, $F(1, 32) = 3.11$, $p = 0.088$], Scientific Principals of Exercise [Wilks Lambda = 0.974, $F(1, 32) = 0.866$, $p = 0.359$], Effects of Exercise on Chronic Disease Risk Factors [Wilks Lambda = 0.931, $F(1, 32) = 2.38$, $p = 0.133$], Exercise Prescription [Wilks Lambda = 0.999, $F(1, 32) = 0.023$, $p = 0.88$], as well as Nutrition Injury Prevention and Consumer Issues [Wilks Lambda = 0.998, $F(1, 32) = 0.074$, $p = 0.787$] did not reach statistical significance. Significant interaction effects for time by group by gender were found for: Concepts of Fitness [Wilks Lambda = .774, $F(1, 32) = 9.36$, $p = 0.004$] and Nutrition Injury Prevention and Consumer Issues [Wilks Lambda = 0.856, $F(1, 32) = 5.37$, $p = 0.027$]. A significant interaction effect was also shown for time by group by age for the Effects of Exercise on Chronic Disease Risk Factors [Wilks Lambda = 0.84, $F(1, 32) = 6.11$, $p = 0.019$].

Components of the Theory of Planned Behavior

The means and standard deviations for the Theory of Planned Behavior Component scores are listed in Table 3.3 with respect to time and treatment group. There was a statistically significant interaction effect of time and group for instrumental attitude [Wilks Lambda = 0.984, $F(1, 32) = 8.36$, $p = 0.007$], perceived behavioral control [Wilks Lambda = 0.861, $F(1, 32) = 5.18$, $p = 0.030$], intention [Wilks Lambda = 0.667, $F(1, 32) = 15.96$, $p = 0.00$], and number of minutes intended to participate in vigorous intensity physical activity per session [Wilks Lambda = 0.790, $F(1, 32) = 8.51$, $p = 0.006$]. Instrumental attitude declined over time in the control group while increasing in the experimental group following the CPAFLA (Figure 3.3). Perceived behavioral control declined over time in the control group and increased in the experimental group (Figure 3.4). Intention to participate in regular health-related physical activity declined in the control group and increased in the experimental group over time (Figure 3.5). Likewise, experimental participants intended to participate in more minutes of vigorous health-related physical activity following the CPAFLA while control participants showed decrements in the number of minutes indented to participate vigorous physical activity per session (Figure 3.6). These results support our hypothesis and suggest that individuals possess more favorable beliefs, have more perceived control, and have more intention towards participation in regular health-related physical activity after the administration of the CPAFLA health related physical fitness assessment and counseling strategy. The time by group interaction effects for affective attitude [Wilks Lambda = 0.99, $F(1, 32) = 0.321$, $p = 0.575$], injunctive norm [Wilks Lambda = 0.974, $F(1, 32) = 0.87$, $p = 0.358$], descriptive norm [Wilks Lambda = 0.943, $F(1, 32) = 1.921$, $p = 0.175$], number of days intended to participate in vigorous physical activity [Wilks

Lambda = 0.902, F (1, 32) = 3.49, p = 0.071], and number of days [Wilks Lambda = 0.942, F (1, 32) = 1.98, p = 0.169] as well as minutes [Wilks Lambda = 0.992, F (1, 32) = .255, p = 0.617] intended to participate in light to moderate physical activity did not reach statistical significance. Significant interaction effects were found for time by age for number of minutes intended to participate in light-moderate health-related physical activity per session [Wilks Lambda = 0.866, F (1, 32) = 4.95, p = 0.033], with the young adult cohort showing increases in minutes and the middle adulthood cohort showing decreases in minutes over time. Significant interaction effects were found for time by group by age by gender for injunctive norm [Wilks Lambda = 0.865, F (1, 32) = 5.0, p = 0.032], and intention [Wilks Lambda = 0.809, F (1, 32) = 7.55, p = 0.01].

Discussion

To the best of our knowledge, this is the first investigation to empirically examine the effects of administering the Canadian Physical Activity, Fitness and Lifestyle Approach health-related physical fitness assessment and counselling strategy on health knowledge, as well as the Theory of Planned Behaviour components concerning regular physical activity participation. A significant time by group interaction effect was found for both hypotheses. For health knowledge, our results showed improvements in knowledge specific to the components of physical fitness following administration of the CPAFLA assessment and counselling strategy. In contrast, participants who did not receive the CPAFLA assessment and counselling session displayed lower scores on the Components of Physical Fitness questions. In addition, individual beliefs, attitudes, and intentions towards participating in regular health-related physical activity improved in comparison to baseline measures following the administration of the CPAFLA.

Specifically, these effects were demonstrated via increases in measures of instrumental attitude, perceived behavioural control, and intention.

The significance of this investigation adds to the documented importance regarding the objective measurement of health-related physical fitness. Researchers, especially in the public health domain, value the data that is generated from the assessment of health-related physical fitness. These data substantially contribute to the epidemiological knowledge health scientists utilize to evaluate populations in terms of health status, disease risks, and functional capacities (Malmberg et al., 2002; Oja, 1995). In addition, the accurate quantification of health-related physical fitness measures is essential when evaluating the effectiveness of interventions designed to augment physical fitness (Vanhees et al., 2005). Furthermore, the evaluation and application of the data provided by standardized health-related fitness measures provides useful informatics which are vital towards the design and implementation of population based health promotion and preventative care initiatives and interventions (Suni et al., 1998; Shephard, 1986). The current investigation supports previous research; however, it uniquely contributes by analyzing the immediate benefit(s) participants receive from taking part in standardized fitness assessment and counseling procedures. Our results suggest that after participating in the CPAFLA (a holistic assessment of health-related physical fitness) individuals demonstrate greater inclination towards for integrating physical activity and healthy lifestyle behaviors into their daily schedules. These findings promote the usefulness of professional fitness assessments.

Health Knowledge

Health depends on our understanding of its determinants, and the application of this knowledge in the prevention and treatment of disease (Pakenham-Walsh & Priestley, 2002). In accordance, health knowledge enables individuals to identify the symptoms and communicability of diseases, allows individuals to select and participate in appropriate preventative health strategies (e.g., resistance training), and gives individuals an understanding of where and how to obtain health assistance (Freimuth, 1990). Moreover, fitness knowledge (a component of health knowledge) is understood to influence the health and exercise behaviors of individuals (Zhu et al., 1999). Research suggests that individuals who have increased fitness knowledge via health education are more likely to be active and fit (Petersen, Byrne, & Cruz, 2003). Our results suggest that the administration of the CPAFLA assisted individuals in understanding the components of an essential determinant of health (i.e., physical fitness). These components include knowledge pertaining to the health-related importance and functionality of: the cardiovascular system; the respiratory and pulmonary systems; musculoskeletal strength, endurance, power, and flexibility; as well as body composition (Zhu et al., 1999). These results are in line with the CPAFLA objectives, as the administration of the holistic assessment by a knowledgeable health and fitness professional incorporates the evaluation of each major physical fitness component and provides participants with substantial amounts of valuable information pertaining to the importance and function of each element in a reasonable timeframe. Moreover, even though there is a lot of information being provided to participants, this information is being presented, acquired, and stored as a result of an experiential learning process. Research has suggested that knowledge acquisition and retention is superiorly accomplished via experiential education versus the traditional methods of knowledge translation (Lewis & Williams, 1994). Even if other methods have been identified as significant contributors towards health-related knowledge, for example: single lectures (Andrade et al., 1999), physical education courses (Adams, Higgins, Adams, & Graves, 2004; Nahas, 1992), and media campaigns (Marcus, Owen, Forsyth, Cavill, & Fridinger, 1998); the experience of participating in a fitness assessment and counselling session is unique and therefore, not easily forgotten. Fitness professionals, health care providers, and health promotion agencies should aim to create unique learning experiences like the CPAFLA that allow individuals to holistically engage in the subject matter at hand in an attempt to foster greater knowledge acquisition and retention. In addition, further research that functions to examine the long-term retention and transfer of health knowledge and this interventional approach is warranted.

Theory of Planned Behaviour Components

The Theory of Planned Behavior offers a valuable framework to investigate beliefs, attitudes and intentions towards the participation in regular health-related physical activity (Tsorbatzoudis, 2005). The theory suggests that the most immediate and significant determinant of volitional behavior is an individual's intention to participate in the behavior (Ajzen, 1991). The motivational factors that stimulate a behavior are assumed to be wrapped up in an individual's intentions (Ajzen, 1991). These intentions are indices of how hard someone is willing to try, or how much effort one is willing to put forth towards the performing a particular behavior (Ajzen, 1991). Intentions are assumed to result logically from behavioral, normative, and control beliefs concerning a particular behavior (Ajzen & Fishbein, 2005). This multidimensional belief set, which leads to the formation of behavioral intentions, is influenced by attitudes (positive or negative assessment of the behavior), social norms (perceived societal standards relating to the behavior) and perceived behavioral control (perceived ability to execute the behavior) each of which can be divided into the respective sub components (Ajzen, 2002) (i.e. instrumental/affective attitude, injunctive/descriptive norm, self efficacy/controllability). Our results indicate that after the administration of the CPAFLA fitness assessment and counseling session participants were more inclined to participate in regular physical activity. This was indicated by increases in instrumental attitude, perceived behavioral control, and intention concerning regular physical activity participation. These results provide the first empirical data that supports one of the primary objectives the CPAFLA (physical activity promotion) (CSEP, 2003). Previous investigations have successfully increased the Theory of Planned Behavior components relating to physical activity participation (Tsorbatzoudis, 2005); however, this is, to the best of our knowledge, the first Canadian investigation to examine the changes in these components as a result of participating in a standardized health-related physical fitness assessment such as the CPAFLA. In addition, these findings provide evidence refuting the second order model proposed by Ajzen (2002) whereby the components (e.g. instrumental and or affective attitude) of each theory of planed behavior construct are hypothesized to be caused from a common general factor (e.g. overall attitude). This evidence is substantiated by the individual and significant change found for instrumental vs. affective attitude as a result of participation in the CPAFLA intervention. Specific to our results, it makes conceptual sense that the CPAFLA was able to target instrumental vs. affective attitude. This distinctively shows that the CPAFLA intervention was successful in formulating belief systems concerning the health benefits associated with regular physical activity participation as the assessment of instrumental attitude encompassed beliefs and attitudes concerning the benefits and harms associated with physical activity. More importantly, these findings support the subcomponent conceptualization by Rhodes & Courneya (2003). This model assumes that the Theory of Planed behavior subcomponents (e.g. injunctive and or descriptive norm) have direct effects upon the general concept (e.g. subjective norm) and relationships between subcomponents may arise from exogenous common causes (e.g. past experience, personality, belief systems) versus a second order concept. This subcomponent modeling makes greater conceptual sense as traits such as attitude and perceived behavioral control are more dynamic and changeable social cognitive concepts (Rhodes & Courneya, 2003).

The measurement of responses outlining or promoting a particular behavior (e.g., physical activity participation) has the ability to facilitate behavior change. This is commonly referred to as 'the mere measurement effect' (Morwitz, Johnson, & Schmittlein, 1993). Theoretically, actions that increase an individual's commitment to a behavior generally have a strong effect on the behavior. These 'mere measurement effects' occur because an individual's responses to questions outlining a specific behavior have the capacity to generate 'psychological commitment' toward the behavior. For example; interventions that provide opportunities to express personal views (e.g., survey completion) could aid in increasing motivation and the initiation of behavior change (Maio et al., 2007). The trends within our data suggest that mere measurement effects were not present. Even though formal statistical procedures were not performed to rule out these effects, the documented declines in the control group for instrumental attitude, perceived behavioral control, as well as intention during the post test were enough evidence to support this notion.

Conclusion

Given that the CPAFLA has been acknowledged as the most widely used standardized health-related fitness appraisal throughout Canada (Katzmarzyk, 2002), is accepted as Canada's primary health-related physical assessment tool (Warburton et al., 2006b), and is administered on over a million Canadians every year (CSEP, 2003), the results of this investigation provide important evidence substantiating one of the primary purposes of the CPAFLA (i.e., physical activity promotion and motivation). Thus, when thinking of innovative ways to combat the Canadian health care burden (Katzmarzyk & Janssen, 2004) the CPAFLA should be seriously considered. After participating in the Canadian Physical Activity, Fitness & Lifestyle Approach individuals showed increases in health knowledge, as well as instrumental attitude, perceived behavioural control and intention regarding health-related physical activity participation. These results suggest that participants benefit from participating in an all encompassing fitness appraisal and counselling session such as the CPAFLA. As a result individuals should be more able to integrate positive health behaviours (e.g., physical activity) into their lifestyles. Therefore, providing increased access to health-screening and counselling is essential to combat the health care burden which arises from physical inactivity, obesity, and the increasing variety of chronic hypokinetic disease states associated with sedentary behaviour. Primary health care providers should routinely send their patients to certified personal trainers and certified exercise physiologists for habitual physical fitness checkups and counselling. This investigation suggests that fitness appraisals and counselling sessions provide participants with motivation to increase their physical activity participation and healthy lifestyle behaviours at the same time as providing valuable and standardized information concerning health status and disease risks to both the practitioner and participant. Future research is warranted to investigate the long term effects of participating in standardized health-related physical fitness appraisals like the CPAFLA on behaviour.

Table 3.1. Physical Activity Participation

Physical Activity Measurement	Control (n =20)				Experimental (n = 20)			
	Young (n = 10)		Middle-Age (n = 10)		Young (n = 10)		Middle-Age (n = 10)	
	Female (n = 5)	Male (n = 5)	Female (n = 5)	Male (n = 5)	Female (n = 5)	Male (n = 5)	Female (n = 5)	Male (n = 5)
Vigorous (Times/Week)	0.4 ± 0.5	1.0 ± 0.7	0.6 ± 0.9	0.6 ± 0.9	0.5 ± 0.5	0.4 ± 0.5	0.5 ± 0.9	0.2 ± 0.4
Vigorous (Minutes/Session)	9.0 ± 13.4	35 ± 25.5	11 ± 17.6	9 ± 13.4	30 ± 36.7	11 ± 17.5	14 ± 26	15 ± 33.5
Moderate (Times/Week)	1.4 ± 1.1	1.2 ± .84	1.6 ± 1.1	1.0 ± 1.0	0.4 ± 0.5	1.0 ± 1.0	1.3 ± 0.7	0.6 ± 0.9
Moderate (Minutes/Session)	30 ± 28.3	27 ± 1.7	22 ± 15.25	14 ± 13.4	18 ± 26.8	26 ± 26.1	26 ± 5.5	14 ± 26.1
Light (Times/Week)	7.0 ± 8.2	3.4 ± 2.9	3.6 ± 2.2	2.6 ± 0.9	2.8 ± 2.7	5.2 ± 6.1	1.2 ± 1.3	3.8 ± 2.7
Light (Minutes/Session)	27 ± 13	21 ± 5.2	24 ± 15.2	17 ± 7.6	17 ± 8.4	30 ± 22.4	45 ± 49.7	26 ± 20.4

Table 3.2. FitSmart Health-Related Physical Fitness Knowledge Scores

Measurement	Control (n =20)		Experimental (n = 20)	
	Test Day 1	Test Day 2	Test Day 1	Test Day 2
Overall Score (%)	75.0 ± 9.3	72.5 ± 8.3	69.0 ± 12.4	70.6 ± 10.4
Concepts of Fitness (%)	84.9 ± 8.5	81.0 ± 17.4	74.3 ± 16.3	79.5 ± 17.7
Scientific Principals of Exercise (%)	68.6 ± 15.0	63 ± 21.4	64.3 ± 8.1	66.3 ± 17.4
Components of Physical Fitness (%) *	75.2 ± 15.0	64.0 ± 12.4	67.4 17.6	68.0 ± 13.0
Effects of Exercise on Chronic Disease Risk Factors (%)	66.0 ± 19 .4	77.7 ± 15.0	65.3 ± 22.7	67.5 ± 19.5
Exercise Prescription (%)	80.0 ± 41.0	82.5 ± 24.5	75.0 ± 41.3	80.0 ± 29.9
Nutrition Injury Prevention and Consumer Issues (%)	73.5 ± 15.1	75.4 ± 13.5	67.5 ± 20.0	67.8 ± 16.0

