IMMUNE RESPONSE IN GROUP FITNESS INSTRUCTORS

By

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Bachelor of Science

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Tulsa, Oklahoma

1993

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
December, 2001

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Dean of Graduate College

ACKNOWLEDGEMENTS

I would like to extend my sincere appreciation and thanks to the members of my graduate committee: Robin Purdie, for her medical knowledge, humor, and candor; Dr. Betty Edgley, for her meticulous proof-reading and great attention to detail; and especially Dr. Steve Edwards, chair of my committee, whose initial encouragement and support gave me the confidence I needed to accomplish the task.

Special thanks as well to my family, especially my father and his computer skills, and to friends Ben Froidevaux and Laurie Smith for their ready encouragement when I needed it most.

TABLE OF CONTENTS

Chapter

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Since group fitness classes began in the 1970's (American Council on Exercise [ACE], 1994) they have played a central role in the growth and development of the fitness industry. According to a recent survey by the International Dance and Exercise Association (IDEA), 72% of health and fitness facilities support a group fitness program, with the majority of programs offering a variety of classes at least four days a week (IDEA Fitness Manager, 2001). Fitness club directors and staff report that group fitness participants tend to be the most loyal members with the highest rate of exercise adherence and thus the lowest rate of membership attrition (Ace FitnessMatters, 2000). It appears as though group fitness is a key component for the success of both the individuals who participate in the classes and the clubs that offer such classes.

A key element in a group fitness class is the group fitness instructor. The fitness instructors serve as both leaders and participants in the physical activity they are instructing. This typically means that as a fitness instructor's work schedule increases, so does his or her amount of exercise. Fitness instructors, by the very nature of their job, are expected to maintain a level of optimum health and wellness. The instructors must be healthy to physically lead their classes, and also serve as healthy role models for their students (American Council on Exercise,1994). Some instructors feel the need to teach as many classes as possible – motivated by financial need, personal desire, or work-related pressure (Bram, 1999). However, there are no clear guidelines at this point as to what kind of teaching schedule, and therefore what amount of exercise, is conducive to an instructor's optimum health.

The role exercise plays in long-term health appears fairly well established in the literature. Regular exercise lowers the risk of chronic diseases, including coronary artery disease, Type 2 diabetes, hypertension, high cholesterol, and obesity (ACE, 1994; American College of Sports Medicine [ACSM], Cooper Institute of Aerobic Research [CIAR], 1999). Less is known about the more immediate role exercise plays in the body's immune system and its connection to the body's risk of illness and infection. Much of the recent research concerning exercise and immune response supports the idea of a J-shaped relationship between the two (Nieman & Nelson-Cannarella, 1992; Shephard, 1999; MacKinnon, 1999). The "J-shape" hypothesis suggests that although moderate exercise may enhance the immune system, heavy and chronic exercise may suppress it.

It is unknown the extent to which the J-curve theory applies to group fitness instructors, and if the number of classes an instructor teaches plays a role in the number of upper respiratory tract infections he or she contracts. The author of this study investigated the relationship between group fitness instructors, exercise/teaching schedules, and immune response.

<u>Purpose for the Study</u>

The purpose of the study was to determine if the teaching loads of group fitness instructors affected their immune response, as reflected by the frequency of symptoms of upper respiratory tract infections. Another purpose of the study was to determine if the amount of sleep an instructor averaged and the age of the instructor affected the immune response, also reflected by the frequency of symptoms of upper respiratory tract infections.

Need for the Study

Regular exercise has long been recognized as a vital component in the pursuit of a healthy life (ACE, 1994; ACSM, 2000; CIAR, 1999). Many people find they are more motivated and push themselves harder when they work out in a group setting with an instructor (Ashon & Gerald, 2000). In that respect, group fitness instructors have the potential to play an important role in the lives of individuals trying to improve their health and well-being by attending fitness classes. Like most professionals, fitness instructors need to maintain a level of optimal health to do their job well (ACE, 1994). However, unlike most professionals, when a fitness instructor's schedule increases, so does his or her amount of exercise. The question of whether an increase in classes and therefore exercise plays an adverse role in the instructor's immune response is an issue worthy of more investigation. The information could be of use to the fitness instructors themselves, as well as the directors/managers of the health facilities that employ the instructors. Such information could also contribute to the growing body of literature in the field of exercise immunology.

Hypotheses

1. There will be no significant difference in the number of classes a group fitness instructor teaches each week and the frequency of upper respiratory tract infection symptoms (coughing, sneezing, nasal discharge, stuffy nose, sore throat,

headaches, malaise, chilliness, shaking chills, fever, laryngitis, aching joints and muscles, and watery eyes).

2. There will be no significant difference in the amount of sleep a fitness instructor averages and the frequency of upper respiratory tract infection symptoms.

3. There will be no significant difference in the age of a fitness instructor and the frequency of upper respiratory tract infection symptoms.

Delimitations

The following study was delimited to:

1. The data collected was from group fitness instructors who attended the Dallas Mania Fitness Convention in Dallas, Texas, in August, 2001. Approximately 400 instructors attended the conference.

2. The data from the instructors was divided into three groups -- light, moderate, and heavy teaching loads - based on the number of aerobic-based classes the instructors reported teaching per week.

3. Frequency of upper respiratory tract infection symptoms were measured using a self-reporting cold symptom checklist.

Limitations:

1. The subjects were not randomly sampled.

2. The information derived from the cold symptom checklist were not corroborated by any other assessments.

3. The subjects were asked to recall and remember symptoms for a three-month period.
4. Personal healthcare habits such as sleep, diet and life stressors were not controlled.

Assumptions:

1. All subjects completed the questionnaires honestly and correctly.

Definitions:

Definitions pertaining to the sample population and the survey used in this study include:

Aerobic-based exercise class: a class that includes at least 30 minutes of cardiovascular conditioning that is of moderate-to-high intensity for the instructor. Aerobic-based classes include dance aerobics, step aerobics, sports drills, kickboxing, and "spinning" (indoor cycling). Classes where the emphasis is on stretching or toning, such as yoga, or classes of very low intensity, such as seated exercise, are not considered aerobic-based.

Light teaching load: 1 to 3 classes a week

Moderate teaching load: 5 classes a week

Heavy teaching load: Seven or more classes a week*

*Teaching loads were determined using the ACSM definition of "moderate exercise," five days/sessions a week for 20-60 minutes at 60-80% of maximal oxygen uptake (VO2max) or 70-85% of maximum heart rate.

Group Fitness Instructor: a health/fitness professional who leads a group of people through a pre-planned, formatted session of exercise. This differs from a group personal training session in that the group fitness instructor almost always participates in the activity and serves as visual model for the class to follow.

Upper respiratory tract infection(URTI): Infectious illness involving the oral and nasal regions; e.g., the common cold or rhinovirus (MacKinnon, 1999). The presence of an URTI was self-reported using a previously validated 13-symptom checklist (Meschievitz, Schultz, & Dick, 1984). The symptoms include cough, nasal discharge, sneezing, stuffy nose, sore throat, headaches, malaise, chilliness, shaking chills, fever, laryngitis, aching joints or muscles, and watery eyes.

Definitions pertaining to the physiology of exercise immunology include:

Catecholamines: epinephrine and norepinephrine; two stress-specific hormones released by the adrenal medulla during times of physical or psychological stress (MacKinnon, 1999; Nieman & Nehlsen-Cannarella, 1992).

Corticosteroids: primarily cortisol; stress-specific steroids released by the adrenal cortex during times of physical or psychological stress (MacKinnon, 1999; Nieman & Nehlsen-Cannarella, 1992).

Immunoglobulins (IgA): glycoproteins found in blood, mucous, and salivia. Salivary and mucosal IgA serves as first-line-of-defense against infectious agents that enter the nose and throat (Eichner, 1993; MacKinnon, 1999).

Leukocyte: a type of white blood cell related to immune function. Leukocytosis is an increase in circulating leukocyte number (MacKinnon, 1999).

Lymphocyte: a type of white blood cell related to immune function. Lymphocytosis is an increase in circulating lymphocyte number (MacKinnon, 1999).

Natural Killer Cells (NK): A type of lymphocyte; serves as a first-line-of-defense to eliminate infectious bloodborne viruses (Eichner, 1993; MacKinnon, 1999).

