1-1-1992

The validity of perceived physical fitness in adult men and women

Patricia Anne Mortati McCollum
University of Nevada, Las Vegas

Order Number 1351241

The validity of perceived physical fitness in adult men and women

McCollum, Patricia Anne Mortati, M.S.

University of Nevada, Las Vegas, 1992

U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

THE VALIDITY OF PERCEIVED PHYSICAL FITNESS IN ADULT MEN AND WOMEN

by

Patricia Mortati McCollum

A thesis submitted in partial fulfillment
of the requirements for the degree of

Master of Science
in
Exercise Physiology

College of Human Performance and Development
University of Nevada, Las Vegas
August 1992

The Thesis of Patricia Mortati McCollum for the degree of Master of Science in Exercise Physiology is approved.

Chairperson, Lawrence A. Golding, Ph.D.

Examining Committee Member, Gerald E. Landwer, Ph.D.

Examining Committee Member, Richard D. Tandy, Ph.D.

Examining Committee Member, John C. Young, Ph.D.

Graduate Faculty Representative, Carol Kimball, D.M.A.

Graduate Dean, Ronald W. Smith, Ph.D.

University of Nevada, Las Vegas
August, 1992

McCollum, Patricia M., M.S., August 1992 Exercise Physiology

THE VALIDITY OF PERCEIVED PHYSICAL FITNESS IN ADULT MEN AND WOMEN (117 pg.)

Director of Thesis: Lawrence A. Golding, Ph.D.

Abstract

National health and fitness experts have defined and explained physical fitness and its benefits. Although the public has a general concept of the components of physical fitness, it is hypothesized that there is a poor relationship between an individual's self-assessed perceived physical fitness and actual measured physical fitness. This study investigated the perception of personal physical fitness in adult men and women by comparing Perceived Physical Fitness Index (PPFI) with a composite index of measured fitness. Subjects were 106 apparently healthy volunteer adults 36-55 years of age ($\overline{X} = 44$). They completed a PPFI and were then assessed for body composition, cardiorespiratory endurance, muscular strength and endurance, as well as flexibility. A composite fitness score was compared with their PPFI score. Perceived fitness was significantly different than actual fitness ($F(1,100) = 31.3$, $p < 0.001$) and there was a significant gender difference ($F(1,100) = 13.56$, $p < 0.001$). However, a significant gender x fitness assessment method (perceived/actual) interaction ($F(1, 100) = 21.88$, $p < 0.0001$) indicated that the difference between perceived and actual fitness was not consistent for males and females. Further analysis indicated that females were able to estimate their fitness level more accurately than males. Males tended to overestimate their

fitness level. An examination of the criteria used by men and women when formulating a rating of their personal physical fitness and a cross-validation of the PPFI are discussed.

TABLE OF CONTENTS

List of Tables

List of Figures

Acknowledgements

The completion of this study would not have been possible without the help of a number of dedicated individuals. Many, many thanks to the following:

To committee members Dr. Jerry Landwer, Dr. Jack Young and Dr. Carol Kimball for your support and encouragement. A special thank you to Dr. Dick Tandy for making "stats" a friend. A very special thank you to Dr. Larry Golding, chairperson of my committee and my life for the past two years, for his guidance, patience and living example of how fitness contributes to "quality of life."

To my fellow graduate students for their individual and collective contribution to a very rewarding two years. A special thank you to Maria Diener for freely sharing her time, knowledge and enthusiasm.

To Janice Matson, who facilitated my testing of hundreds of subjects and everyday cheerfully gave above and beyond her job description.

To Dr. Lori Temple who generously lent her editorial expertise to make this paper even better than I could envision.

To the most wonderful man in the world, my loving husband Mike McCollum, for his neverending support, words of wisdom, and wish that I be the best I can be.

Chapter 1

Introduction

Physical fitness in the 1990's is enjoying much attention. Aging baby boomers, suddenly in touch with the realities of heart disease and backaches, have committed themselves to starting fitness programs. There has been a rise in the number of government agencies and corporations that provide fitness incentives for their employees and a renewed interest in the President's Council on Physical Fitness and Sport. The popularity of new types of fitness workouts, personal trainers, and community activities targeted for the whole family are other indications of the broad-based appeal of fitness.

National health and fitness experts have defined and explained physical fitness and its benefits. Exercise scientists have agreed upon the distinction between two kinds of physical fitness: motor fitness which pertains to athletic ability and health-related fitness which pertains to physical well-being. Health-related fitness is receiving much attention as a result of recent epidemiologic studies that have emphasized the importance of exercise in promoting positive health, that is, preventing cardiovascular and other chronic diseases. Professional literature suggests that the components of health-related fitness are cardiorespiratory endurance, muscular strength and endurance, body composition, and flexibility (ACSM, 1988).

Information from professionals in the field, disseminated through a variety of media resources, has produced a public aware of physical fitness basics.

Numerous "How do you rate?" articles contain fitness tests and target weight ranges in an effort to provide the public with a fitness baseline (*Self,* 1991; *USA Today*, 1990). Hopkins and Robinson (1988), organizers of physical fitness tests at numerous medical school "open days," maintain that "it is clear that the public are very interested in physical fitness and are keen to have their fitness assessed." Their study showed that people are often surprised by the discrepancy in the fitness rating produced by a fitness test and their personal perception of fitness usually rating themselves either higher or lower than tests indicate. Some researchers believe that the discrepancy between perceived and actual fitness may be that the public's concept of fitness is different from that of the physiologist. Although the public may have a general idea of the components of physical fitness as defined by professionals, it is hypothesized that there is a poor relationship between perception of one's personal physical fitness and actual measured physical fitness.

Historically, perceived physical fitness has been investigated by psychologists, sport psychologists, physical educators, exercise scientists and medical doctors. Primarily, studies of perceived fitness have focused on its comparison with psychological variables (Abadie, 1988b; Heaps, 1972; Leonardson & Garguilo, 1978; Young, 1985). Other research has primarily focused on the relationship between perceived fitness and a fitness test(s) rating with a variety of additional sub-problems: Is perceived fitness predictive of actual fitness? (Thornton et al., 1987). What reference group is used by an individual when rating personal fitness? (Optenberg et al., 1984). How does perceived fitness relate to the public's concept of physical fitness? (Hopkins & Robinson, 1988; Hopkins & Walker, 1988).

Psychology-based studies have explored possible relationships of estimations of physical fitness or physical ability with variables such as self-concept (Leonardson, 1977; Young, 1985), personality (Heaps, 1972), and trait anxiety (Abadie, 1988b). Some of these studies are concerned with the possibility of a cause and effect relationship between psychological and physiological functionings, for example, do endurance activities enhance or increase self-esteem? Additionally, some of these studies incorporate tests of cardiovascular endurance as a measure of actual fitness (Abadie, 1988b; Heaps, 1972; Young, 1985). Heaps, for example, found that it is not actual fitness that is related to self-concept, but rather a person's feeling about their physical condition.

Other perceived fitness studies have examined the relationship between perceived fitness and actual physical fitness for the purpose of determining the public's understanding of the term "physical fitness" (Hopkins & Robinson, 1988; Hopkins & Walker, 1988). Results showed no significant correlation between perceived fitness and actual fitness as measured by a cycle ergometer test (Hopkins & Robinson, 1988). However, physical fitness was found to be associated with the level of regular exercise rather than the ability to perform on an exercise test. When subjects were asked to give a reason for the rating that they selected on a perceived fitness scale, the most popular reason related to amount of regular exercise.

Although relationships of perceived fitness with actual fitness have been investigated, only one study could be found that examined differences among groups on the two variables. No attempt has been made, however, to examine differences among groups on the two variables utilizing a Likert-type scale of perceived physical fitness and a composite index of measured physical fitness.

Need for the Study

If it can be shown that a discrepancy in perceived and actual fitness exists, the need for fitness evaluations becomes apparent. Fitness evaluations can be used as a baseline for beginning an exercise program, as an initial health screening and/or to monitor fitness progress. For the millions of people nationwide who cannot afford adequate health care, fitness testing accompanied by interpretation and recommendations can serve as an important component of a preventive health care program. Even those able to afford proper health care can benefit from fitness testing as a preventive health care measure.