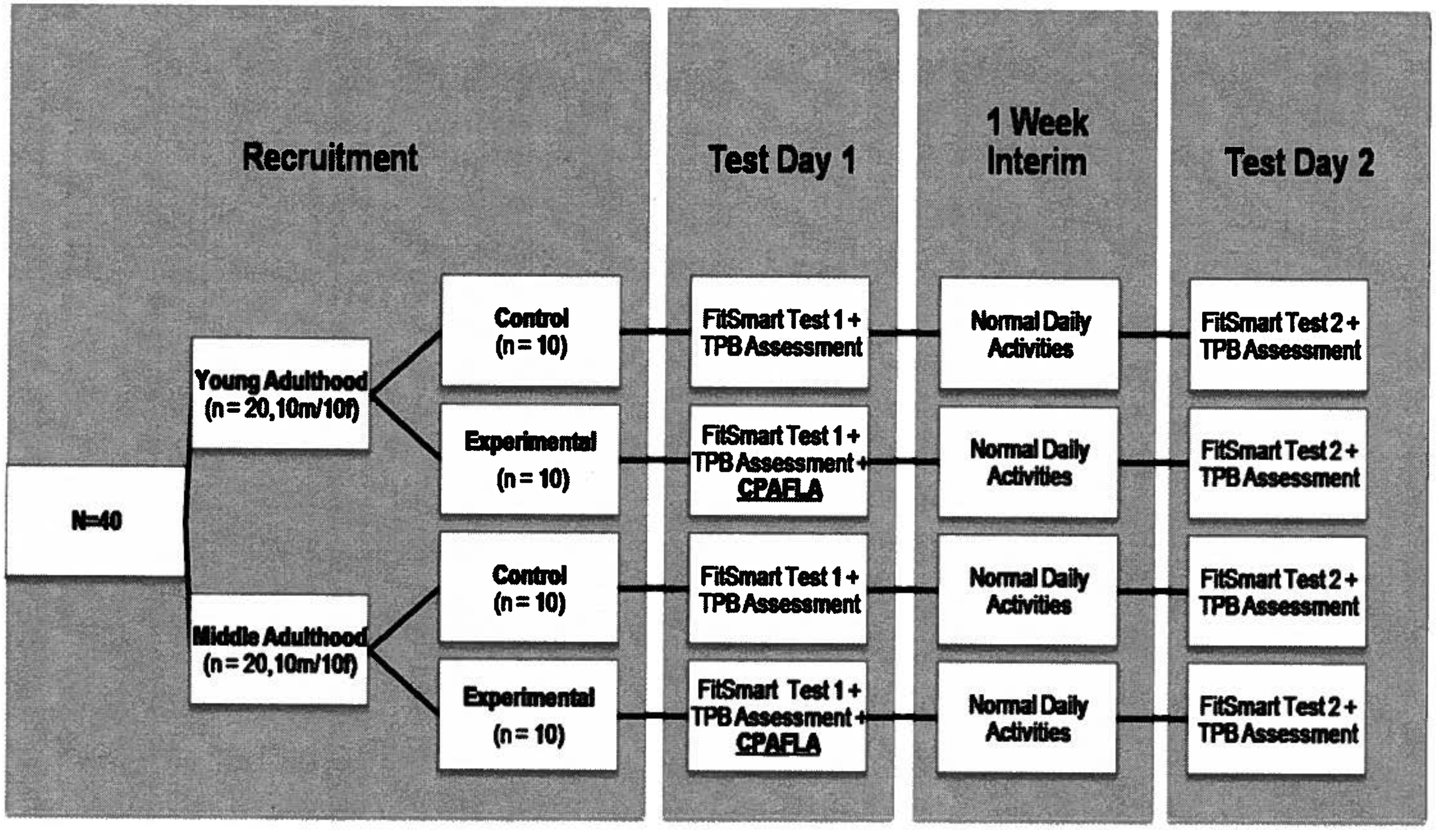
Note: * significant time by treatment group interaction effect ($p < 0.05$).

Table 3.3. Theory of Planned Behaviour Scores

Measurement	Control (n =20)		Experimental (n = 20)	
	Test Day 1	Test Day 2	Test Day 1	Test Day 2
Instrumental Attitude (x/21) *	18.9 ± 1.7	18.2 ± 2.8	17.1 ± 2.9	18.4 ± 1.7
Affective Attitude (x/21)	15.4 ± 3.5	15.5 ± 2.6	15.6 ± 2.8	16.2 ± 2.1
Injunctive Norm (x/21)	17.5 ± 3.1	16.9 ± 3.1	17.5 ± 2.4	17.9 ± 2.3
Descriptive norm (x/21)	13.0 ± 4.7	13.6 ± 3.8	13.5 ± 3.5	15.5 ± 3.2
Perceived Behavioural Control (x/42)*	31.9 ± 6.2	30.7 ± 7.3	33.2 ± 6.0	35.2 ± 3.9
Intention (x/21)*	17.0 ± 2.5	16.3 ± 3.3	14.9 ± 2.8	17.3 ± 1.8
Vigorous Physical Activity Intention (Days/week)	2.7 ± 1.8	2.4 ± 1.8	2.4 ± 1.7	2.8 ± 1.4
Vigorous Physical Activity Intention (Minutes/Session)*	34.8 ± 20.8	24.0 ± 17.7	36.0 ± 21.8	42.3 ± 18.2
Light-moderate Physical Activity Intention (Days/Week)	3.9 ± 1.6	3.9 ± 1.8	2.8 ± 1.7	3.4 ± 1.5
Light-moderate Physical Activity Intention (Minutes/Session)	32.5 ± 16.4	35.5 ± 14.7	38.5 ± 17.8	39.0 ± 17.9

Note: * significant time by treatment group interaction effect ($p < 0.05$).

Figure 3.1. Schematic of Randomized Block Design with Delayed Repeated Measures



Note: TPB, Theory of Planned Behavior; CPAFLA, Canadian Physical Activity Fitness & Lifestyle Approach.

Figure 3.2. Time by Treatment Effects for Components of Physical Fitness Score

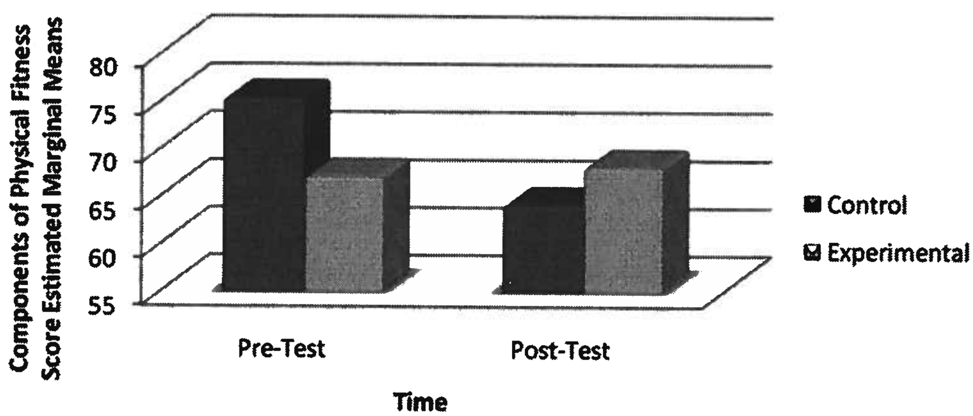


Figure 3.3. Time by Treatment Effects for Instrumental Attitude

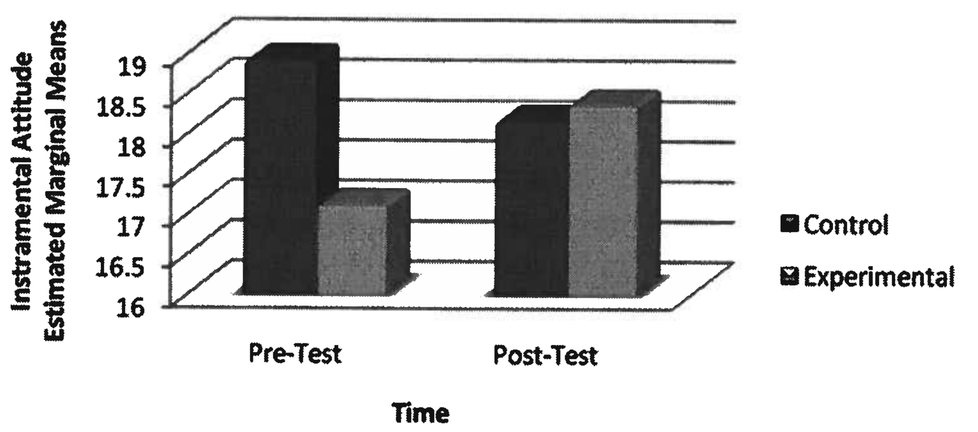


Figure 3.4. Time by Treatment Effects for Percieved Behavioural Control

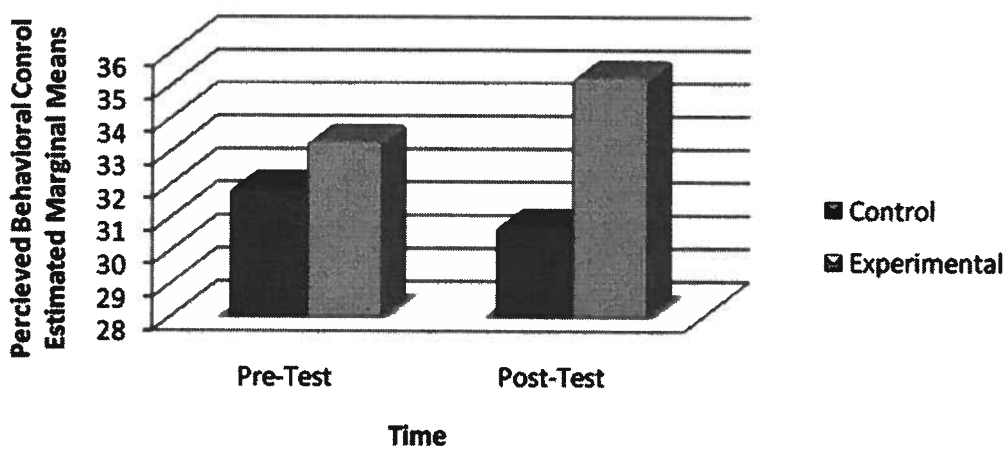


Figure 3.5. Time by Treatment Effects for Intention

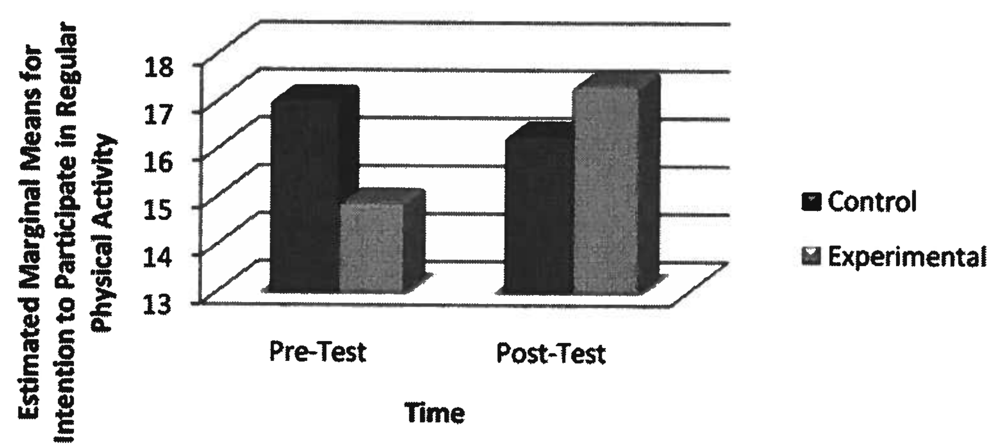
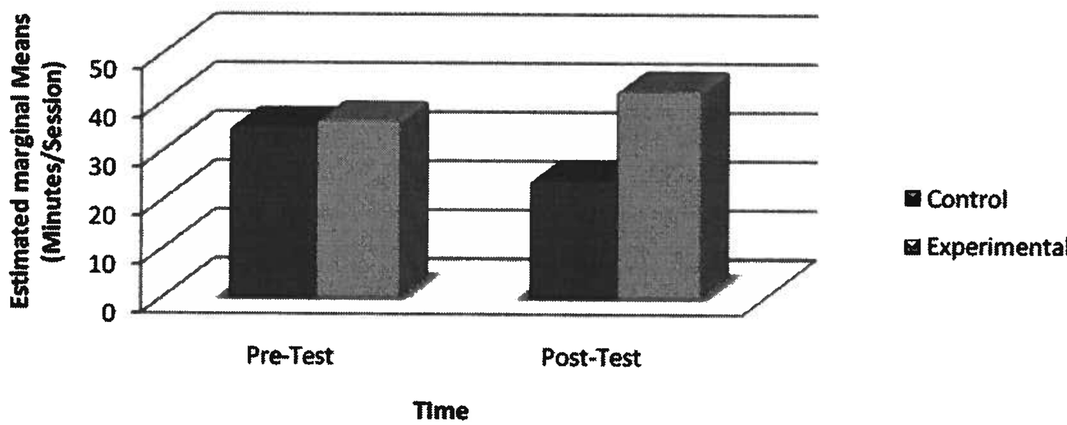


Figure 3.6. Time by Treatment Effects for Intention to Participate in Vigorous Physical Activity



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CHAPTER 4

Conclusion

This thesis entitled "Health-Related Physical Fitness, Knowledge, and Administration of the Canadian Physical Activity, Fitness, and Lifestyle Approach" was conducted to fulfill the requirements pertaining to a Master's of Science degree through the Department of Human Kinetics within the Faculty of Education at the University of British Columbia. One large study examining two distinct sub-questions was conducted by Marc D. Faktor with intellectual input (scientific and editorial) provided by Dr. Shannon S.D. Bredin (largest contribution), Dr. Darren E.R. Warburton, and Dr. Ryan E. Rhodes.

The first line of investigation was to examine the relationship between health-related physical fitness knowledge and health-related physical fitness in young and middle adulthood. We also examined the relationship between health literacy and health-related physical fitness knowledge. Our findings showed that health-related physical fitness knowledge was positively and significantly correlated to health-related physical fitness in adulthood. Specifically, knowledge was a significant correlate to and the strongest individual predictor of musculoskeletal fitness. In addition, health literacy was found to be a significant correlate to and the strongest predictor of knowledge. These findings have been compiled into a manuscript titled, "The relationship between health knowledge and measures of health-related physical fitness" (See Chapter 3). Given the empirical evidence relating musculoskeletal fitness to health status (Warburton, 2001) and our findings relating health-related physical fitness knowledge to musculoskeletal fitness, it is imperative that individuals are provided opportunities to access and acquire knowledge pertaining to health-related physical fitness. It is important to integrate education of this knowledge into multidimensional health promotion programs, educational systems and other learning initiatives whenever possible. Additionally and more specifically, the results presented in Chapter 3 support other research findings (e.g., Petersen, Byrne, & Cruz, 2003) that highlight the importance of addressing and promoting advanced concepts (e.g., scientific principles of exercise) in educational materials designed for both health care professionals and the general population.

The impact of health-related knowledge on lifestyle is important to acknowledge. Individuals with less education, lower incomes, and blue collar employment are more likely to be physically inactive than those with more education and higher paying white-collar employment (Draheim, 2002). Correspondingly, research indicates that people who are educated in fitness concepts are more likely to be physically active and fit (Petersen et al., 2003). The consequences of a sedentary lifestyle are well documented and contribute to a myriad of hypokinetic diseases (Warburton et al., 2006a). Additionally, a large number of health economic studies have ascertained that higher education is associated with positive health outcomes, even when factors like income are controlled for (Kenkel, 1991). One explanation for this is that schooling helps people choose healthier lifestyles by improving their understanding of the relationships between health behaviour and health outcomes (Kenkel, 1991). The current British Columbia physical education secondary curriculum (developed by the British Columbia Ministry of Education, Skills and Training in 1998), provides students opportunities to engage in and acquire health-related physical fitness learning objectives. For example, under the curriculum organizer 'Active Living', the grade 11 and 12 prescribed learning outcomes state that student's are expected to be able to (adapted from p. A-3 and A-5):

- Design, implement, evaluate, and monitor plans for a balanced, healthy lifestyle (e.g., nutrition, exercise, rest, work), taking into consideration factors that affect the choice of physical activity (e.g., age, gender, culture, environment, and body-image perceptions) throughout life;
- Describe strategies, as well as analyse and design plans for stress management and relaxation;
- Adapt physical activities to minimize environmental impact;
- Design, Implement, evaluate, monitor, and adapt coaching plans for exercise programs for themselves and others, that apply the principles of training (i.e., progression, overload, specificity);
- Demonstrate an understanding of physiology and performance modifiers such as how the cardiovascular, muscular, and skeletal systems relate to human motor performance;
- Develop a plan to maximize personal motor performance for themselves and others;
- Demonstrate a willingness to use community-based recreational and alternative-environment opportunities to develop a personal functional level of physical fitness;
- Evaluate the influence of consumerism and professional athletics on personal perception of body image; and
- Analyse and describe the effect of professional sports role models on the choice of personal lifetime activities.