Neutrophil: a type of leukocyte; serves as a first-line-of-defense to eliminate infectious agents from the body (Eichner, 1993; MacKinnon, 1999).

CHAPTER II

LITERATURE REVIEW

Introduction

The purpose of this study was to determine whether the teaching loads of group fitness instructors affected their immune response, as evidenced by the frequency of upper respiratory tract symptoms. The literature review covered some of the more widely accepted ideas in exercise and immune response research, including the "J-curve" model; how the immune system physiologically responds to the stress of moderate and strenuous exercise; the cumulative effects of exercise over time; and the "open window" theory of decreased protection. Large-scale studies in this area looked most often at runners, while other studies sometimes gave conflicting data on the amount of exercise linked to optimum health. The literature review also explored other factors that may affect an active individual's immune response and then addressed the issue of exercising with a viral infection.

Exercise Immunology History

The field of exercise immunology is not a new one, though early studies were few and far between. In 1902, Larrabee reported the presence of leukocytosis (an increase in circulating white blood cells) in four runners immediately following the Boston marathon. Larrabee noted that the "violent exercise" of the marathon caused changes in the white blood cells counts that paralleled those seen in certain diseased conditions

(1902). The 1940's saw a series of retrospective studies showing that the severity of paralysis from polio was positively related to the amount and intensity of physical activity at the onset of infection (Russell, 1949). Russell classified patients by the amount of physical activity performed during the early stage of infection and then by the severity of paralysis resulting from the infection. Of the patients who performed only mild physical activity, 80% recovered with either very little paralysis or none at all. Of those who performed intense physical activity, more than 60% became severely paralyzed. These studies were among the first to suggest that intense physical activity during the early stages of a viral infection adversely affects the body's ability to protect itself.

Following Russell's work, research in exercise immunology began to develop in two directions (MacKinnon, 1999). In one direction, public and community health researchers continue to investigate the relationship between physical activity and viruses for its application in newly developing nations where manual labor is still essential and newly identified viruses such as AIDS are spreading rapidly. Meanwhile, in the other direction, exercise physiologists and immunologists focus on physical activity and immune response for its application to health, sports, and performance – in athletes both elite and recreational (MacKinnon, 1999; Nieman & Nelson-Cannarella, 1992).

During the last decade, study of exercise immunology in this particular genre began to flourish. Sixty percent of the articles in this area have been published since 1990 (Nieman,1997). The majority of published articles appear to advance the idea that regular exercise is beneficial to the immune system, but too much exercise can be detrimental. Just how much exercise is "too much," however, is more difficult to define.

The "J-Curve" Hypothesis

Much of the present literature points to a J-shaped relationship between exercise and susceptibility to infection (Heath, Ford, Craven, Macera, Jackson, & Pate , 1989; MacKinnon, 1999; Nieman & Nelson-Cannarella 1992; Shephard, 1999). According to the "J-shape" hypothesis, a regular routine of moderate physical activity, such as that prescribed for general health, enhances immune response, thus decreasing a person's susceptibility to infection. On the other hand, excessive amounts of exercise, or too rapid an increase in volume or intensity, suppress a person's immunity, making a person more susceptible to infection (See Figure 1).

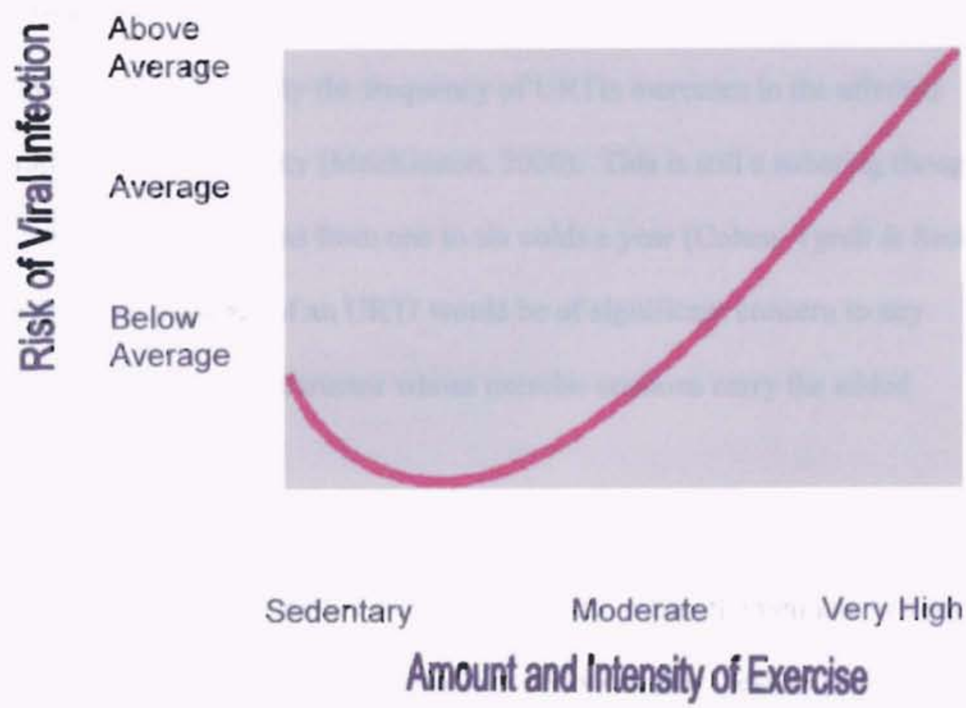

FIGURE 1: The "J-shaped" model suggests that moderate amounts of exercise may lower the risk of a viral infection while excessive amounts may increase the risk.

MacKinnon (2000) points out that the majority of exercisers and athletes with mild immune suppression are *not* clinically immune deficient. They do not develop illnesses commonly associated with immune deficiency, such as the human immunodeficiency virus (HIV). However, athletes *do* seem more susceptible to catching upper respiratory tract infections (URTIs). An URTI, also known as a rhinovirus infection or "common cold," is the most common of human infections (Dick, Jennings, Mink, Wartgow & Inhorn, 1987; Meschievitz, et al.,1984). URTIs are the causes of frequent acute disability among athletes than all other diseases combined, and URTIs consistently head the list of illnesses at both the summer and winter Olympic Games (Weidner, 1994).

It appears as though only the frequency of URTIs increases in the affected exercisers rather than the severity (MacKinnon, 2000). This is still a sobering thought, considering the average adult has from one to six colds a year (Cohen, Tyrell & Smith, 1991). The frequent presence of an URTI would be of significant concern to any exerciser, especially a fitness instructor whose exercise sessions carry the added responsibility of a job.

Moderate Exercise and Immunity

A host of exquisitely complex mechanisms occur within the immune system when the body begins to exercise. During moderate-intensity exercise several positive changes occur. White blood cells re-circulate the body at a higher rate, blood levels of immunoglobulins and antibodies increase, and stress hormones such as catecholamines do not increase to potentially harmful levels (Eichner, 1993; Nieman, 1997; Shephard & Shek, 1999). Once the exercise session ends, the immune system quickly returns to pre-exercise levels, but each session represents a boost to the resting immune system (Nieman, 2000a, 2000c).

The idea that moderate exercise training reduces incidence of illness is one supported by most habitual exercisers and some researchers. Many habitual exercisers anecdotally report a lower incidence of illnesses and upper respiratory tract infections than their more sedentary counterparts. Much of the literature supports this, asserting that the physiological stress of each moderate exercise session causes immune cells to circulate the body at a higher rate (Heath, et al.,1989; MacKinnon, 1999). Although the immune cells usually return to baseline levels after each session, it is possible that each exercise-induced "inoculation" builds on another, thus producing a cumulative affect (Nieman,1993).

Several studies seem to support the idea of moderate exercise and enhanced immunity. In one study, 36 mildly obese, inactive women were randomly assigned to either a walking group that walked 45 minutes a day, five times a week; or a control group that did not walk (Nehlsen-Cannarella, Nieman, Balk-Lamerton, Markoff, Chritton, Gusewitch, et al., 1991). The subjects used a pre-coded daily log to self-report their cold symptoms. After 15 weeks, the walkers reported fewer days with URTI symptoms (5.1 days) than the sedentary group (10.8 days) A study with a group of moderately-trained female runners saw somewhat similar results. The women were assigned to run five days a week for 45 minutes at about 60% heart rate reserve -- roughly equivalent to 70% maximum heart rate (1990b). Although there was no statistically significant reduction in the incidence of URTIs among the women, there was a reduced duration of the URTI symptoms (Nieman, Nehlsen-Cannarella, Markoff, Balk-Lamberton, Yang, et al.,1990b.)