For people currently participating in an exercise program, a fitness evaluation can provide valuable information regarding the effectiveness of their program. Regular fitness evaluations can also reinforce the benefits derived from exercise and provide motivation for continued participation. The public needs to understand that perception (of fitness) alone can not take the place of actual physiological measures.

Purpose of the Study

The purpose of this study was to investigate the perception of personal physical fitness in men and women by comparing an index of perceived physical fitness with a composite index of actual physical fitness. Sub-problems relating to the investigation of perceived physical fitness included: 1) a comparison of perceived physical fitness with actual physical fitness using gender and physical activity level as independent measures; 2) an examination of the criteria used by a sample adult population for the perception of their

personal physical fitness; and 3) a cross-validation of the Perceived Physical Fitness Index (PPFI) using the Abadie Perceived Physical Fitness Scale.

Limitations and Assumptions

1. Subjects were residents of Las Vegas, Nevada between the ages of 36 and 55 who volunteered to have their physical fitness assessed. The volunteer status of the subjects may limit the reference population.
2. Actual fitness was limited to a composite of four components: body composition, cardiorespiratory endurance, muscular strength and endurance, and flexibility with equal emphasis given to each component.
3. It was assumed that the four fitness tests used in this study were valid and reliable.
4. It was assumed that directions for each test were consistently administered and that subjects followed directions when performing the fitness tests.

Chapter 2

Review of Related Literature

Evolution of the Concept of Physical Fitness

The development of the concept of physical fitness in the world has reflected each culture and society. Cave people originated and practiced "survival of the fittest." As ancient civilizations such as China, Greece and Rome developed new technologies which made for more comfortable environments, the concept of fitness expanded to include leisure time physical activity frequently in the form of competitive games and contests (Redmond, 1988). During the ascetic lifestyle of the Dark Ages, the Church suppressed "frivolous" games and sports and only knights were allowed to develop their bodies with goals of acquiring military and sport skills. As Redmond (1988) summises, "Given that exercise may be a biological necessity of existence for all living creatures, a changing cultural ideal of physical fitness may be discerned for all human civilizations."

Throughout history, the competing goals of exercise for fitness or for military preparedness have endured (Sharkey, 1991). "The ancient Greeks set great value on the fitness of the individual, regarding it as the basis of good health and of success in war" (Shephard 1977). The Greeks' liberal approach encouraged men as well as women to participate in running, throwing, wrestling and other aspects of physical training such as diet and massage. The ancient

Olympic Games (for men only), however, were largely based on military skills with the top soldiers of the day often winning the most contests.

In Sparta, however, physical fitness was considered necessary for the development of a strong army to defend the military state against all enemies (Bucher, 1968). Healthy young males entered a public training program consisting of activities such as wrestling, boxing, running, gymnastics, and swimming (Adams, 1991). From early childhood, boys were drilled for military success utilizing competitive sport as a means of preparation for war. Physical fitness was important for females as well. From age seven until marriage, females participated in many of the same conditioning activities as the males for the sole purpose of bearing healthy, strong sons. "Newborn infants, if found to be defective or weak, were left on Mount Taygetus to die" (Bucher, 1968).

In Rome, physical training was oriented toward young students for military preparedness or the professional athlete (Gerber, 1971). As Rome's wealth increased, mercenary soldiers were hired and physical training for the average citizen became unimportant and time consuming (Bucher, 1968). Romans became a nation of spectators with swimming in elaborate open-air public baths as their only form of exercise (Adams, 1991). In fact, sport as a means for fitness became "so separated from the lives of the people that they needed some deliberate, contrived means to preserve their health" (Gerber, 1971). Galen, the famous second-century physician, recognizing this need stressed the importance of a balanced relationship between exercise, diet and medicine. He believed in health through moderation and condemned professional athletes as poor role models with their practice of "over-exercising, over-eating and over-sleeping like pigs" (Gerber, 1971). Galen developed a program of

exercises performed with a small ball for health, the maintenance of good body condition and mental excellence.

During the Dark Ages the only role of fitness was to prepare young boys for a life of chivalry. At the age of 7 boys began physical training in preparation for knighthood and succeeded only if, at the age of 21, they could prove their physical prowess (Bucher, 1968). The Renaissance, a transitional period between the feudalistic Dark Ages and the beginning of modern times, had a great impact on physical fitness. Emphasis on the development of the body and the belief that body and soul were inseparable led to a promotion of learning through good physical fitness. As in ancient Greece, the concept of the "fully developed man" was stressed by humanists such as Vittorino Da Feltre (1378-1446), one of the first teachers to combine physical, intellectual and moral development in a school setting. Da Feltre, credited with elevating the position of physical instruction in the curriculum, taught fitness activities such as gymnastics "as an art, deserving of perseverance for its own sake, apart from military training or mere recreation" (Gerber, 1971).

While Rousseau and other 18th century humanists defended the educational values of exercise, nationalism became the dominant influence on fitness which continued into the 1800s as competing European exercise systems vied for acceptance. In Germany, Friedrich Jahn developed turnkurst, a program of formal outdoor gymnastics based on ideas by Gutsmuth to restore national morale following Napoleonic defeat (Shephard, 1977). Jahn was convinced that his system of gymnastics would develop German youths into strong citizens capable of defending against foreign rule. Jahn's system gradually gained acceptance throughout Germany as many cities organized their own Turnvereins (gymnastic societies). In Sweden, nationalist Per Henrik

Ling based his system of gymnastics on the sciences of anatomy and physiology. He was interested in investigating the effect of exercise on the heart, the musculature and other systems of the body (Bucher, 1968). In Czechoslovakia, the Sokol (Falcon) program of gymnastics that was developed in 1862 was also inspired by nationalism. The Sokol system was later adopted by Poland and Hungary to form the basis of their national physical fitness programs as well (Redmond, 1987). Although many of these exercise systems were imported to the United States by European immigrants, the Turnverein movement was the most prolific, spawning over 150 Turner societies encompassing 10,000 members by the time of the Civil War (Barney, 1972).

England's preoccupation with sports and organized games also had an influence on our concept of exercise and fitness despite efforts by national physical educators to instill the importance of physical training through formal exercise systems. Archibald Maclaren, an advocate of "balanced" programs encompassing both recreational games and formal exercises, is better known for his system of apparatus exercises that he developed for the military. Although he attempted to spread his formal system throughout England's civil institutions, "sports continued to be the most popular form of exercise" (Gerber, 1971). During the first half of the 19th century in America, sports continued to flourish as new U.S. citizens from Europe enjoyed a "melting pot of sports" (Freeman, 1982).

In America, research by medical doctors in the late 1800s based on the needs of the American people began to change the way we viewed fitness. In 1861, Dr. Edward Hitchcock inaugurated a testing program of anthropometric and strength measurements many of which are still used today. For fifty years each of his students were measured at regular intervals for height, weight,

finger reach, chest girth, lung capacity and pull-ups (Massey, 1970). His work in anthropometric measurement and strength testing was continued by Harvard physician Dudley Sargent. Sargent advocated physical training not just for the elite athlete, but for the "great mass of students, particularly the weakest," thus promoting the concept of health and fitness for everybody (Gerber, 1971). Prior to physical training programs, Sargent initiated complete physical examinations which included a health history, strength tests, measures of lung capacity and numerous anthropometric measurements. Sargent also introduced personal exercise prescriptions complete with "before" and "after" photographs. His innovative Intercollegiate Strength Test included strength measurements of the back, legs, arms, chest and lung capacity (strength of the respiratory muscles) (Gerber, 1971). In 1892, a "battle of the systems" was being fought over which physical training system should be adopted in the public schools. George Fitz, Harvard physician and physiologist, recognizing the importance of validating claims made by various exercise programs, established the first physiological research laboratory to test the effects of exercise on the body (Gerber, 1971).

The record number of recruits judged unfit for service in World War I refocused attention on the "fitness for war" concept and emphasized the need for youth fitness. Consequently, fourteen states passed mandatory physical education programs between 1917 and 1919 (Bucher, 1968). Soon after, however, interest in physical fitness once again waned as people, wanting to forget the war, turned to games and spectator sports. This "natural play" movement was fostered by physical educators such as Clark Heatherington and Thomas Wood (Johnson & Nelson, 1986). Heatherington is remembered for his much quoted dictum, "Play is the child's chief business in life" (Gerber, 1971).