The strengths in this curriculum stem from the active engagement in the material at hand. Students are expected to work in groups, relate the material being presented to themselves, and then adapt it to others within the group. This allows the student to gain perspective of the information being presented and empathize with others in a variety of situations. In addition, students are evaluated on the real life application of the teachings presented in school (e.g., students are required to demonstrate a willingness to utilize community resources in an attempt to bolster physical fitness and health). This real life application has the potential to have a profound effect on one's health knowledge and literacy. It provides students with experiences that show where and how to engage in preventative health measures within their communities. It also increases the probability of students receiving and responding to new and up to-date sources of health information that are usually present in community fitness based dwellings. This continual interaction with health and fitness practices and educational materials has the potential to increase health knowledge in addition to health literacy. However, when students reach the end of high school (e.g., grade 11 and 12) physical education is no longer a mandatory subject. This is a definite weakness in the curriculum that needs to be revised. Students at this age are able to comprehend and apply information to a much greater extent; thus, could potentially benefit the most from health education in the later high school years. Research that functions to investigate the relationship between health-related physical fitness knowledge, health literacy, and physical education participation in the later high school years needs to be utilized to promote making physical education compulsory at all grade levels.

In our findings, as well as in other investigations, it has been shown that individuals lack knowledge specific to the scientific principles of exercise. Peterson et al.

(2003) suggested that individuals should be provided with more opportunities to strengthen existing content knowledge, rather than relying on individuals to take specific and elective exercise physiology courses. Simple and repeated teachings of the acute and chronic adaptations that our bodies endure in response to physical activity and exercise should be implemented at a young age to ensure individuals understand the modifications that occur in the body as a result of physical activity or inactivity (e.g., blood pressure adaptations and ramifications, triglyceride profile changes, insulin sensitivity as well as resistance). Simple adaptations to curriculum that function to integrate these teachings across multiple mandatory course offerings at all educational levels should function to translate this essential knowledge for greater retention and transfer. Moreover, lectures and tutorials should be held to help students identify the relationships between health knowledge and behaviour as individual's that possess low levels of health knowledge will have a limited understanding of the benefits of engaging in healthy lifestyle behaviours. This limited understanding leads to a decreased awareness of: disease symptomoogy and risk, preventative health care approach's (e.g., proper nutrition and physical activity), and other sources of medical treatment (Freimuth, 1990). These health knowledge issues have been documented in individuals with intellectual disabilities (Graham, 2000; Stanish, 2006) and low levels of health literacy (Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association, 1999; Davis, 2004).

If individuals do not learn from health promotion efforts designed to highlight the relationships between health behaviours and health outcomes their ability to partake in a healthy and active lifestyle will be compromised. Thus, it is essential for health promotion efforts to target individuals based on their individual capabilities and needs

(Fish & Nies, 1996). For example, cohorts with increased knowledge will be able to receive and respond appropriately to more complex health promotional messages and services than those with less knowledge and intellectual capabilities. This example emphasizes the need to assess the health knowledge of people in order to maximize and target the effects of a health promotional intervention. Furthermore, health literacy is a contemporary and well warranted topic of concern for the advancement of high quality health care (Parker et al., 2003). It is recommended for health care practitioners to assess health literacy, in an attempt to further individually tailor health education and counselling. For example: if a health care professional determines a client to have limited health literacy, their knowledge translational activities should be adjusted to an elementary level which suites the client's capabilities. This will then aid in ensuring adequate knowledge acquisition and retention on the clients end.

This present investigation adapted the concept of health literacy assessment, which is usually performed in primary care, to the health and fitness domain. Our health literacy findings (see Chapter 3 Results) and the relationship(s) between health literacy, health outcomes, and health knowledge are a great value and should be utilized in the health and fitness industry. Health care practitioners of all scopes should administer and apply the results of brief standardized health literacy assessments in order to individually tailor the communication and guidance provided to clients, patients, and students (Weiss et al., 2005). In addition, our research group designed a health-literacy assessment specific to the health and fitness discipline to pilot in this investigation (the results will be disseminated in a short communication piece via the CSEP Health & Fitness BC). We utilized a modified Weiss method that incorporates essential health-related physical fitness documents. Participants were given a 2 page physical activity readiness questionnaire document (PAR-Q and You) (CSEP, 2003), and were asked to read, comprehend, apply and analyze the available information to answer six content based questions. The questions were asked orally, the responses were recorded on a separate score sheet and time constraints did not apply. This tool did not have a categorical score scale like the NVS does, nevertheless the literacy concepts measured do parallel each other and lower scores were indicative of low literacy.

Further scientific investigation into the relationship(s) between health literacy, health-related physical fitness knowledge, and the components of health-related physical fitness is warranted. Investigations that function to determine how to maximize knowledge retention and translation need to be conducted in order to fully apply these findings. Interdisciplinary collaborations should be made to investigate the most appropriate media vehicles health promotion and education programs can utilize to circulate health-related knowledge. These media vehicles should operate to disseminate health-related knowledge in insightful, meaningful, and sustainable ways that function to ensure knowledge retention and application.

The second research objective of this investigation was to examine objectively the effects of administering the CPAFLA health-related physical fitness assessment and counselling strategy on health knowledge and the Theory of Planned Behaviour components (i.e., attitude, subjective norm, perceived behavioural control, and intention) concerning regular physical activity participation in adulthood. Our findings showed that administrating the CPAFLA increased health knowledge related to the components of physical fitness, as well as important elements of the TPB (i.e., instrumental attitude, perceived behavioural control, and intention). These findings have been compiled into a manuscript titled, "The effects of administering the Canadian

Physical Activity Fitness & Lifestyle Approach (CPAFLA) on health-related physical fitness knowledge as well as beliefs, attitudes, and intentions towards regular physical activity participation" (see Chapter 4).

Provided that the CPAFLA is administered on over one million Canadians every year (CSEP, 2003) and considered to be the most widely utilized standardized health-related fitness appraisal within Canada (Katzmarzyk, 2002; Warburton et al., 2006b); the results generated by this investigation are of much importance when thinking of innovative ways to reduce the health care expenditures associated with physical inactivity and obesity (Katzmarzyk & Janssen, 2004). The increases in health knowledge and beliefs, attitudes, and intentions concerning regular physical activity that were demonstrated after participating in the CPAFLA suggest that participants considerably benefit from its administration. Consequently, CPFALA participants ought to be better off integrating positive health behaviours (e.g. physical activity) into their lifestyles. Therefore, providing increased access to health-screening and counselling is essential to combat the health care burden which arises from the increasing variety of chronic hypokinetic disease states associated with sedentary behaviour. Primary health care providers should utilize health and fitness practitioners as valuable resources by referring their patients to certified personal trainers and exercise physiologists for fitness appraisals and counselling. It must be widely recognized that these types of referrals should function to motivate individuals to increase their physical activity participation and healthy lifestyle behaviours. Moreover, the standardized and Canadian normative referenced information generated by a holistic assessment like the CPAFLA can provide primary health care practitioners with valuable information that can positively contribute to treatment plans.

In view of the fact that the Canadian Society for Exercise Physiology's mission statement (i.e., "To promote the generation, synthesis, transfer and application of knowledge and research related to exercise physiology (encompassing physical activity, fitness, health, nutrition, epidemiology, and human performance)") highlights the need for continuous application and adaptation, this thesis investigation has the potential to significantly contribute to the CPAFLA revisions process. Based on the methodology and the results generated; some potential adaptations to the CPAFLA could include:

I. A brief assessment of health-related physical fitness knowledge

II. A health literacy assessment specific to the health and fitness domain

III. The assessment of the Theory of Planned Behaviour constructs relating to physical activity participation

In collaboration, these additions to the CPAFLA would assist with the knowledge translation and education objectives. Specifically, the results of these cognitive assessments will provide fitness professionals with an ammunition of personalized data that will function to enhance the quality of information provided to participants. This in turn should lead to increased retention and application on the participants end. Given that the information provided to participants during the CPAFLA is intended to assist individuals in increasing their physical activity participation and healthy lifestyle behaviours these proposed adaptations warrant serious consideration.

Taken together, the results from this thesis provide empirical evidence substantiating the relationship(s) between health-related physical fitness knowledge, health literacy, and the components of health-related physical fitness. In addition, these findings support one of the primary objectives that the Canadian Physical Activity Fitness and Lifestyle Approach health-related physical fitness assessment and counselling strategy conforms to (i.e., health promotion through regular physical activity participation). Future research that investigates the long term effects of retention and application associated with these findings is warranted.

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APPENDIX A

Extended Review of Literature

In the following review, relevant literature pertaining to health knowledge, health-related fitness, as well as the influence of health knowledge on health-related fitness is discussed. This chapter functions as a condensed review of the current literature related to health knowledge, health-related physical fitness, and the relationship between these two variables of interest. Although the review of literature presented here is considered to be condensed, it provides greater depth than what is provided in the introductory sections of each respective manuscript. As such, the purpose of this chapter is to provide the reader a broader perspective on the concepts focused on within this thesis.

Health and Fitness Knowledge

To provide an overview of the literature concerning health and fitness knowledge, definitions of health, health knowledge, as well as health and fitness knowledge will be provided. Rationale will then be given as to why health knowledge should be assessed. Following the basis for health knowledge assessment, health knowledge and its contribution to behaviour change will be discussed in relation to the Theory of Reasoned Action/Planned Behaviour (the dominant health-related behaviour change model). The next section will outline how health knowledge and health-related beliefs, attitudes and intentions should be assessed within a research setting and relevant examples of such assessments will be provided. The impact of health knowledge will also be presented briefly followed by a discussion of health literacy.

Defining Health and Health Knowledge

Health depends on our understanding of its determinants, and the application of this knowledge in the prevention and treatment of disease (Pakenham-Walsh & Priestley, 2002). It is imperative for definitions of health and its conditions to be detailed and meaningful (Awofeso, 2005), as scientific research abides by the principles of comparability and reproducibility (Ustün, 2005). The most commonly quoted definition of health, sanctioned by the World Health Organization (WHO) over 50 years ago, states that health is: " a complete state of physical, mental and social well-being, and not merely the absence of disease or infirmity" (WHO, 1999, p, 10). Accordingly, each dimension of health (physical, mental and social) can be characterized on a continuum with positive and negative poles. Positive health is associated with the ability to enjoy life and endure its impediments. Negative health is associated with a decreased capacity to enjoy life and withstand its obstacles. Therefore, positive health is not only the absence of disease. (CSEP, 2003). The WHO definition of health is broad enough to be applied equally to both genders as well as developed and developing countries. Health is a cumulative state, which must be promoted throughout life to ensure benefits in the later phases of life (WHO, 1999).

In today's health care environment accurate knowledge pertaining to health is essential for the required prevention and treatment of illness and disease (Beier & Ackerman, 2003). Health knowledge enables individuals to identify the symptoms and communicability of diseases, allows individuals to select and participate in appropriate preventative health strategies, and gives individuals an understanding of where to obtain health services (Freimuth, 1990). Fitness knowledge (a component of health knowledge) is understood to influence the health and exercise behaviours of individuals

(Zhu et al., 1999). Health-related physical fitness knowledge can be discussed according to several sub-domains such as: concepts of fitness; scientific principles of exercise; components of physical fitness; effects of exercise on chronic disease risk factors; exercise prescription; as well as nutrition, injury prevention, and consumer issues (e.g., Zhu et al., 1999). Concepts of fitness refers to knowledge pertaining to fitness definitions, and the relationship(s) between fitness, physical activity, and health, whereas scientific principles of exercise includes knowledge relating to the acute/chronic physiological and psychological adaptations to exercise. Components of physical fitness addresses knowledge pertaining to cardiovascular, respiratory and pulmonary function; muscular strength and endurance; flexibility; and body composition. The chronic disease risk factor component focuses on knowledge pertaining to the common chronic hypokinetic disease states (e.g., cardiovascular disease), the risk factors associated with them (e.g., physical inactivity, obesity, smoking), and the positive effects exercise elicits on the chronic diseases and their risk factors. Knowledge related to exercise prescription takes into account the concepts of frequency, intensity, duration, mode, self-evaluation, and exercise adherence. Last, the items pertaining to nutrition, injury prevention and consumer issues, address common issues fitness consumers encounter (e.g., best times view a gym when thinking of becoming a member), basic nutritional information, and evidence based ways to decrease the chance of injury (e.g., warm up, cool down, progression).

Rationale for Health Knowledge Assessment

Within health education the four basic educational outcomes are: knowledge, attitudes, behaviours, and skills. Despite the fact that behaviour is the outcome of most interest in the health education and promotion sector, knowledge can be assessed with increased accuracy over a variety of settings (Kilander, 2001). Health knowledge is associated with health-promoting behaviours (Courtenay, 1998), and acquired knowledge contributes to the initial stimuli required to prompt behaviour change by aiding individuals in the development of beliefs, attitudes, and intentions, all of which shape behaviour (CSEP, 2003; Ajzen & Fishbein, 2005). Once behaviour change has commenced, further knowledge improvements can reinforce the stimuli for change. Furthermore, the provision of health knowledge is a major tool of public health promotion organizations (Nayga, 2001). Health education and promotional activities are guided by the influence of health knowledge on health conditions, as well as variation in health knowledge across socio-demographic groupings (Nayga, 2001).

Within education (especially physical education) the assessment of health knowledge is common in the research world and these findings and should be considered essential to program evaluation and development; however, this is commonly overlooked in actual practice. According to Miller and Berry (2000), one goal of a good fitness curriculum is to provide students with adequate knowledge and skills that will provide encouragement for them to develop habits for a healthy and active lifestyle. Research has demonstrated that teachers are instrumental in developing health-related knowledge of students (Miller & Berry, 2000). Moreover, assessments are employed to determine the knowledge and capabilities of prospective physical educators, in-service physical educators, and health professionals (Castelli & Williams, 2007; Kilander, 2001; Miller, 1998). Health knowledge assessments are also valid instruments in assessing the product of health or physical education (i.e. student knowledge) (Keating, 2007; Kilander, 2001). The results of such assessments should be utilized in curriculum revision to enhance level of contemporary health education (Kilander, 2001; Miller & Berry, 2000).

Health knowledge evaluation is also important for health care enhancement, especially in terms of effective patient-physician communication (Williams, 2002). The doctor-patient relationship is a bond that requires unambiguous, precise and complete transfer of information for effective health advice (Samora, 1961). A patient's level of health knowledge can provide health practitioners and physicians with important information that can positively affect the influence they have on their clients or patients. Numerous studies have documented that physician's use of scientific jargon in combination with patient's limited health knowledge and vocabulary, results in ineffective health care advice and confused patients (Williams, 2002). For example, Lerner et al. (2000) revealed limited understanding of medical terminology (47%) when assessing the health knowledge of participants in urban and suburban American hospital emergency rooms. Although medical terms are used as part of normal conversation between health care providers, it was suggested that when communicating with patients, medical terminology should be carefully explained (especially to patients with low health knowledge) in order to ensure optimal health care and advice.

In summary, the assessment of health knowledge can benefit health care practitioners and clients in all disciplines (e.g., exercise physiology, dentistry, physical education); however, actual assessment protocols and procedures are lacking in many health care settings. Thus, it is important for practitioners to consider assessing their client's knowledge base specific to the discipline or specialty being provided. In terms of health-related physical fitness and activity prescription, the evaluation of fitness knowledge evaluation is a critical first step towards the effective delivery of information for improved health status.