One study examined the affects of moderate exercise and immune response when the subjects were under the added physiological stress of a low-calorie diet (Nieman, Nehlsen-Cannarella, Henson, Alexander, Butterworth, et al., 1998). Forty-three sedentary, obese women were put on a low-calorie diet, asked to keep a daily health log, and assigned a walking program of 45 minutes a day, five days a week. The women were matched with a control group of sedentary overweight women, also on a low-calorie diet and assigned a health log. After four months, researchers drew blood samples to determine any changes in the immune response, as evidenced by the proliferation of lymphocytes, leukocytes, and natural killer cell activity. The results did not reveal any significant changes in the resting immune function of the two groups of women. However, in the daily health logs, the walking women reported about half the number of days with URTI symptoms as the non-walking women.

Since advancing age is believed to play a part in the decline of the immune system (Kostka, Berthouze, Lacour, & Bonnefoy, 2000; Nieman, 2000a), several studies have examined the role of moderate exercise in the health of older adults. The studies seem to support the idea of a positive relation between moderate exercise and immune response.

Nieman, Henson, Johnson, Lebeck, Davis, et al., compared the incidence of URTIs in three groups of elderly women: sedentary women, newly exercising women who walked, and highly-trained women who ran (1993). A group of 32 sedentary elderly women were randomly assigned to either a walking group (5 days a week for 37 minutes) or a non-exercising control group. The two groups, along with a group of 12 age-matched but highly-conditioned runners, were asked to keep daily logs to self-report any URTI symptoms. After six months, the data revealed that self-reported URTIs were most prevalent in the sedentary group (50%), less prevalent in the new walkers (21%), and appeared least of all in the runners (8%).

Kostka, et al., tracked the physical activity and presence of URTI symptoms in a group of 61 apparently healthy older adults living in independent living communities (2000). The study was divided into two parts. For the one-year retrospective study, subjects were asked to remember their average activity levels over the year and their frequency of URTI symptoms throughout the past year. For the one-year prospective study, subjects used self-reporting checklists and daily logs to record the same information for a year. Researchers concluded that the older adults who were the most active, engaging almost daily in activities with intensity levels between 4 to 7 metabolic equivalents (such as brisk walking), reported the fewest URTI symptoms for both studies.

Snyder, Foster and Wehrenberg (2000) reported similar results in a 17-week study that compared effects of nutritional supplements and/or exercise for frail older adults. The study involved 112 men and women, all at least 70 years old. The subjects were divided into four groups: the first group participated in supervised exercise sessions, the second group was put on a vitamin-enriched diet, the third group participated in both the exercise and the vitamin-enriched diet, and the fourth group served as a control. The exercise sessions were twice a week for 45 minutes and consisted of stretching and joint mobility exercises. By the end of 17 weeks, the two exercise groups showed a small but statistically significant improvement in their immune response, as measured by cellular response to antigens. The enriched diet group only showed an improvement in blood-vitamin levels but not in immune response.

Defining Moderate and Heavy Exercise

The American College of Sports Medicine defines exercise along a continuum of physical activity, with the upper limits of "moderate exercise" described as five aerobic sessions a week for 20 to 60 minutes. ACSM recommends that for "already active individuals", moderate exercise may be at an intensity of 60-80% maximal oxygen uptake, also known as VO2 max. (ACSM, 2000, p. 151). ACSM recommends that the beginning exerciser burn a minimum of 1000 calories a week in physical activity for health benefits, while the more experienced exerciser or individuals trying to shed body fat and/or improve fitness levels burn a minimum of 1500 calories a week in physical activity (ACSM, 2000, p. 153).

The Cooper Institute of Aerobics Research (CIAR) agrees with the ACSM guidelines. A CIAR instructional text aimed at fitness specialists defines moderate exercise as a caloric expenditure of about 1000-1500 calories a week (CIAR, 1999, p. 3). CIAR suggests that individuals who expend 3000 calories or more a week through planned exercise may at some point see a decrease in the *health* benefits of exercise in exchange for whatever *other* goal is motivating the increased activity – such as athletics or the military (CIAR, 1999, p. 3).

Many clinical studies with the goal of measuring the effects of "heavy" exercise training ask their subjects (usually elite athletes) to undergo 90 or more minutes of continuous cardiovascular exercise at 70% to 90% maximal oxygen uptake (MacKinnon, 1999, 2000; Nieman, 1993, 1997; Shephard, 1999). In one exception, subjects were asked to run only 30 minutes at 80% of maximal oxygen uptake, but this was in conjunction with an increased volume of outside training (Verde,Thomas, Moore, Shek, & Shephard, 1992). Generally speaking, clinical studies examining the acute physiological changes within the immune system after exercise focus on exercise bouts that are both high in duration and intensity.

Heavy Exercise and Immune Response: Clinical Data

Given the intricacy, complexity, and overlapping redundancy of the body's immune system, it is unlikely that one single mechanism is responsible for the apparent suppression of immune function following periods of heavy exercise (Cannon, 1993; MacKinnon, 2000; Nieman, 1997). Many of the acute effects appear to be related to neuroendocrine changes, in particular the release of stress hormones such as catecholamines and corticosteroids. Stress hormones act as mediators in a host of immune responses, including neutrophil function, natural killer cell activity (NKCA), immunoglobulin (IgA) synthesis, and redistribution of immune cells throughout the body (MacKinnon, 2000). A detailed explanation of each mechanism and how it affects another is beyond the scope of this literature review; however, the following sections will attempt to give a streamlined explanation for each of the changes mentioned.

The earliest studies investigating the link between heavy exercise and infection involved infecting rats with a virus, then walking or running rats to exhaustion on a treadmill device or forcing the rats to swim to exhaustion (Baetjer, 1932). Different pathogens had different rates of mortality, but it was difficult to pinpoint the exact physiological mechanisms that led to a greater infection because of the confounding variable of psychological stress. From the rat's point of view, the lab activities were likely perceived as life-or-death struggle. The role of psychological stress and its impact on exercise and immunity cannot be ignored in human studies as well, especially those that involve an artificial environment (laboratory) or competition (Cannon, 1993).

As soon as a person begins to exercise, the white blood cell (WBC) count begins to increase (MacKinnon, 1999; Nieman, 1997; Simon, 1984). White blood cells include leukocytes, with subsets of granulocytes and neutrophils; and lymphocytes, with a subset of natural killer cells. The rise in WBC during exercise is almost always followed by a drop during the recovery period. How long this suppression lasts depends on how prolonged or how heavy the exercise session was (Nieman, 1997).

Neutrophil Response to Heavy Exercise

Neutrophils make up about two-thirds of all blood leukocytes and serve as first-line-of-defense cells to eliminate infectious agents from the body (Nieman, 1997). The almost immediate surge in neutrophils during exercise is due to the mechanical effects of increased cardiac output and the physiologic effects of the stress chemical adrenaline. These two forces encourage the movement of neutrophils from the endothelium of blood vessels to the body's circulatory system, and may also be responsible for increases in granulocytes and lymphocytes as well. (Eichner, 1993). If the exercise session is strenuous, there is second rise in the WBC count, due to the rising levels of the stress chemical cortisol in the blood. Cortisol triggers the release of immature neutrophils from bone marrow into the bloodstreams and also prevents mature neutrophils from leaving the bloodstream and entering muscle tissue. The notable increase in blood cortisol and therefore second increase in WBCs is typically observed only in strenuous exercise bouts lasting a minimum of 30 minutes (Eichner, 1993; Shephard, et al., 1991). Following exercise, the amount of circulating neutrophils remains high, but the degree of neutrophil function in the bloodstream is actually decreased (MacKinnon, 1999). This could be because neutrophils are involved in the muscle tissue inflammatory response to strenuous exercise. It is generally believed that neutrophil infiltration into skeletal muscle occurs in response to the cellular damage caused by the repeated mechanical loading and contracting of exercise (Eichner, 1993; MacKinnon, 1999; Nieman, 1997).

