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The Effects of Education and Exercise on Fitness and Stress

by

Carol A Malec

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ABSTRACT

The study described in this thesis explored the relationship between fitness levels and perceived stress in a group of older, previously sedentary adults. The purpose of the study was to track people as they became more fit in order to further understand how fitness and stress are related in a demographically diverse population. This was done by monitoring stress variables and looking for changes across time as fitness levels increased. Participants self-selected into one of three conditions. Group 1 was offered education on healthy active lifestyle along with aerobic exercise training. Group 2 was offered education on healthy active lifestyle only. Group 3 was offered the same healthy active lifestyle program at the end of the study, but acted as the waiting list control with the request that they not participate in aerobic exercise for the duration of their waiting period. Participant stress levels and fitness levels were assessed at the onset of the study for baseline measures and once every 4 weeks thereafter for the duration of 12 weeks. Stress was measured by a combination of paper and pencil self-report measures and self-monitoring scales. Fitness was measured by the Cooper Fitness Test, heart-rate recovery rate following exercise, and resting heart rate. Findings of the study showed a strong link between improved aerobic fitness and lowered stress levels. Analysis of the data showed that as aerobic fitness levels improved, stress levels dropped significantly in the groups exercising. Compared to the control group, both treatment groups reported significantly less stress at week 4, and although both treatment groups continued to improve, only Group 1 showed significant differences at week 12. This study demonstrates that moderate exercise (twice a week for 40 minutes) can yield significant gains in fitness and significant reductions in stress.

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Dedication

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Chapter One

Introduction

Brown (1990) describes the effects of stress on society as "profound". Though stress is omnipresent, too much stress for too long produces staggering problems in psychological, intellectual, social, and physical states, as well as in occupational and work settings (Betera, 1990; Hoiberg, 1982; Matteson & Ivancevich, 1987; Schafer, 1992; Selye, 1974, 1976). Stress has long been implicated in the development of psychological problems and disruption in intellectual states such as: phobias, reduced motivation, low self-esteem, irritability, restlessness, sleep disturbances, decreased life satisfaction, mood disorders such as anxiety and depression, difficulty problem-solving, poor concentration, and memory problems. The impact of stress on social problems include: sexual and relationship difficulties, interpersonal conflict, automobile accidents, and interpersonal problems.

Stress plays a pivotal role in an estimated 80% of disease (FitzGerald, 1995) and some of the more common health problems include: high blood pressure, heart attack, muscular tension, increased infections, non-cardiac chest pain, rheumatoid arthritis, stroke, psoriasis, gastritis, neurodermatitis, ulcerative colitis, gastric and duodenal ulcers, tension and migraine headaches, and decreases in functional immune measures resulting in increased susceptibility to disorders ranging from colds and flu to cancer and AIDS (Beech, Burns, & Sheffield, 1982; Bennett Herbert & Cohen, 1993; Schafer, 1992). Problems in the work environment linked to stress are: theft and sabotage at the work-site, absenteeism, high staff turnover, reduced productivity, high insurance pay-outs, industrial injuries, and litigation for stress disabilities (Matteson & Ivancevich, 1987). Stress has also

exhibited an affect on health-related behaviors such as: smoking, excessive use of alcohol, illicit drug-use, over-or-under eating, increased use of stimulants such as coffee, tea, and cola drinks, and use of over-the-counter drugs (Elliot, 1994; Schafer 1992; Pelletier, & Lutz,1991).

Along with data that report 3.5 million Canadians suffer from severe stress (Canadian Mental Health Association), it is estimated that up to 90% of all visits to health care professionals are for stress-related disorders (Bennett Herbert & Cohen, 1993; Perkins, Leserman, Gilmore, Petitto, & Evans, 1994). Such evidence suggests that rather than abating, stress-related problems in society are increasing (Bennett Herbert & Cohen, 1993; Hiebert, Kirby, & Jaknavorian, 1989; Reed, 1984; Repetti, 1993). Stress-related problems for example, occupy a large proportion of counsellor case loads (Hiebert, 1988b) as aversive mental states, emotional arousal from stressful events, and personal calamities have become the focus in multiple facets of counselling and clinical efforts (Rosenthal, 1993). Though a prescribed regimen of psychoactive substances have been a powerful medicinal option for dealing with stressful states, data suggest that sustained use of drug therapy, may itself create psychotic symptoms far worse than the symptoms of stress and can also lead to addiction problems (Downs et al., 1992; Rosenthal). Sustained use of nueroleptic drugs prescribed frequently for treating anxiety for example, entail major risks such as Neuroleptic Malignant Syndrome occurring in 1% of patients and carries a mortality rate of 10-30% (Rosenthal). Clearly, the cost of stress to business and to society is high (Matteson & Ivancevich, 1987) as stress-related problems in the general population continue to rise (Hiebert et al., 1989). In view of the current health-care reform

in Canada, it would seem judicious to pursue further systematic research on the non-medicinal management of stress (Health Canada, 1995).

Stress Management

Evidence from the literature leaves little doubt that how we manage stress vitally influences the degree to which we experience well-being or illness (Selye, 1974, 1976), maintain work productivity (Beech, Burns, & Sheffield, 1982), or simply enjoy daily life. The human costs from stress are inestimable and currently there is a great deal of interest on the part of the public, private, corporate and governmental sectors in Canada to determine ways in which the deleterious effects of stress can be reduced (Health Canada, 1995).

It is not always practical, or even possible to avoid the demands of daily life and much of the current research suggests that it is difficult to curb stress by changing the environment because each person has a different perception of what events are stressful (Hiebert, 1988a). From this it follows that an effective approach to reduce the impact of stress on health, well-being, and productivity would be to enhance one's ability to cope with stress (Beech, Burns, & Sheffield, 1982). The literature on stress-management examines several possible approaches to reducing stress: Meditation, Deep Relaxation, Biofeedback, Self-Monitoring, Rational Emotive Therapy, Thought-Stopping, Cognitive Stress-Inoculation Training, Autogenic Training, Yoga, Social Support, and use of Health Buffers (Elliot, 1995; Girdano, Everly, & Dusek, 1993; Mason, 1988; Schafer, 1992). Another option commonly recommended for stress management is aerobic exercise (Health and Welfare Canada, 1990). Some empirical research, for example, indicates that people with high aerobic capacity recover from stress more quickly (Blumenthal et al.,

1990; Steptoe, Kearsley, & Walters, 1993), and therefore are more likely to be less stressed overall.

Rationale For The Current Study

Promoting well-being through effective stress management can be addressed by further research validating the effectiveness of aerobic exercise on stress as existing literature remains insufficient and inconclusive. Library research on fitness and stress currently show, for example, that relatively few attempts have been made to describe the relationship between fitness and stress. Moreover, previous research has tended to examine only before and after measures of stress and fitness. In addition efficacy data on exercise as a stress intervention have been difficult to interpret as many studies utilized non-standardized training programs of exercise for the experimental treatments, as well as experimental exercise treatments requiring "maximal effort" from participants such that only the "true athlete" could actually participate in the research. Furthermore, generalizability of findings from previous research is difficult as many of the populations studied have utilized a homogeneous Group of college men described as "athletic jocks". Clearly, a systematic investigation of the relationship between fitness and stress across time would add a significant contribution to the scientific literature on stress intervention. Further discussion of the rationale for further research and delineation of the research problem follows.

The Need for Further Research

Though popularized as a stress-moderator, the research literature on aerobic exercise shows equivocal support (Brown, 1990; King, Taylor, & Haskell, 1993; Pierce, Madden, Siegel, & Blumenthal, 1993; Roy & Steptoe, 1991; Sinyor, Golden, Steiner, &

Seraganian, 1986). Using an experimental design, Sinyor et al (1986) concluded that there is no relationship between improvement in aerobic fitness, and arousal or anxiety levels, frequency or intensity of Daily Hassles and uplifts, nor psychological symptoms of stress. In another study (King et al., 1993) using random assignment, aerobic exercisers showed significant reductions in anxiety levels and perceived stress relative to the control Group. Equivocal literature suggests efficacy data for the use of aerobic exercise in stress control remains inconclusive.

In addition to the inconclusive data on exercise efficacy for stress control, existing research has been insufficient in describing the relationship between fitness and stress. The need for further research is demonstrated by the lack of systematic investigation on fitness and stress across time (King, Taylor, Haskell, & DeBusk, 1989). Though the concept of reduced stress is central to the issue of stress research, relatively little is known about the course of the change during the period of study (King et al., 1989). Previous research most often looks at the beginning-point and the end-point of exercise-effects on stress and thus limits the evaluation of change process in stress variables as fitness levels improve (King et al.). Further understanding of the process of change in stress variables as fitness levels improve is necessary to help determine the time-frame and fitness level where stress begins to attenuate. Therefore tracking people as they become more fit would provide an opportunity to evaluate this change process. The utility of using multiple measures over time has been observed in the investigation of other preventive health behaviors (Ingebretsen, 1982; Scott, Denier, Prue, & King, 1986).

As much of the previous research has tended to use non-standardized fitness programs for the research treatment, evidence of exercise treatment efficacy for stress

intervention has been difficult to establish (Brown, 1990). Experimental treatments manipulating fitness through suitable training programs with licensed fitness instructors would facilitate more precise evaluation of exercise as an intervention for stress. In addition, investigation using "moderate effort" as contrasted to "maximal effort" in order to yield significant fitness improvement and establish reductions in stress, supports further investigation of the relationship between fitness and stress.

Finally, Haskell, Montoye, and Orenstein (1985) point out that previous research has tended to use college students (mostly men in their early twenties) as subjects, and consequently, they have become the reference population against which the findings are compared in other sex and age Groups. It is also noted that overweight, older, and female persons have typically not been included as study participants in previous research examining the effects of aerobic exercise on stress (King et al., 1993). A study that collects empirical evidence for validating the efficacy of aerobic exercise on stress reduction in a diverse Group of previously sedentary, middle-aged, mixed gender Group of individuals would make an important scientific contribution to the literature.

The Problem

The present study investigated the relationship between aerobic fitness and stress. This was done by monitoring stress variables using a multiple measures across time approach, looking for changes in stress as fitness levels increased. The study utilized a mixed population of persons from the community, who can be characterized by a variety of demographic, lifestyle, physiological, and psychological attributes. In addition, a standardized training program was utilized along with exercise treatments requiring "moderate effort" from the participants.

The present study tested the following hypothesis: Aerobic exercise training will be related to significant reductions in stress symptoms and perceived Daily Hassles and significant increase in aerobic fitness levels over a period of 12 weeks in a representative community sample of older adults in relation to the participants not receiving such training.

An Overview

This chapter has set the context for this study. Chapter Two reviews the literature regarding the impact of aerobic exercise on stress and health. It explores the implications of aerobic exercise for stress control and closes with the specific research questions addressed in the study. Chapter Three describes the methods for recruiting participants, and the pretreatment and treatment conditions for the three Groups of the study. Chapter Four describes the results of the study and the relationship of these results to the research questions asked. A detailed discussion of the results in Chapter Five relates the results of this study to the extent literature, assesses the short comings and strengths of the study, discusses the implications for further research, and offers some final conclusions.

Chapter Two

Literature Review

Chapter two describes the evidence regarding the impact of aerobic exercise on stress and health. The literature review includes an operational definition of stress and aerobic exercise, a discussion of the specific effects of aerobic exercise as an intervention, and a presentation of the current theories explaining how aerobic exercise works to control stress. Included in this chapter is a discussion of specific problems treated with aerobic exercise and an outline of the conceptual framework used to generate the research questions. Finally, this chapter discusses the implications of aerobic exercise for stress control by reviewing the efficacy data and closes with the specific research questions addressed in the study.

What is Stress?

Stress is seen as a multidimensional, integrated response occurring when a cognitive appraisal of a situation results in a perceived inequity between the demands and one's coping resources (Hiebert, 1983,1988a,b). The multidimensional stress response following this perceived imbalance is manifest in physiological, cognitive, and behavioral ways. The multidimensional response suggests the need for a multi-faceted master plan for stress control. Using Hiebert's stress model, controlling stress is approached either by (a) reducing the imbalance between stress and coping resources (stressor management), or (b) tempering the response to stress (stress management) (Hiebert, 1988a). In order to reduce the imbalance, one must either reduce the demand, or increase their coping skills. Tempering the stress response in Hiebert's framework is the other strategy for stress

control. This is an effort to calm the different components of the stress response. Illustrated in this framework (Appendix A), aerobic exercise fits on the right, where it is possible to lessen the behavioral response that accompanies stress. Here aerobic exercise helps to drain off arousal, remain calm, and restore homeostasis. Aerobic exercise could fit also on the left of the illustration (Appendix A), where the recovery time for the physiological response to stress is lessened. Reduced physiological recovery time from stress helps to prevent accumulation which contributes to less reactivity and less chance for imbalance. In summary, aerobic exercise likely works in the following ways to buffer stress, it could: a) temper the stress response, b) help reduce the demand/coping imbalance through increasing aerobic fitness, c) help to alter the appraisal of demands, and d) utilize the individual as the active change agent.

Stress Control

One therapeutic option available for stress-management that is commonly cited in the literature is aerobic exercise (Health and Welfare Canada, 1990). The Heart and Stroke Foundation of Canada asserts that people who have been trained in exercise programs do a better job of managing the stress in their lives and have reduced risk of stress related health problems (Lefever, 1996). Correlational studies have shown improved fitness is associated with better self-reported health status and less stress (Health and Welfare Canada), and poor fitness is related to worse health status and more stress. Some empirical research indicates that people with high aerobic capacity recover from stress more quickly (Blumenthal et al., 1990; Steptoe, et al., 1993), and therefore are more likely to be less stressed overall. More recent research suggests that exercise can directly buffer psychosocial stress responses (Rajeski, Thompson, Burbaker, & Miller, 1992).

Sufficient evidence of a positive relationship between aerobic fitness and improved health warrants recommending a physically active lifestyle in conjunction with other health promotion behaviors (King et al., 1993). Since we know that persons who exercise record a lower incidence of stroke, respiratory diseases, all cancers, and deaths from all causes than persons who do not exercise (Paffenbarger, Hyde, Wing, & Steinmetz, 1984; Siscovick, Laporte, & Newman, 1985), it is reasonable to posit that aerobic exercise might be useful for stress management.

What is Aerobic Exercise?