Health Knowledge and Behaviour Change

Developed by Ajzen (1988, 1991) as an evolution of the Theory of Reasoned Action (Fishbein, 1967), the Theory of Planned Behaviour has been utilized as the explicit theoretical basis for several hundred published scientific investigations since 1985 (Francis et al., 2004). This theory has successfully provided greater understanding of diverse health-related behaviours such as: exercising, adhering to low-fat diets, contraceptive use, illicit drug use, as well as numerous more health behaviours (see Ajzen & Fishbein, 2005 for a current review). It is the most prominent conceptual model for thinking about the determinants of particular behaviours to-date (Ajzen, 2007). The Theory of Planned Behaviour suggests a framework about how human action is generated. It estimates the incidence of a particular behaviour given that the behaviour is intentional. It is suggested that behavioural intentions are assumed to result sensibly from beliefs (behavioural, normative, and control) about performing the behaviour (Ajzen & Fishbein, 2005). It is important to note that the behavioural, normative and control beliefs people possess regarding the performance of a particular behaviour are influenced by a broad assortment of situational, cultural, and personal background factors. These beliefs can be accurate, inaccurate, biased, and even illogical. Nevertheless, this set of beliefs is the cognitive foundation that guides human action, which is influenced by three major factors: a positive or negative assessment of the behaviour (attitude regarding the behaviour), perceived societal influence to execute or not execute the behaviour (social norm), and perceived ability to execute the behaviour (perceived behavioural control). The amalgamation of attitude towards the behaviour, subjective norm, and perception of behavioural control leads to the formation of a behavioural intention (the strongest predictor of human behaviour). In general, the more favourable the attitude and subjective norm, in combination with increased perceived behavioural control, a person's intention to perform the desired behaviour will be greatest. Lastly, given a significant degree of actual control over the behaviour, individuals are expected to execute their intentions when presented with an opportunity. A schematic representation of the Theory of Planned Behaviour is presented in Figure A.1.

According to Ajzen and Fishbein (2005) a reasoned action/planned behaviour approach does have its limits. Inaccurate information has the ability to produce unrealistic beliefs, attitudes, and intentions which can result in unwanted behaviours; lack of volitional control can inhibit individuals from executing intended behaviours; strong emotions can activate beliefs and attitudes that are not part of one's everyday cognitive processes; and unanticipated circumstances may lead to deviations in intentions. Therefore, in terms of health-related physical fitness knowledge, if an individual possesses inaccurate information pertaining to the constructs of fitness the individual's fitness behaviours can be compromised by unfavourable attitudes and beliefs towards the behaviour. According to Ajzen (2007) knowledge, or correct factual information plays no direct role in the process of the TRA/TPB because behaviour-relevant beliefs will be formed regardless of whether or not the information one possesses is correct or incorrect. Thus, the behaviour will still be initiated; however, the health-related outcome depends on whether the information works for or against the behaviour.

Health-Related Knowledge Assessment

One of the most popular methods for collecting descriptive data is the survey approach. Surveys are composed of a series of questions, relating to the research question, which are posed to a group of participants and may be conducted in the form of an oral interview, written questionnaire or examination, or computer based questionnaire or examination (Portney, 2000). Surveys are often concerned with describing the levels of knowledge a specific group possesses (Portney, 2000). In terms of health and fitness knowledge, the most popular assessment tools are self report questionnaires or examinations. These methods have been used to have assess the health and fitness knowledge of children (Mobley, 1996), adolescents (Haltiwanger, 1994; Keating, 2007; Merkle & Treagust, 1993), adults (Beier & Ackerman, 2003; Losch & Strand, 2004; Miller, 1998; Petersen et al., 2003) and the elderly (Fitgerald et al., 1994).

When constructing an assessment tool the reliability and validity should always be taken into account. Content validity of a health knowledge assessment tool ensures that the items provide an adequate sampling of health knowledge for the relevant health education standards (Morrone, 2007). Measures of a tools internal consistency provide an index of the overall reliability of an assessment device (Portney, 2000). To establish acceptable levels of content validity and internal consistency for a health knowledge assessment tool the following steps are recommended (Morrone, 2007; Portney, 2000): (1) identify the relevant health education standards;

(2) develop questions based on the research question and results from a literature review conducted to identify validated outcomes;

(3) have a panel of experts review the items;

(4) revise the document based on the panels comments;

(5) pilot test the instrument and conduct interviews or focus groups; and

(6) revise the document based on results from the pilot testing and interviews/focus groups.

Developed by Zhu, Safrit, and Cohen (1999) and made available by Human Kinetics ™ the FitSmart is an established, valid and reliable test to accurately measure knowledge of fundamental health and fitness concepts at the high school level of education. It can be written as a computer based or pencil and paper test. The development of this knowledge examination was in accordance with the recommendations provided by Morrone and Portney (as mentioned above); thus, the FitSmart has undergone rigorous reliability and validity tests, as well as numerous pilot investigations (Zhu et al., 1999). The FitSmart consists of two equivalent versions (Forms 1 and 2) containing 50 multiple-choice items, measuring six sub-domain components. Normally, scores for this test are reported on a standard score scale ranging from 20-80. This score scale was developed using an appropriate item response theory model with results from 4,025 high school students. A cut off score of 50 on the standard score scale is used to indicate a Healthy Fitness Knowledge Zone appropriate for high school students. However, all scores (overall and categorical) can be converted into raw scores to gain percentage values for knowledge translational purposes. The sub-domain components, tested in equal numbers of questions within both forms, include: concepts of fitness; scientific principles of exercise; components of physical fitness; effects of exercise on chronic disease risk factors; exercise prescription; as well as nutrition, injury prevention, and consumer issues. Since both forms contain an equal number of questions and the content within these questions has been equally balanced it is possible to directly compare the scores on the two forms (Zhu et al., 1999). The FitSmart has been used as a valid and reliable health and fitness knowledge assessment tool for adolescents (Keating, 2007) and adults (Losch & Strand, 2004; Petersen et al., 2003). Furthermore, other investigations have incorporated items from the FitSmart into their multidimensional assessment protocols due to the tests established validity in the assessment of exercise knowledge (Zizzi, Ayers, Watson, & Keeler, 2004).

Employing Form 1 of the FitSmart, Keating and colleagues (2007) examined the health and fitness knowledge of 185 ninth grade students in a metropolitan area school district. The overall mean raw score of the ninth graders (16/50) indicated serious deficiencies in health and fitness knowledge. These findings suggest that health promotion efforts that function to increase health and fitness knowledge are needed within the educational system (Keating, 2007).

Peterson, Byrne, and Cruz (2003) employed the FitSmart to assess the health-related fitness knowledge of 63 pre-service physical education teachers. Peterson et al. chose the FitSmart because the concepts being evaluated are ones that pre-service teachers will be expected to communicate to high school students. Results of the health knowledge assessment were not especially impressive for educated college seniors who are expected to teach this material in the near future. Pre-service physical educators scored an average of 75.2% on the FitSmart. Component analysis revealed that pre-service educators were most competent in the exercise prescription domain (mean = 92.0%) and weakest in the domains of physical fitness (mean = 67.7%) and scientific principles of exercise (mean = 67.7%). The various university level courses that each participant had taken during their course of study were also examined. Exercise physiology was identified as the primary course responsible for pre-service physical educator's in-depth knowledge of health and fitness concepts. The majority of the participants (90.5%) had only taken one course in exercise physiology and the grades received were judged as substandard. Approximately half (49%) of the participants reported earning grades of "C" or lower, 15% could not remember their grades, and only 4.8% of the participants earned "A" grades. To overcome these knowledge deficiencies, Petersen et al. (2003) suggested that future educational curriculums should integrate and reinforce fitness concepts across a variety of courses to ensure knowledge retention of the subject matter.

In an investigation similar to Peterson et al's (2003), Losch and Strand (2004) revealed comparable findings when assessing the health and fitness knowledge level of 36 male and female physical education teaching majors. The average score for the FitSmart test was 69.4%. Compartmental analysis of the scores also paralleled Peterson et al's investigation with the highest scores occurring on the exercise prescription component (mean = 85.9%), and the lowest scores occurring in the components of physical fitness (mean = 63.9%), scientific principals of exercise (mean = 65.3%), as well as the nutrition injury prevention, and consumer issues (mean= 64.5%). In parallel with Peterson et al, the remodelling of post-secondary course curriculum to integrate health and fitness concepts into a variety of core courses is warranted to reinforce the retention of these deficient knowledge areas.

Miller and Berry (2000) measured the health-related physical fitness knowledge of student allied health professions (i.e., Physical Therapy, Athletic Training, and Nursing) via a multiple-choice test. This test was constructed by a panel of experts who had specific educational training and experience in exercise physiology and physical education. The assessment spanned five health-related fitness domains including body composition, flexibility, muscular strength, muscular endurance, and cardiovascular conditioning. The multiple-choice test consisted of a total of 40 questions spanning 20 health-related fitness concepts (agreed on via expert consensus), with 8 questions for each domain. The study utilized a pre-test post-test design with a 2 year time interval (time taken from beginning to completion of professional program) between tests. Results indicated that student athletic trainers earned significantly higher total scores, in comparison to the nursing and physical therapy groups, on the post-test in relation to baseline measures. In addition, both the athletic training and physical therapy group's post-test scores were significantly higher in comparison to the nursing groups total post test score. This data demonstrates the impact that curriculum has on the basic content knowledge of its graduates. Moreover, this highlights the importance of curriculum reviews and identifying gaps in essential knowledge. When designing health curriculum, it is essential to ensure that students in all health disciplines acquire the pre-requisite knowledge to function as reputable allied-health professionals (Miller & Berry, 2000).

Beier and Ackerman (2003) utilized a health knowledge battery to assess a wide sampling of health information available to the general public. The battery consisted of ten subscales, which included: aging, orthopaedic and dermatological concerns, common illnesses, childhood and early life, serious illnesses, mental health, nutrition and exercise, reproductive health, safety and first aid, and the treatment of illness and disease. Beier and Ackerman showed that the inter-correlations among the ten health subscales were significant and large. Factor analysis suggested that those who know more about one health domain are more likely to be highly knowledgeable concerning other domains. The significant inter-correlations between the health scales allowed a composite knowledge score to be generated by summing the scores of individual health scales (Beier & Ackerman, 2003). When examining the gender differences in health knowledge, women (on average) performed superior to men on each health knowledge domain, with the largest gender differences occurring for the reproductive and early life scales.

In summary, health knowledge can be readily assessed with tools that have been devised to ensure proper content validity, internal consistency, and reliability. Moreover, the FitSmart is an assessment tool that has under gone tests of validity, consistency, and validity. To-date it has been utilized as a primary measure of health-related physical fitness knowledge in multiple age groupings with varying educational backgrounds. The results of health knowledge assessments provide substantial information to researchers and educators that should be used to evaluate the educational outcomes of students and health-related professionals to optimize knowledge retention and translation.

Assessment of Health-Related Beliefs, Attitudes, and Intentions

The reasoned action/planned behaviour approach has been used in attitude-behaviour research for decades as specific behaviours are reasonably determined by ones beliefs, attitudes, and intentions (Ajzen and Fishbein, 2005). However, early attempts in attitude-behaviour research to outline the determinants of specific behaviours usually produced poor correlation and unsatisfactory results. Recent research has shifted focus from broad to specific behavioural dispositions to attitudes toward behaviour. This was due to the notion that general attitudes are poor predictors of single behaviours; however, they correlate strongly with behavioural aggregates. Thus, current attitude assessments based on the reasoned action/planned behaviour model have turned to behaviour-focused attitudes that are congruent with behavioural criterion in terms of action, target, context, and time elements (Ajzen and Fishbein, 2005). Accordingly (and of interest to this thesis), Rhodes and Courneya (2003) have recognized these important considerations and have implemented them into their assessment protocols for use with a variety of population samples (e.g., young, old, healthy, and clinical). Specifically, Rhodes and Courneya (2003) developed a tool to investigate multiple components of the Theory of Planned Behaviour constructs (i.e., instrumental attitude, affective attitude, injunctive norm, descriptive norm, self efficacy, controllability, and intention) in the exercise domain within clinical and healthy population samples (i.e., cancer survivors, and university undergraduate students).

In 2004, a manual was developed in response to health service researcher's requests to predict and understand behaviour (Francis et al., 2004). The manual is based on the Theory of Planned Behaviour (Ajzen, 1988, 1991) and it is designed to assist psychologists and non-psychologists involved in health-related research to produce effective questionnaires to measure the constructs of the Theory of Planned Behaviour. For more information on the assessment of health-related beliefs, attitudes, and intentions refer to this manual.

Impact of Health Knowledge

Individuals with less education, lower incomes, and blue collar employment are more likely to be physically inactive than those with more education and higher paying white-collar employment (Draheim, 2002). Correspondingly, research indicates that people who are educated regarding fitness are more likely to be physically active and fit (Petersen et al., 2003). The consequences of a sedentary lifestyle are well documented and contribute to a myriad of hypokinetic diseases (Warburton et al., 2006a). Additionally, a large number of health economic studies have ascertained that higher education is associated with positive health outcomes, even when factors like income are controlled for (Kenkel, 1991). One explanation for this is that schooling helps people choose healthier lifestyles by improving their understanding of the relationships between health behaviour and health outcomes (Kenkel, 1991). Individual's that possess low levels of health knowledge will have a limited understanding of the benefits of engaging in healthy lifestyle behaviours. They will also have trouble identifying the symptoms and communicability of diseases, selecting appropriate preventative health strategies, and understanding where and how to select appropriate medical treatment (Freimuth, 1990). These health knowledge issues have been documented in individuals with intellectual disabilities (Graham, 2000; Stanish, 2006) and low levels of health literacy (Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association, 1999; Davis, 2004).

If individuals do not learn from health promotion efforts designed to highlight the relationships between health behaviours and health outcomes their ability to partake in a healthy and active lifestyle will be compromised. Thus, it is essential for health promotion efforts to target individuals based on their individual capabilities and needs

(Fish & Nies, 1996). For example, cohorts with increased knowledge will be able to receive and respond appropriately to more complex health promotional messages and services than those with less knowledge and intellectual capabilities. This example emphasizes the need to assess the health knowledge of people in order to maximize and target the effects of a health promotion intervention.

<u>Health Literacy</u>

According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), a functionally literate individual is one who possesses adequate knowledge in reading and writing which allows them to successfully participate in activities in which literacy is culturally assumed (United Nations Educational, Scientific and Cultural Organization, 1970). Literacy is directly related to overall health status and mental health status (Rootman, 2005). Health literacy includes dimensions additional to reading and writing abilities. It is referred to as the degree in which people have the competence to obtain, process, and understand basic health information and services needed to make appropriate health decisions (Parker et al., 2003). It is a contemporary and well warranted topic of concern for the advancement of high quality health care (Parker et al., 2003). Health literacy is pivotal to numerous health care system initiatives including quality assurance, cost maintenance, safety, and patient's active involvement in health care decisions (Parker et al., 2003).

The International Adult Literacy and Skills Survey (IALS) is the primary and current source of literacy measures of the general population in Canada and in other countries (Rootman, 2005). The most recent IALS results (circulated in 2005) highlighted major deficiencies in the literacy levels of the population (Statistics Canada, 2005). Almost half of the Canadian adult population falls into the lowest 2 of 5 literacy levels (outlined on p.16-17 (Statistics Canada, 2005)) in regards to their ability to read and comprehend prose (48%) and documents (49%). The majority of the population falls into the two lowest levels concerning problem solving ability (72%) and numeracy (55%) (Statistics Canada, 2005). Correspondingly, 22% of the Canadian adult population is seriously challenged in terms of literacy and another 26% have skills inadequate for what is required to successfully participate in today's "knowledge economy" (Rootman, 2005; Statistics Canada, 2005). Furthermore, special populations, such as the elderly, aboriginal people, immigrants, and francophones, were deemed to have significantly lower levels of literacy (Statistics Canada, 2005). In the United States, the American Medical Association has identified the high prevalence of inadequate health literacy among the elderly as a concern (Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association, 1999). In a study measuring patient's functional health literacy at two public hospitals via the Test of Functional Health Literacy (TOFHLA) (Parker, Baker, & Williams, 1995), 81.3% of English speaking patients equal to or above 60 years of age possessed inadequate or marginal levels of health literacy (Williams et al., 1995). This places considerable concern towards the health and well being of senior citizens given that the aging process is associated with a myriad of chronic degenerative co-morbidities which commonly result in increased health care utilization and dependency (WHO, 2002).

Inadequate health literacy can and usually is associated with several health-related consequences. Literacy is related to numerous aspects of health inclusive of health knowledge, health status and use of health services (Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association, 1999).

When related to health outcomes, patients with low literacy are generally 1.5-3 times more likely to experience inferior health outcomes inclusive of knowledge, transitional disease indicators, morbidity measures, utilization of health resources, and general health status (DeWalt et al., 2004). Using self report measures, patients with inadequate health literacy are more likely to report their health as poor (Baker et al., 1997). There exists an independent association between insufficient functional health literacy (determined via the TOFHLA) and hospital admissions (Baker et al., 1998). Previous investigation has showed that patients with inadequate functional health literacy were twice as likely to be hospitalized then patients with adequate literacy levels (Baker et al., 1998).