Natural Killer Cell Activity and Heavy Exercise

The subset of lymphocytes known as natural killer (NK) cells act as the "minutemen" in defending the body against bloodborne viruses. During strenuous exercise, natural killer cell activity (NKCA) increases, mediated largely by increased levels of the stress chemical adrenaline (Eichner, 1993; MacKinnon, 1999; Nieman, 1997; Shephard & Shek, 1999). Shortly after exercise, NKCA in the bloodstream begin to decrease, in part due to the influence of cortisol redistributing the NK cells from the body's blood compartment and back into tissues (Nieman, 1997). NK cells may return to pre-exercise baseline levels or drop below baseline, depending on how strenuous the exercise session was. It may take from 6 to 24 hours for the NK levels to return to baseline, and during this time, activity and division of T-cell lymphocytes tends to be reduced (Eichner, 1993).

Some studies suggest a cumulative decline in the numbers of resting NK cells over a time of strenuous training. Fry, Morton and Keast reported progressively declining NK cell numbers over 10 days of twice-daily sprint training in five well-trained military personnel (1992). By day 10, resting NKCA levels were 40% below pre-study values and remained that low even after five days of very easy recovery training. On the other hand, moderate exercise may enhance or have no effect on resting NKCA levels. In two studies of walkers and runners, Nieman, et al. (1993, 1998) reported slightly higher resting values for NKCA for the runners and walkers than the sedentary control groups. However, the values were noted at the beginning of the study, in the previously-trained subjects, suggesting that a permanent enhancement of NKCA may take years of consistent moderate exercise training (MacKinnon, 1999).

Immunglobulin Response to Heavy Exercise

Salivary and mucosal immunoglobins, or IgA, act as the "minutemen" against infectious microorganisms in the nose and throat. Because of the importance of mucosal IgA in resisting viral infection, this may be an area of clinical exercise immunology that will command more attention in the coming years (MacKinnon, 2000). IgA levels have been shown to decline acutely immediately following strenuous exercise (MacKinnon, 2000), though usually returning to baseline within 24 hours (Eichner, 1994). While some studies have shown the resting IgA levels of athletes to be normal or slightly lower when compared to nonathletes, other studies have shown the IgA levels in the overtrained athletes to be significantly lower than those of the moderately trained athletes (MacKinnon, 2000).

Several studies suggest a relationship between declining salivary IgA concentration and the appearance of URTIs in elite athletes. In one study of competitive squash and field hockey athletes, researchers found that a decline in salivary IgA during strenuous exercise accurately predicted the appearance of URTI symptoms within two days (MacKinnon, Hooper, Jones, Bachman & Gordon, 1997). In another study, researchers followed the resting and post-exercise levels of IgA over a season for elite swimmers (Gleeson, McDonald, & Pyne, 1999). The researchers found that low resting and postexercise levels of IgA were predictative of development of URTI's. Moderate exercise training appears to exert little, if any, effect on IgA levels (Nieman, 2000b, 2000c; MacKinnon, 2000).

The "Open Window"

The majority of exercise-induced changes, including the white blood cell changes just described, appear to follow a pattern: during heavy exercise, WBCs are stimulated; following heavy exercise, WBCs are suppressed. The state of altered immunity lasts from 3 to 72 hours before immune parameters return to normal resting values (Nieman, 2000c). Much of the literature calls this period of decreased protection the "open window" – a time when bacteria and viruses have a greater chance of gaining foothold inside the host (MacKinnon, 1999; Nieman, 1997. 2000c; Pedersen & Ullum, 1994; Shephard, 1995). The "open window" hypothesis proposes that athletes are more susceptible to infection during the hours of immune suppression after exercise.

Pederson and Ullum (1994) discussed the implications of an "open window" hypothesis for athletes and exercisers who train every day, sometimes twice a day, for weeks or months with few appreciable breaks. Using the model of an "open window," it is possible that an exerciser may begin another training session before his or her immune system has fully recovered from the previous session. Studies have observed the like with specific immune parameters. For example, a cumulative reduction in NKCA was observed in highly-trained military subjects who performed ten days of intense sprint training (Fry, et al., 1992), and a cumulative reduction in mucosal and salivary IgA levels was observed among elite swimmers over a season (MacKinnon, et al., 1997). A pattern of starting each exercise session before fully recovering from the previous one may eventually lead to chronic suppression of the immune system (Pederson & Ullum, 1994). However, such suppression is more likely to be manifest by frequent URTIs than serious illnesses associated with immunodeficiency (MacKinnon, 1999, 2000).

Exercise Training and Infection: Runners' Studies

The first study to observe the rates of illness among a large exercising population was a study by Peters and Bateman (1983) in which 141 runners were surveyed about symptoms of URTIs both before and after a 56-km (33.6 miles) ultramarathon. Each runner had a control, an age-matched non-runner living in the same household. During the two weeks following the race, more than twice as many runners reported symptoms of URTIs than the non-running controls (33% compared to 15%). Moreover, the incidence of illness increased as the runners' race times decreased. Forty-seven percent of the fastest runners -- those who finished the race in less than four hours – reported an URTI in the two weeks following the event. Of the slower runners – those who finished in about six hours – less than 20% reported any illness.

Ten years later, the same research lab followed 84 ultramarathon runners (and 73 non-running controls) to determine the effectiveness of vitamin C supplementation in reducing illness after a 90-km (54 miles) ultramarathon (Peters, Goetzsche, Grobbelaar, & Noakes, 1992). Although the vitamin C did reduce the incidence of illness in the runners taking it, the placebo runners reported twice as many URTI symptoms as the non-runner controls in the two weeks following the race. In addition, the lowest incidence of URTI symptoms appeared in the runners who reported moderate training before the event, rather than excessive or infrequent training.

Similar data is seen from a 1987 study of more than 2000 runners training for the Los Angeles Marathon (26.2 miles) (Nieman, Johanssen, Lee, & Konstantinos, 1990). The purpose of the study was to examine the relationship between reported incidences of URTIs and various levels of training two months prior to the event, as well as examine the reported incidences of URTIs in the week following the event. One week after the marathon, nearly 5000 randomly selected runners were sent questionnaires that asked for information on training habits, weekly mileage, workout intensities, and number of infectious episodes in the past two months. Of the 2311 runners who responded, the runners who trained more than 60 miles a week reported nearly twice the incidence of URTIs than runners who ran less than 20 miles a week. Almost 13% of the marathon participants who were *not* sick before the race reported an infectious episode in the week following the race. Only 2.2% of the trained runners who chose not to run the marathon for reasons other than illness reported any illnesses in the week following the race.

A 12-month study of 530 runners also concluded that training mileage is a statistically significant risk for an URTI (Heath, et al., 1991). Each runner filled out a monthly log that asked questions pertaining to training habits and mileage as well as frequency of URTI symptoms such as runny nose, sore throat and cough. Runners were asked to differentiate between symptoms due to URTI episodes and symptoms due to chronic allergies. Runners were divided into four groups, depending on their yearly mileage. Runners in the third quartile who ran between 866 and 1388 miles over the year (16.5 to 26 miles a week) reported twice as many URTIs as the runners in the first quartile who trained less than 485 miles over the year (9 miles a week). Surprisingly, runners in the fourth quartile, who ran *more* than 1388 miles over the year, reported slightly fewer URTIs than the runners from the third quartile. Researchers in the study suggested that perhaps the more high-mileage runners tended to practice more consistent healthcare habits, such as adequate sleep, nutrition, and supplementation, which play a role in decreasing their incidence of URTIs

Additional Studies

There is not a lack of studies comparing various levels of exercise training and the immune response of participants, as measured by clinical data, self-reports of illness, or both. Some results appear to contradict others, even within the same studies.