The most effective muscular work for stress management is aerobic exercise (Blumenthal et al., 1990; Brown, Morgan, & Raglin, 1993; Petruzello, Landers, Hatfield, Kubitz, & Salazar, 1991; Steptoe, Edwards, Moses, & Mathews, 1989). Aerobic exercise involves any form of activity in which the heart rate is substantially elevated above the resting rate in response to sustained movement by large muscle Groups (Schafer, 1992) whereby the energy needed to fuel the exercise is supplied by inspired oxygen (Thomas, Lee, Franks, & Paffenbarger, 1981). The body's adaptation to repeated aerobic exercise produces an aerobic training effect, increasing the efficiency with which oxygen is transported in the blood stream and in turn, improves one's endurance allowing one to perform everyday activities with reserve energy for any potential emergency situation that might arise (Miller & Allen, 1995). The extent of the bodily adaptations to aerobic exercise depends primarily on the intensity, duration, and frequency of the exercise performed (Sharkey, 1979).

Effects of Aerobic Exercise

Review of the literature on the effects of aerobic exercise examines physiological, perceptual, cognitive, and behavioral domains. Physiological changes resulting from aerobic exercise include; release of muscle tension, burning off stress-induced adrenaline, production of beta-endorphins, lowered tension level, habituation of physiological arousal, and post-exercise quieting of the sympathetic nervous system (Rajeski et al., 1992; Schafer, 1992). Although unsure of the exact physiological mechanism responsible for controlling stress, repeated research suggests that exercise moderates the stress response in two ways; reducing stress reactivity (Crews & Landers, 1987; Rajeski, et al.) and hastening physiologic recovery from stressful events (Azar, 1996). In the first case, exercise acts as a buffer and produces a quieting of the sympathetic nervous system such that the demand on the body's physiology is reduced. In the second case, aerobic exercise produces a more rapid physiological recovery so that an individual returns to homeostasis sooner following a stressful event (Azar, 1996; Blumenthal et al., 1990; Steptoe et al., 1993). Most of the literature support is for the first explanation, wherein exercise produces a blunting affect on the autonomic nervous system when the body responds to stress. (McGlynn, Franklin, Lauro, & McGlynn, 1983; Rajeski, et al.). Correspondingly, the lower sympathetic arousal produces several physiologic adaptations: a lower heart rate in response to the stress (Hull et al., 1984; Sherwood et al., 1989), a decrease in the electrodermal response (Sime, 1977), and, a decrease in blood pressure (Blumenthal et al.; McGlynn et al., 1983; Raglin & Morgan, 1987; Sherwood et al.). Hiebert (1988a,b) also suggests quieting of the sympathetic nervous system reduces the demand on the body's

physiology and restores an individual's equilibrium. Lowering of the arousal level aids in stress control as the individual experiences less reactivity to a stressor, and helps the person deal with the demand more effectively by using more of a cognitive approach (and less of an emotional one) for problem solving.

Perceptual, cognitive and behavioral changes resulting from aerobic exercise training are scientifically less understood. Perceptual changes resulting from aerobic exercise are characterized by an improvement in self-image (Thomas et al., 1981), re-defining the subjective meaning of stress arousal as well as changing the perception of stress symptoms (Dishman, 1988). Cognitive changes resulting from aerobic exercise are; an improvement in mood responses such as depression, anger, and negative mood states, and a significant anxiety reducing effect. Finally, behavioral changes resulting from aerobic exercise are; an overall reduction in Type A Behavior which includes; chronic time urgency, polyphasic thinking and behavior, dichotomous thinking, insecurity of status, free-floating hostility, hyperaggressiveness, and drive to self-destruct (Schafer, 1992). Though aerobic exercise has shown measurable influences on perceptual, cognitive, and behavioral domains (Dishman, 1988; Schafer, 1992; Thomas et al., 1981), the majority of research literature focuses on the physiological changes.

Aerobic Exercise in Controlling Stress

Exercise is regarded as a good stress control by the populace. Exercise research however, mostly examines "fitness" as the primary variable, though some studies do exist that explore the connection between aerobic exercise and stress. Those studies examining the connection between exercise and stress are the focus of this chapter, and the emphasis will be on aerobic exercise, not on all forms of exercise.

Types of Problems Treated Using Aerobic Exercise

Although the relationship between aerobic exercise and the risk of coronary heart disease has been the most extensively investigated, studies have suggested that aerobic exercise may contribute to the prevention and control of several other diseases as well. A review of the clinical-epidemiological literature suggests that among others, aerobic exercise contributes to the prevention and control of heart disease, cancer, diabetes, obesity, osteoporosis, depression, and AIDS.

Heart diseases and cancer. Diseases such as heart disease and cancer are listed as the most common cause of hospitalization in Canada (Statistics Canada, 1994), and both show a strong link to stress (Isselbacher et al., 1994). Preventive measures identified in the literature capable of reducing the incidence of heart disease and cancer by up to 50%, include aerobic exercise ((Isselbacher et al.; Paffenbarger et al., 1984). Symptomatic coronary artery disease is more prevalent in sedentary people than in physically active ones and regular aerobic exercise of sufficient intensity is listed as the most efficacious means of reducing heart disease risk (Acierno, 1985; Blumenthal, et al.,1988). Aerobic exercise has been commonly prescribed by physicians for high cholesterol (Avraiz, Wigle, & Mao, 1992), and hypertension (Bursztyn, 1990; Kavanagh, Shepard, Lindley, & Pieper, 1983). A study of 157 men with moderate cardiovascular risk factors for example found a significant decrease in blood pressure after six months of moderate aerobic exercise (Hellenius, Faire, Berglund, Hamsten, & Krakau, 1993). Aerobic exercise has been examined as a preventative and treatment approach in cancer also. A recent study investigating the association between fitness and the incidence of prostate cancer found that increasing cardiorespiratory fitness had a significant preventive effect on the incidence

of prostate cancer in white, well educated men (Oliveria, Kohl, Trichopoulos, & Blair, 1996). A study looking at the effects of a running program found an inverse relationship between high levels of running and a significant decrease in the risk of colon cancer (Cordain, Latin, & Behnke, 1986). Furthermore, increasing amounts of aerobic exercise appear to confer greater degrees of protection against colonic cancer (Bouchard, Shepard, & Stephens, 1993; Calabrese, 1990; Simon, 1990) and in rehabilitation treatment, appears to improve breast cancer patients' physiologic and psychologic well being (Calabrese, 1990; Friedenreich, & Courneya, 1996).

Diabetes, obesity, osteoporosis, depression, and AIDS. Aerobic exercise has also been recommended as a treatment for reducing the complications of diabetes, obesity, osteoporosis, depression and AIDS. Aerobic exercise training increases insulin sensitivity (Berger & Kemmer, 1990; Bouchard, Shephard, Stephens, Sutton, & McPherson,1990; Vranic & Wasserman, 1990) and therefore may reduce insulin requirements in insulin-treated diabetics. Epidemiological studies of large populations (Bouchard, et al., 1993) were shown to have a significant reduction in the risk of developing non-insulin dependent diabetes in an estimated 25% of the population by maintaining a routine of aerobic exercise. Results of 53 studies examining exercise also show that in patients with obesity problems, body mass was significantly reduced by aerobic exercise and along with food restriction, it is the most effective in producing fat loss (Ballor & Keesey, 1991; Bouchard at al.). In one controlled study using a 10 week program for example, the exercise Group showed significant reduction in body weight when compared to the non-exercise Group (Blumenthal, Williams, Williams, & Wallace, 1980). In the treatment and prevention of osteoporosis, exercise increases bone mineral content and reduces the risk of osteoporosis

and its complications in people of all ages (Johnston & Slemeda, 1987; Munnings, 1992). Furthermore, in the treatment of depression, Martinsen, Medhus, and Sandvik (1985) demonstrated that jogging is at least as effective, and more economical, than drug therapy for cases of mild depression.

Another study separating 47 subjects into an aerobic exercise Group, a relaxation Group, and a control Group found the exercise Group showing a significant decrease in depression following the training when compared to the other Groups (McCann & Holmes, 1984). Finally in the treatment of HIV-1 seropositive individuals, aerobic exercise training resulted in significant improvement in immune measures (LaPerriere et al., 1990).

Effectiveness of Aerobic Exercise in Stress Control

It is important to decide whether individuals can effectively or practically change their response to stressful situations by utilizing a program of aerobic exercise. It must emphasized however, that aerobic exercise is not a panacea for all stress-related situations (Thomas et al., 1981) but rather a strategy among many others, that acts as a health buffer to build protection against distress (Schafer, 1992). To review the efficacy data, this paper has drawn heavily on research with experimental designs using aerobic exercise as the independent variable, and components of the stress response as the dependent variables. Some evidence using cross-sectional studies, however, has been included, with the acknowledgment that inferences concerning causation are considered tentative (McCall, 1990). It is also important to point out that the studies discussed below have defined their experimental effect from aerobic exercise as contrasted to other forms of exercise. Stress has been shown to produce problems for an individual in physiological, psychological, and

behavioral domains, and in the work environment as well. The following section examines the efficacy data on aerobic exercise in each of these domains.

Stress, exercise and the physiological effects. Sherwood, Light, & Blumenthal (1989), in a controlled study, compared a strength training Group to an aerobic training Group. Following 12 weeks of 35 minute training sessions, the aerobic exercise Group showed a significantly lower heart rate following exposure to a stressful event when compared to the strength training Group. Following an acute bout of aerobic exercise, Boone, Probst, Rogers, and Berger (1993) found a reduction in blood pressure, and during this post exercise hypotensive period the blood pressure response to a stressor remained attenuated. In a study using a 14 week program of aerobic exercise (McGlynn et al., 1983) the average increase in muscle tension during periods of stress was significantly lower in an aerobic exercise Group when compared to a control Group. Another well controlled study however, involving 56 male university students found that the "healthier heart" of fit individuals did not result in faster recovery from a moderate level of psychosocial stress (Jamieson & Lavoie, 1987). Aerobic exercise has shown other effects on the physiological component of the stress response, including: a decrease in catecholamine release of epinephrine (Blumenthal et al., 1990) and more rapid attainment of peak levels of norepinephrine (Sinyor, Schwartz, Peronnet, Brisson & Seraganian, 1983). These observations however, have shown equivocal support (Bramnert & Kokfelt, 1984; Staessen et al., 1985). Some researchers alternatively suggest that improved aerobic fitness enables an individual to more effectively manage stress by giving the individual vigor, alertness without undue fatigue, ample energy to meet the demands of daily life, and

is achieved with fewer health problems (Hays, 1994; Keller & Seraganian, 1984; Mulder & Allsen, 1983; Roth & Holmes, 1985; Sherwood et al., 1989; Steptoe et al., 1989).

Crews and Lander's (1987) review of 34 studies, demonstrates that aerobically fit subjects have a reduced physiological stress response and a faster physiological recovery, thus resulting in a lowered stress response and reduced time experiencing stress. Aerobic exercise thereby acts as a coping strategy through hastening recovery time of the autonomic nervous system, and rendering the demanding situation innocuous by intermittently exposing the SNS (sympathetic nervous system) to a physical demand. These repeated exposures to exercise produce an adaptation of the SNS, such that subsequent demands don't produce an intense physiologic reaction, and are perceived as less harmful (Steptoe et al., 1989). In Lazarus and Folkman's (1984) view, such physiologic changes resulting from exercise alter a person's appraisal of the demand thereby producing a reduction in his or her perception of a demanding event.

Stress, exercise and the psychological effects. Though the robustness of aerobic exercise effects on psychological cognitive functioning are less clear (Brown et al., 1993), there are some conclusive findings demonstrated in repeated, well-designed studies. Aerobic exercise has a clear anxiety reducing effect shown to persist for 2 - 5 hours (Raglin & Morgan, 1987) which may account for the frequent self-reports that some people "feel better" or "feel good" (McGlynn et al., 1983) after aerobic exercise. Even single sessions of aerobic exercise for 15 minutes have been sufficient to significantly reduce anxiety states (Brown et al., 1993; Roth, 1989). Studies have also shown a positive association between aerobic exercise and an alteration in mood response (Steptoe et al., 1989). These mood alterations are: a reduction in levels of depression (Hull et al., 1984;

not report less stress, and those who obtained higher levels of fitness during the conditioning program fared no better in reducing stress than their counterparts who obtained lower levels of aerobic fitness.

A meta-analytic review (Petruzello et al., 1991) however, found aerobic exercise to increase sense of self-efficacy which was identified as a mechanism in improving self esteem. Landers and Petruzzello (1994) point out that the results of studies to date suggest that initially, highly anxious people with low fitness levels have the most to gain psychologically from an aerobic exercise program. A study that looked at the relationship between aerobic fitness, activity level and well-being in 54 adults however, found no relationship between well-being and objective measures of fitness (Cooper test; Canadian home fitness step-test) or weekly activity (Dowall, Bolter, Flett, & Kammann, 1988). The authors of this study therefore conclude that the degree of well-being was not related to fitness.

Stress, exercise and the behavioral effects. Behavioral effects on the stress response using aerobic exercise were found in a study of Type A individuals (Blumenthal et al., 1980). After a 10 week aerobic exercise program, the experimental Group showed a significant reduction in Type A behavior, and the only differentiating variable from the control Group was aerobic exercise. In addition, aerobic exercise has shown positive affects on individuals who are coping with stress by resorting to alcohol consumption and substance abuse (Sinyor, Brown, Rostant, & Seraganian, 1982). Exercise-related benefits such as improved mood, enhanced self-concept, reduced symptoms of anxiety, and lowered mild-to-moderate depression suggest that exercise has shown to be a useful adjunct in alcohol programs and other substance abuse prevention and treatment programs

(Bouchard, Shepard, & Stephens, 1990). Furthermore, an increase in alcohol consumption is commonly accepted as a ineffective coping mechanism for stress. A research study of 60 young male college students described as heavy drinkers (consuming at least 45 drinks per month) who were randomly assigned to exercise, mediation, or control conditions concluded that vigorous aerobic exercise was associated with lower levels of alcohol intake (Murphy, Pagano, & Marlatt, 1986).

Another common behavior associated with stress is smoking. A study in Canada examined smoking behaviors in a 8,088 men and women and found that those under 40 years of age who were classified as active were less likely to smoke than were their moderately active or inactive peers (Faulkner, Bailey, & Mirwald, 1987). The value of aerobic exercise as an intervention technique was experimentally studied using random assignment to either a behavioral intervention, or a behavioral intervention plus exercise for a 5 week treatment (Hill, 1985). Findings showed that smoking quit rates did not differ significantly at posttreatment or at three or six month follow-up assessments. Though smoking rates were lower in the Group assigned to both behavioral intervention and exercise, the statistical power of the study design was too low (N=36) to detect a statistical difference. Other reviews conclude that changes in fitness and participation in exercise interventions did not appear to alter smoking rates (Blair, Jacobs, & Powell, 1985).