In terms of knowledge, there exists a positive and significant relationship between literacy levels and knowledge of health services or health outcomes (DeWalt et al., 2004). Studies indicate that individuals with low literacy capabilities and chronic or infectious diseases such as diabetes (Williams et al., 1998), hypertension (Williams et al., 1998), asthma (Williams et al., 1998), or HIV/AIDS (Kalichman et al., 2000) have inferior knowledge concerning their disease and its recommended treatment. Furthermore, research has indicated that poor health literacy alone is the most significant predictor of disease prevention knowledge when compared to ethnicity or education (Lindau et al., 2002). Uniformly, a study analyzing the relationship between literacy levels and asthma knowledge and self care (Williams et al., 1998) indicated that literacy level was the strongest correlate of health knowledge and disease management skills (Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association, 1999).

Summary

Health knowledge is a key determinant of health status. It is a valuable construct to assess as the findings can be used to improve health education initiatives in many disciplines. The Theory of Planned Behaviour has been utilized as the theoretical basis in hundreds of scientific investigations, and has aided in understanding a diverse array of health related behaviours. Assessments of the Theory of Planned Behaviour Constructs have become more specific over the years and can be utilized in the exercise domain with confidence. Based on the health literacy findings it is evident that health knowledge itself is an important factor in determining health status and health management skills. Even though literacy is a primary determinant of health knowledge, it is health knowledge itself which has a primary impact on the health behaviours and status of individuals. A preventative health care approach that incorporates low literacy interventions in collaboration with health education (low knowledge intervention) would be a viable initiative to accentuate health status across the lifespan. In order to construct a health promotional intervention as such, the individual capabilities and needs of individuals must be targeted. Research that functions to assess the current levels of health knowledge is a prudent elementary step in the process of tailoring an evidence based health promotion intervention.

Health-Related Physical Fitness

In this section, health-related physical fitness will be defined along with its components and primary contributors. The importance of conducting health-related fitness assessments will be discussed followed by an outline of the methods used to evaluate health-related physical fitness. The impact of health-related fitness will also be summarized.

Defining Health-Related Physical Fitness and Primary Contributors

Health-related physical fitness encompasses the components of physical fitness that are related to health status, including cardiovascular fitness, musculoskeletal fitness, body composition and metabolism (Warburton et al., 2006b). Health-related physical fitness is different than performance-related physical fitness, whereby performance-related physical fitness encompasses a set of attributes that people possess or achieve relating to their ability to perform specific physical challenges which can provide the fundamentals for sport or performance. Health-related physical fitness focuses on the health risks and benefits associated with each of its components in relation to the general population (CSEP, 2003).

More specifically, cardiovascular or aerobic fitness is a measure of the combined efficiency of the lungs, heart, bloodstream, and exercising muscles in getting oxygen to the muscles and putting it to work (CSEP, 2003). Musculoskeletal fitness refers to the fitness of the musculoskeletal system, encompassing muscular strength, muscular endurance, muscular power, flexibility, back fitness and bone health (Warburton et al., 2006). Muscular strength is referred to as the maximum tension or force a muscle can exert in a single contraction, while muscular endurance is the ability of the musculoskeletal system to maintain or repeatedly develop contractile force. Muscular power is a combination of strength and speed corresponding to the maximum rate of force generation within a single rapid contraction of the musculature. The range of motion in a joint or series of joints is known as flexibility (CSEP, 2003). The relative amounts of muscle, fat, bone and other anatomical components that contribute to a person's total body weight (U.S. Department of Health and Human Services, 1999) are what make up an individual's body composition and contribute to their metabolic capacity.

It is regularly assumed that health-related physical fitness is a product of habitual physical activity participation (Katzmarzyk, 1998). Physical Activity refers to any bodily movement produced by skeletal muscles that results in energy expenditure (EE) and is positively correlated with physical fitness (Caperson et al., 1985). When physical activity is planned, structured, and incorporates repetitive bodily movement geared towards improving or maintaining one or more components of physical fitness, it is referred to as exercise (Caperson et al., 1985).

Importance of Health-Related Physical Fitness Assessment

Health–related physical fitness is considered a significant component of health status (Katzmarzyk, 1998). The results of a stringent and standardized health-related fitness assessment can provide individuals with a lot of valuable information pertaining to their health status. This information is expected to educate individuals on their current health condition and contains evidence-based guidance on how to enhance current health by focusing on improvements in the lowest ranked fitness components. The provision of this information is intended to motivate individuals to develop healthier lifestyles and increase their physical activity participation in a safe, efficient and progressive fashion (CSEP, 2003). Aside from the individual benefits of a health-related fitness assessment, population health can be targeted by tailoring health promotion interventions to accommodate trends in epidemiological fitness data (Shephard, 1986).

Assessment of Health-Related Physical Fitness

The assessment of health-related physical fitness can be easily accomplished with the use of well established appraisal protocols from agencies such as the Canadian Society for Exercise Physiology (CSEP, 2003) and the American College of Sports Medicine (ACSM, 2005) (Warburton et al., 2006b). These assessments have been established based on normative regional data and are designed to appraise the individual elements of health-related physical fitness (see previous section) (Warburton et al., 2006b).

Specific to this investigation, the Canadian Physical Activity, Fitness and Lifestyle Approach (CPAFLA) (see Table A.1.) (CSEP, 2003), has been acknowledged as the most widely used standardized health-related fitness appraisal throughout Canada (Katzmarzyk, 2002). Furthermore, it is accepted as Canada's primary health-related physical assessment tool (Warburton et al., 2006b). This health-related fitness assessment protocol is administered on over a million Canadians every year (CSEP, 2003).

Impact of Health-Related Physical Fitness

While the risk of death for the most sedentary individuals is approximately twice as high as that of the most active individuals, the respective risk of low-fitness individuals is seven to eight times higher than that of high-fitness individuals (Oja, 1995). There appears to be a graded effect regarding the impact of physical fitness on the risk of premature death, such that even small improvements in physical fitness are associated with a decreased risk. An increase in physical fitness will reduce the risk of premature cardiovascular-related death, and a decrease in physical fitness will increase the risk. Regular physical activity participation in collaboration with high fitness levels are correlated to a decreased risk of premature fatality from any cause (especially cardiovascular related diseases) among asymptomatic men and women. Routine physical activity participation aids in the primary and secondary prevention of cardiovascular-related diseases, diabetes mellitus, cancer (colon and breast in particular), osteoporosis, depression, and obesity (see Warburton et al., 2006a for a more complete review of the literature).

Provided that aerobic fitness is defined as the combined efficiency of the lungs, heart, bloodstream, and exercising muscles in getting oxygen to the muscles and putting it to work, the health-related impact of aerobic fitness is significant and should not be overlooked. Improved aerobic fitness can be achieved by a variety of exercises and sporting activities, is essential for continual functional independence, and reduces the risks of cardiovascular-related diseases (e.g., heart failure) and risk factors (e.g., hypertension) (CSEP, 2003).

Composite body composition is assessed by combining BMI, skinfold measurement (approximation of body fat) and waist circumference. Unhealthy BMI values (either too low (< 18.5) or too high (> 24.9)) statistically increase one's risk of premature death (CSEP, 2003). Obesity is now a pandemic affecting many people worldwide. It is a condition of excess body fat that results from a chronic energy imbalance whereby intake exceeds expenditure. Too much body fat significantly increases a person's risk of premature death from chronic diseases such as coronary artery disease, stroke, type 2 diabetes mellitus, gallbladder disease and some cancers (Katzmarzyk, 2002). Obesity in collaboration with physical inactivity places a significant burden on the Canadian health care system by accrediting $9.6 billon towards their treatment and management (Katzmarzyk, 2004).

There is increasing evidence that inferior musculoskeletal fitness is associated with a decline in overall health status and an increase in the risk of chronic disease and disability (Warburton, 2001). Longitudinal investigations have discovered that individuals with low levels of muscular strength have increased functional limitations and higher incidences of chronic diseases including diabetes, stroke, coronary artery disease, arthritis, and pulmonary disorders (Rantanen, 1998). Furthermore, deficient musculoskeletal fitness is positively associated with functional dependence, immobility, glucose intolerance, poor bone health, psychological disturbances and decreased quality of life, increased risk of falls, illness and premature death (Warburton et al., 2006a).

Summary

The health-related physical fitness components (physical activity participation, body composition, aerobic and musculoskeletal fitness) and their contributors are essential to one's health status. There are many benefits associated with the assessment of health-related physical fitness. Moreover, the CPAFLA is a standardized and well recognized approach to the assessment of health-related physical fitness in the general population. Since the CPAFLA appraisal process is designed to increase one's knowledge and awareness concerning health-related physical fitness we hypothesize that individuals who participate in the CPAFLA will increase components of their health-related physical fitness knowledge base. Investigations that function to assess health-related physical fitness are of much relevance to health care practitioners and agencies promoting health.

Health Knowledge in Relation to Health-Related Physical Fitness

Knowledge is considered one of the essential factors in establishing human behaviour (Andrade, 1999). People who understand the concepts of physical fitness are also more likely to incorporate physical activity and exercise into their everyday life (Zhu et al., 1999). Thus, an important step in becoming physically fit and endorsing constructive attitudes in relation to fitness is learning the concepts and principles of health-related physical fitness (Miller & Housner, 1998). Evidence supporting a positive relationship between health-related physical fitness knowledge and health-related physical fitness has been suggested in adolescents (Keating, 2007), limitedly shown in adulthood (Avis, McKinlay, & Smith, 1990; Liang et al., 1993), and within elderly populations (Fitgerald, Singleton, Neale, Prasad, & Hess, 1994). However, literature delineating the relationship between health knowledge base and health-related physical fitness is inconsistent. For example, investigations have shown no significant relationship between fitness knowledge and components of physical fitness (i.e., physical activity) (Morrow et al., 2004). This section will outline the pertinent investigations that highlight the relationship between health-related physical fitness knowledge base and health-related physical fitness.

Health Knowledge and Physical Fitness in Adults

Avis et al. (1990) examined the level of cardiovascular risk factor knowledge and its relationship to behaviour in females. On average, the participants were more educated and had higher incomes in comparison to the general population. In addition, only a small portion was not Caucasian. Cardiovascular risk factor knowledge was assessed by asking participants to outline the specific steps an individual could take to decrease the risk of a stroke or heart attack. Interviewers lobbied respondents to mention all actions of which they were aware. The risk factors and health behaviours measured included smoking (self report # cigarettes per day), weight status (BMI), cholesterol (venous blood sample), physical activity (kilocalories expended via Harvard alumni scale (Paffenbarger, Wing, & Hyde, 1978)), blood pressure (standard sphygmomanometer), and stress (self report). Health knowledge was positively related to education ($p < .01$), being female ($P < .01$), and amount of exercise ($p < .05$). The authors suggested that the positive relationship between the health-related physical fitness components and health knowledge may have been mediated by the sampling of a higher socioeconomic bracket. Further investigation incorporating well established and standardized assessment measures is needed to quantify this relationship in representative samples of the general population. In addition, the results of this investigation suggest that education and knowledge are necessary to prevent negative health behaviours, but not sufficient to influence behavioural change once health damaging behaviours (e.g., smoking) have been established. Thus, evidence based health promotion programs focusing on prevention are needed to educate and increase knowledge regarding the positive relationship between health behaviours and health outcomes.

Liang et al. (1993) examined whether or not first year medical student's knowledge and attitudes concerning health and exercise affected physical fitness. The fitness assessment took into account body fat (hydrostatic weighing) and cardiovascular fitness (maximal aerobic fitness test ($VO2_{max}$)). A questionnaire was utilized to assess knowledge and attitudes regarding health promotion, disease prevention, and exercise. Results showed that health knowledge influenced medical student's fitness levels; however, attitudes concerning health promotion and disease prevention were stronger predictors of fitness levels

Morrow et al. (2004) studied the influence of exercise knowledge on the physical activity behaviours of American adults. All data was generated via random digit dialling phone interviews. A 20 item verbal questionnaire incorporating exercise prescription, traditional physical activities, and lifestyle activities was used to determine levels of health-related exercise knowledge. Physical activity behaviour was assessed by asking participants to select one of eight responses that functioned to best describe their current behaviour (Martin, Morrow, Jackson, & Dunn, 2000). Results indicated that knowledge of exercise recommendations had no effect on exercise behaviours; however, ethnicity, education level, and age were significantly correlated to health knowledge. The authors suggest that the results could support the concept of knowledge being required yet not sufficient for behaviour change. Other factors (e.g., self motivation, attitudes or perceived benefits) could be interacting with knowledge to influence behaviour change (Morrow et al., 2004). Nevertheless, it is recommended for health promotion programs to emphasize aspects of knowledge that are directly related to the behaviour change of interest. Rutledge et al. (2001) showed that greater knowledge concerning breast cancer and its detection methods was significantly correlated to breast self examination behaviours. Thus, individuals that possess specific knowledge regarding health-related physical fitness should be better predisposed to engage in these fitness behaviours. Unfortunately, even though many adults are aware of the benefits related to physical activity, many lack specific knowledge of how to be physically active for a health benefit (Morrow, Jackson, Bazzarre, Milne, & Blair, 1999).

Health Knowledge and Physical Fitness in the Elderly

Fitzgerald et al. (1994) examined physical activity (self report), measured fitness status, exercise knowledge, and exercise beliefs of African American and Caucasian females (ages 50-80) in good health. One question addressed in this investigation asked, "What are the exercise knowledge and beliefs of this group and how do exercise knowledge and beliefs relate to measured fitness status and exercise behaviour?". The degree to which exercise knowledge and beliefs are related to physical activity in the elderly is of much relevance to geriatric practitioners as preventative measures are essential to halt the aging process and increase longevity (Fitgerald et al., 1994). Fitness status was determined via a sub-maximal treadmill test (up to 70% predicted maximum heart rate). A 7-day physical activity recall estimating frequency and duration of significant aerobic exercise was utilized to assess physical activity. The exercise knowledge assessment consisted of three questions derived from the American College of Sport Medicine guidelines for cardiovascular fitness. Results indicated that exercise beliefs and knowledge do influence exercise habits. Fitzgerald et al. suggested that the regression model implemented for the statistical analysis was a poor fit of the data, meaning that the independent variables did not significantly explain fitness status (Fitgerald et al., 1994). This was most likely due to the variability in the measures used. A more rigorous fitness assessment along with knowledge assessment is recommended to examine the relationship of interest.

Summary

Knowledge is considered one of the critical factors in establishing human behavior (Andrade, 1999.) Furthermore, people who understand the concepts of physical fitness are also more likely to incorporate physical activity and exercise into their everyday life (Zhu et al., 1999). Thus, since regular physical activity participation is often assumed as a significant predictor of health-related physical fitness (Katzmarzyk, 1998), we postulate that individuals who possess superior levels of health-related physical fitness knowledge will demonstrate higher levels of health-related physical fitness.

To-date, literature demonstrating a positive relationship between fitness knowledge and health-related physical fitness in adulthood is limited. When analyzing why these previous investigations provide inconsistent evidence supporting this relationship, methodology seems to be the issue. Each investigation utilized different health knowledge assessments, measures of physical fitness, as well as sampling methods. Given the deviations in methodology between investigations the limited and inconsistent evidence is not surprising. A study or set of investigations that implement similar established, valid, and reliable protocols which function to evaluate this relationship within a cross-sectional design (e.g., young adulthood vs. middle adulthood) would make an important contribution to the current body of literature.

Table A.1. Components of the Canadian Physical Activity, Fitness and Lifestyle Approach (CPAFLA): A Standardized Health-Related Physical Fitness Assessment Tool (Adapted from CSEP, 2003).