For example, researchers Mueller, Villiger, Callaghan and Simon directed and observed the training habits of 20 cross-country skiers for two months (2001). Ten of the skiers were competitive athletes on the Swiss National Team and ten of the skiers were moderately trained athletes who skied for recreation. The study also included ten sedentary but otherwise healthy men as controls. After two months of intensive training, the group of competitive skiers showed a significant decrease in two parameters of immune function, T-cell lymphocyte counts and monocyte counts. The group of recreational skiers, who followed a moderate regime of training, showed a significant increase in T-cell lymphocyte production. However, during the two months, one of the moderate skiers contracted a viral infection and none of the competitive skiers reported any kind of illness. Researchers suggested that because of their competitive status, perhaps these skiers undertake every possible measure to safeguard against illness.

Before the study on the Los Angeles Marathon runner, Nieman, et al. (1990) test-piloted the questionnaire intended for the marathon on a group of 273 runners preparing for a much shorter race. The runners were asked to recall their training habits and incidence of illness while preparing to race either a 5-km (3.1 miles), 10-km (6.2 miles) or a half-marathon (13.1 miles). The results showed a non-significant trend of more illness among the runners who trained less. Of the runners who ran less than 15 miles a week, 34% reported at least one URTI; of the runners who ran more than 15 miles a week, 25% reported an URTI. Only 6.8% of the runners training for the half-marathon reported any illness as compared to 17.9% of the runners training for the shorter races. The researchers suggested that the runners with a more serious commitment to their sport may practice better healthcare habits and enjoy an improved immune system due to years of moderately high, but not excessive, exercise training.

Exercise and URTIs: Other Factors

Factors beyond the duration, intensity and pattern of exercise can influence an individual's susceptibility to infection. Poor nutrition can contribute to diminished immune function, especially if the athlete or exerciser is deficient in vitamin B, vitamin E, folic acid, essential fatty acids, arginine, L-carnitine and trace elements. This is especially true for female athletes who may reduce their energy intake because they are concerned how their physical appearance and body weight affects their sport of activity (Shephard, 1999). It is possible that many group fitness instructors, in their role as demonstrators, models, and leaders, may feel pressure to maintain a body weight that requires an energy-reducing diet. One 1999 study of female group fitness instructors found that 64% of the instructors expressed the desire for a figure that was one size smaller/slimmer than their own, even though the instructors were already within a normal weight range or less-than-normal weight range (Nardini, 1999).

Exercising in close proximity to other exercisers may increase the risk for infection (Primos, 1996). This is partly due to increased exposure to other participants who may be carrying pathogens, and partly due to the increased chance of pathogen transmission through heavy respiration and coughing. Such acts may transmit nasal and pharyngeal (throat) secretions containing infectious organisms (MacKinnon, 1999; Primos, 1996). Infection may also be transmitted by contact with contaminated objects such as mats, towels, water bottles, dumbbells, and other types of equipment. In addition, many group fitness instructors share a microphone headset with a foam windscreen.

The level of psychological stress an individual feels may influence their risk of infection. Cohen, Tyrrell, and Smith investigated the relationship between perceived levels of stress and susceptibility to the common cold (1991). The study asked 394 healthy subjects to answer a detailed questionnaire designed to assess their degree of psychological stress, then each subject was given nasal drops containing a respiratory virus. Researchers reported that the rate of respiratory infections and common colds increased in a dose-response manner with increases in the degree of psychological stress. The effects were not altered even when controlled for numerous variables such as personality type and baseline health.

The exact role of psychological stress in relation to exercise and immune response is difficult to define. The effects of psychological stress and vigorous exercise tend to be additive, since vigorous exercise itself triggers many of the same hormonal changes the stress does – namely, increased secretions of cortisol and catecholamines (Shephard, 1999). In addition, there is the undeniable factor of the very individual nature of stress itself (Seyle,1956). What is extremely stressful to one person may not be to another.

Exercising While Ill

The benefits of exercise are decreased during illness, and most physicians are apt to advice their patients to rest until the infection has passed (Eichner, 1993). However, many exercisers are reluctant to take a day off, and group fitness instructors face the problem of finding a substitute instructor to replace them or calling off the class.

In some cases, reducing the intensity and duration of the activity may be an acceptable alternative (Eichner, 1993; Primos, 1996; Shephard, 1999), though each author cautions this is only true if the illness is "simple" URTI and responds well to the use of antihistamines and/or decongestants. If the viral illness is systemic in nature, exercise of any type is not advised. Exercise could increase the severity of the infection, possibly leading to post-viral fatigue syndrome, a condition that can last up to six months, or even viral myocarditis, which can result in cardiac arrest and death (Eichner, 1993; Primos, 1996; Shephard, 1999).

Eichner (1993) recommends that exercisers perform a "neck check" to better determine between "harmless" URTIs and possible febrile infections. If the symptoms are above the neck only – such as a mild sore throat and nasal congestion – the individual can begin their exercise routine at a reduced intensity and re-evaluate their condition after 10 minutes. However, if the symptoms are below the neck, such as a hacking cough, fever, chills, diarrhea, and myalgia, the individual should not attempt to exercise.

Exercise Habits of Group Exercise Instructors

From the literature, it is possible to draw some guidelines for what constitutes heavy and moderate exercise. However, many group fitness instructors do not fit into either group. Most instructors teach classes that are 60 minutes or less in duration (the literature defines "prolonged" exercise as 90 minutes or more). While it is difficult to estimate the maximal oxygen uptake of instructors while they're teaching, it is safe to assume the instructors are working an intensity low enough to allow them to speak and cue throughout the class. However, many instructors far exceed the guidelines of "moderate" exercise as set by the American College of Sports Medicine and the Cooper Institute of Aerobics Research (five one-hour sessions of exercise a week). It is not unusual for an instructor to teach several classes in one day or even back-to-back. The potential problem for group fitness instructors is not so much the intensity or length of each individual class, but the repeated bouts of exertion over short amounts of time, sometimes with little recovery time in between.

Although no studies exist with exact guidelines on how much rest is necessary between cardiovascular workouts, authors of almost every study on exercise and immune response are quick to point out the importance of rest, recovery and sleep. Nieman (2000a) notes that the rest period between workouts may play just as powerful a role in a person's immunity as the hormonal changes that take place during the workout. MacKinnon (2000) warns that the seemingly small changes in immune parameters may be exacerbated by inadequate rest and may lead to overall immune suppression and subsequent illness.

Summary

The majority of literature concerning exercise and immune response supports, to some extent, the idea of a "J-curve" model. According to the "J-curve" hypothesis, a regular routine of moderate physical activity enhances immune response, thus decreasing the risk of infection; while excessive amounts of exercise may suppress a person's immunity, thus increasing the risk of infection.

When an individual begins to exercise, changes in the white blood cell counts occur almost immediately. Whether these changes are beneficial or not seems to depend on the length and/or intensity of the exercise. Studies that focused on the affects of moderate exercise often found no clinical difference in the resting immune systems of subjects, but the exercising subjects reported fewer incidences of URTIs than the non-exercising controls. Studies that focused on the affects of strenuous exercise reported differences in the several immune parameters, including reduced NKCA, alterations in neutrophil numbers and function, and reduced amounts of IgA. Such alterations usually returned to baseline levels within three to 72 hours. Some researchers called this period of diminished immune response "the open window" – a time when viruses can more easily enter the body and thrive.

Several large studies involving runners provided data supporting the "open window" theory. The studies reported that the runners who trained the most and/or ran the fastest in a marathon or ultramarathon were the ones most likely to report an URTI following the race. However, other studies comparing recreational exercisers to more competitive exercisers either saw no difference in the URTI frequency of the two groups or less URTIs in the more competitive group.

Besides hormonal and white blood cell changes, other exercise-related factors can increase a person's risk of infection. The likelihood of pathogen transmission is greater because of increased respiration and the shared physical contact of things such as mats, equipment, and towels. Psychological stress and its connection to exercise can also diminish the immune response.

The question of whether an individual should exercise while sick seems to be best answered by the idea of a "neck check." If the symptoms are above the neck, such as a scratchy throat or runny nose, exercise of reduced intensity and duration may be all right. If the symptoms are below the neck, such as a fever or hacking cough, the infection may be systemic and exercise is strongly discouraged.