In addition to the natural play movement another influence on the concept of fitness at this time in America was the idea of fitness-for-life through participation in carry-over or lifetime sports. Physical educators Delphine Hanna and Jay B. Nash were instrumental in spreading this philosophy. Nash also believed in the benefits of health and fitness for overall quality of life. Nash said, "Physical fitness which can be maintained through the years lays the basis for a full life" (Gerber, 1971).

World War II brought about renewed interest in physical fitness and demands for military drill (Sharkey, 1991). Once again the spotlight was placed on physical training as prominent exercise scientists and physical educators were used by the Army, Navy and Air Force to develop training regimens and accompanying fitness test batteries. The military test batteries of sit-ups, push-ups, and obstacle course running was extended to secondary schools and by the end of the war these tests were synonymous with physical fitness. Intramural sports programs, which the military emphasized as another phase of fitness, were also adopted by schools after the war (Freeman, 1982).

After the war, fitness once again faded into the background until it reemerged with a startling report sent to President Eisenhower by Dr. Hans Kraus suggesting that American youths were much less fit than European children. This report, based on results from the Kraus-Weber Test, prompted Eisenhower to form the President's Council on Youth Fitness in 1955. In reaction to the Kraus-Weber Test, the American Association for Health, Physical Education and Recreation (AAHPER) formulated a physical fitness test battery with norms for American school children (AAHPERD, 1980). This, together with a revival of the President's Council on Physical Fitness renamed by President

Kennedy, created a sustained peace-time interest in physical fitness (Massey, 1970).

While youth fitness continued to have the spotlight throughout the fifties, adult fitness was primarily restricted to work physiology and sport except for the research conducted by Dr. T.K. Cureton, Jr. who devoted his career to adult physical fitness. Cureton organized and directed the Physical Fitness Research Center at the University of Illinois from 1944 into the 1970s. Thousands of men and women participated in his adult fitness program while serving as subjects for the development of objective methods for testing physical fitness. Cureton's widely used battery of practical performance-oriented tests, originally published in 1941, included measurements of balance, flexibility, agility, strength, power and endurance (Cureton, 1965). Among the numerous tests he developed are the All-Out Treadmill Run test, the Progressive Pulse-Ratio (Step) Test for cardiovascular fitness and the forward-bending-of-trunk test which is the precursor to today's sit-and-reach test of flexibility. Cureton's interest in the human physique led to the creation of a simple physique rating scale for use by the non-expert (1947) and he was the first to offer a modified version of Sheldon's somatotype system (1951).

Reports of the association of heart disease with inactivity led most (men) to the surprisingly popular 5BX Fitness Plan devised for the Royal Canadian Air Force in the 1950s, emphasizing once again the enduring quality of military fitness. In the early 1960s, University of Oregon Coach Bill Bowerman started a community jogging program (based on Lydiard's Australian program) which he later outlined in the popular book, *Jogging,* co-authored by cardiologist Dr. W.E. Harris in 1968. That same year Dr. Kenneth Cooper "made aerobics a household word" (Sharkey, 1991). The contemporary fitness boom has

continued to grow steadily, reinforced by epidemiological research such as the study by Paffenbarger et al. (1984) of 16,936 Harvard alumni, 1962-1978, which supplied evidence that physical activity can make a difference not only in the quality of life but in the length of life as well.

Fitness, which has grown into a billion dollar industry in the past two decades, was pursued in the 1980s for reasons beyond the attainment of health. Ubiquitous health and fitness clubs became the new social arenas, replacing nightclubs and blind dates as a place to find "friendship, sex and love" (Green, 1986). In the 1980s people pursued fitness "to please themselves...to increase self-esteem, attract a partner, be fashionable, live longer, obtain a better job, or whatever" (Redmond, 1987). As the narcissism of the 1980s gives way to the back-to-the-basics attitude of the 1990s, the concept of fitness is refocused on the health-related aspects.

While America "grays" and the cost of health care rises, recent research showing adaptations from training with older populations is providing the impetus for the "fitness for lifelong health" concept. This concept is being promoted by organizations such as the American College of Sports Medicine whose updated position stand (1991) indicates how regular moderate physical activity throughout life can contribute to the prevention of disease and promotion of positive health.

Since the cave people many individuals, reflecting their cultures and societies, have influenced the development of the concept of physical fitness. Throughout the evolution of the concept, the goals of fitness for military preparedness or fitness for health have endured. Humanists have defended the educational values of fitness whereas physical educators have promoted the concept of total fitness encompassing the social, psychological as well as

the physiological aspects. Others have advocated fitness as it relates to recreation and sport. Currently, physical fitness has garnered attention for its role in the prevention of chronic diseases and the promotion of positive health. The philosophy of physical fitness was, and continues to be, influenced by its evolving definition and the tests used to measure it.

Physical Fitness Defined

R.J. Shephard, a physiology student in the 1940s recollects, "When I was a student, my professor felt the term [physical fitness] so vague as to be devoid of scientific meaning, he resolutely prohibited its use" (Shephard, 1977). In the 1990s, operational definitions of physical fitness have evolved to reflect an expanded body of knowledge and the public's recognition of the health benefits derived from regular exercise (Pate, 1988). Although professionals in the field have debated the nuances for decades, it appears that people in general are decisive when using the terms "fit" and "unfit" to describe their physical fitness (Hopkins & Robinson, 1988). Notwithstanding, the overwhelming need of the exercise scientist to quantify and measure fitness demands that it be specifically defined.

T.K. Cureton, a pioneer in the exercise science field, identified three components of physical fitness in 1947: 1) physique, 2) organic efficiency, and 3) motor fitness. Physique is generally defined as the ratio of height to weight and is primarily an inherited trait. A weight component greater than average that is due to excess fat can impede physical performance and increase the incidence of degenerative disease. However, a greater than average weight component due to excess muscle mass may enhance physical performance. Organic efficiency refers to the functional quality of the muscular, nervous,

cardiovascular, respiratory and endocrine systems which dependently affect physical fitness. Heredity and level of physical activity affect, in varying degrees, the functional capacity of each organ system (Adams, 1991). Motor fitness includes those fitness components that involve big muscle groups used in athletic skills, that is, balance, flexibility, agility, strength, power and endurance (Cureton, 1965).

Twenty years later, Golding and Bos (1967) included the elements of strength, cardiovascular endurance, speed, agility, power, flexibility, balance and coordination in their definition of physical fitness. However, they concluded that "muscular strength, muscular endurance, and cardiovascular endurance are considered the hard core of physical fitness" (Golding & Bos, 1967). Golding and Bos refer to body composition as a physical condition rather than a fitness component as it is considered today. They noted, however, that body composition was of great interest to everyone, albeit for aesthetic rather than for health reasons.

More recently, exercise scientists have agreed upon the distinction between two kinds of physical fitness: skills-related, or motor fitness, that pertains to athletic ability and performance; and health-related fitness, that pertains to physical well-being (Caspersen et al., 1985). Although there are basic principles of the development and maintenance of various fitness components that are common to both subcategories, health-related fitness refers to fitness as it pertains to prevention of disease and promotion of health (ACSM 1991).

In 1988, physical educator Russell Pate defined health-related fitness but argues that, in view of the well-publicized health benefits of being "fit", the definition of "physical fitness" and "health-related physical fitness" should be one and the same. His definition of (health-related) physical fitness is: "a state

characterized by (a) an ability to perform daily activities with vigor, and (b) demonstration of traits and capacities that are associated with low risk of premature development of hypokinetic diseases." Currently, there is a general consensus within the profession that health-related fitness is a construct of the following components: body composition, cardiorespiratory endurance, muscular strength and endurance, and flexibility (ACSM, 1991; Caspersen et al., 1985; Golding et al., 1989; Pate, 1988; Pollock et al., 1978). Health-related fitness as defined by Pate above was adopted for the present study.