Pre-Appraisal Screening

- The Physical Activity Readiness Questionnaire (PAR-Q)
    - A pre-activity screening tool designed to identify people for whom certain physical activities may be inappropriate and those who should seek medical advice (e.g., individuals with documented cardiovascular disease).
- Measurement of resting heart rate and blood pressure
- The Healthy Physical Activity Participation Questionnaire
    - Used to assess current levels of physical activity

Composite Body Composition Assessment

- Body mass index
- Waist circumference
- Skinfold thickness (a measure of subcutaneous body fat)

Assessment of Aerobic Fitness

- Modified Canadian Aerobic Fitness Test (mCAFT)
    - A valid and reliable, predictive, submaximal, and progressive step exercise test designed specifically for the general population

Assessment of Musculoskeletal Fitness

- Grip strength
- Push-ups
- Sit-and-reach test
- Partial curl-ups
- Vertical jump
- Back extension endurance

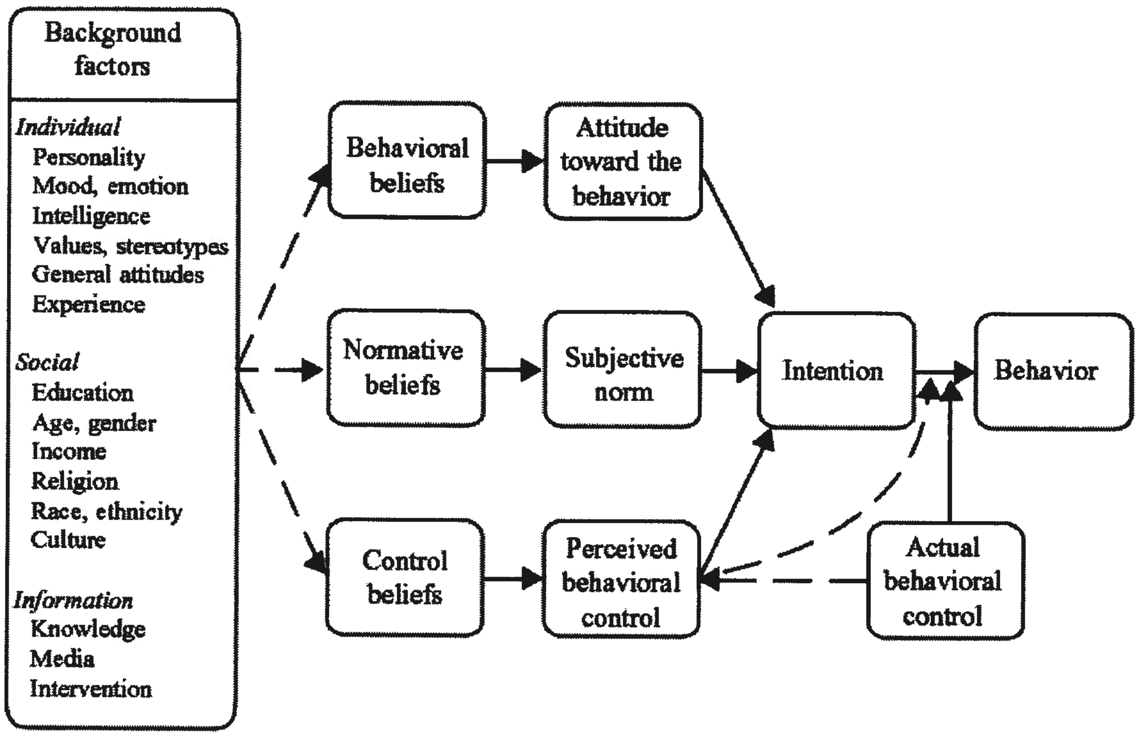
Assessment of back health

- Weighted scores for physical activity participation, waist circumference, sit and reach, partial curl-ups, and back extension, are combined to provide an indication of composite back fitness.

Results and Counselling Session

- Individual results generated based on Canadian normative data
- Evidence based guidance provided to stress the health benefits of regular physical activity participation
- Fitness goals are set based on individual data

Figure A.1. Schematic of the Theory of Reasoned Action/Planned Behaviour (From Ajzen & Fishbein, 2005).



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APPENDIX B

UBC Clinical Research Ethics Board Certificate of Approval

The University of British Columbia
Office of Research Services
Clinical Research Ethics Board – Room 210, 828 West 10th Avenue, Vancouver, BC V5Z 1L8

ETHICS CERTIFICATE OF FULL BOARD APPROVAL

PRINCIPAL INVESTIGATOR:	INSTITUTION / DEPARTMENT:	UBC CREB NUMBER:
Shannon S.D. Bredin	UBC/Education/Human Kinetics	H08-00468

INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT:

Institution	Site
UBC	Vancouver (excludes UBC Hospital)

Other locations where the research will be conducted:
N/A

CO-INVESTIGATOR(S):
Marc D. Faktor
Darren Warburton
Ryan Rhodes

SPONSORING AGENCIES:
N/A

PROJECT TITLE:
HEALTH-RELATED PHYSICAL FITNESS KNOWLEDGE: THE INFLUENCE OF PHYSICAL FITNESS AND ADMINISTRATION OF THE CANADIAN PHYSICAL ACTIVITY FITNESS & LIFESTYLE APPROACH.

THE CURRENT UBC CREB APPROVAL FOR THIS STUDY EXPIRES: April 8, 2009

The full UBC Clinical Research Ethics Board has reviewed the above described research project, including associated documentation noted below, and finds the research project acceptable on ethical grounds for research involving human subjects and hereby grants approval.

REB FULL BOARD MEETING REVIEW DATE:
April 8, 2008

DOCUMENTS INCLUDED IN THIS APPROVAL: | **DATE DOCUMENTS APPROVED:**

Document Name	Version	Date	Date Documents Approved
Protocol:			
Condensed Research Proposal	1	February 21, 2008	**June 20, 2008**
Consent Forms:			

Informed Consent Form	2	June 4, 2008	
Advertisements:			
Recruitment Notice	2	June 6, 2008	
Questionnaire, Questionnaire Cover Letter, Tests:			
FitSmart: Health-Related Physical Fitness Knowledge Examination Forms 1 and 2	N/A	March 7, 2008	
Health Literacy Assessment (Newest Vital Sign Score Sheet)	1	June 6, 2008	
Health Literacy Assessment (Newest Vital Sign Nutrition Label)	1	June 6, 2008	
PAR-Q	2	June 4, 2008	
PARmed-X	1	January 9, 2008	
Physical Activity Beliefs and Attitudes Survey	2	April 21, 2008	
Health Literacy Assessment (PAR-Q)	1	June 13, 2008	
Letter of Initial Contact:			
Letter of Initial Contact	2	June 6, 2008	
Other Documents:			
External Peer Review Report	1	February 19, 2008	

CERTIFICATION:

In respect of clinical trials:

1. The membership of this Research Ethics Board complies with the membership requirements for Research Ethics Boards defined in Division 5 of the Food and Drug Regulations.

2. The Research Ethics Board carries out its functions in a manner consistent with Good Clinical Practices.

3. This Research Ethics Board has reviewed and approved the clinical trial protocol and informed consent form for the trial which is to be conducted by the qualified investigator named above at the specified clinical trial site. This approval and the views of this Research Ethics Board have been documented in writing.

The documentation included for the above-named project has been reviewed by the UBC CREB, and the research study, as presented in the documentation, was found to be acceptable on ethical grounds for research involving human subjects and was approved by the UBC CREB.

Approval of the Clinical Research Ethics Board by one of:

Dr. Gail Bellward,
Chair

APPENDIX C

Sample FitSmart Health Knowledge Examination Questions

1. The most accurate indicator of cardiorespiratory fitness is

A. percent body fat.
B. maximum oxygen uptake.
C. resting heart rate.
D. vital capacity.

2. Which of the following principles about physical fitness is most accurate?

A. It is reversible and needs continuous exercise through moderate to vigorous activity.
B. It is a permanent quality which carries over from youth into adulthood.
C. It is maintained through heavy exercise.
D. it is maintained through a person's normal lifetime activities

3. What is the relationship between physical fitness and health?

A. People who are highly fit are always healthier; people who have poor fitness are always unhealthier.
B. People who are moderately fit typically enjoy good health.
C. The relationship is more important for children than adults.
D. There is no relationship between physical fitness and health.

4. An individual's heart rate immediately after exercise indicates

A. the recovery rate of the heart.
B. the strength of the heart.
C. the intensity of the exercise.
D. all of the above.

5. Which of the following occurs to muscle fibers with regular weight training?

A. Increase in number
B. Increase in size
C. Increase in length
D. Increase in fat

6. Threshold of training refers to the effort needed to increase fitness. It applies to which of the following?

A. Minimum effort required
B. Maximum effort required
C. Level of effort when fitness begins to decline
D. Level of effort associated with decreasing intensity of exercise

APPENDIX D

Theory of Planned Behaviour Component Assessment

Identification #__________

Regular Physical Activity Beliefs and Attitudes Survey
Instructions

In this survey, we are going to ask you a series of questions about your beliefs and attitudes towards regular physical activity. There are no right or wrong answers and all we ask is that you provide responses that are as honest and accurate as possible. The questionnaire should take about 15 minutes for you to complete. All responses are completely confidential and will never be used in any way that could link them to you. It is important to answer all questions so that we can include your responses in our analyses. If you have any questions please ask the research assistant. When your questionnaire is completed, please raise your hand and the research assistant will collect your questionnaire.

Definition of Regular Physical Activity

All the questions in this survey ask you about regular physical activity. Here, we define regular physical activity as:

A) leisure-time activity performed at least 3 times per week, for at least 20-30 minutes in duration (can include multiple daily sessions of 10 minutes), at a vigorous intensity (i.e., hard breathing, heart beats rapidly, heavy sweating). Some examples of vigorous physical activities are running, jogging, aerobics, circuit weight training, and vigorous sports such as hockey or soccer. Or,

B) leisure-time activity performed at least 3 times per week, for at least 30-60 minutes in duration (can include multiple daily sessions of 10 minutes) at a moderate intensity (i.e., slightly increased breathing, faster then normal but not rapid heart beat, light sweating, can keep a conversation going). Some examples of moderate intensity physical activities are brisk walking, yoga, house work, bicycling 5 to 9 mph, water aerobics and sports such as baseball, golf while carrying clubs, and archery.

The following question asks you to rate how you feel about participating in regular physical activity on 6 different scales. Pay careful attention to the words and descriptors at the end of each scale and place an "X" over the line that best represents how you feel about participating in regular physical activity. Please answer all items from a) to f).

1. For me, participating in regular physical activity over the next month would be:

a)

_____	_____	_____	_____	_____	_____	_____
extremely harmful	quite harmful	slightly harmful	neutral	slightly beneficial	quite beneficial	extremely beneficial

b)

_____	_____	_____	_____	_____	_____	_____
extremely useless	quite useless	slightly useless	neutral	slightly useful	quite useful	extremely useful

c)

_____	_____	_____	_____	_____	_____	_____
extremely unimportant	quite unimportant	slightly unimportant	neutral	slightly important	quite important	extremely important

d)

_____	_____	_____	_____	_____	_____	_____
extremely unenjoyable	quite unenjoyable	slightly unenjoyable	neutral	slightly enjoyable	quite enjoyable	extremely enjoyable

e)

_____	_____	_____	_____	_____	_____	_____
extremely boring	quite boring	slightly boring	neutral	slightly fun	quite fun	extremely fun

f)

_____	_____	_____	_____	_____	_____	_____
extremely painful	quite painful	slightly painful	neutral	slightly pleasurable	quite pleasurable	extremely pleasurable

This next set of questions ask you to rate how other people in your life may feel about you participating in regular physical activity over the next month. Pay careful attention to the words and descriptors at the end of each scale and place an "X" over the line that best represents what you think about their feelings. Please answer all items from a) to c).

2. I think that if I were to participate in regular physical activity over the next month, most people who are important to me would be:

a) _____ _____ _____ _____ _____ _____ _____

extremely disapproving	quite disapproving	slightly disapproving	neutral	slightly approving	quite approving	extremely approving

b)

______	______	______	______	______	______	______
extremely unsupportive	quite unsupportive	slightly unsupportive	neutral	slightly supportive	quite supportive	extremely supportive

c)

______	______	______	______	______	______	______
extremely discouraging	quite discouraging	slightly discouraging	neutral	slightly encouraging	quite encouraging	extremely encouraging

This next set of questions ask you to rate how active you think other people in your life are likely to be over the next month. Pay careful attention to the words and descriptors at the end of each scale and place an "X" over the line that best represents their physical activity levels.

3. I think that over the next month, most people who are important to me will be:

____	____	____	____	____	____	____
extremely inactive	quite inactive	slightly inactive	neutral	slightly active	quite active	extremely active

4. I think that over the next month, most people who are important to me will participate in regular physical activity.

____	____	____	____	____	____	____
extremely disagree	quite disagree	slightly disagree	neutral	slightly agree	quite agree	extremely agree

5. I think that over the next month, the regular physical activity participation levels of most people who are important to me will be:

____	____	____	____	____	____	____
extremely low	quite low	slightly low	neutral	slightly high	quite high	extremely high

This next set of questions ask you to rate how likely you feel it is that <u>you will be able</u> to participate in regular physical activity over the next month <u>if you were really motivated</u>. Pay careful attention to the words and descriptors at the end of each scale and place an "X" over the line that best represents your feelings.

6. If you were really motivated, how controllable would it be for you to participate in regular physical activity over the next month?

____	____	____	____	____	____	____
extremely uncontrollable	quite uncontrollable	slightly uncontrollable	neutral	slightly controllable	quite controllable	extremely controllable

7. If you were really motivated, how easy or difficult would it be for you to participate in regular physical activity over the next month?

____	____	____	____	____	____	____
extremely difficult	quite difficult	slightly difficult	neutral	slightly easy	quite easy	extremely easy

8. If you were really motivated, do you feel that whether or not you participate in regular physical activity over the next month would be completely up to you?

____	____	____	____	____	____	____
extremely disagree	quite disagree	slightly disagree	neutral	slightly agree	quite agree	extremely agree

9. If you were really motivated, how confident are you that you could participate in regular physical activity over the next month?

____	____	____	____	____	____	____
extremely	quite	slightly	neutral	slightly	quite	extremely

unconfident unconfident unconfident confident confident
confident

10. If you were really motivated, do you feel you would have complete control over whether or not you were physically active over the next month?

_____	_____	_____	_____	_____	_____	_____
extremely untrue	quite untrue	slightly untrue	neutral	slightly true	quite true	extremely true

11. If you were really motivated, how certain or uncertain would you be that you could participate in regular physical activity over the next month?

_____	_____	_____	_____	_____	_____	_____
extremely uncertain	quite uncertain	slightly uncertain	neutral	slightly certain	quite certain	extremely certain

This next set of questions ask you to rate how motivated you are to participate in regular physical activity over the next month. Pay careful attention to the words and descriptors at the end of each scale and place an "X" over the line that best represents your motivation.

12. How motivated are you to participate in regular physical activity over the next month?

_____	_____	_____	_____	_____	_____	_____
extremely unmotivated	quite unmotivated	slightly unmotivated	neutral	slightly motivated	quite motivated	extremely motivated

13. I strongly intend to do everything I can to participate in regular physical activity over the next month.

_____	_____	_____	_____	_____	_____	_____
extremely untrue	quite untrue	slightly untrue	neutral	slightly true	quite true	extremely true

14. How committed are you to participating in regular physical activity over the next month?

_____	_____	_____	_____	_____	_____	_____
extremely uncommitted	quite uncommitted	slightly uncommitted	neutral	slightly committed	quite committed	extremely committed

15. I intend to participate in vigorous physical activity _____ times per week over the next month for _____ minutes each time.
(please place a number between 0 and 7) (please place a number between 0 and 60)

16. I intend to participate in light-moderate physical activity _____ times per week over the next month for _____ minutes each time.
(please place a number between 0 and 7) (please place a number between 0 and 60)

For this next question, we would like you to recall your average weekly physical activity participation over the past month. How many times per week on average did you do the following kinds of physical activity over the past month?

When answering these questions please:

- ☐ consider your average over the past month.
- ☐ only count physical activity sessions that lasted 10 minutes or longer in duration.
- ☐ note that the main difference between the three categories is the intensity of the exercise.
- ☐ please write the average frequency on the first line and the average duration on the second line.

	Times Per Week	Average Duration Per Session
a. STRENUOUS (HEART BEATS RAPIDLY, SWEATING) (e.g., running, jogging, hockey, soccer, squash, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling, vigorous aerobic dance classes, heavy weight training)	________	________
b. MODERATE EXERCISE (NOT EXHAUSTING, LIGHT PERSPIRATION) (e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)	________	________
c. MILD EXERCISE (MINIMAL EFFORT, NO PERSPIRATION) (e.g., easy walking, yoga, archery, fishing, bowling, lawn bowling, shuffleboard, horseshoes, golf, snowmobiling)	________	________

This last part of the questionnaire is needed to help understand the characteristics of the people participating in the study. For this reason it is very important information. All information is held in strict confidence and its presentation to the public will be group data only.

1. Age: ______

2. Sex: Male_____ Female _____

3. With which ethnic group do you identify? ________________

4. Education Level (Highest formal education diploma/certificate received or in-progress) ________

5. Annual Income (If supported by parents please select their annual income): < $20,000 _____
$20-39,000 _____ $40-59,000 _____

$60-79,000 _____ $80-99,000 _____ > $100,000 _____

APPENDIX E

The Newest Vital Sign (NVS) health literacy assessment

Nutrition Label

Nutrition Facts

Serving Size			**½ cup**
Servings per container			**4**
Amount per serving			
Calories	**250**	**Fat Cal**	**120**
			%DV
Total Fat 13g			**20%**
Sat Fat 9g			**40%**
Cholesterol 28mg			**12%**
Sodium 55mg			**2%**
Total Carbohydrate 30g			**12%**
Dietary Fiber 2g			
Sugars 23g			
Protein 4g			**8%**

***Percentage Daily Values (DV) are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.**

Ingredients: Cream, Skim Milk, Liquid Sugar, Water, Egg Yolks, Brown Sugar, Milkfat, Peanut Oil, Sugar, Butter, Salt, Carrageenan, Vanilla Extract.