The group fitness instructor does not fit easily into the literature's guidelines of moderate or heavy exerciser. Although he or she may teach exercise classes of moderate length and moderate intensity, the sheer quantity of classes taught on a daily or weekly basis may put the instructor outside the guidelines of "moderate exerciser." Whether this increased quantity of exercise sessions affects a person's immune response, thereby increasing their risk of contracting an URTI, is a topic yet to be explored. However, given the central role that group fitness instructors play in the ever-growing field of health and exercise, it is a topic worth exploring.

CHAPTER III

METHODS AND PROCEDURES

The purpose of the study was to determine if the teaching loads of group fitness instructors affected their immune response, as reflected by the frequency of upper respiratory tract infection symptoms. Two sub-problems under investigation were to determine if the amount of sleep and the age of the instructors affected the immune response, also reflected by the frequency of upper respiratory tract symptoms.

Selection of Site:

The data was originally gathered in the form of a survey and cold symptom checklist at the "Dallas Mania Fitness Convention." The convention was held in the Fairmont Hotel in downtown Dallas from August 24-26, 2001. The results from the survey were given to the author at a later date. The surveys were anonymous with no identifying marks and no attempts were made to identify the subjects.

Selection of Subjects:

The subjects were the 332 male and female group fitness instructors who attended "Dallas Mania" and correctly completed a survey. Group fitness instructors typically attend such conventions to earn continuing education credits to uphold various teaching credentials. Eleven subjects were male, 319 were female. Subjects ranged in age from 19-55 years. The subjects' experience of teaching group fitness classes ranged from less than one year to more than 20 years.

Selection of Instruments:

The instruments used were a survey including questions about general demographic data and a 13-symptom checklist for symptoms of an upper respiratory tract infection (URTI). The checklist was in the form of a Likert scale. The survey and checklist can be found in Appendix A and B.

The demographic questions asked the subjects to mark their birth dates, gender, years teaching fitness classes, and the number of classes the subjects taught each week. This information was used to group the instructors into three different groups of teaching loads for the analysis of variance. The survey also asked the subjects to mark how often they had been ill in the past three months and how many hours of sleep they averaged each night.

The cold symptom checklist was originally developed by Meschievitz, Schultz, and Dick (1984) in a study that attempted to establish a model in which the rhinovirus ("common cold") could be predictably transmitted from infected donors to susceptible recipients in a controlled environment. Infected donors shared closed quarters with uninfected recipients. The rate of transmission was tracked in part by having all subjects fill out an hourly checklist. The checklist contained the following symptoms: cough, nasal discharge, sneezing, stuffy nose, sore throat, headaches, malaise, chilliness, shaking and chills, fever, laryngitis, aching joints or muscles, and watery eyes.

At least two other studies have used the checklist. Dick, Jennings, Mink, Wartgow and Inhorn (1987) conducted a study to investigate how quickly a rhinovirus would spread if potential recipients were restricted from touching their hands to their faces. Infected donors and uninfected recipients played two 12-hour rounds of poker. During one game, a set of donors and recipients played naturally, using cloth handkerchiefs if needed. During the other game, the recipients wore large plastic collars and arm braces that allowed them to play cards but restricted touching of the hands to the face. All subjects of both games filled out the 13-symptom checklist on an hourly basis.

Weidner (1994) used the checklist in a study of 290 intercollegiate athletes over a sports season. The intent of the study was to determine the frequency of URTI's in the athletes and the reporting behaviors of the athletes who were sick. The 13-symptom checklist served as a basis for the instrument used to gather data from the athletes. The checklist was used three times during the season.

The checklist for this study asked the subjects to mark the frequency of each of the symptoms (never, rarely, sometimes, frequently, all the time). The subjects were asked to recall the frequency at which they experienced any of the 13 symptoms over a three-month period (June, July, August).

Procedures:

The data for this study was collected from the surveys and checklists distributed at the "Dallas Mania Fitness Convention." The convention was held at the Fairmont Hotel in downtown Dallas during the last weekend of August 2001. The convention was organized by a fitness company called "Sara's City Workout." Employees and volunteers for "Sara's City Workout" received the surveys and checklists by mail one week before the convention began. The employees and volunteers put the surveys and checklists inside the participants' convention welcome packets the night before the convention began. The welcome packets contained other materials such as a convention master schedule, coupons for clothing items, and a complimentary notebook. The surveys and checklists included instructions on when and where to return them before the end of the convention. Participants had ample time to read and fill out the surveys and checklists during the three-day convention. Surveys and checklists were returned to a data collection table inside the convention's "Fitness Expo" (a large room filled with educational booths and shopping opportunities). The surveys were put inside a box on the data collection table and later given to the author. Participants who walked past the data collection table but did not have a survey or checklist to return could pick up both items at the table and fill them out. Both the demographic survey and the cold symptom checklist were anonymous. Participants answered questions by circling responses or making checkmarks (see Appendices A and B). No attempts were made to identify the participants.

Research Design:

The research design was a comparative survey. The independent variables in this study were the group assignments based on how many classes an instructor typically taught each week. A light teaching load was considered 1-3 classes a week, a moderate teaching load was 5 classes a week, and a heavy teaching load was 7 or more classes a week. The dependent variables included the scores from the previously validated cold symptom checklist (13 symptoms); the instructor's age; and the hours of sleep the instructor averaged per night.

Statistical Analysis:

One-way ANOVA's were used to compare the three instructor groups on the dependent variables. Where appropriate the Bonferroni *post hoc* test was used for mean comparisons. All hypotheses were tested at the 5% level.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter includes a description of the sample, an analysis of the hypothesis data, and a discussion of the results.

Description of the Sample

Completed surveys were returned by 332 participants. The subjects were divided into three groups based on the number of classes they reported teaching on a weekly basis. The group of instructors with a light teaching load (1-3 classes) consisted of 107 subjects; the group of instructors with a moderate teaching load (5 classes) consisted of 127 subjects; and the group of instructors with a heavy teaching load (7 or more classes) consisted of 98 subjects.

The demographic questions consisted of the following categories: 1) gender, 2) age category, and 3) number of years teaching fitness classes. Eleven subjects were men and 319 subjects were women. The instructors ranged in age from age 19 to 54 years, with a mean age of 37.2 years. The number of years teaching fitness class ranged from one year to more than twenty years, with a mean of 8.46 years.

The subjects in Group Three, who taught seven or more fitness classes a week, reported the highest mean of years teaching fitness, 10.21 years. The mean age of the Group Three instructors was almost two years older than the mean age of the other two groups. The breakdown is reflected in Table I.

TABLE I

	N		Mean age	Mean years teaching
	Male	Female		
	11	319		
Group 1	107		36.5	7.49
Group 2	127		36.8	7.91
Group 3	98		38.5	10.21
Total	332*		37.2	8.46

* Two subjects did not specify gender

The subjects were also asked questions regarding 1) the number of times they had missed teaching class due to illness over the past 3 months, 2) the number of times they had taught a class while ill over the past 3 months, and 3) how many hours they typically slept each night. The breakdown is reflected in Table II.

For all the subjects, the mean number of classes missed due to illness was .37. However, the mean number of classes the instructors reported teaching while ill was .92. The mean number of classes the instructors reported teaching while ill increased with each group: the group teaching three or less classes a week reported a mean of .67; the group teaching five classes a week reported a mean of .95; and the group teaching seven or more classes a week reported a mean of 1.15.

Nearly half of the instructors (45.6%) reported sleeping six hours or less a night. The mean hours of sleep each night for the total group was 6.73. As the number of classes an instructor reported teaching increased, the amount of sleep reported decreased.

Group One instructors reported 6.85 hours of sleep while Group Three instructors reported 6.52.

The breakdown is reflected in Table II.

TABLE II

	Mean classes missed due to illness*	Mean classes Taught while ill*	Mean hours of sleep per night*
Group 1 (n=107)	.33	.67	6.85
Group 2 (n=127)	.37	.95	6.78
Group 3 (n=98)	.41	1.15	6.52
Total (n=332)	.37	.92	6.73

* = as reported over a 3-month period

The cold symptom checklist asked the instructors to mark the frequency they had experienced 13 different cold-related symptoms over a three-month period. Table III shows the breakdown among the three groups of instructors.