Stress, Exercise and the Economic and Business Effects. The importance of exercise effects on stress do not stop with the individual. They ripple outward to economics, business and political science. Fitness and lifestyle programs have been examined closely by the researchers in an attempt to understand the effect on work related

stress. For example, following a 5 year workplace fitness and health education program, Prudential Insurance Company demonstrated a 47.5 % reduction in major medical expenses, a 20.1 % decrease in absenteeism rates and a reduction of 31.7 % in costs directly related to health problems (Rosenstein, 1987). A study in 1983 reported that a workplace fitness program resulted in a direct annual saving to the Occupational Health Plan of $ 130 per program participant (Fitness Canada, 1988). A pilot project by the Saskatchewan government showed that reduced absenteeism from employees resulted in a return on investment of $ 1.82 for every $ 1.00 spent on employee wellness (Vance, 1991). Other research however (Bernacki & Baun, 1984), found that performance ratings did not change after the initiation of the fitness program and therefore concluded that job performance was not influenced by exercise to any great extent. Thus, the support for the economic and organizational impact of exercise programs is not universal, but the majority of evidence suggests exercise has a positive impact.

Conclusion from the Literature

The empirical evidence demonstrates that aerobic exercise has the ability to temper the stress response, help reduce the demand/coping imbalance, alter the appraisal of demanding events, reduce stress related health problems, possibly promote psychological well-being, and may help to reduce ineffective coping behaviors such as smoking and alcohol consumption. This clearly demonstrates that aerobic exercise may be a useful strategy for stress management.

The review of the literature partially substantiates the claim that aerobic exercise reduces the pathogenic effects of stress. This technique for stress management attempts to moderate the deleterious effects of stress by attenuating its physiological responses and

occurs by way of the autonomic nervous system adaptations resulting from aerobic exercise training. Not less relevant, but less understood, are the causal mechanisms involved in the cognitive and psychological domain which also seem to counterbalance the distressing impacts of situations. It appears that aerobic exercise has promising potential for improving personal health and wellness, tempering stress responses, and offering self-motivated changes towards a less distressful environment.

Importance of the Current Study

The literature on aerobic exercise and stress management emphasizes that research which aids our understanding of the influences of aerobic exercise on stress levels will be a significant contribution to the current literature which is limited, equivocal, and inconclusive. It is expected that this study will shed light on the debate regarding the impact of exercise on stress by examining the effects of aerobic exercise on both fitness and level of perceived stress. Ultimately this research is aimed at early intervention strategies for preventing stress-related illnesses and promoting well-being in Groups at risk. Results from the present study have useful application in educational policy, health-care prescription, employee-assistance programs, and public health policy. If reduced stress can be achieved through a moderate exercise program, adherence to exercise programs might be enhanced. The anticipated results would be useful to agencies who market national, multi-disciplinary, and multi-level strategies for encouraging people to be more physically active.

Research Questions

The goal of the current study, is to evaluate the stress reducing potential of aerobic exercise in a sedentary Group of older members of the Calgary community and to compare

those results to similar people not receiving an aerobic exercise treatment. A second goal is to determine the relationship between aerobic fitness variables and stress indicators. There were two research questions which arose from these goals.

1. What are the differential effects on fitness and stress associated with people receiving health education, those receiving health education plus exercise, and those receiving no treatment?
2. What are the differential effects associated with demographic variables such as gender, education level and degree of aerobic fitness level obtained in relation to perceived stress and aerobic exercise treatment?

Chapter 3

Methodology

In April of 1995, a Cooperative venture between the University of Calgary Trym Gym Program, and the author, was initiated for the purpose of conducting this thesis research. The project began in September of 1995 and took approximately 1 year to complete.

Pilot Study: Phase One

In order to test the hypotheses and the experimental protocol, a pilot study was conducted in the fall of 1995. Participants were recruited through the local newspaper and community newsletters. As a result, 18 participants enrolled. Changes were made to the study protocol following the completion of the pilot, in order to refine and streamline the experimental procedures. For example, a pre-treatment orientation (Appendix B) was developed for the participants, in order to familiarize them with the study and to provide them with instruction and practice time for the activities they would be asked to do during the study. Further description of the orientation is discussed below under "participant pre-treatment orientation".

To assist with the time consuming data collection procedures, 22 volunteers were recruited from the University of Calgary, Mount Royal College, Alberta Vocational College, and the local hospitals. Volunteers consisted of Registered Nurses, Licensed Practical Nurses, medical students, Certified Fitness Instructors, senior undergraduate students, graduate students, and one Physician. A training orientation session was developed for the volunteers assisting with the study. The purpose of the orientation was

to review: the guidelines for administering the dependent measures, the record keeping, and the general protocol in order to maintain consistency in the delivery of the research protocol (Appendix C). Furthermore, practice sessions were held on the fitness track in order to familiarize the timers and the volunteer research assistants with the equipment and techniques necessary to standardize the fitness testing.

Another refinement to the research protocol was the development of an exercise log. This was developed in order to determine the amount and type of exercise participants were engaging in, prior to commencing the study and, over the course of the study. Participants were asked to log the frequency, duration and type of exercise on a standardized form which they submitted each month (Appendix D).

Research Study: Phase Two

Participant Recruitment

Participants for phase two of the research study were recruited from the local community via city newspaper articles, flyers, posters, radio announcements, and corporate and community newspapers (Appendix E). A logging system recorded over 1700 inquiries from local Calgarians responding to the advertising. The participants were introduced to the study and assessed for the enrollment criterion via a telephone interview conducted by the primary investigator. The telephone interview was standardized in order to provide consistency in recruiting the participants. The standardization involved relaying the same information regarding the research project to each individual. The incentives for the volunteers to participate included partaking in an important research study, as well as having the opportunity to obtain an individual analysis of their fitness and stress measures following the completion of the study.

Participants

Enrollment suitability was based on the following criterion: 1) must be 18 years of age or older, 2) previously sedentary, 3) not aware of any recent acute illness that would prohibit her/him from participating in exercise, 4) not aware of any chronic health conditions or disabilities that would hinder or add further risk to health or well-being by participating in exercise, 5) available for a 12 week commitment, 6) not aware of any other reason that might prohibit her/him from participating in the study such as; use of certain medications; having an implanted heart pacemaker; experiencing episodic dizziness, and others.

Complete data were collected for 70 of the 77 participants finishing the study. The age of the participants ranged from 23 - 77 years (Mean = 45 years). There were 57 females and 20 males, a proportion similar to other studies (Goldfried, Linehan, & Smith, 1978; Yorde & Witmer, 1980).

The majority of the participants were married or cohabitating, with 21% having no children, 26% having 2 children or less and a large portion (51%) expecting a child. Participants were well-educated, with 63% reporting completing a college or university degree or degrees, 33% completing high school, and 3% reporting completing only grade school. Most of the participants were working, with only 3% reporting to be unemployed and looking for work. Of the 79% employed, only 7% were working shift work. Approximately 1% of the participants indicated that they had an Afro-American ethnic background, 3% reported a Native American background and 96% of the participants indicated that they were Caucasian. See Table 1.

Table 1

Participants' Demographics

Variable	N	% of Participants
Age		
20-29	3	4%
30-39	20	29%
40-49	28	40%
50-59	14	20%
60-69	4	6%
70-79	1	1%
	70	100%
Marital Status		
Single	7	10.0%
Co-habitating	4	6.0%
Married	49	70.0%
Separated	2	3.0%
Divorced	7	10.0%
Widowed	1	1.0%
	70	100%
Highest Educational Degree Completed		
Grade school	2	3.0%
High school	23	33.0%
Community College	13	19.0%
University (Bachelor's degree)	24	34.0%
Master's degree	7	10.0%
Doctoral degree	1	1.0%
	70	100%

Ethnic Background		
Afro-American	1	1.0%
Asian American	0	0%
Caucasian	67	96.0%
Chicano or Spanish	0	0%
Native American	2	3.0%
	70	100%
Number of Children		
No children	15	21.0%
Expecting	36	51.0%
2 Children or less	18	26.0%
More than 2 Children	1	1.0%
	70	100%
Employment		
Not/not currently looking	10	14.0%
Not/currently looking	2	3.0%
Currently working	55	79.0%
Other (maternity leave, compensation, disability)	3	4.0%
	70	100%

Representativeness

Population figures for Calgary and Alberta were used to assess the study sample for community representativeness. Alberta statistics on marital status report that 73% of the population is married, the study sample was 70%. On educational status, 28% of the population in Calgary have completed High School, while 33% of the study sample had completed High School. The population statistics show that 55% have completed Community College or University Bachelor's degree, compared to 53% of the study sample. Population figures on ethnicity show that .5% of the population is Afro-Canadian,

8% Asian Canadian, ,5% Chicano or Spanish and .8% Native Canadian. The study sample was 1% Afro-Canadian, 0% Asian Canadian, o% Chicano or Spanish, and 3% Native American. Population figures on families with children show that 49% have 2 children or less while the study sample was lower at 26%. Population figures on employment show 59% currently working while the study sample was higher at 79%. Therefore the study sample is reasonable representative of the Calgary population.

Of the initial 76 participants enrolling into programs (Exercise + Education Program, Education Program), only 3 participants withdrew before program completion resulting in only a 4% attrition rate. One participant withdrew due to an illness and hospitalization requiring surgery, a second participant reported a sudden and unexpected job layoff, and one provided no information. Table 2 summarizes participant enrollment and attrition. There were 3 participants who, due to scheduling conflicts, completed the program they were enrolled in but missed one of the four data collection times. Complete data were obtained for 70 participants. See Table 2.

Table 2. Participant Enrollment and Attrition

Group	Enrolled			Completed Program			Completed Data		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Exercise + Education Program	12 24%	37 76%	49 100%	12 100%	35 95%	47 96%	10 83%	26 70%	36 73%
Education Program	8 30%	19 70%	27 100%	8 100%	17 89%	25 93%	6 75%	13 68%	19 70%
Wait List Control	3 14%	19 86%	22 100%	NA	NA	NA	3 100%	12 63%	15 68%
Total	23 23%	75 77%	98 100%	20 100%	52 93%	72 95%	19 83%	51 68%	70 71%

Participant Pre-Treatment Orientation

All participants in the study attended a 1.5 hour pre-treatment orientation (Appendix B) led by the primary investigator and assisted by several volunteer research assistants. The purpose of the orientation was to: provide information about the purpose of the research study and scheduling details, obtain informed consent, familiarize the participants with the study protocols, provide practice time for the fitness testing, introduce the reporting methods for the self-monitored dependent measures, and to provide an orientation to the facilities where the testing procedures would be administered (classrooms, and indoor track).

When describing the research project and its purpose, it was emphasized that participation was voluntary, and that anonymity and confidentiality would be ensured. General information included: protocol for missed scheduling, troubleshooting advice for taking Resting Heart Rate measures taken at home, and recognizing warning signs and symptoms to stop exercising during the testing procedures. The orientation session also included instruction and practice of the fitness testing procedures that would be used in the study. Any questions were answered during the meeting, and the participants were encouraged to phone the primary investigator if there were questions or concerns arising later about the study.

Participants gave signed consent on a form which described the format and general purpose of the study (Appendix F). Additionally they were asked to complete a medical questionnaire which allowed the primary investigator to identify any individuals for whom exercise could pose a medical risk (Appendix G). Any individuals who were identified

were then required to obtain medical clearance from their physician in order for them to participate in the study. The participants were also asked to sign a "Release of liability, waiver of claims, assumption of risks and indemnity agreement" form as required by the protocol of the University of Calgary Fitness facilities.

Instruction and practice of the fitness testing included: measuring and recording Resting Heart Rate (Appendix H) at home, the Cooper Fitness Test, and the Post-exercise Heart Rate (Appendix I). The instruction and practice session for measuring Resting Heart Rates included a demonstration by the primary investigator: to identify the pulse points, palpate and count the pulse, and finally record the results in the heart rate passport. This was followed by participant practice. Research Assistants and registered nurses circulated during the practice session in order to check for participant accuracy in their self-measured heart rates. Resting Heart Rate Passports were circulated with the standard protocol printed on the inside cover. The participants were shown the method of entering their self-measured heart rates in the passport. All participants were encouraged to practice taking their heart rates at home using the method in the standard protocol, in order to improve the accuracy of their measurements.

Description of The Treatment and Non Treatment Groups

Enrollment into Treatment Groups

Based on the suitability criterion, participants were enrolled into the study in one of three Groups using a self-selection process. Group 1 began a lifestyle change program which included an education on healthy active lifestyle plus a modest program of aerobic exercise. Group 2 began the same lifestyle change program as Group 1 but without the exercise component. Group 3 did not receive a treatment and became a waiting list control

Group. Group 3 were asked to not participate in any aerobic exercise activities for the duration of the study.

Treatment Group 1 (education + exercise)

Group 1 participants received a program of classroom instruction once a week on healthy lifestyle education as well as an instructed aerobic exercise class twice a week. The education program involved a standardized 12 week comprehensive course led by a team of health professionals including a fitness instructor, nurse, and dietitian. The program was originally designed as a lifestyle program for weight management and has a well established record of effectiveness for the last 25 years. All members of the team of health professionals delivered the program guided by a syllabus produced by Trym Gym Calgary.

The educational program involved 1 hour per week of presentations and Group discussions. The program covered the essential behaviors, knowledge, and skills needed to modify lifestyle for general well being, and focused on topics such nutrition, weight loss, general health practices, and physical activity. The program provided a course manual-workbook for each participant which included course content, written objectives with behavioral outcomes, and take-home assignments. Basic physiological measurements such as height, body weight, waste-hip ratio, body mass index, blood pressures and food diaries were taken upon enrollment and repeated each week for client feedback. These measurements were taken primarily as feedback about participants' progress in the program. Participants reported that having a monthly indication of their progress provided tangible evidence of the effectiveness of the program. In addition, participants reported the feedback was very motivating in helping to keep them involved until the completion of their program.

The exercise component, led by a licensed fitness instructor, focused on low impact exercise at a "moderate effort" and was scheduled twice a week for 1 hour. The routine consisted of 10 minutes of stretching for a warm-up, 30 minutes of "low impact" aerobic exercise to music, then a 10 minute cool-down period. In addition to the exercise treatment they received in the program, the participants were asked to log the frequency, duration, and type of exercise on a standardized form for aerobic exercise they did outside of the program.

Treatment Group 2 (education only)

Group 2 participants received the same standardized lifestyle change program as Group 1, but without the exercise component. Although Group 2 participants were not provided with an instructional exercise component in their program, they were encouraged to participate in physical activities on their own. The participants were asked to log the frequency, duration and type of exercise on a standardized form. This Group was included in the study to allow for clearer determinations of whether important mediators of stress reduction lay with factors specific to aerobic exercise itself, or with the other nonspecific factors such as staff attention, Group support, time-out from home and work, or weight loss.