As the science of exercise continues to expand, the definition of physical fitness and what consitutes its components is likely to change. Sharkey (1991) contends that current research on aerobic fitness highlights the need for "new approaches for defining and measuring aerobic fitness." He concludes that within aerobic fitness (endurance) there are two components, short-term endurance characterized by brief, high intensity work and long-term endurance which is defined by sustained work at a lower intensity. Both components, he argues, cannot be adequately measured by one test. Ultimately, new definitions or additional components of physical fitness will require new tests, spawning new hypotheses, etc. Thus, the cycle continues in the evolution of a universally accepted definition of physical fitness.

The definition of physical fitness has evolved to reflect the physiologist's expanded body of knowledge and the public's recognition of its benefits. Exercise scientists have made a distinction between skills-related (motor) fitness and health-related fitness. Health-related fitness is operationally defined as including body composition, cardiorespiratory endurance, muscular strength and endurance, and flexibility. The underlying concept is that higher levels of fitness in each component are associated with lower risks of developing

cardiovascular and other chronic diseases. The evolution of the definition of physical fitness is influenced not only by research but by the tests used to measure it.

Physical Fitness Testing

Historical Overview

Physical fitness testing parallels the growth and development of exercise research and the physical fitness movement. A century ago objective measures of physical fitness were introduced causing exercise research and fitness testing to integrate. Each new test has generated interest in further research which in turn leads to the development of more tests in an effort to determine human physical parameters. What began with a physical description of humankind has evolved into a scientific exploration of the physiological limits of human physical performance.

Measurement can be traced back to ancient Greece, but it was not until the mid-1800s that testing data was reported (Johnson & Nelson, 1986). Most of the early research involved anthropometric measurements that were commonly used for describing proportions of the "average" or "ideal" American man and woman and for monitoring physiological changes of the body. Following shortly thereafter, an interest in strength training led to the development of numerous strength tests which continued to be popular for the next fifty years (Massey, 1970). While both anthropometry and strength testing made great strides in the 19th century, they limited the evaluation of physical fitness to physique and strength. During World War I, however, physical fitness testing broadened to include evaluations of the circulatory and respiratory systems. During the

1920s tests of motor ability were developed and physical fitness testing began to resemble the testing programs used today.

World War I renewed interest in physical training and created a need for new tests and indices to assess physical fitness. Schneider introduced his "now classic" Schneider Index, an orthostatic tolerance test based on heart rate and blood pressure response to a change in posture (Massey, 1970). In Schneider's opinion, a more fit individual would have less of a change in blood pressure and heart rate when moving from a supine to an upright position. Fliers in WWI, and again in WWII, were given the Schneider test to determine if they were "functionally fit to fly" (McCloy & Young, 1954).

Measures of the respiratory and circulatory systems were also used as routine assessments of fitness. Tests of breath-holding, developed by both Schneider and Cureton (mass testing), were popular as measures of potential endurance even though results "correlated so highly with the subject's will power" (McCloy & Young, 1954). In 1914, Barach developed the Energy Index (systolic + diastolic pressure x pulse rate/100) to measure the energy expended by the heart (blood output) based on research that strenuous training led to a reduction in systolic blood pressure (McCloy & Young, 1954).

In 1920s, Sargent devised his "physical test of a man," known as the Sargent Jump Test and Frederick Rand Rogers developed the Physical Fitness Index (PFI), a revision of Sargent's strength test (Massey, 1970). The PFI, a single numerical score used as an overall measure of physical fitness, was computed from six different strength tests (plus lung capacity) and was, therefore, basically a measure of strength. The PFI was based on the assumption that there is a positive relationship between strength and fitness (Mathews, 1973).

Research by C.H. McCloy broadened the scientific base of physical fitness to include measurements of motor ability and skills testing in addition to strength. He developed an Athletic Strength Index, a General Strength Index and an Athletic Quotient for boys based on height, weight, age, and scores from several track and field events. The General Motor Achievement Quotient he developed based on earlier work (1927) by Brace he believed was the "motor analogue of the Intelligent Quotient in the mental field" (Gerber, 1971).

The basis for contemporary physical fitness testing can be traced back to World War II. Each branch of the service enlisted the help of fitness experts to establish physical fitness test batteries and norm tables to be used for personnel fitness appraisals. Basic test batteries, which primarily measured strength and endurance, consisted of push-ups, pull-ups, sit-ups and obstacle course running. Other batteries included additional motor fitness items to test agility, flexibility and balance (Mathews, 1973). Subsequently, as a result of pressure by the government to develop a program to increase the physical fitness of youth, these test batteries were adapted for use by the nation's schools and colleges (Bucher, 1968).

Another classic test developed during the war for military use and later modified for youth and women was the Harvard Step Test, a test designed to measure the capacity of the cardiorespiratory system to adapt and recover from hard work. The original test consisted of stepping up and down on a 20 in bench at the rate of 30 steps per minute for 5 minutes. Pulse rate was taken at several intervals after exercise to measure recovery rate. Based on early work by Dr. D.B. Dill at the Harvard Fatigue Laboratory and later credited to his colleague Brouha in 1943, the Harvard Step Test was "a landmark test in its day, [although] it is no longer widely used because of its strenuousness" (Safrit,

1986). The Harvard Step Test improved on early field tests (e.g., 1-mile run) by testing a standardized workload and controlling for environment and competitiveness. It is still considered the standard for the many step tests that have since been developed and are in use today.

In 1957, in response to the poor Kraus-Weber Test results obtained from American youth, the American Association (now Alliance) for Health, Physical Education and Recreation (AAHPER) developed and nationally administered the Youth Fitness Test for grades 5-12. Although the Kraus-Weber Test was basically a test of low back function (Safrit, 1986), AAHPER's 7-item battery with accompanying norms consisted of pull-ups, sit-ups, 40-yard shuttle run, standing broad jump, 50-yard dash, a softball throw for distance and a 600-yard run-walk (Massey, 1970). The original test battery, and the subsequent 1965 and 1975 revisions, included skills-related tests "...for fear that the public would conclude that physical education programs were only designed to improve fitness" (AAHPERD, 1980). In 1980 the test battery, sponsored by AAHPERD, was revised to reflect a contemporary concept of health-related physical fitness. The fitness components (and tests) included cardiorespiratory fitness (1-mile run or 9-minute run), body composition (sum of triceps and subscapular skinfolds), and abdominal and low back musculoskeletal function (modified, timed sit-ups and sit-and-reach) (AAHPERD, 1984). The test battery, however, has been criticized for the failure to include a strength test.

While debate continues over the merits of athletic skills (i.e., motor ability), other testing programs have recently been developed (e.g., FITNESSGRAM and Fit Youth Today) that include primarily health-related fitness tests. In addition, current youth fitness test batteries now include criterion-referenced standards which some physical educators believe to be an improvement upon

traditional normative standards such as percentile scores (Cureton & Warren, 1990). The criterion-referenced standards (usually near the 50th percentile) are considered to be indicative of the levels of physical fitness necessary for good health. In the past, interpretation of a child's test results was based on how he or she compared with others.

The development of contemporary physical fitness testing for adults primarily parallels that of the youth fitness approach. The YMCA, for example, offers a battery that incorporates health-related fitness tests of body composition, aerobic fitness, muscular strength and endurance, and flexibility (Golding et al., 1989). While many health clubs follow the YMCA's lead by offering multi-test profiles of fitness, other health and wellness programs utilize tests of cardiorespiratory endurance as the measure of overall fitness. The military continues to use test batteries to assess new recruits and to "...promote combat readiness by motivating soldiers to develop and sustain a high level of physical fitness" (Knapik, 1989). The current Army Physical Fitness Test (APFT) measures aerobic capacity and muscular strength/endurance with a two-mile run, push-ups and sit-ups. Currently there is a trend toward specificity of fitness testing with the development of occupational-specific tests exemplified by firefighting and law enforcement agencies (Sharkey, 1991).

Abbreviated Fitness Tests

While exercise scientists recommend that fitness testing batteries include a variety of measurements, this is often not feasible due to lack of time, equipment or trained personnel. For these reasons scientists have used the measure of one fitness component as an indication of overall physical fitness. That component is cardiorespiratory (endurance) fitness, also referred to as aerobic

fitness. Cardiorespiratory fitness has been synonymous with physical fitness for many years primarily due to its relationship with the body's capacity for hard prolonged work (Sharkey, 1991). Cardiorespiratory fitness involves three major systems of the body, the respiratory, cardiovascular and musculoskeletal, and is positively associated with health, that is, high levels of aerobic fitness are associated with low risks of cardiovascular disease and all-cause mortality (ACSM, 1991, Blair et al. 1989, MMWR, 1989, Paffenbarger et al., 1986).