The Newest Vital Sign (NVS) health literacy assessment

Score Sheet

Score Sheet for the Newest Vital Sign Questions and Answers

READ TO SUBJECT: This information is on the back of a container of a pint of ice cream.

Question	ANSWER CORRECT? yes	no
1. If you eat the entire container, how many calories will you eat? ***Answer:*** *1,000 is the only correct answer*		
2. If you are allowed to eat 60 grams of carbohydrates as a snack, how much ice cream could you have? ***Answer:*** *Any of the following is correct: 1 cup (or any amount up to 1 cup), Half the container Note: If patient answers "two servings," ask "How much ice cream would that be if you were to measure it into a bowl."*		
3. Your doctor advises you to reduce the amount of saturated fat in your diet. You usually have 42 g of saturated fat each day, which includes one serving of ice cream. If you stop eating ice cream, how many grams of saturated fat would you be consuming each day? ***Answer:*** *33 is the only correct answer*		
4. If you usually eat 2500 calories in a day, what percentage of your daily value of calories will you be eating if you eat one serving? ***Answer:*** *10% is the only correct answer*		
READ TO SUBJECT: Pretend that you are allergic to the following substances: Penicillin, peanuts, latex gloves, and bee stings. 5. Is it safe for you to eat this ice cream? ***Answer:*** *No*		
6. (Ask only if the patient responds "no" to question 5): Why not? ***Answer:*** *Because it has peanut oil.*		
Number of correct answers:		

Interpretation

Score of 0-1 suggests high likelihood (50% or more) of limited literacy
Score of 2-3 indicates the possibility of limited literacy.
Score of 4-6 almost always indicates adequate literacy.

APPENDIX F

CFAFLA Preliminary Instructions for Participants

Name of Participant________________________________ Age_____________

Appraisal Date________________ Time__________ Location______________

Name of Appraiser____

Please adhere to the following conditions for the appraisal:

Dress Requirements: Shorts and short-sleeved or sleeveless shirt/blouse should be worn. Running shoes are the recommended footwear.

Food and Beverages: Do not eat for at least two hours prior to your appraisal. Also refrain from drinking caffeine beverages for two hours and alcoholic drinks for six hours prior to the appraisal.

Smoking: Do not smoke during the two hours prior to the appraisal

Physical Activity: Strenuous physical activity should be avoided for six hours prior to the appraisal.

Note:

- Failing to adhere to the above conditions may affect your results negatively.

Source: (CSEP, 2003). *The Canadian Physical Activity, Fitness & Lifestyle Approach*

APPENDIX G

Physical Activity Readiness Questionnaire (PAR-Q)

Physical Activity Readiness Questionnaire - PAR-Q (revised 2002)

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO	
☐	☐	**1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?**
☐	☐	**2. Do you feel pain in your chest when you do physical activity?**
☐	☐	**3. In the past month, have you had chest pain when you were not doing physical activity?**
☐	☐	**4. Do you lose your balance because of dizziness or do you ever lose consciousness?**
☐	☐	**5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
☐	☐	**6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?**
☐	☐	**7. Do you know of any other reason why you should not do physical activity?**

If you answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or
- if you are or may be pregnant – talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME ________________________________

SIGNATURE ________________________________ DATE ________________

SIGNATURE OF PARENT ________________________________ WITNESS ________________
or GUARDIAN (for participants under the age of majority)

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

 Supported by: Health Canada Santé Canada

continued on other side...

Source: (CSEP, 2003). *The Canadian Physical Activity, Fitness & Lifestyle Approach*

APPENDIX H

Physical Activity Readiness Medical Examination (PARmed-X)

Physical Activity Readiness Medical Examination (revised 2002)

PARmed-X PHYSICAL ACTIVITY READINESS MEDICAL EXAMINATION

The PARmed-X is a physical activity-specific checklist to be used by a physician with patients who have had positive responses to the Physical Activity Readiness Questionnaire (PAR-Q). In addition, the Conveyance/Referral Form in the PARmed-X can be used to convey clearance for physical activity participation, or to make a referral to a medically-supervised exercise program.

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. The PAR-Q by itself provides adequate screening for the majority of people. However, some individuals may require a medical evaluation and specific advice (exercise prescription) due to one or more positive responses to the PAR-Q.

Following the participant's evaluation by a physician, a physical activity plan should be devised in consultation with a physical activity professional (CSEP-Professional Fitness & Lifestyle Consultant or CSEP-Exercise Therapist™). To assist in this, the following instructions are provided:

PAGE 1: • Sections A, B, C, and D should be completed by the participant BEFORE the examination by the physician. The bottom section is to be completed by the examining physician.

PAGES 2 & 3: • A checklist of medical conditions requiring special consideration and management.

PAGE 4: • Physical Activity & Lifestyle Advice for people who do not require specific instructions or prescribed exercise.

• Physical Activity Readiness Conveyance/Referral Form - an optional tear-off tab for the physician to convey clearance for physical activity participation, or to make a referral to a medically-supervised exercise program.

This section to be completed by the participant

A PERSONAL INFORMATION:

NAME ______________________

ADDRESS ______________________

____

TELEPHONE ______________________

BIRTHDATE ______________ GENDER ________

MEDICAL No. ______________________

B PAR-Q: Please indicate the PAR-Q questions to which you answered YES

- ❑ Q 1 Heart condition
- ❑ Q 2 Chest pain during activity
- ❑ Q 3 Chest pain at rest
- ❑ Q 4 Loss of balance, dizziness
- ❑ Q 5 Bone or joint problem
- ❑ Q 6 Blood pressure or heart drugs
- ❑ Q 7 Other reason: ______________

C RISK FACTORS FOR CARDIOVASCULAR DISEASE:

Check all that apply

- ❑ Less than 30 minutes of moderate physical activity most days of the week.
- ❑ Currently smoker (tobacco smoking 1 or more times per week).
- ❑ High blood pressure reported by physician after repeated measurements.
- ❑ High cholesterol level reported by physician.
- ❑ Excessive accumulation of fat around waist.
- ❑ Family history of heart disease.

Please note: Many of these risk factors are modifiable. Please refer to page 4 and discuss with your physician.

D PHYSICAL ACTIVITY INTENTIONS:

What physical activity do you intend to do?

____

____

____

This section to be completed by the examining physician

Physical Exam:

Ht	Wt	BP i) /
		BP ii) /

Conditions limiting physical activity:

- ❑ Cardiovascular ❑ Respiratory ❑ Other
- ❑ Musculoskeletal ❑ Abdominal

Tests required:

- ❑ ECG ❑ Exercise Test ❑ X-Ray
- ❑ Blood ❑ Urinalysis ❑ Other

Physical Activity Readiness Conveyance/Referral:

Based upon a current review of health status, I recommend:

Further Information:
- ❑ Attached
- ❑ To be forwarded
- ❑ Available on request

- ❑ No physical activity
- ❑ Only a medically-supervised exercise program until further medical clearance
- ❑ Progressive physical activity:
  - ❑ with avoidance of: ______________
  - ❑ with inclusion of: ______________
  - ❑ under the supervision of a CSEP-Professional Fitness & Lifestyle Consultant or CSEP-Exercise Therapist™
- ❑ Unrestricted physical activity—start slowly and build up gradually

Supported by: Health Canada Santé Canada

Source: (CSEP, 2003). *The Canadian Physical Activity, Fitness & Lifestyle Approach*

Appendix G

Physical Activity Readiness Medical Examination (PARmed-X)

Physical Activity Readiness
Medical Examination
(revised 2002)

PARmed-X PHYSICAL ACTIVITY READINESS MEDICAL EXAMINATION

Following is a checklist of medical conditions for which a degree of precaution and/or special advice should be considered for those who answered "YES" to one or more questions on the PAR-Q, and people over the age of 69. Conditions are grouped by system. Three categories of precautions are provided. Comments under Advice are general, since details and alternatives require clinical judgement in each individual instance.

	Absolute Contraindications	Relative Contraindications	Special Prescriptive Conditions	ADVICE
	Permanent restriction or temporary restriction until condition is treated, stable, and/or past acute phase.	Highly variable. Value of exercise testing and/or program may exceed risk. Activity may be restricted. Desirable to maximize control of condition. Direct or indirect medical supervision of exercise program may be desirable.	Individualized prescriptive advice generally appropriate: • limitations imposed; and/or • special exercises prescribed. May require medical monitoring and/or initial supervision in exercise program.	
Cardiovascular	☐ aortic aneurysm (dissecting) ☐ aortic stenosis (severe) ☐ congestive heart failure ☐ crescendo angina ☐ myocardial infarction (acute) ☐ myocarditis (active or recent) ☐ pulmonary or systemic embolism—acute ☐ thrombophlebitis ☐ ventricular tachycardia and other dangerous dysrhythmias (e.g., multi-focal ventricular activity)	☐ aortic stenosis (moderate) ☐ subaortic stenosis (severe) ☐ marked cardiac enlargement ☐ supraventricular dysrhythmias (uncontrolled or high rate) ☐ ventricular ectopic activity (repetitive or frequent) ☐ ventricular aneurysm ☐ hypertension—untreated or uncontrolled severe (systemic or pulmonary) ☐ hypertrophic cardiomyopathy ☐ compensated congestive heart failure	☐ aortic (or pulmonary) stenosis—mild angina pectoris and other manifestations of coronary insufficiency (e.g., post-acute infarct) ☐ cyanotic heart disease ☐ shunts (intermittent or fixed) ☐ conduction disturbances • complete AV block • left BBB • Wolff-Parkinson-White syndrome ☐ dysrhythmias—controlled ☐ fixed rate pacemakers	• clinical exercise test may be warranted in selected cases, for specific determination of functional capacity and limitations and precautions (if any). • slow progression of exercise to levels based on test performance and individual tolerance. • consider individual need for initial conditioning program under medical supervision (indirect or direct).
			☐ intermittent claudication	progressive exercise to tolerance
			☐ hypertension: systolic 160-180; diastolic 105+	progressive exercise; care with medications (serum electrolytes; post-exercise syncope; etc.)
Infections	☐ acute infectious disease (regardless of etiology)	☐ subacute/chronic/recurrent infectious diseases (e.g., malaria, others)	☐ chronic infections ☐ HIV	variable as to condition
Metabolic		☐ uncontrolled metabolic disorders (diabetes mellitus, thyrotoxicosis, myxedema)	☐ renal, hepatic & other metabolic insufficiency	variable as to status
			☐ obesity ☐ single kidney	dietary moderation, and initial light exercises with slow progression (walking, swimming, cycling)
Pregnancy		☐ complicated pregnancy (e.g., toxemia, hemorrhage, incompetent cervix, etc.)	☐ advanced pregnancy (late 3rd trimester)	refer to the "PARmed-X for PREGNANCY"

References:

Arraix, G.A., Wigle, D.T., Mao, Y. (1992). Risk Assessment of Physical Activity and Physical Fitness in the Canada Health Survey Follow-Up Study. J. Clin. Epidemiol. 45:4 419-428.

Mottola, M., Wolfe, L.A. (1994). Active Living and Pregnancy, In: A. Quinney, L. Gauvin, T. Wall (eds.), Toward Active Living: Proceedings of the International Conference on Physical Activity, Fitness and Health. Champaign, IL: Human Kinetics.

PAR-Q Validation Report, British Columbia Ministry of Health, 1978.

Thomas, S., Reading, J., Shephard, R.J. (1992). Revision of the Physical Activity Readiness Questionnaire (PAR-Q). Can. J. Spt. Sci. 17: 4 338-345.

The PAR-Q and PARmed-X were developed by the British Columbia Ministry of Health. They have been revised by an Expert Advisory Committee of the Canadian Society for Exercise Physiology chaired by Dr. N. Gledhill (2002).

Disponible en français sous le titre
«Évaluation médicale de l'aptitude à l'activité physique (X-AAP)»

Continued on page 3...

Source: (CSEP, 2003). *The Canadian Physical Activity, Fitness & Lifestyle Approach*

Physical Activity Readiness Medical Examination (PARmed-X)

Physical Activity Readiness
Medical Examination
(revised 2002)

	Special Prescriptive Conditions	ADVICE
Lung	❑ chronic pulmonary disorders	special relaxation and breathing exercises
	❑ obstructive lung disease ❑ asthma	breath control during endurance exercises to tolerance; avoid polluted air
	❑ exercise-induced bronchospasm	avoid hyperventilation during exercise; avoid extremely cold conditions; warm up adequately; utilize appropriate medication.
Musculoskeletal	❑ low back conditions (pathological, functional)	avoid or minimize exercise that precipitates or exasperates e.g., forced extreme flexion, extension, and violent twisting; correct posture, proper back exercises
	❑ arthritis—acute (infective, rheumatoid; gout)	treatment, plus judicious blend of rest, splinting and gentle movement
	❑ arthritis—subacute	progressive increase of active exercise therapy
	❑ arthritis—chronic (osteoarthritis and above conditions)	maintenance of mobility and strength; non-weightbearing exercises to minimize joint trauma (e.g., cycling, aquatic activity, etc.)
	❑ orthopaedic	highly variable and individualized
	❑ hernia	minimize straining and isometrics; stregthen abdominal muscles
	❑ osteoporosis or low bone density	avoid exercise with high risk for fracture such as push-ups, curl-ups, vertical jump and trunk forward flexion; engage in low-impact weight-bearing activities and resistance training
CNS	❑ convulsive disorder not completely controlled by medication	minimize or avoid exercise in hazardous environments and/or exercising alone (e.g., swimming, mountainclimbing, etc.)
	❑ recent concussion	thorough examination if history of two concussions; review for discontinuation of contact sport if three concussions, depending on duration of unconsciousness, retrograde amnesia, persistent headaches, and other objective evidence of cerebral damage
Blood	❑ anemia—severe (< 10 Gm/dl) ❑ electrolyte disturbances	control preferred; exercise as tolerated
Medications	❑ antianginal ❑ antiarrhythmic ❑ antihypertensive ❑ anticonvulsant ❑ beta-blockers ❑ digitalis preparations ❑ diuretics ❑ ganglionic blockers ❑ others	NOTE: consider underlying condition. Potential for: exertional syncope, electrolyte imbalance, bradycardia, dysrhythmias, impaired coordination and reaction time, heat intolerance. May alter resting and exercise ECG's and exercise test performance.
Other	❑ post-exercise syncope	moderate program
	❑ heat intolerance	prolong cool-down with light activities; avoid exercise in extreme heat
	❑ temporary minor illness	postpone until recovered
	❑ cancer	if potential metastases, test by cycle ergometry, consider non-weight bearing exercises; exercise at lower end of prescriptive range (40-65% of heart rate reserve), depending on condition and recent treatment (radiation, chemotherapy); monitor hemoglobin and lymphocyte counts; add dynamic lifting exercise to strengthen muscles, using machines rather than weights.

*Refer to special publications for elaboration as required

The following companion forms are available online: http://www.csep.ca/forms.asp

The Physical Activity Readiness Questionnaire (PAR-Q) - a questionnaire for people aged 15-69 to complete before becoming much more physically active.

The Physical Activity Readiness Medical Examination for Pregnancy (PARmed-X for PREGNANCY) - to be used by physicians with pregnant patients who wish to become more physically active.

For more information, please contact the:

Canadian Society for Exercise Physiology
202 - 185 Somerset St. West
Ottawa, ON K2P 0J2
Tel. 1-877-651-3755 • FAX (613) 234-3565 • Online: www.csep.ca

Note to physical activity professionals...

It is a prudent practice to retain the completed Physical Activity Readiness Conveyance/Referral Form in the participant's file.