Non-Treatment Group 3 (Waiting List Control)

To control for the influence of time-tied effects and repeated exposure to stress questionnaires, a control Group with no treatment was included in the design. Group 3 participants received no treatment program. They agreed not to participate in any aerobic exercise activities while waiting to commence the lifestyle change program at the end of the study. To remain consistent with the design of the study, they were also asked to log

the frequency, duration and type of exercise on a standardized form. This was done in order to verify they indeed refrained from aerobic exercise activities. They were offered the treatment program at the end of the study.

Dependent Measures

All dependent measures were taken at the commencement of the study, and once every 4 weeks thereafter for 12 weeks. The time of day and day of the week was the same for each of the 4 data collection sessions. This was done to maintain consistency of biorhythms and time-of-day schedules across each data collection. The same-day, same-time scheduling also provided consistency for participants to help to minimize the attrition.

Participants from each of the 3 Groups were pooled for data collection. All of the research assistants were blind to the Group designation of the participants. At all times, the stress measures were administered first, followed by the fitness measures.

Stress Dependent Measures

The stress measures were taken using a combination of paper/pencil self-report measures, self-monitoring scales including: the Symptoms of Stress Inventory, and the Daily Hassles Inventory. The stress questionnaires were administered using the standardized procedures detailed in the administration manuals.

Symptoms of Stress Inventory (SSI). The Symptoms of Stress Inventory questionnaire (Leckie & Thompson, 1979) is designed to measure the frequency with which people experience physiological, behavioral, and cognitive stress-related symptoms.

The SSI is sensitive to change and has been used frequently in research (Allen & Hiebert, 1991; Hiebert & Eby, 1985; Hiebert, Kirby, Jaknavorian, 1989; Pennebaker, 1984). The inventory consists of a 95 item checklist on which respondents indicate the

frequency (on a 5-point Likert scale) with which they have encountered various stress-related symptoms over the last two weeks using ratings of "never", "infrequently", "sometimes", "often" and "very frequently" experienced over the last 2 weeks. The SSI has ten Subscale Scores (Peripheral, Cardiopulmonary, Neural, Gastrointestinal, Muscle Tension, Habit Patterns, Depression, Anxiety, Anger, and Cognitive Disorganization) as well as a Total Score (Thompson, 1987).

Reported face validity is high for the Symptoms of Stress Inventory, and the reliability using Cronbach's alpha ranges from .71 to .87 for the subscales, and is .96 for the full scale score (Hiebert & Eby, 1985). Leckie and Thompson (1979) report a correlation of r=.82 with the Symptom Checklist-90-R (Derogatis, 1982), which is a standardized test that has high levels of both internal consistency and test-retest reliability and coefficient alphas between .77 and .90. Internal consistency is reported as .97 (Cronbach's alpha). Other reports indicate the Symptom Checklist-90-R has an overall coefficient alpha of .95 and a series of test-retest coefficients between .81 and .94 (Everly & Sobelman, 1987).

The Daily Hassles Scale (DHS). The Daily Hassles Scale (DHS) is a self-report inventory used to measure the frequency and severity of events considered by the person to be stressful. The inventory was primarily developed as a research instrument to investigate stress as either an independent or dependent variable (Lazarus & Folkman, 1991).

The DHS (Kanner et al., 1981) is a 117-item self-report questionnaire that has been reported as a better predictor of psychological and physical symptoms of stress than the standardized Life Events Survey (DeLongis et al., 1982; Kana et al.; Weinberger,

Hiner, & Thierney, 1987). A study by Delongis (1982) found both frequency scores and intensity scores of "Hassles" to be related to illness and predicted measures of stress.

Respondents are instructed to indicate occurrences of items which they perceive to have "hassled" them in the past 2 weeks. Scale items reflect content areas of work, family, social activities, environment, finances, practical considerations and health. Operationally, hassles are defined as "the irritating, frustrating, distressing demands that to some degree characterize everyday transactions with the environment" (Kanner, et al. 1981, p.3). Items are answered in response to the question "how much of a hassle was this for you?" Responses indicate the occurrence of the stressful event within the last two weeks as well as the severity of the hassle experienced in conjunction with the event. Items are rated on a 4-point Likert scale stem (0 = none or did not occur; 1= somewhat severe; 2 = moderately severe; 3 = extremely severe). From this information, two scores are tabulated: 1) a frequency score, which simply counts the number of items checked, and 2) an intensity score, which counts the mean severity reported for all items that are checked (Delongis, et al, 1982).

The scale has a high test-retest reliability of $r = .79$ for frequency and an $r = .48$ for intensity (Delongis et al., 1982). The Hassles frequency is significantly correlated with stress symptom levels both in the initial and final stages, with correlations of $r = .27$, $p < .01$, and $r = .35$, $p < .01$ respectively (Delongis et al.). Subjects in this study (Delongis et al.) who had high frequency of hassles were found to have relatively high levels of somatic symptoms of stress.

Fitness Dependent Measures

The fitness measures were taken using standardized fitness tests including: the Resting Heart Rate, the Cooper Fitness Test, and the Post-exercise Heart-Rate Recovery. The selection of these measures was based on the recommendations of trainers and researchers at the Human Performance Lab at the University of Calgary, and the faculties of Kinesiology and Medicine. These include: Resting Heart Rate (upon morning wakening), Heart Rate Recovery (immediately following a standardized exercise session), and the Cooper Fitness Test (Cooper, 1968). In addition, the quantity and quality of extra-program aerobic activity was monitored.

Resting Heart Rate. Participants were instructed to measure their Resting Heart Rate and record it at home, using the standard protocol developed for the study, and record the result in their fitness passport. Self-monitored Resting Heart Rate was recorded by the participants upon rising for 7 consecutive days prior to the scheduled data collection. Upon rising, participants were instructed to locate their pulse, count the pulse exactly for 1 minute, and record the number on the provided passport. A study by Hiebert, Cardinal, and Dumka (1983), suggests that self-monitored heart rate can be trusted as an accurate reflection of a machine-monitored heart rate measurement. Correlations between self-monitored and machine-monitored readings range from .94 -.97 (Hiebert, et al., 1983).

12-Minute Cooper Test. Participants were asked to walk or run using "moderate effort", as far as they are able within a timed 12 minute period on a 200 meter indoor track at the University of Calgary. The number of completed laps were recorded and later

converted to total distance in meters. The Cooper 12-minute (Cooper, 1968) measured the total distance covered by the participant either running and/or walking around a 200 meter indoor track for a timed 12 minute period. The Cooper Test measurements are then converted using standardized scales to reliably predict VO2 max which is an index of oxygen uptake in the blood stream and physiological fitness.

To maintain the self-recorded accuracy of the distance covered during the test, each participant was given a 5 inch length of masking tape and asked to record their name, date, Group number, and number of laps around the 200 meter track completed in 12 minutes. The tape was applied to the back of the participants' non-dominant hand or the sleeve of their shirt (lower arm). Each lap completed was recorded on the masking tape using a small pencil held in the participants' hand. Participants were instructed to record the final lap by rounding up to the nearest $1/8^{th}$ of a lap. Verification of participants' accuracy was determined by spot check recordings done by the researcher and the research assistants. The distance completed would later be converted using standardized scales to a predicted VO2 max, corrected for age and sex (Fisher & Jensen, 1990).

This test is an excellent predictor of aerobic fitness, lending itself well to Group testing situations (Sharkey, 1979; Wilmore & Costill, 1994), and through testing has shown strong correlations between the score in the test and maximum aerobic power (Harrison, Bruce, Brown, & Cochrane, 1980).

Post-Exercise Heart Rate Recovery. This measurement was taken by the participants immediately following their 12-minute Cooper measurement exercise session. The heart rate was taken immediately at 30 seconds, 2-minutes, and 5-minutes after completing the Cooper Fitness Test. Participant were assisted by timers, nurses, research

assistants and fitness instructors. Participants were oriented to 4 timing stations at quarter marks around the 200 meter track. An official timer, holding a running stop watch synchronized to a running stop watch held by the primary investigator, was stationed at each of the 4 timing stations. Once the whistle was blown by the primary investigator to indicate the completion of the 12 minute Cooper Test, participants moved quickly to the closest timing station. Station 1 was the starting block, station 2 was located at the 50 meter mark, station 3 was located at the 100 meter mark, and station 4 was the 150 meter mark.

Each timing station was supervised by both a timer and a registered nurse, who would assist the participants to find their pulse points. Another whistle by the primary investigator would synchronize each of the 4 timers to begin a loud verbal 10-second count down to the participants, to fore-warn them of their first pulse measurement. The timers stated loudly "start counting" and participants began counting their self-measured pulse rates and after 15 seconds the timers stated loudly "stop counting".

The participants were instructed to raise their hand at the 10 second warning whistle if they had not located their pulse points. The research assistants would then measure the pulse rate for the participant. At each timing station, research assistants would randomly select participants and check the accuracy of their pulse counts. Confirming the participants' pulse count was done by the research assistant simultaneously counting the pulse of the participants' free arm. The same method was used for all 3 post-exercise heart rate measures.

The heart rate was counted for a 15 second period and recorded on a piece of masking tape. The rates were later re-calculated by multiplying each number by four to

obtain a beats per minute post-exercise heart rate. The rates, and the differential between the three measurements, were recorded, as well as the changes in the differential over time.

Another index of fitness was calculated using the 5 minute post-exercise heart rate recovery rate. The index would calculate how close participants would get to their normal Resting Heart Rate following an exercise period (Cooper 12-minute). The 5 minute Post-exercise Heart Rate was subtracted from the calculated average Resting Heart Rate, to see how close the 5 minute rest period would approximate to the person's average Resting Heart Rate. An index that shows improved fitness would record a progressively closer approximation to Resting Heart Rate following a 5-minute resting period following a standard exercise session.

Chapter 4

Results

The goal of the current study, was to evaluate the stress-reducing potential of aerobic exercise in a sedentary Group of older members of the Calgary community and to compare those results to similar people not receiving an aerobic exercise treatment. A second goal was to determine the relationship between aerobic fitness variables and stress indicators.

Research Question 1

What are the differential effects on fitness and stress associated with people receiving health education, those receiving health education plus exercise, and those receiving no treatment?

The first goal of the study was tested using a 3 (Group) by 4 (time) MANOVA for repeated measures. See Table 3 for Means and Standard Deviations (in parentheses).

Table 3.
Mean Stress and Aerobic Fitness Scores Across Time

Group	n	Time 1	Time 2	Time 3	Time 4	Total
Symptoms of Stress Inventory						
Exercise + Education	36	88.75 (39.38)	61.67 (36.69)	55.25 (38.06)	47.42 (38.82)	63.27 (38.24)
Education	19	80.74 (44.79)	63.32 (41.73)	58.53 (38.01)	45.84 (31.71)	62.11 (39.06)
Wait List Control	15	84.87 (59.42)	96.53 (62.36)	73.33 (58.97)	67.60 (62.93)	80.58 (60.92)
Total	70	85.74 (45.14)	69.59 (46.12)	60.01 (43.22)	51.31 (43.64)	66.66 (44.53)

Hassles, F (3, 201) = 11.02, p<.01, Symptoms of Stress Inventory F (3, 201) = 30.23, p<.01, Resting Heart Rate, F (3, 201) = 2.90, p<.04, and Cooper Fitness Test, F (3, 201) = 16.22, p<.01; and a significant Group x time interaction for the Symptoms of Stress Inventory, F (6, 201) = 3.78, p<.01, and Cooper Fitness Test, F (6, 201) = 4.42, p<.01.

Manova results showed no significant difference between Groups at the start of the study on the Symptoms of Stress Inventory and the Cooper Fitness Test, F (4, 132) = 1.65, p = .165.

Follow up univariate tests found a significant time effect for; Group 1 on both Symptoms of Stress, F(3,105) = 24.24, p < .01, and Cooper fitness, F(3, 105) = 25.13, p < .01; Group 2 on both Symptoms of Stress, F(3, 54) = 14.52, p < .01, and Cooper fitness, F(3, 54) = 3.97, p < .01; and Group 3 for Symptoms of Stress only, F(3, 42) = 10.47, p < .01.

A between Group Post hoc analysis was conducted using Scheffe (Harris, 1975) and a significance level of p <.05. Results indicated that at week 4, Group 1 (exercise + education) and Group 2 (education only) were both significantly higher than Group 3 (waiting list), but not different from each other, on Cooper fitness. Additionally, Group 1 was lower than Group 3 on Symptoms of Stress. At week 8, the results were similar, Group 1 and Group 2 were higher than Group 3 on Cooper fitness, but only Group 1 was significantly lower than Group 3 on Symptoms of Stress. At week 12 , only Group 1 was significantly higher than Group 3 on Cooper fitness.

A between time Post hoc analysis of the 4 measurement times (baseline, 4 weeks, 8 weeks, and 12 weeks) using Scheffe and a significance level of p <.05 was conducted on each of the Groups separately. Comparing week 4 to baseline, Group 1 showed significant

increases in Cooper and significant decreases in Stress Symptoms, Group 2 showed significant decreases in Stress Symptoms, and Group 3 showed no change. This effect was maintained at week 8. By week 12, Cooper fitness showed a further significant increase for Group 1, and Stress Symptoms showed a further significant decrease for Group 2. For Group 3, Stress Symptoms rose slightly and then fell to a point where Stress Symptoms at week 12 was lower than week 4, but not significantly lower than baseline. Thus, Group 1 attained an increase in fitness more quickly than Group 2 (or Group 3) and only Group 1 showed a significant difference in Cooper fitness and Stress Symptoms compared to Group 3 at week 12.

Conclusion. These results suggest that participants in Group 1 (education + exercise) benefited more than participants in Group 2 (education only) or Group 3 (waiting list control). There were no significant Group differences in stress levels at the onset of the study. Over time, aerobic fitness levels improved and stress levels dropped significantly in the two treatment Groups. Compared to the control Group, both treatment Groups reported significantly less stress at week 4, and although both treatment Groups continued to improve, only Group 1 showed significant differences at week 12.

Low cell size did not permit the analyses of differential effects associated with gender or with other demographic variables such as education level and occupation.

Research Question 2

What is the relationship between aerobic fitness variables and stress indicators?

The second goal of the study was to determine the relationship between aerobic fitness variables and stress indicators. This was tested using Pearson correlation

coefficients among the dependent measures. Table 4 provides the correlation coefficients for relationships among Stress Symptoms Inventory, Daily Hassles, Cooper Fitness Test and Resting Heart Rate variables reported in this study.