Physical fitness in many studies is often measured by the test for maximal oxygen uptake (Abadie, 1988b, Blair et al., 1989, Heaps, 1972, Hopkins & Robinson, 1988, Leonardson & Garguilo, 1978, Optenberg et al., 1984) considered to be the criterion measure for aerobic fitness (Sharkey, 1991). Direct measurement of maximal oxygen uptake (VO2 max) involves expensive laboratory equipment, trained personnel and subjects willing and able to perform graded, maximal exercise. It is, therefore, unsuitable for most testing situations. In 1954, however, Astrand and Ryhming established linear relationships between heart rate, oxygen uptake and the rate of work that made it possible for development of submaximal aerobic tests that could estimate maximal oxygen uptake (Golding et al., 1989). Subsequently, research in this area has progressed dramatically in the past 20 years increasing the number of tests and exercise modalities that are low risk, relatively inexpensive, and easy to administer. Following are brief descriptions of aerobic fitness tests used today. The tests can be classified into four basic types: distance runs, step tests, cycle ergometer tests, and walking tests (ACSM, 1991).

Distance runs (e.g., one mile), the earliest field tests, were good for mass testing but too many extraneous variables went uncontrolled (e.g., environment, competitiveness). In 1963, Balke developed the 1.5 Mile Run, an aerobic test

he referred to as "a simple test of physical fitness" (Balke, 1963). The test was based on a linear relationship between steady state oxygen uptake and speed of running. Balke's research was expanded by Cooper who also used speed of running to estimate VO2, however, Cooper's 12-Minute Run differed in that it measured the distance that was run. Cooper established age and gender adjusted fitness level tables that were based on an oxygen uptake of 42 ml/kg/min which Cooper believes to be a "satisfactory level of fitness" (Cooper, 1977). The disadvantage of both running tests is that they require a maximal performance making them unsuitable for the inactive individual.

Step tests have also been used for mass testing. Canada has developed a national self-administered home step test for health assessment and as a motivational tool to increase the physical activity of their citizens (Bailey et al., 1976). An age and gender dependent stepping rate was developed to elicit a workload of 65-70% of VO2 max for the average sedentary Canadian. Duration of stepping and heart rate response results in a fitness score. Many other step tests have also evolved from the original Harvard Step Test, including the Kasch 3-Minute Step Test. The Kasch test consists of stepping on a 12 in bench at a rate of 24 steps per minute for 3 minutes. A one minute post exercise heart rate becomes the score. The National YMCA, who uses this protocol in their fitness test battery, has developed norm tables based on 33,000 tests.

Cycle ergometer tests are widely used because they are a true submaximal test and external work can be easily monitored. They are also non-weight bearing, require little training and can be easily transported (Golding et al., 1989). There are several protocols that are commonly used today. The Astrand-Ryhming test, for example, is based on the heart rate response to one

workload. The chosen workload is dependent on gender and activity level. The six minute test duration and 50 rpm speed are held constant for every subject and maximal oxygen uptake is estimated from an average heart rate taken at the fifth and sixth minute (Astrand & Rodahl, 1986). The protocol used by ACSM is also dependent on the subject's activity level plus the weight of the subject. Workloads increase for two or three stages until heart rate reaches 65-70% of predicted maximal heart rate (ACSM, 1991). The YMCA cycle ergometer test utilizes heart rate response to an initial (standard) workload to determine workloads for the subsequent stages. VO2 max is estimated by plotting the two workloads that elicit heart rates between 110 and 150 bpm, then extrapolating to predicted maximal heart rate (Golding et al., 1989). The major disadvantage to cycle ergometry is the probability of local muscle fatigue, especially for those individuals unpracticed at cycling.

Walking tests of short duration (e.g., 600-yard run-walk) have been used in the past although they did not correlate well with VO2 max (Sharkey, 1991). The recent validation of the Rockport 1-Mile Fitness Test, however, expands aerobic fitness testing to accommodate the sedentary and/or the aged. The Rockport walking test consists of walking on a track as fast as possible for one mile. Age, gender, heart rate and performance time are used to classify subjects into a fitness category. Original research also used body weight as a variable in the development of norm tables (Decker et al., 1989).

Aerobic endurance tests that estimate maximal oxygen uptake are commonly used as a measure of physical fitness because they are low risk, require little or no equipment, and are easy to administer. These tests include distance runs, step tests, cycle ergometer tests, and walking tests. Although the

aerobic tests involve three major systems of the body and are positively related to health, they do not provide a complete picture of health-related fitness.

Fitness Tests Used in the Present Study

Assessment of the four health-related physical fitness components, body composition, cardiorespiratory endurance, muscular strength and endurance, and flexibility provides an individual with a physical fitness profile. In the present study, these fitness components were assessed by the following fitness tests: percent body fat, cycle ergometer test, bench press test and sit-and-reach test. The four tests were taken from the National YMCA test battery (Golding et al., 1989). In addition to being valid and reliable, these tests were chosen because of the availability of accompanying norm tables.

1) Skinfold Measurements

Percent body fat was estimated by skinfold measurements, a technique highly correlated with underwater weighing and considered to be the "gold standard" for evaluating body composition. Prediction equations for estimating percent body fat are validated by comparison to underwater weighing (Golding et al., 1989). With proper training and practice, results are highly reliable. Skinfold measurements are appropriate when a large number of subjects are to be tested because little time is required for obtaining the measurements and computing the scores. Although percent body fat predicted from skinfold measurements is technically not a fitness test, it was utilized in the present study to evaluate the body composition fitness component.

The Jackson-Pollock prediction equations for sum of four sites for men and women, respectively, were utilized in the present study to estimate percent body

fat. Developed specifically for the YMCA fitness test battery, these valid and reliable equations were based on the abdomen, ilium, triceps and anterior thigh sites. Lange skinfold calipers, used by Jackson-Pollock to obtain the original data, were also used in the present study. The age and gender adjusted evaluation profiles, used for scoring in the present study (see Appendix J) were based on a target weight of 16% fat for men and 23% fat for women.

2) Cycle Ergometer Test

The YMCA developed its own modified protocol for the cycle ergometer test from research by Sjostrand (1947) and Astrand and Rhyming (1954) based on the linear relationship between heart rate and work (Golding et al., 1989). Prediction of VO2 max from the YMCA cycle ergometer test has a high correlation with actual measured VO2 max (Lindsay, 1988). The test can be used to predict VO2 max and maximum physical working capacity. Two workloads that elicit a heart rate response between 110 and 150 bpm are plotted and then extrapolated to a predicted maximal heart rate using formula 220-age.

The workload guide for the YMCA protocol starts at an initial workload of 150 kgm (the lowest workload possible) for everyone. Pedalling at 50 rpm, steady state heart rate response to this workload is used as a guide for subsequent workloads. If the heart rate response is low, the next workload is higher than if the heart rate response is high. The goal is to obtain the heart rates from two workloads while the subject is still working submaximally. Since oxygen consumption is a function of size, predicted VO2 max was expressed per kilogram of body weight. The YMCA evaluation profiles, used in the present study, score the cardiorespiratory component as VO2 in ml/kg (see Appendix I).

3) Bench Press Test

Chin-ups and push-ups have been popular tests to evaluate muscular strength since it was established that a significant correlation existed between elbow flexion and extension and total body strength (Clarke, 1966). Both tests involve performing as many repetitions as possible and, therefore, also became tests of muscular endurance (Golding & Lindsay, 1989). The disadvantage of these tests, however, is that they are very strenuous and frequently result in a skewed distribution of scores for the average population. As a result, professionals in the field developed a strength and endurance test for the YMCA test battery that accommodates the average adult on a normal distribution curve.

The YMCA bench press test, which utilizes elbow extension, was designed so that the average number of repetitions would be 15. It was determined experimentally that 35 lbs. for women and 80 lbs. for men was the amount of weight that the average college man and woman could lift 15 times (L.A. Golding, personal communication, April 1992). It was also determined with the same study population that no statistical correlation existed between body weight and the bench press score (Golding & Lindsay, 1989). Therefore, age and gender adjusted norm tables were developed that did not take weight into consideration (see Appendix J). A recent test-retest reliability study of the bench press test reported correlations of .94 for men and .89 for women (Dacuma & Golding, 1992).