The key for Table III is as follows:

Group 1: light teaching load; three or less classes a week

Group 2: moderate teaching load; five classes a week

Group 3: heavy teaching load; seven or more classes a week

Table III

Cold Symptoms	Total Group	Group 1*	Group 2*	Group 3*	F	Probability
(n)	332	107	127	98		
Cough	1.84±.90	1.76±.88	1.82±.88	1.97±.95	1.52	.22
(n)	331	107	127	97		
Nasal Discharge	2.40±1.03	2.47±1.09	2.39±1.00	2.33±.99	.47	.63
(n)	326	102	126	98		
Sneezing	2.34±.90	2.40±.91	2.31±.92	2.33±.85	.32	.72
(n)	326	105	126	95		
Stuffy Nose	2.33±.97	2.34±1.05	2.30±.94	2.36±.92	.10	.90
(n)	330	107	127	96		
Sore Throat	2.03±.95	1.95±.95	2.06±.93	2.07±1.00	.49	.62
(n)	329	106	125	98		
Headache	2.57±1.01	2.51±1.00	2.62±1.01	2.56±1.02	.32	.73
(n)	330	107	127	96		
Malaise	2.63±1.00	2.57±1.01	2.62±.99	2.70±1.01	.44	.64
(n)	330	96	127	96		
Chilliness	2.03±1.16	1.81±1.03	2.08±1.21	2.21±1.19	3.18	.04
(n)	331	106	127	98		
Chills	1.32±.64	1.25±.59	1.35±.67	1.36±.65	.90	.40
(n)	332	107	127	98		
Fever	1.40±.65	1.35±.63	1.41±.67	1.46±.66	.77	.46
(n)	332	107	127	98		
Hoarse	1.86±1.06	1.66±1.05	1.90±1.02	2.03±1.10	3.23	.04
(n)	331	107	126	98		
Aching Muscles	2.61±1.09	2.54±1.14	2.59±1.08	2.71±1.06	.68	.51
(n)	332	107	127	98		
Watery Eyes	1.96±1.04	2.00±1.05	1.87±.99	2.04±1.09	.89	.41
(n)	331	106	127	98		
Sleep	6.73±1.10	6.85±1.09	6.78±1.23	6.52± .90	2.532	.81
(n)	318	102	123	93		
Age	37.2±8.73	36.5±8.86	36.8±8.56	38.5±8.77	1.518	.22
(n)	331	106	127	98		
Years of teaching	8.46±5.85	7.49±5.81	7.91±5.46	10.21±6.04	6.639	.001

Hypothesis One

It was hypothesized that the amount of classes a group fitness instructor teaches each week would not cause a significant difference in the frequency of upper respiratory tract infection symptoms. Such symptoms included coughing, sneezing, nasal discharge, stuffy nose, sore throat, headaches, malaise, chilliness, shaking chills, fever, laryngitis or hoarseness, aching joints and muscles, and watery eyes.

There was a statistically significant difference in two variables, chilliness and hoarseness. However, since the checklist contained 13 symptoms, and differences existed only in those two, the null hypothesis was accepted.

Hypothesis Two

It was hypothesized that the amount of sleep a fitness instructor averages would not cause a significant difference in the number of upper respiratory infections she or he acquires. Table III shows the differences between the three groups in regards to sleep, and the difference was not statistically significant. Therefore the null hypothesis was accepted.

Hypothesis Three

It was hypothesized that the age of the fitness instructor would not cause a significant difference in the number of upper respiratory infections he or she acquires. Table III shows the differences in the three groups in regards to age, and the differences were not statistically significant. Therefore the null hypothesis was accepted.

Discussion of Results

Numerous studies in the literature review supported the idea of "J-curve" in exercise and immune response. (Heath, et al., 1993; MacKinnon, 1999; Nieman & Nelson-Cannarella 1992; Shephard,1999). According to the "J-curve" model, individuals who exercise moderately may enhance their immune response, while those who surpass the boundaries of moderate exercise may suppress it. The American College of Sports Medicine (2000) and the Cooper Institute of Aerobics Research (1999) suggest the upper guidelines of "moderate" exercise be no more than five 60-minute sessions a week. Therefore, some of the literature indicated that instructors who taught more than seven classes a week would report a greater incidence of URTI symptoms. This was not the case in this study.

There are several possible reasons as to why the results of this study did not have the same results as the majority of studies in the literature review. First, the survey and cold-symptom checklist the group fitness instructors filled out were self-reporting instruments. The instructors were asked to recall the frequency of 13 symptoms over a three-month period, and it may have been difficult for many to accurately remember the presence of absence of symptoms over that time span. Although the instrument had been previously validated, some of the cold symptoms may have been confusing to the participants. For example, how does one distinguish between the aching muscles and joints that indicate an infection, or the aching muscles and joints that result from a taxing exercise session? Also, the recall period was during the summer, when the prevalence of URTIs does not seem as high as during the winter because people are outdoors more and not as confined to indoor spaces with re-circulating air. There may have been some confusion among the instructors as to whether the symptoms, if any, were infection-related or allergy-related. Finally, instructors filled out the surveys while attending a large fitness convention with a very stimulating environment. The concentration necessary to recall one's health over three months may have been compromised by the many distractions of the convention itself.

Since the survey was a self-reporting instrument, it was not possible to control for each instructor's perception of what constitutes strenuous exercise. The possibility exists that the majority of instructors who filled out a survey engage in what the literature review would consider moderate rather than strenuous, exercise – even if teaching seven or more classes a week. Much of the data on the effects of strenuous exercise involves subjects who exercised at more than 70% of their maximal oxygen uptake, and sometimes as high as 90%. Since an instructor needs to be able to speak easily throughout the entire class (to cue and give instructions), it is very possible he or she is *not* exercising at such a high intensity. The intensity levels of the classes may better match that of brisk walking or jogging, which the literature defines as "moderate."

Much of the literature review also stressed the importance of adequate sleep and recovery when individuals undergo periods of heavy exercise (MacKinnon, 2000; Nieman, 2000a; Uusalito, 2001). However, there were no significant differences in the amounts of sleep between the three groups or the effects on the rates of illness. Again, lack of concentration and time when filling out the survey may have affected the participants' responses. It is typical at such conventions, because of the multitude of events, for participants to miss hours of sleep. Participants who did not read the survey carefully may have responded to the sleep questions based on the weekend's experience rather than recalling an average for the past three months.

Finally, it was expected that age would play a role in the incidence of URTIs among group fitness instructors. According to the literature, advancing age is believed to play a part in the decline of the immune system (Kostka, et al., 2000; Nieman, 2000a). It was expected that older fitness instructors might report more illness than younger instructors. The data revealed that age did not make a significant difference in the rates of reported illness for these instructors. This could be due to the experience of older instructors and their ability to modify the intensity of their teaching style in response to how they physically feel. Also, the older instructors may gravitate toward teaching classes with an older, less physically demanding population. Although the classes are aerobic in nature, they may be more low-key than the classes taught by younger instructors.

The responses concerning sleep may be of some cause for concern. Nearly half of the instructors (45.6%) reported sleeping six hours or less a night. Most sleep researchers agree that a *minimum* of eight hours is considered necessary for optimal health and functioning (Leger, 1994). Given the high activity levels that their teaching jobs demand, and the expectations to be healthy role models for their clients, one would expect the instructors to make adequate sleep a priority. Perhaps since many fitness instructors teach classes as a "hobby career" on top of holding down a fulltime job, it is possible they are finding the time to do so only by giving up sleep. Since sleep is such a vital component in all areas of health and wellness, the issue of adequate sleep among health professionals is an area worthy of greater exploration and study.

CHAPTER V

SUMMARY 0F FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This final chapter provides an overview of the study, including a summary of findings, conclusions with suggestions for health and fitness professionals, and recommendations for further studies.

Summary of Findings

The purpose of this study was to determine if the teaching loads of group fitness instructors affected their immune response, as reflected by the frequency of upper respiratory tract infection symptoms. The instructors were divided into three groups according to teaching loads – light, moderate, and heavy. The strength of the immune response was measured by the frequency of upper respiratory tract infections. The frequency of URTIs was measured by a self-reporting cold symptom checklist distributed in a survey form. Three hundred and thirty-two group fitness instructors attending a fitness convention participated in the study by completing a survey.