Table 4. Correlation between Stress & Exercise Variables of 70 Participants

	DHS1	DHS2	DHS3	DHS4	SSI1	SSI2	SSI3	SSI4
DHS1	----							
DHS2	.73***	----						
DHS3	.74***	.84***	----					
DHS4	.63***	.80***	.85***	----				
SSI1	.75***	.60***	.63***	.55***	----			
SSI2	.65***	.77***	.73***	.69***	.74***	----		
SSI3	.65***	.70***	.82***	.70***	.74***	.87***	----	
SSI4	.59***	.68***	.77***	.80***	.70***	.84***	.89***	----
Coop1	.09	-.16	-.11	-.24*	.12	-.17	-.14	-.21
Coop2	.12	-.19	-.07	-.15	.15	-.22	-.12	-.14
Coop3	.10	-.18	-.07	-.13	.08	-.22	-.11	-.13
Coop4	.02	-.20	-.10	-.19	.05	-.24*	-.15	-.19
RHR1	-.07	-.04	-.04	-.05	-.21	-.09	-.09	-.13
RHR2	-.13	-.03	-.09	-.06	-.23*	.00	-.08	-.08
RHR3	-.05	-.01	-.07	-.01	-.15	-.07	-.05	-.07
RHR4	-.06	.07	.06	.04	-.16	.06	.02	-.01

* $p < .05$
** $p < .01$
*** $p < .001$

	Coop1	Coop2	Coop3	Coop4	RHR1	RHR2	RHR3	RHR4
Coop1	----							
Coop2	.91***	----						
Coop3	.86***	.92***	----					
Coop4	.82***	.87***	.90***	----				
RHR1	-.31**	-.23*	-.32**	-.33**	----			
RHR2	-.33**	-.35**	-.39***	-.42***	.92***	----		
RHR3	-.23	-.25*	-.28*	-.28*	.49***	.51***	----	
RHR4	-.33**	-.33**	-.37**	-.46***	.85***	.89***	.52***	----

* $p < .05$
** $p < .01$
*** $p < .001$

Each dependent measure is correlated with itself across time. The mean total Daily Hassles score was significantly correlated with the Symptoms of Stress total score at the start of the study and every 4 weeks for the duration of the 12 weeks of the study ($r = .75, .77, .82, .80, p<.01$).The average distance in meters covered in the Cooper Fitness Test was inversely correlated with the average Resting Heart Rate at the start of the study ($r = -.31, p<.01$), after 4 weeks ($r =-.35, p<.01$), at 8 weeks ($r = -.28, p<.05$) and more strongly at the end of 12 weeks ($r = -.46, p<.01$). Therefore, lower Resting Heart Rate is associated with longer distances on the Cooper Fitness Test in the present study.

An expected inverse relationship was found between the variables of fitness and stress. The correlations between Stress symptoms and Cooper fitness were all in the expected direction, but most of the correlations were not significant. Correlations between stress and Resting Heart Rate were not in the expected direction and did not attain significance. A strong relationship between the fitness and stress variables did not emerge from the correlation findings in the present study.

In order to determine if the expected relationship between aerobic fitness variables and stress indicators emerged with the 2 treatment Groups but not the control Group, each of the 3 Groups was examined separately. The results were similar to those obtained from the samples as whole. See Appendix J for correlation tables.

The finding of the separate Group analysis was a stronger relationship between Resting Heart Rate and Cooper Fitness for Group 1. High scores on fitness are associated with low Resting Heart Rate. In Group 3 however, the relationship between Resting Heart

Rate and Cooper was not significant and was also not in the expected direction. Therefore the results of the control Group may be masking the relationship between Cooper Fitness and Resting Heart Rate for the fitness participants.

Supplemental Results

Less Fit versus More Fit

Further analyses were performed in order to determine whether participants with initially higher levels of fitness were different on the dependent measures when compared to those with relatively lower levels of fitness. Participants from the 2 treatment Groups were pooled and divided into high fit and low fit categories based on a median split of the first Cooper Fitness Test at Time 1. Participants with Cooper results greater than 1350, were classified as more fit and those participants with results equal to, or lower than 1350, were classified as less fit. The rationale for pooling the 2 treatment Groups was that both Groups showed significant improvement over time.

An analysis with a 2 (Group) by 4 (time) MANOVA for repeated measures was used to examine the differences between less fit participants and more fit participants. See Table 5 for Means and Standard Deviations(in parentheses).

Table 5.

Mean Stress Scores and Resting Heart Rate Across Time for Lower and Higher Fit

Group	n	Time 1	Time 2	Time 3	Time 4
Symptoms of Stress Inventory					
Less Fit	29	81.72	68.24	60.38	51.97
		(40.56)	(41.99)	(43.49)	(43.50)
More Fit	26	90.73	55.54	51.92	41.19
		(41.95)	(32.81)	(30.26)	(25.53)
Total	55	85.98	62.24	56.38	46.87
		(41.10)	(38.12)	(37.72)	(36.23)
Daily Hassles Inventory					
Less Fit	29	46.24	42.03	38.03	39.54
		(25.38)	(24.50)	(25.00)	(23.25)
More Fit	26	50.58	32.62	31.69	28.42
		(24.78)	(17.86)	(20.60)	(20.25)
Total	55	48.29	37.58	35.03	34.29
		(24.96)	(21.95)	(23.94)	(22.39)
Resting Heart Rate					
Less Fit	29	67.53	66.24	66.28	64.97
		(7.46)	(7.61)	(7.51)	(7.17)
More Fit	26	61.35	60.16	63.41	60.24
		(5.78)	(6.58)	(16.75)	(6.49)
Total	55	64.61	63.37	64.92	62.74
		(7.35)	(7.71)	(12.70)	(7.20)

There was a statistically significant omnibus effect for time $F(9, 382) = 12.57$, $p<.01$, and a significant Group x Time interaction, $F(9, 382) = 2.23$, $p<.02$. Follow-up univariate F-tests indicated a significant time effect for Daily Hassles, $F(3, 159) = 17.71$, $p<.01$, and Symptoms of Stress Inventory $F(3, 159) = 40.26$, $p<.01$; and a significant

Group x Time interaction for the Symptoms of Stress Inventory, F (3, 159) = 3.51, $p<.02$, and Daily Hassles, F (3, 159) = 4.80, $p<.01$.

Even though at the start, less fit participants had lower stress scores on both the Symptoms of Stress and the Daily Hassles, participants who were comparatively more fit experienced a significantly greater reduction in stress and finished the study with significantly lower Daily Hassles and Symptoms of Stress scores.

Higher Stress Symptoms versus Lower Stress Symptoms

Additional analyses were performed in order to determine whether participants with initially lower levels of stress symptoms were different on the dependent measures when compared to those with relatively higher levels of stress symptoms. Participants from the 2 treatment Groups were divided into higher stress and lower stress categories based on a median split of the Symptoms of Stress Inventory at Time 1. Participants with Stress symptoms greater than 84.00, were classified as higher stressed and those equal to, or less than 84.00, were classified as less stressed.

An analysis with a 2 (Group) by 4 (time) MANOVA for repeated measures was used to examine the differences between higher stress and lower stress participants. See Table 6 for Means and Standard Deviations (in parentheses).

Table 6.

Mean Stress and Fitness Scores Across Time for Participants with Lower and Higher Stress Symptoms

Group	n	Time 1	Time 2	Time 3	Time 4
Daily Hassles Inventory					
Lower Stress	29	31.54	25.29	21.57	23.93
		(16.41)	(17.37)	(14.46)	(17.31)
Higher Stress	26	65.67	50.33	49.00	45.03
		(19.96)	(18.85)	(22.08)	(22.25)
Total	55	48.29	37.58	35.04	34.29
		(24.96)	(21.95)	(23.04)	(22.39)
Cooper Fitness Test					
Lower Stress	29	1414.29	1519.64	1583.93	1606.25
		(331.29)	(403.42)	(398.45)	(441.78)
Higher Stress	26	1475.00	1639.82	1684.26	1696.30
		(286.81)	(316.48)	(346.49)	(343.67)
Total	55	1444.09	1578.64	1633.18	1650.46
		(309.08)	(365.07)	(373.83)	(395.62)
Resting Heart Rate					
Lower Stress	29	64.64	64.17	66.14	62.99
		(5.80)	(6.40)	(15.92)	(7.27)
Higher Stress	26	64.58	62.54	63.66	62.47
		(8.79)	(8.91)	(8.27)	(7.27)
Total	55	64.61	63.37	64.92	62.74
		(7.35)	(7.71)	(12.70)	(7.20)

There was a statistically significant omnibus effect for Group, $F(3, 51) = 14.69$, $p<.01$, and a significant effect for time $F(9, 382) = 12.34$, $p<.01$. Follow-up univariate F-tests indicated a significant Group effect for the Daily Hassles Inventory, $F(1, 53) = 40.86$, $p<.01$; and a significant time effect for Daily Hassles, $F(3, 159) = 16.49$, $p<.01$,

and Cooper Fitness Test, F (3, 159) = 26.99, $p<.01$. Participants in the treatment Groups who had fewer symptoms of stress also reported significantly less Daily Hassles and over time Daily Hassles decreased and aerobic fitness increased.

Chapter Five

Discussion

This chapter presents a discussion of the practical implications of the results described in Chapter four, highlights the weaknesses and strengths of the study, provides recommendations for future research and discusses the contributions the study has made to the field.

The results of this study extend the current literature supporting the efficacy of modest aerobic exercise for increasing fitness and ameliorating psychological stress. The exercise training, compared to controls not receiving such training, was found to be accompanied by significant reductions in stress symptoms across 12 weeks in a reasonably representative community sample of healthy, older adults in relation to controls not receiving such training. Most importantly, and in contrast to the adopted standards of the American College of Sports Medicine which recommend at least 15-20 weeks of exercise 3-4 times per week as necessary before important fitness and health benefits are realized (American College of Sports Medicine, 1991a), this study indicates that exercise training of low intensity, modest effort, and twice weekly was found to be effective. The findings of this study add further support for exercise efforts that are neither vigorous or uncomfortable, but achieve significant mental health gains and improvement in cardiovascular fitness (King et al., 1993; Steptoe & Cox, 1988).

Practical Implications

Results of this research are relevant to the key findings of the Health Needs Assessment through Alberta Health and the Calgary Regional Health Authority (1996).

The report found that health consciousness needs to be raised at the primary prevention level, and recommended that people are going to be expected to take more responsibility for becoming, and remaining, healthy. The focus of health care in the current climate of reform, is on creating within each individual, a strong sense of personal responsibility for health and well-being. This research provided tangible evidence which supports personal efforts towards positive lifestyle habits such as regular exercise. The findings of the present study are consistent with research showing that the more involved people are in their health care, the better the health outcome (Cousins, 1989).

New evidence has increased the recognition that the etiology of poor overall health and wellness is multidetermined. One's lifestyle, including patterns of eating, exercise, drinking, coping with stress, and use of tobacco and drugs, together with environmental hazards, are the major known modifiable causes of most illness today (Lazarus & Folkman, 1984; Meichenbaum & Turk, 1982; Perkins, Leserman, Gilmore, Petitto & Evans, 1994; Rosch, 1996; Selye, 1974, 1976, 1986; Shephard, 1993; Simon, 1990). Meichenbaum and Tursk (1982) therefore, suggest that comprehensive approaches to health promotion will need to include a combination of factors such as exercise and stress management that contribute to overall health and wellness. The data from this study support this suggestion. It is notable in the present study, that the education program which covered the essential behaviors, knowledge, and skills needed to modify lifestyle for general well being, combined with a self prescribed program of regular exercise, was accompanied by significant improvement in fitness and reduction in stress. However, the same program, combined with an instructional program of exercise, was found to have a more powerful effect.

Treatment interventions that can help alleviate stress would make an important contribution to research as stress and stress-related problems in our society continue to rise (Whitehead, 1994). Additionally, the Group approach to treatment used in this study has economic benefits and is consistent with the new thrust of health care reform, where Group treatments are seen as cost effective.

The data from this study have practical implications for exercise prescription and compliance in older populations. Proponents of exercise rely on the adopted National standards of exercise for recommendations of frequency, intensity, and duration of exercise. Such a "carte blanche" approach to prescribing exercise supports an erroneous notion that older adults are like younger adults in health, personality, and functional capacity. The exercise treatment used in the study was less intense, less frequent, and of shorter duration than the recommended standards, but remained highly effective for an older population. Special emphasis should be given to the issue of intensity of adopted standards of exercise because of its close association with medical risks (Koplan, Siscovick, & Goldbaum, 1985), its impact on public acceptance, and its appropriateness for older adults. The majority of middle-aged and older adults prefer more modest formats of exercise than what is often recommended (Iverson, Fielding, Crow, & Christenson, 1985; King, 1994; King, Taylor, Haskell, & DeBusk, 1988; King, Taylor, Haskell, & DeBusk, 1990).

Limitations

The addition of an attention-control condition Group in the study would have allowed for clearer determinations of whether important mediators of psychological change lay with factors specific to the physical activity itself or with other nonspecific factors such as

the emotional benefits accruing from Group support, positive interpersonal interaction, distraction from work stress, time-out from home, and the effects of encouragement from a fitness instructor. There are also potential confounding factors not examined in the data analysis which could account for the observed relationships. One example is the constitutional differences between those who chose to respond to the advertising for the study and those in the general public who did not. One study of Exxon Corporation executives for example, invited 422 persons to participate in a medically supervised exercise program, resulting in participation from 309 (73 %). When a comparison was made between those who entered the program and those who did not, it was observed from the results of periodic health examinations that the ones who did not participate were older, smoked more, had higher blood fat levels, higher blood pressure, more heart disease, and poorer treadmill performance (Yarvote, McDonagh, Goldman, & Zuckerman, 1974). Unfortunately, the cell sizes in the various demographic subsamples in this study were too small to analyze the extent to which these types of factors may have been contributing to the results.

Voluntary participation may reflect a stronger expectation of psychological benefits which might act as a confounding factor in the research results. Psychological benefits of exercise have been propagandized by the popular press and the vast majority of public information has highlighted the stress reducing effects of exercise. It is possible that self-selected, motivated volunteers in an experiment may demonstrate improvement in psychological functioning simply because they are expecting such improvement (Folkins & Sime, 1981), or because they know that observers want them to display such improvement. Because of the high expectations now rooted within the population, it is

practically impossible to determine the influence of such factors. Furthermore, Ward and Morgan (1984) suggest that participants involved in exercise programs often "get religious" about lifestyle modifications, changing their intake of drugs and stimulants and modifying eating, sleeping and other living habits. The present study did not track these sorts of "spin off" effects that could have influenced the results.

For ethical issues concerning personal safety of participants, the sampling methods screened out participants who had major health problems. This may have excluded participants who in fact had stress-related health problems and were more representative of an older age Group. A bias may have resulted by including in the study, only participants who had lower stress levels to begin with. Additionally, volunteer participation in a supervised lifestyle change program with an attached program cost, is positively related to level of socioeconomic status. Therefore, the results of the study may not be applicable to a more economically diverse Group of people.