4) Sit-and-Reach Test

The sit-and-reach test is commonly used today as a measure of low back and hamstring flexibility. Although it is common knowledge that flexibility is joint

specific, many test batteries utilize the sit-and-reach as an indication of overall flexibility. The sit-and-reach is based on early work by Cureton who developed the forward-bending-of-the-trunk test in 1930. The test has seen many modifications through the years. The modified sit-and-reach included in the YMCA test battery was developed by Johnson in 1966 (Johnson & Nelson, 1986). Reported test-retest reliability is $r = .94$, utilizing the best score from three trials (Johnson & Nelson, 1986). Johnson's stated objective of the sit-and-reach is to measure hip and back flexion and extension of the hamstring muscles. Recent research, however, suggests that the sit-and-reach is questionable as a measure of low back flexibility (Jackson & Langford, 1989). Nevertheless, the test was used in the current study as a measure of flexibility.

Perceived Physical Fitness

Previous studies of perceived physical fitness comprise the most relevant part of the literature review. The review of the perceived physical fitness literature includes the following subsections: 1) a definition of perceived physical fitness; 2) a summary of studies of perceived physical ability sometimes used interchangeably with perceived physical fitness; 3) a description of the Perceived Physical Fitness Index (PPFI), the instrument used to assess perceived fitness in this study; 4) an examination of reported perceived fitness studies and the instruments used to measure self-perceptions of physical fitness; and 5) a summary of this section.

Definition

In the context of the present study, perceived physical fitness is the subjective assessment of one's physical fitness level. Simply stated, perceived

fitness asks the question, "How fit do you think you are"? One of the problems in an assessment of personal physical fitness is that an individual's concept of fitness may be different from that of the physiologist. The irony is that professionals, too, have a difficult time arriving at a consensus of a definition of physical fitness (Pate, 1988). Presupposing that the public and the profession are in agreement about what constitutes physical fitness, it is, nevertheless, unclear (unless specified) whether self-assessments are made by comparing one's own fitness within the self, with a peer group, with one's self as a younger person or with a standard of fitness excellence.

A recent perceived fitness study (Hopkins & Robinson, 1988) reported that a majority of subjects (78%) based the perception of their physical fitness on the amount of their regular exercise. Health and adiposity (relative leanness or fatness) were rated a distant second and third, respectively, comprising fewer than 10% of the reasons given for a perceived fitness rating. Based on these findings, level of regular exercise appears to be a good barometer of physical fitness and should, therefore, be included in any appraisal of physical fitness. Depending on the population, other concepts are highly related to perceived fitness ratings. For example, state of health has been shown to be favored more among the elderly (Hopkins & Walker, 1988) and adiposity tends to influence the self-perception of fitness among women (Hopkins & Robinson, 1988).

Physical Fitness vs. Physical Ability

Perceived fitness literature indicates that physical fitness and physical ability are sometimes used interchangeably (Sonstroem, 1974), yet fitness is defined as a set of attributes that people have or achieve (Caspersen et al., 1985) and ability denotes performance level of a skill, such as throwing ability

or coordination. There are numerous examples of studies that compare perceived physical ability with scores from primarily health-related fitness test batteries (Sonstroem, 1974, 1976; Fox et al., 1985; Thornton et al., 1987). A summary of reported correlations between perceived physical ability and actual measured fitness is presented in Table 1.

Table 1

Reported Correlations of Perceived Physical Ability (PPA) with a Measure of Actual Fitness

Source	Subjects	Instruments / Design	Results
Sonstroem, 1974	710 high school males	EST* (PPA) score from PEAS** Scale compared with an index score from Fleishman Basic Fitness Battery (10 tests which measure 9 fitness components)	r= .53, p<.01
Sonstroem, 1976	109 jr. high and 112 sr. high males	EST* (PPA)score from PEAS** compared with index score from AAHPER Youth Fitness Test.	r =.41, p<.01 (sr.) r =.48, p<.01 (jr.)
Fox et al., 1985	77 female & 94 male college students	EST* (PPA) score from PEAS** compared with composite score from skinfolds, submax bike test, sit-and-reach test and grip strength test	r =.52, p<.01 (female) r =.50, p<.01 (male)
Thornton et al., 1987	68 female & 67 male adults	PPA score from PSE*** scale compared separately with skinfolds, back and grip strength, sit-ups, submax bike test and sit-and-reach scores	r =-.26, p<.01 (%fat) r =-.01, p>.05 (grip) r = .22, p<.05 (back)**** r = .34, p<.01 (sit-ups) r = .24, p<.01 (bike) r = .15, p<.05 (s&r)

* EST - estimation of physical ability
** Physical Estimation and Attraction Scale
*** Physical Self-Efficacy Scale
**** Male participants only

Perceived Physical Fitness Index (PPFI)

A seven-point Likert-type scale, entitled Perceived Physical Fitness Index (PPFI), was developed and used in the present study to measure self-perceptions of physical fitness. Subjects were asked, "How do you rate your physical fitness"? Their choices were "excellent," "good," "above average," "average," "below average," "poor," or "very poor." For statistical purposes, an "excellent" rating was worth 7 points, followed by "good" (6 pts.), "above average" (5 pts.), "average" (4 pts.), "below average" (3 pts.), "poor" (2 pts.) and "very poor" (1 pt.).

Likert-type scales that ranged from 3- to 9-points have been reported in the literature with options from "poor" to "excellent" or from "very very unfit" to "very very fit." The PPFI was developed to coincide with the classifications used by the National YMCA in age/gender-dependent norm tables (see Appendix J). These norm tables were used to obtain the subject's score (7-1 points) for each of the four tests. Scoring was identical to the PPFI, that is, an "excellent" rating was worth 7 points whereas "very very poor" was worth 1 point. The PPFI is presented in Appendix C.

Perceived Physical Fitness Studies

Perceived physical fitness and perceived physical ability have been investigated by psychologists, sport psychologists, physical educators, exercise scientists and medical doctors. Primarily, the purpose of these studies has been to investigate the relationship of perceived physical fitness, actual physical fitness and psychological variables such as self-acceptance, self-concept, self-esteem, self-perception, trait anxiety, etc. (Abadie, 1988b; Fox et al., 1985; Heaps, 1972, 1978; Leonardson & Gargiulo, 1978; Sonstroem, 1974,

1976; Young, 1985). Several studies incorporated perceived physical fitness as an independent variable without including a measure of actual physical fitness (Leonardson, 1977; Netz, 1987). Four studies investigated the relationship between perceived physical fitness (or ability) and indices of actual physical fitness (Hopkins & Robinson, 1988; Hopkins & Walker, 1988; Optenberg et al., 1984; Thornton et al., 1987). Of these, two studies also explored the average person's concept of physical fitness in an attempt to determine if perceived physical fitness is an appropriate measure of actual physical fitness (Hopkins & Robinson, 1988; Hopkins & Walker, 1988).

Perceived fitness research can be classified according to the type of instrument used to assess perceived fitness. These instruments include the: 1) Physical Activity Attitude Inventory (PAAI); 2) Physical Estimation and Attraction Scale (PEAS); 3) Physical Self-Efficacy Scale (PSE); 4) Abadie Perceived Physical Fitness Scale; and 5) Likert-type scales. A discussion of each follows.

1) Physical Activity Attitude Inventory (PAAI)

Sonstroem developed the Physical Activity Attitude Inventory, a 76-item test to "assess two aspects of a person's self-perceived relationship to physical activity" (Neale, Sonstroem & Metz, 1969). The first aspect, estimation (EST), is a self-assessment of a subject's abilities in sport and/or vigorous activity. The second aspect, attraction (ATTR), assesses attraction to vigorous physical activity. The Physical Activity Attitude Inventory, originally developed for college and middle-age adult males, was modified for use with high school boys (Neale et al., 1969). Test-retest reliability results were not reported.