The data collected in this study was analyzed by a one-way ANOVA test at the .05 level of significance. The hypotheses were examined to determine any difference in immune response among the three groups of instructors with various teaching loads, the amount of sleep an instructor averaged, and age. The data gave the following findings:

Hypothesis One – There will be no significant difference in the number of classes a group fitness instructor teaches each week and the frequency of upper respiratory tract infection symptoms (coughing, sneezing, nasal discharge, stuffy nose, sore throat, headaches, malaise, chilliness, shaking chills, fever, laryngitis, aching joints and muscles, and watery eyes).

There were no significant differences among the three groups of instructors with varying teaching loads, except for very slightly significant differences in two of the symptoms, chilliness and hoarseness. Hypothesis one was accepted.

Hypothesis Two -- There will be no significant difference in the amount of sleep a fitness instructor averages and the frequency of upper respiratory tract infection symptoms.

There were no significant differences in the incidence of URTI symptoms between the fitness instructors who averaged the most sleep and the fitness instructors who averaged the least sleep. Therefore hypothesis two was accepted.

Hypothesis Three – There will be no significant difference in the age of a fitness instructor and the frequency of upper respiratory tract infection symptoms.

There were no significant differences in the incidence of URTI symptoms between the older fitness instructors and younger fitness instructors. Therefore hypothesis three was accepted.

Conclusions

The results of this study indicate that the number of classes a group fitness instructor teaches has no significant effect on his or her immune response. Even the instructors who exceeded the guidelines of "moderate" exercise as set by the American

College of Sports Medicine (more than five 60-minute exercise sessions a week) reported no significant difference in the frequency of URTI symptoms than the instructors who taught less. These results would lead one to conclude that the number of classes an instructor teaches has no bearing on his or her overall health, regardless of age or sleeping habits.

Despite the results of the author's study, group fitness instructors and their employers should pay closer attention to the overall health and healthcare habits of the instructors. As the health and fitness industry continues to grow, the role and expectations of the group fitness instructor continues to grow as well. The fitness instructor is expected to be a leader, educator, coach, trainer and role model. Such demands require an optimum state of health, so it would helpful for both instructors and their employers to have guidelines to follow as to what constitutes a healthy teaching schedule.

At this point no guidelines exist. There is a paucity of information in the literature regarding the long-term effects of moderate-intensity exercise performed at a high frequency. The literature review produced studies of essentially two varieties: studies that focused on moderate-intensity exercise for moderate periods of time; and studies that focused on high-intensity exercise for prolonged periods of time. The author's study falls into neither category. The studies that focused on moderate exercise (Kostka, et al., 2000; Nieman, et al., 1990, 1991, 1993) used exercise plans that involved five or less workouts a week for an hour or less each time. The exercise plans usually consisted of a moderate intensity workout such as brisk walking or jogging, and it can be assumed that the average fitness instructor is working at a comparable level of intensity, or perhaps slightly higher. However, there are no comparable studies with subjects who exercised moderately several times a day or more than five times per week as do many fitness instructors.

It might to be helpful to fitness instructors and their employers to be aware of the "J-curve" theory, and the increased chance of illness linked to increased amounts of exercise. Instructors may not consider that a high frequency of URTIs could be due to a suppressed immune system caused by too many exercise sessions with too little recovery time. There is a common perception among group fitness instructors of physical "invincibility," promoted in part by the demands and pressures to teach while ill. Few jobs require the worker to physically and mentally motivate a group of people; talk, instruct, yell and encourage nonstop for an hour; coordinate music, choreography, and contrasting personalities – all the while moving nonstop and sweating profusely. It is a lot to expect of any one person, and especially if that person is physically fighting an infection. Although low-to-moderate intensity exercise with a "simple" URTI is not contraindicated (Eichner, 1993; Primos, 1996; Shephard, 1999), exercise of any kind when the infection is systemic can have very serious, even fatal, consequences (Eichner, 1993). In addition, a "simple" URTI and a more serious illness may start out with the same symptoms, so a self-diagnosis could be both inaccurate and harmful (Eichner, 1993). With this in mind, group fitness instructors should be more vigilant about listening to their bodies and refusing to teach when ill. Fitness instructors should realize that other people are not expected to exercise when ill, and neither should they.

It would be beneficial to group fitness instructors to learn more about the "J-curve" and bring that information to their employers. With this knowledge, facility managers may wish to develop teaching guidelines within their own facility, as well as develop an atmosphere where instructors are discouraged, rather than praised, for teaching while ill. It is doubtful a health professional would encourage a member to exercise while ill – so why should the health professional? All health professionals, from the fitness instructors to the facility managers, should respect and follow the same advice they give to the public.

Recommendations

Further Studies

The following recommendations are made for further study:

1) A qualitative research method with group fitness instructors would be able to provide more in-depth and accurate information in regards to the subjects' responses about their teaching/exercise schedules and frequency of illness.
2) This same study design could be used, but rather than ask the subjects to recall their cold symptoms over three months, ask them to keep a weekly log in which to record their teaching/exercise schedule, amount of sleep, and frequency of cold symptoms. The same cold symptom checklist in the form of a Likert scale could be used, but it may produce more accurate data if filled out weekly for a period of three months.
3) A one-year (or longer) study with instruments to measure immune response, activity levels, and hours of sleep might provide information as to how these three dimensions affect an individual's state of optimum wellness.

3) A one-year (or longer) study with instruments to measure immune response, activity levels, and hours of sleep might provide information as to how these three dimensions affect an individual's state of optimum wellness.

There is a no shortage of studies in the field of exercise immunology, but few, if any explore the connection between immune response and an exercise regime that involves moderate intensity exercise performed more than five times a week. Although group fitness instructors may benefit the most from such information, other populations would as well, including personal trainers, dance instructors, some coaches, massage therapists, and any profession where consistent physical labor is part of the job description. In addition, although sleep was not the primary focus of this study, the data stood out because almost half of the fitness instructors failed to meet the minimum guidelines of eight hours. This is an area that deserves a closer look.

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APPENDIXES

APPENDIX A

DEMOGRAPHIC SURVEY

GROUP FITNESS INSTRUCTORS SURVEY

Please do not put your name on this survey!

Gender: M F Birth Date: ______

(circle one) Month/day/year

Please answer all questions below as honestly and accurately as possible. For all questions, circle only one answer. For the purpose of this survey, consider an aerobic-based fitness class as one that includes a minimum of 30 minutes of aerobic work at an intensity that is moderate to high exertion for YOU, the instructor. Examples of such a class include step, hi-lo floor, spinning, kickboxing, and sports drills.

1. Circle the number of aerobic-based fitness classes that you teach in one week.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 20+

2. Circle the number of years that you have been teaching group fitness classes.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 20+

3. Over the past 3 months, how many times have you missed teaching class due to a cold-related symptom?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 20+

4. Over the past 3 months, how many times did you teach a class with a cold-related symptom because you could not find a substitute?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 20+

5. How many hours of sleep do you average a night?

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

6. How many hours of additional exercise do you perform each week outside of your regular teaching schedule? (i.e., jogging, weight lifting, cycling, etc)

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 20+

PLEASE TURN THIS PAGE OVER

APPENDIX B

COLD SYMPTOM CHECKLIST

COLD SYMPTOM CHECKLIST

Please review the list of cold symptoms below and think back carefully over the past three months. Darken the square that best describes how often you experienced each particular symptom over the past three months.

		NEVER	RARELY	SOMETIMES	FREQUENTLY	ALL THE TIME
1.	Cough	☐	☐	☐	☐	☐
2.	Nasal Discharge	☐	☐	☐	☐	☐
3.	Sneezing	☐	☐	☐	☐	☐
4.	Stuffy Nose	☐	☐	☐	☐	☐
5.	Sore Throat	☐	☐	☐	☐	☐
6.	Headache	☐	☐	☐	☐	☐
7.	Malaise (Tired out)	☐	☐	☐	☐	☐
8.	Chilliness	☐	☐	☐	☐	☐
9.	Shaking Chills	☐	☐	☐	☐	☐
10.	Fever or Feverish	☐	☐	☐	☐	☐
11.	Hoarseness	☐	☐	☐	☐	☐
12.	Aching Joints/Muscles	☐	☐	☐	☐	☐
13.	Watery Eyes	☐	☐	☐	☐	☐

2

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