The sample, as a whole, excluded participants with chronic diseases or orthopedic problems that would have been aggravated by exercise. By including only "healthy" participants, the results may be confounded by variables associated with health habit differences (healthy eating, adequate rest, non-smoking and non-drinking), and personality variables associated with the individuals who self-select into a study of this nature (volunteers who are concerned about health issues and are proactive with respect to issues concerning health and stress). This sample may have been a unique Group of individuals possessing certain characteristics which may have made them optimally suited for the intervention. In other words, this Group may not be representative of the population as a

whole. It may in fact be the differences in personality characteristics, health and/or degree of stressful life events that may have played a substantial role in the results of the study.

The inclusion of Group 2 (education only) in the study was to primarily control for the possibility that participants feel better simply because of the social interaction and the additional information they receive. This Group also controlled for factors such as social support, positive interpersonal interaction, distraction from work stress, time-out from home, and the effects of encouragement from an instructor. The participants in this Group were not given an exercise treatment, but the exercise logs they submitted indicated that they were unexpectedly exercising on their own. It is therefore not possible to examine the differential effects of the education treatment and the exercise treatment. Apparently when people become more educated about lifestyle factors that affect health, many of them spontaneously begin to exercise more regularly. In this study it is not possible to separate out this effect. However, it still is the case that people in a structured exercise program benefited more.

This study is subjected to the usual limitations of retrospective survey methods used to test stress (e.g., participant recall may be distorted, participants may give socially acceptable responses due to a high degree of social desirability embedded in the questionnaires, and self report may not reflect actual behavior). Confounding from sources such as contextual influences, time of day, length of recall in the retrospective studies (participants were asked to recall the last 2 weeks), and practice effects should be considered when interpreting the results of the stress scale.

Finally, the robustness of the Cooper Fitness Test results in this study may not guaranteed.

The Cooper Fitness Test was originally designed as a "maximal effort" exercise test whereby measurements are converted, using standardized scales, to reliably predict VO2 max (an index of oxygen uptake in the blood stream and physiological fitness). This study adapted the Cooper Test to a "modest effort" exercise test and as such were not converted to predictive VO2 max estimates.

Strengths

There remains a continuing emphasis in our society on vigorous exercise and competitive sport activities primarily focused on the youth. Evidence of this can be found in the advertising campaigns purporting a "no pain no gain" approach to exercise. Many of the populations studied in research are focused on younger persons whose bodies are more resilient and who resist motor activity less than habitual "couch potatoes". Such research examines the exercise effects typically on young college men, who are put through rigorous exercise programs such that only the "athletic jock" could participate. One strength of the present study was the examination of "modest" exercise effects on an older and previously sedentary population from the community. Attention to a more demographically diverse group using much less rigorous exercise programs makes a real contribution to the existing research.

Another important feature of the present study design was the use of multiple measures of the stress and fitness indicators over time. Beginning-point and end-point evaluation of exercise-effects on stress is the most common form of research in this area. Such an approach limits the evaluation of the change process in stress variables as fitness levels improve. Tracking people as they became more fit provided an original contribution

to the research in this area. This allowed the conclusion that the combined exercise and education Group significantly increased in fitness more quickly.

Another notable aspect of the present study was the use of naturally occurring treatments. The artificial environment of lab treatments, which often increase the internal validity of the research, often decrease the external validity of the findings. The present study provided a good example of how research can be interwoven into existing community programs so that external validity is increased allowing broader generalizability of the findings. Naturally occurring treatments offer economy, ease of administration and removes unintentional and intentional biases of an investigator influence. Collaboration and coordination between our research team, the staff of the Trym Gym program, and the participants resulted in an economical and unique approach to conducting research. Additionally, the administrator of the Trym Gym program reports that unexpectedly, business improved substantially as a result of the research program and participants reported that the regular administration of the research measures helped them stay in the program.

Future Research

The sample in this study provided a good representation of healthy adults of middle age who were largely a well educated, white community. However, further research is needed to determine the effects of such treatments in communities differing on these demographic variables.

A larger sample size would enable evaluation of demographic variables such as age, ethnicity, education, income, occupation, and gender that may potentially influence the relationship between stress and exercise participation. A defined population-based

study that ensures all members of the population have an equal chance of being in the study would avoid convenience sampling, and potentially reduce the self selection bias. Stratification across demographic variables in order to ensure a solid cross sectional community sample would also be possible with a population-based study. Research results would then be more generalizable to the population at large.

Further research might incorporate more treatment conditions in order to understand the relative contribution of education and exercise. A fourth group assigned to exercise treatment alone could be added to the study in order to examine the effects of exercise without the educational program, this would enable the research to isolate the differential effects of exercise and education using a controlled treatment. A fifth group assigned to a self-prescribed exercise would enable the research to control for the effects of group support and staff encouragement.

Intervention fidelity measures for the course instructors could be incorporated in the study in order to measure instructor-compliance with the intervention protocol to ensure consistency in treatment interventions. Treatment protocols would also give assurance that the treatments were delivered in a competent fashion and consistently across different instructors. Furthermore, program compliance data incorporated into the assessments would be useful to help examine if adherence to the treatment plan produces larger treatment gains. Treatment fidelity tracking could continue in a more longitudinal design, whereby the study follow-up would include repeated fitness and stress measures for a period of one year. An informal follow-up was conducted in the present study and found that people were continuing to participate in regular moderate exercise. People reported that at the completion of the study, they joined local fitness clubs, walking and jogging

groups, local community exercise Groups or formulated a personalized exercise program. Additionally, many reported that they had observed a significant personal "attitude change" about exercise, such that they were finding exercise "fun" and that it did help them to continue to feel better. A study using a more extensive and systematic follow-up period would be useful in providing more information regarding latency effects of the programs of exercise and education on stress.

A random assignment to conditions would also be an improvement from the original design as it allows for stronger inferences to be made regarding the role of exercise in the management of stress. The major benefit of randomly assigning participants to groups is to balance the characteristics of the participants in all of the Groups. However, in random assignment, certain results are true for certain controlled conditions, but such conditions don't exist in the natural setting, and therefore the results don't address natural phenomena. In natural circumstances, participants self-select into Groups and as such, random selection uses a set of conditions that don't exist in the real world, they are contrived in the sense of creating an "artificial" set of circumstances. A future study might compare outcomes of a random assignment to conditions with non-random assignment to conditions.

Finally, future research could examine Groups "at risk" of stress and stress related problems, such a clinically depressed populations or cancer patient populations. Cancer control is facing challenges from the current problems in the health care-system which include an aging population, unrelenting increases in cancer incidence rates, as well as stable mortality rates (National Cancer Institute of Canada, 1995). Although the etiology of cancer is not well understood, the following hypothesis deserves serious consideration:

exercise, healthy lifestyle education and reduced stress may significantly boost the body's immune system which is known to be involved in suppression of the reproduction and activity of pre-cancerous cells of the body.

Study Contributions

This study demonstrates that moderate exercise (twice a week for 30 minutes) combined with education can yield significant gains in fitness and reductions in stress. Education about the positive impact of lifestyle change by itself is not as beneficial as education combined with an instructional exercise program. However, it is not necessary to be an "exercise devotee" in order to see positive results.

Additionally, participants reported that the monthly progress indicators provided by the data collection procedures were very motivating and helped keep them involved in the program. One major difficulty reported in exercise studies is the high drop-out rate (Dishman, 1990; Dishman, 1994; Doyne et al., 1987; Steptoe et al., 1989; Ward & Morgan, 1984). Frequently, drop-out rates of 40-50% have been reported after 10 weeks of initiating a program (Dishman, 1988; Doyne et al., 1987; Ward & Morgan, 1984). Although there may be numerous factors contributing to the rates of recidivism, such findings may indicate that programs are not meeting the needs of the participants. It is possible that programs are being perceived as aversive, or possibly that the health benefits are not readily available, perceived, or obtained. Of the participants who commenced a program in the present study, 96% were still participating after 12 weeks which is a noteworthy accomplishment. The combination of an effective exercise program, interesting and pertinent information, and tangible indicators of progress helped produce the effects in this study.

It is my hope this line of research will encourage others in promoting multi-disciplinary, multi-component strategies for encouraging people to develop a healthy active lifestyle. This study represents an example of how research can be interwoven with practice to produce a combination that is more effective than either alone. The ultimate benefactors of the collaboration between research and practice used in this study were the participants, who discovered that increased fitness and reduced stress could be achieved through commitment to a moderate program of exercise and education.

Ultimately, it is hoped that the positive results in this research will support the development of early intervention strategies for preventing stress-related illnesses and promoting well-being in Groups at risk. A review of 100 studies published in the Journal of the American Medical Association showed that the sedentary lifestyle developed in the past 50 years causes widespread bodily damage through reduced vital capacity and cardiac output, increased risk of blood clots and stroke, increased levels of cholesterol and triglycerides, promotion of osteoporosis, disruption of bowel function and glucose metabolism, and reduced levels of sex hormone (Bortz, 1982). This damage occurs independently of other health risk factors such as smoking, obesity, alcohol, age and family history of disease. The potential of a program such as the one in this study to offset this trend is enormous.

Research showing that moderate exercise results in substantial decreases in stress is an important contribution to health promotion and prevention efforts as it will be far easier to promote lifestyle change to include exercise. The current adopted National Standards of exercise for health promotion are higher intensity and a longer duration than what is being studied in this research. A Canadian survey indicated that the percentage of

the population who meet the adopted standards of frequency, intensity, and duration of physical activity was 11% (Stephens & Craig, 1990). Recently, medical scientists have begun to value the health benefits of exercise over a wide range of disorders (Blair et al., 1989; Colgan, 1995), and some suggest that exercise combined in a synergistic way to other prevention variables, could be a major strategy for preventing and treating all disease.

In addition to the implications for stress management, the observation that favorable physical and psychological effects emerge with moderate intensity exercise is encouraging from the perspective of health promotion. Epidemiological studies have suggested that increased physical activity may be more important than achieving "fitness" for the prevention of health problems (Doyne et al., 1987; LaPorte et al., 1984; Leon, Connett, Jacobs, & Rauramaa, 1987; Ramlow, Kriska, & LaPorte, 1987). There is also evidence that modest exercise "boosts" immune function while intensive training increases susceptibility to illness (Calabrese, 1990; Douglas & Hanson, 1978; Eskola, et al., 1978). Moderate exercise programs may be more enjoyable, permitting participants to achieve goals of physical activity that have previously seemed beyond them without exerting undue effort. If positive findings are associated with the acceptable demands of moderate exercise, adherence to exercise programs might be enhanced. If the findings observed in the present study are shown to be robust on replication, they may have important implications for the ways in which programs should be devised for the general public.

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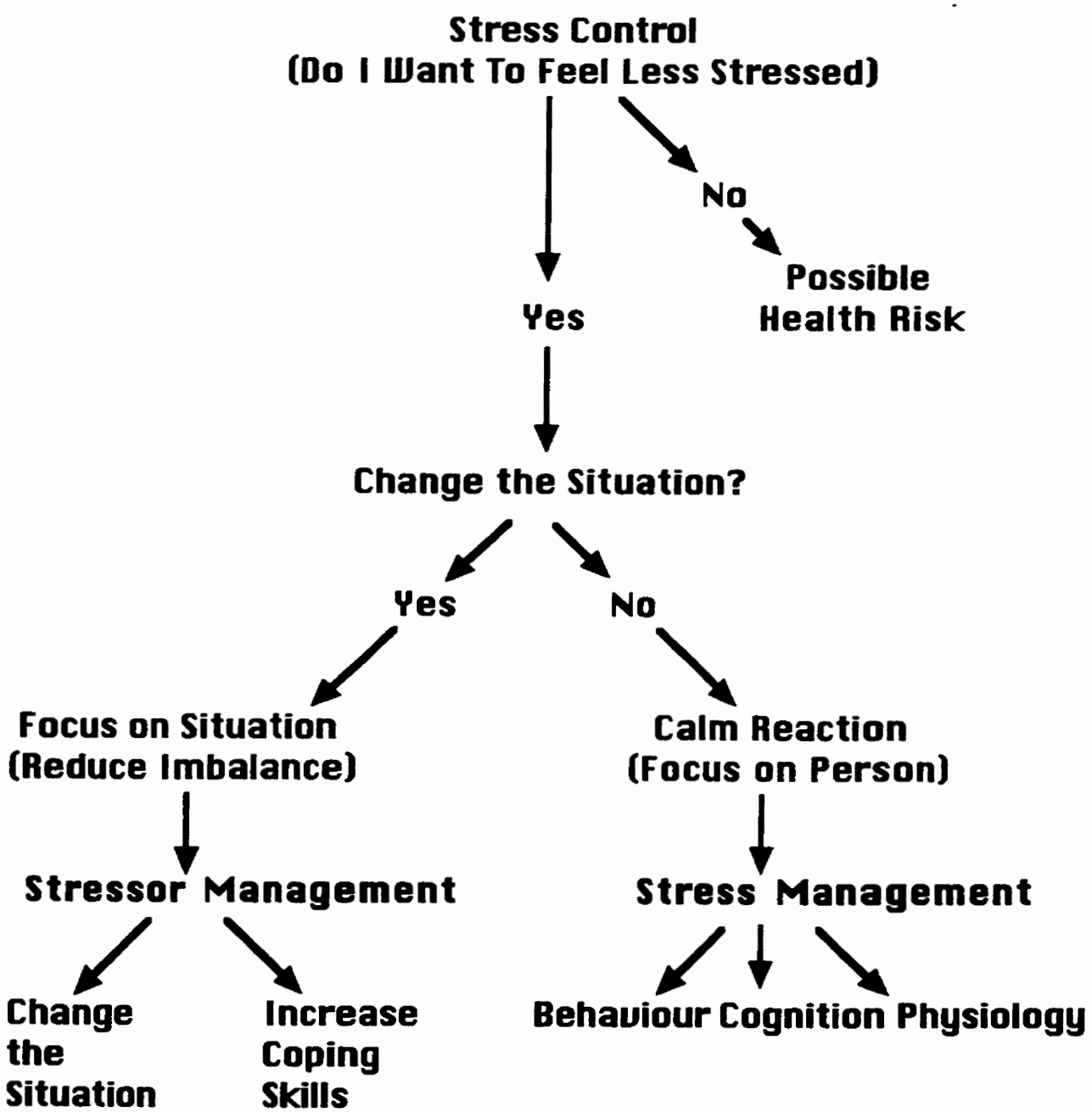
APPENDIX A

Hiebert's Stress Model

A Framework for Controlling Stress



Appendix B

Participant Pre-Treatment Orientation

Participant Pretreatment Orientation

Preliminary:
Place sign and directions on walls and in atrium
Put outline on blackboard
Place consent form and information packages at each table with pen
Place masking tape at each table
Hand our name tags for each research Assistant
Sign our stop watches from equipment room-check to make sure they are working
Notify information desk about orientation and what room we will be in

Orientation

1. Welcome, introductions, and overview of session
2. Thank-you for coming and give time lines for when we will be finished the orientation (1.5 hour). Introduce the thesis project and explain that all components of the research study including everything we will be asking them to do, has been thoroughly reviewed by an ethics committee at the University of Calgary and been given approval. Emphasize that their participation is purely voluntary, may discontinue at any time without repercussions of any kind, and their participation poses no unnecessary risk to their health and safety.
3. Time commitment. Explain the total testing time is 4 occasions requiring a one hour time period. Briefly describe the 2 components we will be measuring 1) fitness components; through a Cooper 12 minute walk/run measurement around a track; a measurement of the heart rate response to the exercise session; and a resting heart measure at home. 2)stress components; using 3 paper and pencil questionnaires which take approx 20-30 minutes. Explain that the measurements will be taken at the start of the study, and then every 4 weeks thereafter for a period of 12 weeks. All measurements will be taken at the university campus. 7-8 days before a scheduled testing day or night, a reminder phone call be given to each participant to verify the date, time and meeting place as well as a reminder to begin measuring Resting Heart Rate upon rising for 7 days prior to testing day, recording the measurements in the heart rate passport, and bringing it with them on testing day.