The EST subscale appraises perceived physical ability. Sample true-false questions from the 47-item EST subscale are: "1) Most people think I have very

good physical skills; 2) I can run faster than most of my friends; 3) I am good at keeping my balance in almost any type of activity" (Neale et al., 1969).

Neale et al. (1969) hypothesized that adolescent boys who were very physically fit would possess more self-esteem than boys who were less physically fit. In their 1969 study 165 boys, age 12-17, were classified as high-fit or low-fit based on scores on the AAHPER Youth Fitness Test. Each score from the 7-test AAHPER fitness battery was plotted on an age-dependent national norm chart and then corresponding percentile ranks for each test were summed. Boys in the upper 50% were classifed as high-fit and those below 50% were classified as low-fit. Both groups completed the PAAI. Results indicated that although high-fit boys did not demonstrate high self-esteem, they did, however, perceive themselves to be more capable at physical activities compared to low-fit boys.

2) Physical Estimation and Attraction Scale (PEAS)

In 1974, Sonstroem improved and validated the Physical Activity Attitude Inventory, renaming it the Physical Estimation and Attraction Scale (Sonstroem, 1974). The two aspects (i.e., estimation and attraction) remained the same, however, there were 89 items in the final version, 33 of which comprised the estimation (EST) subscale. To develop the model, true-false EST questions were administered to 710 high school males. Sample questions include "1) I'm a natural athlete; 2) My body is strong and muscular compared to other boys my age; 3) Even with practice I doubt that I could learn to do a handstand well" (Sonstroem, 1974). The PEAS has reported good test-retest reliability with adult males and with college-aged females (Fox et al., 1985).

A large sample of high school males was used by Sonstroem (1974) to compare scores from EST with a fitness index score obtained from the Fleishman Basic Fitness Battery. The Fleishman battery includes 10 tests that measure the following fitness components: extent and dynamic flexibility; dynamic, explosive, static and trunk strength; gross body equilibrium and coordination; and stamina (Fleishman, 1964). The fitness index score was obtained by summing stanine scores from each fitness test. Results indicated a moderate, but significant relationship (r=.53, p<.01) between the estimation of one's physical ability, as measured by EST, and physical fitness, as measured by the Fleishman test battery. In 1976, Sonstroem repeated this study with 109 junior high males and 112 senior high males. Physical fitness was assessed by obtaining a fitness index score from mean T-scores derived from the AAHPER Youth Fitness Test Battery. Moderate, but significant relationships between perceived ability as measured by EST and physical fitness as measured by the AAHPER tests were found for the junior high group (r=.41, p<.01) and the high school group (r=.48, p<.01).

Fox et al. (1985) modified the PEAS, originally developed for males, to make it suitable for a study that included female college students. Although the EST subscale included health-related fitness items as well as skills-related ability items, the fitness test battery included only health-related fitness tests (i.e., body composition, aerobic power, grip strength, and flexibility). Scores were first converted to T-scores and then a mean T-score was calculated for each subject and used as a fitness index score. Moderate, but significant correlations were found for females (r=.52, p<.01) and males (r=.50, p<.01) for the EST/fitness index relationship. When aerobic power was correlated separately with EST, a moderate, but significant relationship was found for the

females (r=.52, p< .01) and a low, but significant relationship was found for the males (r=.29, p< .01). These findings suggest that in the EST/fitness relationship, aerobic power relates highly as a fitness index for females but not for males.

3) Physical Self-Efficacy Scale (PSE)

Psychologists Ryckman, Robbins, Thornton and Cantrell (1982) developed and validated the Physical Self-Efficacy Scale to further investigate the construct of physical self-concept (i.e., physical competence). The Physical Self-Efficacy Scale has a Likert format with two components: perceived physical ability (PPA) and physical self-presentation confidence (PSPC), that is, confidence in performing physical tasks in the presence of others (Thornton et al., 1987). The perceived physical ability subscale (PPA) includes 10 items and the physical self-presentation (PSPC), 12 items. PPA scores have also been correlated separately with actual fitness (Thornton et al., 1987). The test-retest reliability correlation coefficient for the PPA subscale is r=.85, p<.001 (Ryckman et al.,1982).

The validity of the Physical Self-Efficacy Scale (PSE), in its entirety, has been investigated in studies as a predictor of marathon performance (Gayton et al., 1986) and as a predictor of gymnastic performances by female collegiate gymnasts (McAuley & Gill, 1983). Perceived Physical Ability (PPA), a subscale of the Physical Self-Efficacy Scale (PSE), has been reported to correlate significantly with performance on a motor-skills task (Ryckman et al., 1982). Only one study could be found that investigated the relationship between PPA and indices of actual health-related physical fitness (Thornton et al., 1987).

Thornton et al. (1987) enlisted 135 college employees, relatives and students, age 17 to 64 to investigate if PPA could predict actual physical fitness. The 10-item PPA scale was administered, followed by a submaximal cycle ergometer test, skinfold measurements, sit-and-reach flexibility test, grip strength test, and timed bent-knee sit-ups. Males were also measured for lower back strength with a back dynamometer. Low, but significant correlations were found with aerobic capacity (r =.24, p<.001), muscular endurance (r = .34, p<.001), flexibility (r =.15, p<.05), and body fat (r =-.26, p<.001). The correlation of PPA with males' back strength was also significant (r =.22, p<.05). Grip strength was unrelated to PPA. While correlations cannot determine cause and effect, subjects with higher perceptions of their physical ability generally scored higher on the fitness tests than their counterparts with lower perceived physical ability (Thornton et al., 1987).

4) Abadie Perceived Physical Fitness Scale

In 1988, Abadie constructed and validated the Abadie Perceived Physical Fitness Scale. The scale uses a 5-point Likert scale inventory and was developed to reflect four factors: physical condition, muscular flexibility, muscular condition and body composition. Scores for the 12-question scale range from a low of 12 to a high of 60. Abadie's scale, used in the present study for validation of the Perceived Physical Fitness Index (PPFI), is presented in Appendix G.

Concurrent validity was determined by correlating scale factor scores with actual physiological measures from two sample groups of adults. The older adult group (>50 years of age) was given a symtoms-limited stress test, a grip strength test, a sit-and-reach flexibility test and skinfold measurements.

Correlations were significant for cardiorespiratory endurance and body composition but nonsignificant for strength and flexibility. The younger adult group (<50 years of age) was given the Astrand-Rhyming test for prediction of maximum oxygen uptake, a bench press strength test, a sit-and-reach flexibility test and skinfold measurements. All correlations were significant at the .01 level. In separate studies, test-retest reliability correlations of .92 and .95 were reported (Abadie, 1988a, 1988b).

Abadie (1988b) utilized the Abadie Perceived Physical Fitness Scale in a study that compared perceived and actual physical fitness with trait anxiety. Utilizing older female and male adults as subjects, he compared perceived fitness scores from the Abadie Perceived Physical Fitness Scale with cardiovascular fitness scores determined by duration of a voluntary maximal graded exercise stress test on a treadmill. Results indicated a fair, but significant correlation ($r = .38$, $p<.05$) between perceived physical fitness and actual (cardiovascular) fitness. The results support the conclusions made by Heaps (1978) and Leonardson & Gargiulo (1978) that a small, but significant relationship exists between perceived physical fitness and cardiovascular fitness (Abadie, 1988b).

5) Likert-type scales

Likert-type scales are simple instruments for appraising self-perceptions of physical fitness. Subjects display little hesitation when asked, "How do you rate your present physical fitness level"? or "How physically fit are you"? Scales that range from 3- to 9-points have been reported with options from "poor" to "excellent" or from "very very unfit" to "very very fit" (Hopkins & Robinson, 1988; Hopkins & Walker, 1988; Leonardson & Garguilo, 1978; Optenberg et al., 1984;

Young, 1985). Some scales include an optional "don't know" (Hopkins & Robinson, 1988; Hopkins & Walker, 1988). Young (1985) reported a high test-retest reliability correlation (*r* =.87) with a 5-point Likert-type scale of perceived fitness. Confusion exists, however, as to whether self-assessments are made by comparing one's own fitness within the self, with a peer group, with one's self as a younger person or with a standard of fitness excellence. Only one study made this distinction. Hopkins and Robinson (1988) asked their subjects to rate their fitness by responding to the following: "Within yourself, what is your present level of physical fitness"? and "Compared with most other people, how physically fit do you think you are"? The correlations between the two ratings of perceived fitness were *r* = .79 and .65 for females and males, respectively, indicating a close relationship between the two concepts.