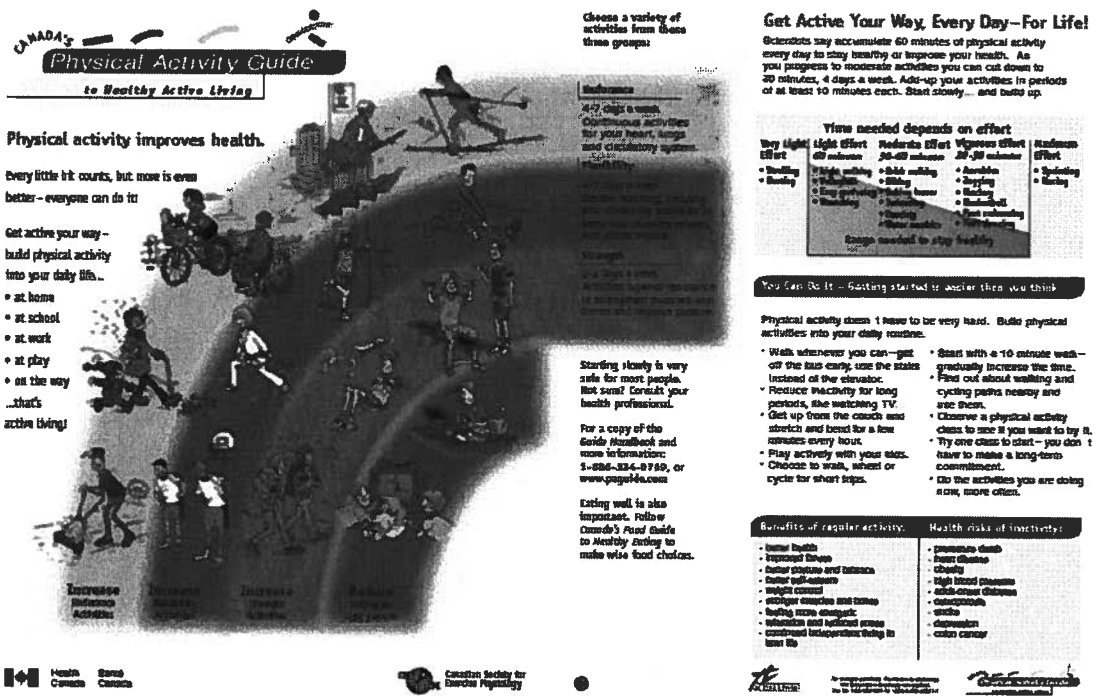
Continued on page 4...

Source: (CSEP, 2003). *The Canadian Physical Activity, Fitness & Lifestyle Approach.*

Physical Activity Readiness Medical Examination (PARmed-X)

Physical Activity Readiness
Medical Examination
(revised 2002)

PARmed-X PHYSICAL ACTIVITY READINESS MEDICAL EXAMINATION



Source: Canada's Physical Activity Guide to Healthy Active Living, Health Canada, 1998 http://www.hc-sc.gc.ca/hppb/paguide/pdf/guideEng.pdf

PARmed-X Physical Activity Readiness Conveyance/Referral Form

Based upon a current review of the health status of ______________________________, I recommend:

- ❑ No physical activity
- ❑ Only a medically-supervised exercise program until further medical clearance
- ❑ Progressive physical activity
  - ❑ with avoidance of: ______________________________
  - ❑ with inclusion of: ______________________________
  - ❑ under the supervision of a CSEP-Professional Fitness & Lifestyle Consultant or CSEP-Exercise Therapist™
- ❑ Unrestricted physical activity — start slowly and build up gradually

Further Information:
- ❑ Attached
- ❑ To be forwarded
- ❑ Available on request

Physician/clinic stamp:

______________________________ M.D.

______________________________ 20______
(date)

NOTE: This physical activity clearance is valid for a maximum of six months from the date it is completed and becomes invalid if your medical condition becomes worse.

4

Source: (CSEP, 2003). *The Canadian Physical Activity, Fitness & Lifestyle Approach*

APPENDIX I

CPAFLA Adult Consent Form

I, the undersigned, do hereby acknowledge:

- my consent to perform a health-related fitness appraisal consisting of stepping on double 20 cm steps at speeds appropriate for my age and gender, measurements of standing height, weight, circumference, and skinfolds, and tests of grip strength, push-ups, sit and reach, curl-ups, vertical jump and back extension test, the results of which will assist in determining the type and amount of physical activity most appropriate for my level of fitness;
- my understanding that heart rate and blood pressure will be measured prior to and at the completion of the appraisal;
- my consent to answer questions concerning my physical activity participation and my lifestyle;
- my consent to the appraisal measures conducted by an appraiser who has been trained to administer the Canadian Physical Activity, Fitness and Lifestyle Approach. I understand that the interpretation of results is limited to placing my scores in the appropriate Health Benefit Zones and providing information on physical activity participation and other healthy lifestyle topics.
- my understanding that there are potential risks; i.e., episodes of transient light headedness, loss of consciousness, abnormal blood pressure, chest discomfort, let cramps, and nausea, and that I assume wilfully those risks;
- my obligation to immediately inform the appraiser of any pain, discomfort, fatigue, or any other symptoms that I may suffer during and immediately after the appraisal;
- my understanding that I may stop or delay any further testing if I so desire and that the appraisal may be terminated by the appraiser upon observation of any symptoms of undue distress or abnormal response;
- my understanding that I may ask any questions or request further explanation or information about the procedures at any time before, during, and after the appraisal;
- that I have read, understood, and completed the Physical Activity Readiness Questionnaire (PARQ) and answered NO to all the questions or received clearance to participate from my physician.

____________________________ ________________________
Signature Date

____________________________ ________________________
Witness Date

NOTE: This form must be completed, signed and submitted to the appraiser, along with the completed PAR-Q, at the time of testing. This form must also be witnessed at the time of signing and the witness must be of the age of majority and independent of the organization administering the appraisal. The fitness appraiser/professional cannot be the witness.

Source: (CSEP, 2003). *The Canadian Physical Activity, Fitness & Lifestyle Approach*

APPENDIX J

Healthy Physical Activity Participation Questionnaire

DETERMINING THE HEALTH BENEFITS OF YOUR PHYSICAL ACTIVITY PARTICIPATION IS AS EASY AS A, B, C ...

A. Answer the following questions

Frequency

Over a typical 7-day period (1 week), how many times do you engage in physical activity that is sufficiently prolonged and intense to cause sweating and a rapid heart beat?

- ☐ At least three times
- ☐ Normally once or twice
- ☐ Rarely or never

Intensity

When you engage in physical activity, do you have the impression that you:

- ☐ Make an intense effort
- ☐ Make a moderate effort
- ☐ Make a light effort

Perceived fitness

In a general fashion, would you say that your current physical fitness is:

- ☐ Very good
- ☐ Good
- ☐ Average
- ☐ Poor
- ☐ Very poor

B. Circle your score below for each answer and total your score

Item	Male	Female	Male	Female	Male	Female
Frequency	Rarely or never		Normally once or twice		At least 3 times	
	0	0	2	3	3	5
Intensity	Light effort		Moderate effort		Intense effort	
	0	0	1	2	3	3
Perceived fitness	Very poor or poor		Average		Good or very good	
	0	0	3	1	5	3

Total score: _______

C. Determine the health benefits of your physical activity based on your total score

Total score	*Health benefit*
9-11	Excellent
6-8	Very good
4-5	Good
1-3	Fair
0	Needs improvement

Source: (CSEP, 2003). *The Canadian Physical Activity, Fitness & Lifestyle Approach.*

APPENDIX K

Detailed Anthropometric Measurements

Body Mass Index (BMI)

Standing Height

Height will be measured with a valid and reliable wall mounted stadiometer. Participants without footwear will stand erect, arms hanging by their sides, feet together, heals and back touching the wall. Participants will be instructed to look straight ahead, stand as tall as possible and take a deep breath. At the point of maximal inhalation the height measurement will be taken to the nearest 0.5 cm (CSEP, 2003).

Body Mass (Weight)

Weight will be measured with a valid and reliable digital *SECA* ^{TM} spring scale designed for research settings. Participants will be instructed to step onto the scale without footwear and in light clothing (shorts and a T-shirt or blouse for women). Weight will be recorded in kilograms to the nearest 0.1kg (CSEP, 2003).

The ratio of body weight in kilograms divided by height in meters squared will equal the BMI (kg/m^2).

Waist circumference (WC)

Participants will be instructed to stand erect in a relaxed fashion with their arms hanging loosely at the sides. The anthropometric tape will be positioned horizontally mid-way between the iliac crest and the bottom of the rib cage. Participants will be asked to take a normal inhalation and the measurement will then be taken at the end of normal expiration to the nearest 0.5 cm (CSEP, 2003).

Skinfold Measurement (S05S)

All measurements will be land marked according to the CPAFLA protocol and made on the right side of the body to the nearest 0.2 mm. Two sets of measurements will be taken. Each full set will be taken before starting the next round of measurements. The mean of the two measurements for each skinfold will be recorded unless the difference between the first and second measure for a particular skinfold is greater then 0.4mm. In this case a third measurement will be taken and the closest two measurements will be averaged. If all three measurements are equidistant -18.6, 19.4 and 19.0, for example, the mean of all three values will be used. Participants will be asked to relax the underlying musculature as much as possible during each measurement (CSEP, 2003). The five skinfolds in order of measurement are: Triceps, Biceps Subscapular, Iliac Crest and Medial Calf. For details on precise location of each of these skinfolds please refer to the 3rd Edition of the CPAFLA (CSEP, 2003 pg. 7-14 to 16). The sum of five skinfolds (SO5S) will be determined by adding the mean values for each skinfold in millimeters.

APPENDIX L

mCAFT Detailed Procedures

Participants will be instructed to stretch their Hamstrings, Calf's and Quadriceps, technical assistance will be provided if required. Participants will then be shown the proper stepping technique and pattern (CSEP, 2003 pg. 7-26). They will be given adequate time to perfect this technique before test execution. Then, post exercise Ceiling Heart Rate will be Calculated using the formula [.85 x (220-age)].

The mCAFT companion CD will set the cadence and allocate 10 seconds after each stage for the appraiser to acquire immediate post-exercise heart rate (HR). Throughout the test the CSEP health and fitness professional will communicate with the participant to ensure safety.

All participants will begin the stepping sequence on double 20.3 cm steps. Fitter (and younger) participants may complete their appraisal with a single step sequence on a 40.6 cm step. For men, stages 1-6 will be done using the two step pattern and stages 7 and 8 will be done using the one step. Women will only be required to use the one step pattern for stage 8.

At the end of each three minute stage, immediate post-exercise HR will be recorded via the use of a high quality Polar ™ heart rate monitor. If the participant's HR is below their predetermined post-exercise ceiling HR (85% of predicted maximum (220-age)) at the end of the three minute stage they will proceed onto the next stage at a more intense cadence.

The test is designed so the first three minute stage is usually at a cadence intensity of 65-70% of the average aerobic power expected by a person 10 years older. The second three minutes of stepping is then performed at 65-70% of the average aerobic power expected for ones own age. The third and following stages are respectively set at a cadence intensity equivalent to 65-70% of the average person ten years younger.

The test is terminated once the participant has reached their predetermined post-exercise ceiling HR. Other criteria for test termination include; complaints of dizziness, noticeable staggering, inability to maintain cadence, extreme leg pain, nausea, chest pain, or signs of facial pallor.

Once participants have completed the last stepping session, determined by the post-exercise HR response they will be instructed to walk around slowly for two minutes and then to sit down. At this point post-exercise blood pressure (BP) will be measured between 2-2.5 minutes post and 3.5-4 minutes post. A second post-exercise HR will then be recorded at 4-4.5 minutes post. These post-exercise measurements are taken as a safety precaution to ensure participants HR and BP fall below resting ceiling levels in an appropriate fashion (CSEP, 2003).

APPENDIX M

Detailed Musculoskeletal Fitness Assessment Procedures

Grip Strength

The participant will stand holding the dynamometer in their hand with the arm holding the dynamometer abducted 45° from their body. Participants will be instructed to squeeze as vigorously as possible in an attempt to exert maximum force. To avoid build up of intrathoracic pressure participants will be told to exhale while generating force. Two measurements will be taken for each hand and the maximum score on either hand will be recorded to the nearest kilogram (CSEP, 2003).

Push-ups

Any participants who suffer from any lower back ailment will not perform this test.
General Procedure:

The participant will complete as many consecutive push-ups as possible in a rhythmical fashion. The push-up assessment will be terminated for the following reasons: volitional fatigue, incorrect technique for more than two consecutive push-ups, or inability to maintain a rhythmical pace (CSEP, 2003).

Males:

The participant will start on his stomach, legs together, hands pointing forward and positioned under the shoulders. Participants will then be instructed to push up from the ground by fully extending their elbows, using their toes as the fulcrum, while keeping their upper body in a straight line. The participant will then return to the starting position, chin to the mat. The maximum number of correct push-ups will be recorded (CSEP, 2003).

Females:

Females will follow the same procedure as males except their knees will be used as the fulcrum. Participants lower legs will remain in contact with the ground, ankles plantar flexed, and feet touching the mat (CSEP, 2003).

Sit-and-Reach

The participant will begin by performing two 20 second modified hurdler stretches per leg before proceeding to the sit and reach measurement. The participant will remove their shoes and sit with their feet flat against the sit and reach block (flexometer). Their feet will be placed just wider than the width of the sliding mechanism. The participant will place one hand on top of the other and situate their fingertips at the edge of the sliding mechanism. As they breathe out, the participant will reach forward as far as possible keeping their legs straight. This measurement will be repeated and the highest score (cm) will be recorded. If improper form is used (ex: bending of knees, bouncing or jerky motions) participants will be asked to repeat the flawed measurement (CSEP, 2003).

Partial Curl-ups

The participant will lie supine with their arms at their sides, knees bent to 90°, feet together and flat on the floor. They will curl their body upwards while sliding their fingers along the ground towards their feet. The participant will curl-up until their fingers have traveled 10cm from their starting position. Curl-ups will be performed at a cadence of 50 bpm set by a metronome. The participants will perform as many curl-ups as possible in one minute to a maximum of 25. The curl-up assessment will be terminated for the following reasons: volitional fatigue, inability to curl-up the required 10 cm, inability to maintain the 50 bpm cadence intensity, or a maximum of 25 has been achieved (CSEP, 2003).

Vertical Jump and Leg power

Any participants who suffer from any back ailment will not perform this test.

Vertical jump will be assessed with the use of the Vertec ™ where the jump height is determined by the participant jumping as high as possible from a semi squat position to push the slats from a starting position (See figure 1 below). The bottom slat will be set at the participants maximum standing reach height. Jump height will be determined from the amount of slats displaced. Each slat is positioned .5 inches apart. Participants will be given 3 trials with a one minute break in-between trials. The maximum jump height of the 3 trials will be recorded in centimeters.

Figure A.1: CPAFLA Vertical Jump

Peak leg power, in watts, will be determined with the use of the Sayers Equation (Peak Leg Power (W) = [60.7 x jump height (cm)] + [45.3 x body mass (kg)] - 2055) which takes into account body mass as well as maximum jump height (CSEP,2003).

Back Extension

Any participants who suffer from any back ailment will not perform this test.

Due to the amount of stress this measure places on the back a screening test will be performed prior to administration. If participants feel any discomfort during the screening test, the back extension will not be done.

The test will be done using the portable steps used for the mCAFT. For participants comfort a cushioned mat will be placed on top of the portable steps. The participant will lie face down on the mat with their iliac crest positioned at the edge of the steps with the rest of their body aligned. The appraiser will then secure the participants lower torso by strapping down the upper calves and lower thighs.

Once secure the participant will be instructed to cross their arms on their chest and support their upper torso in the horizontal position with no rotation or lateral shifting for as long as possible to a maximum of 180 seconds (see figure 2 below). The test will be terminated if the participant drops their torso below the horizontal (allowing for one warning repositioning), or if they experience any pain/discomfort. The number of seconds the horizontal position is maintained will be recorded (CSEP, 2003).

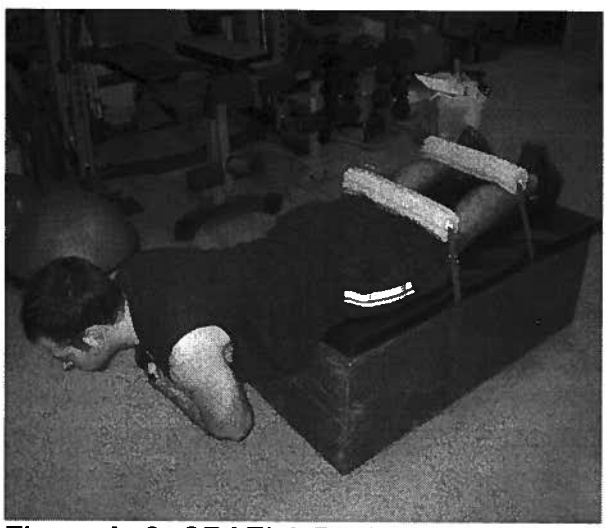


Figure A. 2. CPAFLA Back Extension