2. Participants from all 3 Groups are present, therefore explain each Group, what activities and time will be required in order to participate, and the starting dates of each Group. I will be providing you with a calendar of the dates, times and place for each of the testing sessions.

3. Send around a business card to each person with home and office phone numbers and encourage them to contact me any time with questions, concerns, parking problems, or any other problems that might come up with scheduling or other. Point out on the consent form the number of the academic supervisor and the dean of graduate studies. Emphasize that they should keep me informed of any changes in health status (surgery,

new illness or disability, or new instructions from family Doctor, or if they are told not to participate in any exercise for any reason what-so-ever)

4. Regardless of the Group you will participate in for the study, you will be measured once every 4 weeks for a total of 4 times.

5. Review parking, shower facilities and locker rooms, appropriate shoes (running shoes or good walking shoes) and clothing (layers, loose fitting and comfortable) for exercise session.

6. emphasize keeping in close contact with me. If missing a scheduled testing session or have trouble taking pulse measures at home, call me as soon as possible. Give example of participant in the pilot study who could not take her pulse measure at home, but did not call me until the last day.

7. Thoroughly explain the 6 testing sessions.

8. Explain punctuality issues. I will hold up measurement session as long as 15 minutes. If you are late beyond that for a measurement session, I will offer you 2 options: to stay after the main Group is finished the track testing and then I will do the measurement then, or provide you with an alternate testing day.

9. Discuss importance of honesty in reporting, confidentiality and storage of information, and anonymity. Discuss entry of data entry as an ID number not a name.

10. Emphasize carefulness of completing questionnaires, and that RA will be circulating and checking the answer keys for any missed items. Each questionnaire will be checked twice and initialed in the right hand corner.

11. Allow for any questions.

12. Have them read and sign the consent forms along with the ParQ and waiver forms.

13. An orientation sign-in sheet is being passed around for name/number/identify which Group/ indicate the start dates of the program they will be taking. Explain this is for my records that each participant completed the appropriate paper work, consent forms, and attended the orientation.

14. Teaching and practice session for measuring pulse rates a) at home, and b) on the track following the Cooper exercise session. Follow detailed protocol- allow time for finding pulse and at least 3 practices sessions. RA will be doing accuracy checks.

Instruction and Practice of Measuring Heart Rates and Cooper Fitness Test

1. Explain the recording of pulse rates for a) at home Resting Heart Rate, using the heart rate passport (hand out an example to each person to keep). Encourage practice at home before the starting date of the study.

2. Explain the recording of pulse rates for b) on the track following the Cooper exercise session. Show example how to record on the masking tape including their name/date/Group/and identifying if first, second, or third heart rate measure by writing on the tape before going up to the track to do the measurements. Show where the masking tape will be placed (back of hand, along shirt sleeve, over right hip).

3. Hand out small pencils and practice following the explained protocol, have them do 3 heart rates and record them on the masking tape after placing on appropriate and preferred place.

4. Explain using the diagram on the board, the Cooper exercise test on the track. Placement of the timers, and the whistle indicators as per protocol. Explain counting of the laps and the recording method on the masking tape as they are exercising. Explain the submaximal effort, what to do if pain, dizziness, nausea, or cramping.

5. Explain general track protocol for safety from other users, direction of movement around the track, location of washrooms and water fountains.

6. Allow for questions and clarifications.

7. Take them to show classroom locations and posting of the classroom in the atrium when they arrive on a testing day.

8. Take them to the track for a practice session of the 12 minute Cooper and measurement of heart rate recovery and recording.

9. Follow protocol using whistle as signal.

10. Explain protocol of submitting masking tape to investigator checking for name, date, Group, and going over entries with blue pens.

11. Investigator will check each one as submitted for legibility and completeness of entered information.

12. Allow for questions.

13. Thank them for coming.

14. Tell them they will be receiving a call for the date of first testing day.

Appendix C

Training Protocol for Research Assistants and Volunteers

Training Protocol for Research Assistants and Volunteers

Preliminary:

Place sign and directions on walls and in atrium
Put outline on blackboard
Place consent form and information packages at each table with pen
Place masking tape at each table
Hand our name tags for each research assistant
Sign our stop watches from equipment room-check to make sure they are working
Notify information desk about orientation and what room we will be in

Orientation

1. Welcome, introductions, and overview of session
2. Thank-you for coming and give time lines for when we will be finished the orientation (1.5 hour). Introduce the thesis project and explain that all components of the research study including everything we will be asking them to do, has been thoroughly reviewed by an ethics committee at the University of Calgary and been given approval. Emphasize that the participation is purely voluntary, may discontinue at any time without repercussions of any kind, and their participation poses no unnecessary risk to their health and safety.
3. Time commitment. Explain the total testing time is 4 occasions requiring a one hour time period. Briefly describe the 2 components we will be measuring 1) fitness components; through a Cooper 12 minute walk/run measurement around a track; a measurement of the heart rate response to the exercise session; and a resting heart measure at home. 2)stress components; using 3 paper and pencil questionnaires which take approx 20-30 minutes. Explain that the measurements will be taken at the start of the study, and then every 4 weeks thereafter for a period of 12 weeks. All measurements will be taken at the university campus. 7-8 days before a scheduled testing day or night, a reminder phone call be given to each participant to verify the date, time and meeting place as well as a reminder to begin measuring Resting Heart Rate upon rising for 7 days prior to testing day, recording the measurements in the heart rate passport, and bringing it with them on testing day.
4. Pass around the questionnaires and review the responsibility of the volunteers and RA to check each item for a response (show the technique using a blank paper and guiding it down each item to check for a response) and to place initials in the right hand corner. Show them how to place the left hand over the actual questions so that it shows the participant that you are not checking the item response in a way that identifies what item the participant is responding to. This maintains confidentiality. Each questionnaire must be checked by 2 people. Once completed the package is placed in an envelope. The last person to check will then write the date, measurement time (1,2,3, or 4), and the Group the participant is in.

TIMING FOR POST-EXERCISE HEART RATE

12:00 minutes	Whistle to end exercise session
12:19 minutes	Whistle to prepare 10 second count down
12:20 minutes	**START 10 second count down**
12:30 minutes	**Say loudly *"START COUNTING"***
12:45 minutes	**Say loudly *"STOP COUNTING"* *****
13:49 minutes	Whistle to prepare 10 second countdown
13:50 minutes	**START 10 second count down**
14:00 minutes	**Say loudly *"START COUNTING"***
14:15 minutes	**Say loudly *"STOP COUNTING"* *****
16:49 minutes	Whistle to prepare 10 second countdown
16:50 minutes	**START 10 second count down**
17:00 minutes	**Say loudly *"START COUNTING"***
17:15 minutes	**Say loudly *"STOP COUNTING"* *****

*** Remind them to write the number down on their tape after counting

The investigator will give a whistle warning at the point at which you should begin your 10 second countdown. As soon as you complete the count down you will say "start counting" to the participants. The investigator will give a whistle warning at the point at which you should begin your 10 second count. The stop watch you will be using must coordinate with the indicated times on the chart. Remember that the actual time frame the participants will be counting their pulse will be 15 seconds. At the 15 second mark on the stop watch you will say "stop counting" to the participants and remind them to record the number on the tapes. This will be repeated 3 times.

*** Important Reminders for Research Assistants During Track Timing and Measurement**

1. Keep the participants on track, hurry them in to the timing station as they only have a few seconds to find their pulse and prepare to measure it. Call out to them to "**find your pulse and quickly come in**"
2. Tell them before you get to the 10 second count down that the 10 second count down is about to occur, **does everyone feel a pulse?** Link them to a nurse if they cannot find a pulse **before** the 10 second count down.
3. Remind them to start counting the beats as soon as you say "**start**" and **not wait** until you finish the 2 words "start counting".
4. After each pulse count **remind them to write the number down on the tape**.
5. After you have done the 30 second and the 2 minute pulses, remind them to be sure to **add the last part of their lap to the tape** (example: 1/4, 1/2, or 3/4 lap). You should tell them what station (1/4 mark, 1/2 mark, 3/4 mark) you are at as they may get confused.

Appendix D

Participant Exercise Logs

HOW MUCH EXERCISE DID YOU DO THIS MONTH?

This questionnaire is designed to measure how much exercise you have been doing over the last 4 weeks including today. Specifically we are interested in knowing how much ***AEROBIC EXERCISE*** *that you have participated in this month. If you are in* **Group 1** *for the study, we are interested only in the aerobic exercise you have been doing* ***in addition to*** *your classes at Trym Gym. If you are in* **Group 2** *for the study, we are interested* ***in all of the aerobic exercise*** *you have been doing. If you are in* **Group 3** *for the study, we are interested in determining if you participated* ***at all*** *in aerobic exercise.*

AEROBIC EXERCISES *are activities that raise your heart rate and sustain it for 12 minutes or longer. This usually happens in activities such as running, jogging, swimming, biking, aerobic dance, stairmaster, treadmill, tennis, racquetball, basketball, stationary biking, cross country skiing, rowing machines, nordic machines, etc. If you are not certain if the exercise activity you did participate in is an aerobic activity, please ask the study investigator for assistance now.*

NAME:_____
GROUP:_____ **(1, 2, or 3)**
SESSION:_____**(measurement time 1, 2, 3, or 4)**
DATE:_____

The first question is, did you engage in any aerobic exercise (as listed below) in the past month?

No_____ Yes_____

If you answered no to the above question, then you have completed this questionnaire and may turn it in to the investigator.

If you answered yes to the above question, then please read the following instructions and answer the questions to the best of your memory.

1. ***Please mark an X in the space provided for each type of exercise you participated in over the last month. If you participated in more than one, mark an X beside all the exercises you participated in.***
2. ***For each exercise that you placed an X beside, estimate to the best of your memory, the total number of days you did that activity over the last month including today. Place this number in the second column.***
3. ***For each exercise that you placed an X, estimate to the best of your memory, the number of minutes that you did that activity each time you exercised over the last month including today. Please add up the total number of minutes for all of the days in which you did an activity.***

Example: treadmill x 2 days 15 + 20 35 mins

swimming x 5 days 10 + 20 + 10 +25 +05 65 mins

ACTIVITY		**# OF DAYS**	NUMBER OF MINUTES	**Total Minutes**
running				
jogging				
swimming				
biking				
stationary bike				
aerobic-dance				
cross-country skiing				
treadmill				
tennis				
racquetball				
squash				
ice/roller skating				
basketball				
soccer				
skipping rope				
vigorous dancing				
orienteering				
rugby				
stairmaster				
rowing machine				
nordic machine				
other_____				

Appendix E

Recruiting Advertisements for Participants and Research Assistants

NEIGHBORS: Helping Hands & Volunteers

HEALTH AND FITNESS STUDY - **A University of Calgary** investigator needs volunteers for a study evaluating fitness and its effect on health. Participants must be between the ages of 18 - 68 years, ***previously*** active (within the last 10 years) in an aerobic-exercise activity (jogging, running, swimming, biking, aerobic-dancing, etc), **but for any reason are currently not participating in an aerobic exercise activity of any kind.** Call Carol any time at 220-3675 or 289-8422.

HEALTH AND FITNESS STUDY: Investigator from the ***University of Calgary*** needs volunteers for a study evaluating fitness and its effect on health. Participants must be between the ages of 18-68, ***previously*** active (within the last 10 years) in an aerobic-exercise activity (jogging, running, biking, swimming, aerobic-dancing, etc), **but for any reason are currently not participating in an aerobic activity of any kind**. Call Carol any time at **220-3675 or 289-8422.**

RESEARCH ASSISTANTS NEEDED: Graduate student in counselling needs research assistants to help with *test administration and data collection*. No previous experience necessary. Please call **Carol** anytime at **289-8422 or 220-3675.**

VOLUNTEERS FOR RESEARCH NEEDED

A graduate student at the **University of Calgary** needs **volunteers** to help with **fitness testing** in a **HEALTH AND FITNESS STUDY.** Volunteers must be either ***certified in S.T.F.A.*** or currently **enrolled in the S.T.F.A. program**. **This is a good opportunity to build and develop fitness testing skills !** Call Carol anytime at **289-8422 or 220-3675**.

Nursing Colleges and University of Calgary College of Nursing

***Research Assistants Needed for a* HEALTH AND FITNESS STUDY:**Graduate student needs **research assistants** to help with **administration of questionnaires and data collection.** No previous experience necessary.

Call Carol anytime at **289-8422 or 220-3675.**

Appendix F

Informed Consent Form

Dear participant,

My name is **Carol Malec**. I am a graduate student in the *Department of Educational Psychology at the University of Calgary* conducting a research project as part of the requirement towards a M.Sc. degree. This research project is under the supervision of **Dr. Bryan Hiebert** from the *faculty of Counselling Psychology*. I am writing to provide information regarding my research project which is examining the effects of aerobic exercise on stress, so that you can make an informed decision regarding your participation.

This consent form is part of the process of informed consent. It should give you the basic idea of what the research study is about and what your participation will involve. If you would like more detail about something mentioned, or information not included, you should feel free to ask.

The purpose of the study is to monitor the changes in stress levels as fitness levels change with an exercise program over time. As part of the study you will be asked to record your Resting Heart Rate at home, complete post-exercise heart rate recovery measurements, and do a 12 minute exercise test. The 12 minute exercise test is part of the protocol followed by the **Trym Gym Lifestyle Program at the University of Calgary** and will be administered by licensed fitness instructors. The exercise testing will be administered and supervised by both an A.F.L.C.A. certified fitness instructor and a registered nurse. Other certifications held by the health care leaders include current C.P.R.

You will also be asked to complete 3 questionnaires every 4 weeks, for the duration of the study. These procedures will take approximately 30 - 50 minutes. You should be aware that even if you give permission to participate in this study, you are free to withdraw at any time for any reason and without any adverse affects. You should also feel free to ask for clarification or new information throughout your participation in the study.

Participation in this study will involve no greater risks than those ordinarily experienced in daily life.

To ensure anonymity, the information you will be providing for this study will be collected, recorded and kept in strictest confidence through locked file cabinets at the *University of Calgary*. Only Group results will be reported in any published studies. The raw data will be kept in a locked file cabinet and destroyed two years after completion of the study.

If you have any questions, please feel free to contact me at **289-8422/ 220-3675** my supervisor **Dr. Bryan Hiebert at 220-7770, the Chair, Faculty of Education Joint Research Ethics Committee at 220-5626,** or the **Office of the Vice-President of Research at 220-3381**. Two copies of the consent form are provided. Please return one signed copy to me and retain the other copy for your records. Thank- you for your participation and Cooperation.

Sincerely,

Carol A. Malec

Consent for Participation in Research

Research Project: **Aerobic exercise and stress: The relationship between fitness levels and stress levels.**

Investigator: **Carol A Malec** (M.Sc. Student)

I agree to participate in the research project entitled: Aerobic exercise and stress: The relationship between fitness levels and stress levels.

After reading the enclosed information about the study, I understand that consent means that I will take part in answering questionnaires, completing fitness tests and measuring Resting Heart Rates at home. This will involve a 12 week period of participation and will be commensurate with the Trym Gym Lifestyle Change Program, or other fitness programs I have enrolled in.

The 12 minute exercise test is part of the protocol followed by the Trym Gym Lifestyle Program at the University of Calgary and will be administered by licensed fitness instructors. The exercise testing will be supervised by both a certified fitness instructor and a registered nurse. Licensing for both health professionals include current CPR certification.

I understand that participation in this study may be terminated at any time by my request or at the request of the investigator. Participation in this project and\or withdrawal from this project will not adversely affect me in any way, nor affect the instruction or delivery of the Trym Gym Lifestyle Program, or any other fitness program that I have enrolled in.

I understand that the information from this study will remain confidential and will not be associated with my identity in any way.

My identity will not be revealed to anyone other than the primary investigator, **Carol Malec.**

I understand that only Group data will be reported in any published reports.

I understand that confidentially I may have access to my own results and measurements that are recorded as part of the study.

I understand that if I have any questions I can contact the researcher at **289-8422/ 220-3675** the study supervisor **Dr. Bryan Hiebert at 220-7770**, the **Chair, Faculty of Education Joint Research Ethics Committee at 220-5626**, or the **Office of the Vice-President of Research at 220-3381.**

Date	**Signature of Participant**
Investigator's Signature	**Participant's Printed Name**

Appendix G

Medical Questionnaire

TRYM GYM
PRE EXERCISE QUESTIONAIRE
PLEASE FILL OUT PRIOR TO PARTICIPATING IN A TRYM GYM FITNESS PROGRAM.

1. Do you participate in regular physical activity? (i.e. moderate exercise, 3 times a week) List activities:	Yes No
2. Have you ever had a heart attack ? When? Did you attend Cardiac Rehabilitation?	Yes No Yes No
3. Do you have high blood pressure, a heart murmur, or heart disease? Circle which one and explain:	Yes No
4. Are you taking any medication (ie, digitalis, quinidine, nitroglycerine) or any other drug for a medical condition? Name of drug(s):	Yes No
5. Do you ever have chest, neck, shoulder or arm pains or pressure during or after exercise? Please explain:	Yes No
6. Is your heartbeat irregular, or do you have spells where it is suddenly fast? Please explain:	Yes No
7. If you walked on the level for a mile at an average pace, would you get out of breath, have pain in your chest or legs, or develop extreme tiredness?	Yes No
8. Do you have bone or joint problems such as arthritis or osteoporosis? Please explain:	Yes No
9. Do you have Diabetes? Type 1 or 2 ?	Yes No
10. Do you have Asthma? Is it exercise induced?	Yes No
11. Do you smoke? How many a day?	Yes No
12. Have you ever done a fitness class before?	Yes No

PRINT
NAME: _____ DATE:_____

SIGNATURE:_____
(Parent/guardian must sign for those under 18 years) GROUP_____

If you have answered yes to questions 2 to 8 you may be asked to provide Trym Gym with a letter from your doctor supporting your participation in our program. NB: If you have any health changes , please notify the Trym gym office. Mar96

Appendix H

Instructions for Measuring Resting Heart Rate

Instructions for Measuring Resting Heart Rate at Home

INSTRUCTIONS: Resting Heart Rate can provide useful information about your fitness. It is therefore important to learn how to obtain these measures accurately by use of these steps:

1. Set your alarm for approximately 15 minutes before you normally set it. Apon waking, lay still for another 5-10 minutes in a comfortable position Be sure that you have not had anything to eat or drink for at least 3 hours before taking this measurement. If you smoke, do not smoke for at least 30 minutes prior to taking this measurement.

2. After the rest period and while you are still lying down, take your pulse at the carotid artery on either side of the neck or use the radial pulse at the thumb side of your wrist at the spot where the wrist bends. Use your index finger to find and count the pulse as the thumb has its own pulse and will cause you to count inaccurately. Watching a clock with a sweep hand, count the pulse for an entire minute. The resulting number is your Resting Heart Rate. Record it immediately as you will forget it.

Appendix I

Instructions for Post Exercise Heart Rate Recovery Measurements

MEASURING POST-EXERCISE HEART RATE RECOVERY

PURPOSE:
The purpose of this procedure is to determine how your heart responds to an exercise session once you have stopped exercising.

METHOD:
You will be asked to count your pulse rate within one minute of completing your 12 minute exercise session. The investigator will give you a **10 second signal** before asking you to start counting your pulse. If you have problems finding your pulse, ask the investigator to help you as sometimes it is difficult to find. The investigator will say **"start counting"** and time a 15 second interval. The investigator will then say **"stop counting"**. Record the number immediately. This will be done for 3 separate times:
30-seconds post exercise, **2-minutes** post-exercise, and **5-minutes** post-exercise.

INSTRUCTIONS:
1. Immediately upon finishing your 12 minute fitness test, observe where you have stopped on the track and quickly **record the number of laps around the track that you completed (** to the nearest 1/4 lap of the track).

2. Proceed ***immediately*** towards the designated area where the investigator will be standing and attempt to locate your pulse as you are doing so. The investigator will give you a **count down from 10 seconds to 0 seconds as a signal to get you to prepare for counting your pulse.**

3. The investigator will say **"start counting"** and you should begin to count each heart beat until the investigator says **"stop counting"**. Immediately ***record the number you counted.***

4. Before 2 minutes locate your pulse and prepare for the 10 second count down. When the investigator says **"start counting"**, you should begin to count each pulse until the investigator says **"stop counting"**. Immediately ***record the number you counted.***

5. Before 5 minutes find your pulse and wait for the signal 10 second count down by the investigator. When the investigator says **"start counting"** begin counting your pulse until the investigator says **"stop counting"**. ***Immediately record the number you counted.***

6. You have now completed the fitness testing. **Please print your first and last name on the tape before turning it into the investigator .**

Feel free during this procedure to continue stretching and moving your legs and arms as part of a warm-down stretch.

Appendix J

Correlation Tables for Group 1, Group 2, Group 3

Correlation between Stress & Exercise Variables for **Group 1** (n=36)

	DHS1	DHS2	DHS3	DHS4	SSI1	SSI2	SSI3	SSI4
DHS1	----							
DHS2	.60***	----						
DHS3	.60***	.85***	----					
DHS4	.49***	.72***	.79***	----				
SSI1	.55***	.39*	.37*	.34*	----			
SSI2	.51**	.68***	.73***	.66***	.63***	----		
SSI3	.37*	.51***	.73***	.56***	.49***	.82***	----	
SSI4	.33*	.44**	.58***	.68***	.52***	.77***	***	----
Coop1	.20	-.18	-.21	-.33*	-.19	-.14	-.23	-.29
Coop2	.24	-.22	-.18	-.26	.24	-.12	-.18	-.17
Coop3	.28	-.14	-.10	-.16	.18	-.02	-.08	-.07
Coop4	.17	-.15	-.14	-.24	.20	-.06	-.14	-.17
RHR1	-.11	-.11	.02	.02	-.31	-.25	-.08	-.11
RHR2	-.14	-.12	-.02	.01	-.35*	-.19	-.06	-.05
RHR3	-.01	-.09	-.09	-.04	-.22	-.20	-.12	-.07
RHR4	-.14	-.05	.02	-.00	-.34	-.21	-.08	-.09

* $p < .05$
** $p < .01$
*** $p < .001$

	Coop1	Coop2	Coop3	Coop4	RHR1	RHR2	RHR3	RHR4
Coop1	----							
Coop2	.93***	----						
Coop3	.85***	.88***	----					
Coop4	.84***	.81***	.86***	----				
RHR1	-.46**	-.38*	-.47***	-.50***	----			
RHR2	-.46**	-.42**	-.49***	-.55***	.96***	----		
RHR3	-.25	-.22	-.29	-.29	.58***	.59***	----	
RHR4	-.48***	-.42**	-.53***	-.66***	.90***	.92***	.58***	----

* $p < .05$
** $p < .01$
*** $p < .001$

Correlation between Stress & Exercise Variables for **Group 2** (n=19)

	DHS1	DHS2	DHS3	DHS4	SSI1	SSI2	SSI3	SSI4
DHS1	----							
DHS2	.80***	----						
DHS3	.87***	.81***	----					
DHS4	.73***	.81***	.87***	----				
SSI1	.79***	.56**	.74***	.57**	----			
SSI2	.75***	.69***	.71***	.67**	.81***	----		
SSI3	.80***	.68***	.86***	.72***	.88***	.85***	----	
SSI4	.79***	.76***	.89***	.86***	.79***	.84***	.87***	----
Coop1	.08	.10	.13	.07	.24	-.04	.16	.20
Coop2	.05	.03	.15	.10	.22	-.10	.17	.23
Coop3	-.00	.00	.11	.09	.20	-.11	.16	.19
Coop4	-.15	-.07	.02	.00	-.00	-.23	.05	.10
RHR1	-.02	.18	.10	.28	.04	.28	.10	.19
RHR2	-.19	.09	-.10	.07	-.05	.23	-.05	.03
RHR3	-.05	.16	.02	.17	.08	.26	.11	.10
RHR4	.07	.16	.13	.24	.15	.35	.21	.19

* $p < .05$
** $p < .01$
*** $p < .001$

	Coop1	Coop2	Coop3	Coop4	RHR1	RHR2	RHR3	RHR4
Coop1	----							
Coop2	.94***	----						
Coop3	.94***	.98***	----					
Coop4	.85***	.92***	.92***	----				
RHR1	-.27	-.27	-.25	-.26	----			
RHR2	-.25	-.33	-.31	-.33	.88***	----		
RHR3	-.25	-.29	-.24	-.30	.92***	.90***	----	
RHR4	-.12	-.14	-.10	-.21	.78***	.79***	.86***	----

* $p < .05$
** $p < .01$
*** $p < .001$

Correlation between Stress & Exercise Variables for **Group 3** (n=15)

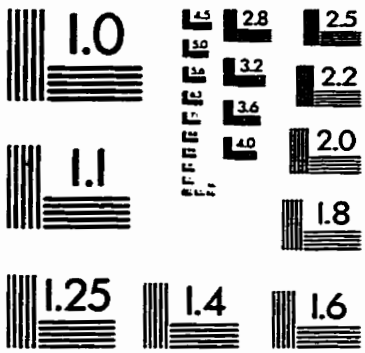
	DHS1	DHS2	DHS3	DHS4	SSI1	SSI2	SSI3	SSI4
DHS1	----							
DHS2	.90***	----						
DHS3	.79***	.87***	----					
DHS4	.72**	.88***	.91***	----				
SSI1	.95***	.90***	.81***	.77***	----			
SSI2	.89***	.91**	.79***	.77***	.93***	----		
SSI3	.92***	.93***	.91***	.86***	.97***	.94***	----	
SSI4	.86***	.89***	.93***	.91***	.92***	.90***	.97***	----
Coop1	-.12	-.22	-.18	-.39	-.10	-.18	-.19	-.33
Coop2	-.12	-.21	-.06	-.27	-.14	-.23	-.18	-.25
Coop3	-.35	-.41	-.22	-.43	-.38	-.45	-.38	-.44
Coop4	-.26	-.37	-.17	-.42	-.29	-.36	-.30	-.36
RHR1	-.03	-.15	-.23	-.37	-.25	-.21	-.28	-.38
RHR2	-.07	-.11	-.24	-.32	-.23	-.09	-.24	-.33
RHR3	-.08	-.07	-.12	-.05	-.16	-.20	-.12	-.20
RHR4	-.02	.04	.01	-.11	-.17	-.05	-.11	-.19

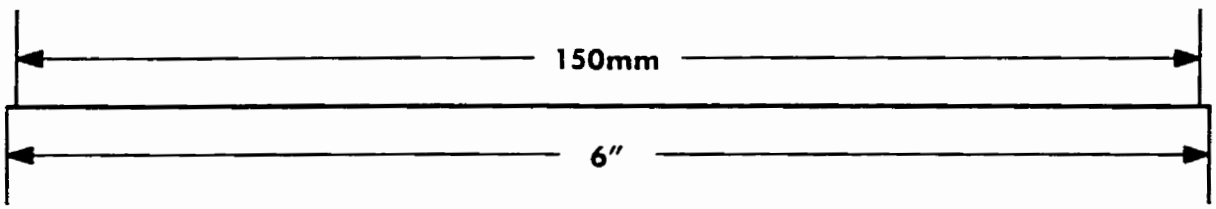
* $p < .05$
** $p < .01$
*** $p < .001$

	Coop1	Coop2	Coop3	Coop4	RHR1	RHR2	RHR3	RHR4
Coop1	----							
Coop2	.85***	----						
Coop3	.80***	.87***	----					
Coop4	.80***	.90***	.97***	----				
RHR1	.17	.24	.21	.25	----			
RHR2	.11	.09	.06	.12	.92***	----		
RHR3	-.10	-.15	-.18	-.18	.30	.31	----	
RHR4	.06	.05	.11	.12	.84***	.90***	.35	----

* $p < .05$
** $p < .01$
*** $p < .001$

IMAGE EVALUATION
TEST TARGET (QA-3)





APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989