Generally, perceived fitness studies that utilize a Likert-type scale for a self-rating of physical fitness can be classified into three groups: 1) studies that compare perceived fitness, actual fitness and psychological functionings (Leonardson & Garguilo, 1978; Young, 1985); 2) studies that compare perceived fitness with another variable (e.g., exercise) (Leonardson, 1977; Netz, 1987); and 3) studies that compare perceived physical fitness with a measure of actual physical fitness (Hopkins & Robinson, 1988; Hopkins & Robinson, 1988; Optenberg et al., 1984). The reported correlations between perceived physical fitness and measurements of actual fitness are presented in Table 2.

Table 2

Reported Correlations of Perceived Physical Fitness (PPF) with a Measure of Actual Fitness

Source	Subjects	Instruments / Design	Results
Heaps, 1972	56 college males	PPF self-estimate (unspecified scale) compared with 12-minute run score*	r = .27, p<.05
Leonardson & Garguilo, 1978	11 male & 15 female college freshmen	PPF (9 pt. scale) score compared with 12-minute run score before & after 10 weeks of jogging	r =.50 (pretest) r =.52 (posttest) (p<.05)
Optenberg et al.,1984	204 clerical & white collar employees	PPF (5 pt. scale) score compared with treadmill performance (VO2) score	r =.2, p<.05 (overall) t =9.4, p<.001 r =.2, p< .05 (female) t =10.66, p<.001 r =.08, p>.10 (male) t =2.46, p<.05
Young, 1985	256 7th, 9th & 10th grade girls	PPF (5 pt. scale) score compared with sit-ups score & 600 yd. run score	r = .37 (sit-ups) r =-.54 (600 yd. run)** (p< .05)
Hopkins & Walker, 1988	94 adults random mail sample	PPF (7 pt. scale) score compared with "imagined" performance of strength, work capacity, fatness, speed, and flexibility	r = .32 for strength r = .42 for work capacity r = .50 for flexibility r = .55 for speed r =-.62 for fatness (p <.005)
Hopkins & Robinson, 1988	64 female & 71 male adults	PPF (7 pt. scale) score compared with submax bike test (VO2) score	r =.14, r =.07 (fem.)*** r =.22, r = .20 (male)*** (ns)
Abadie, 1988	24 female & 8 male seniors	Abadie PPF score compared with cardiovascular fitness score (duration of stress test)	r =.38, p<.05

* Subjects completed PPF self-estimate after test results were known.

** Negative correlations for the 600 yd. run indicate a positive relationship between performance and perceived fitness.

*** Subjects' PPF response was 1) compared to themselves and 2) compared with others.

Heaps (1972) compared perceived physical fitness, actual physical fitness as measured by a 12-minute run, and scores from self-attitude inventories. A sub-problem of the study was to investigate whether an individual's perception of physical fitness changed with knowledge of physiological information (i.e., fitness test results) about his or her fitness level. Heaps' research design, therefore, called for subjects to be given minimum test evaluations following a 12-minute run, but prior to rating self-perceptions of physical fitness. No attempt was made, however, to obtain a rating of perceived fitness prior to performance of the 12-minute run in order that a comparison of pre- and posttest perceptions of fitness could be made. Heaps reported a low, but significant ($r = .27$, $p < .05$) relationship between perceived fitness and actual cardiovascular fitness.

Scores from a 12-minute run were also used as the measure of physical fitness in a study of male and female college freshmen by Leonardson and Garguilo (1978). The purpose of this study was to compare perceived physical fitness and actual physical fitness with self-concept before and after a 10-week jogging program. A moderate, but significant correlation was reported between perceived and actual fitness on both pre- and post-test measures ($r = .50$ and $.52$, $p < .05$, respectively). On the basis of these correlations, Leonardson and Garguilo suggested that self-report measures of fitness were valid but that cross-validation was needed.

Young (1985) used 7th, 9th and 10th grade girls to compare perceived physical fitness and actual physical fitness with self-concept. Sit-ups and a 600-yard run, the two measures used as indications of physical fitness, were compared with a self-perceived fitness rating. Young concluded that perceived physical fitness and sit-ups and perceived fitness and the 600-yard run were significantly related ($r = .37$ and $r = -.54$, $p < .05$, respectively). Correlations

between perceived fitness and aerobic fitness (600-yard run) were higher than correlations between perceived fitness and muscular endurance (sit-ups) for each grade level. Negative correlations for the 600-yard run indicate a positive relationship between performance and perceived fitness.

Hopkins and Robinson (1988) investigated relationships between a self-rating of physical fitness and an actual measurement of cardiovascular fitness (VO2) and found no significant correlations between the two variables for males or for females. However, when Hopkins and Walker (1988) compared perceived physical fitness with an "imagined" level of performance on fitness tests, significant correlations were found. In lieu of fitness tests, subjects were asked to rate themselves in the following attributes: muscular strength, capacity for daily physical work, fatness, speed of exercise (running, cycling or swimming) and body flexibility. Reported significant correlations were fair to moderate ranging from $r = .32$ for strength to $r = -.62$ for fatness ($p < .01$).

Optenberg et al. (1984) also obtained a low correlation ($r = .20$, $p < .05$) between self-reported estimates of fitness and an estimation of oxygen uptake derived from a treadmill test to theoretical maximum heart rate. Additionally, results using paired t-tests showed statistically significant differences between self-reports and physiologic estimates of fitness for the overall group as well as for men and women when examined separately. The population sample, 204 clerical and white-collar corporate employees, rated their fitness substantially higher than physiological measures indicated.

In a study of cardiorespiratory fitness of Canadians by Bailey et al. (1974), 1230 participants were asked to rate their fitness as "below average," "average," or "above average." Perceived fitness ratings were compared with predictions of aerobic power obtained from a standard Astrand cycle ergometer test.

Although statistical results were not reported, they concluded that men assessed their aerobic fitness more accurately than women. Their conclusions regarding perceived fitness may have been based solely on empirical evidence. The largest discrepancy between perceived and actual (aerobic) fitness occurred with women who had rated their fitness "above average."

Three studies utilized Likert-type scales of perceived physical fitness for comparisons with variables other than measures of actual fitness. Leonardson (1977), in an early study of the relationship between self-concept and perceived physical fitness suggested that perceived physical fitness and actual performance were related but recommended that the relationship between the two variables needed further investigation. Netz (1987) studied the relationship between perceived fitness and level of physical activity among middle-aged male and female college professors. He reported that the relationship of perceived physical fitness and amount of exercise was significant for males (r = .60, p<.01) but nonsignificant for females (not reported). He concluded that the female's higher mean score for self-perceived fitness was due to the inflated self-image of his female subjects. Brodie et al. (1988) compared perceived health, perceived fitness, and body composition among indoor sports participants. They concluded that 1) more men than women rated their fitness as "excellent;" 2) men considered themselves "more fit" and women considered themselves "more healthy;" and 3) subjects with poorer perceptions of fitness had greater adiposity.

Summary

Perceived physical fitness studies, which date back to the early 1970s, have been reported by psychologists, sport psychologists, physical educators,

exercise scientists and medical doctors. Perceived physical fitness and physical ability (sometimes used interchangeably) have been compared with measures of actual fitness such as VO2 and with psychological traits such as self-concept, self-esteem, and a long list of other traits related to self perception.

There are five instruments, ranging from the simple to the complex, that have been used to measure self-perceptions of physical fitness or physical ability. They include: 1) Physical Activity Attitude Inventory (PAAI); 2) Physical Estimation and Attraction Scale (PEAS); 3) Physical Self-Efficacy Scale (PSE); 4) Abadie Perceived Physical Fitness Scale; and 5) Likert-type scales. For the present study a self-rating 7-point Likert-type scale, entitled Perceived Physical Fitness Index (PPFI), was developed and used to assess perception of personal physical fitness.

Perceived fitness studies have utilized male and female subjects ranging from junior high age to seniors. Different instruments have been used to obtain an index of perceived physical fitness or physical ability that is later compared with an index of measured physical fitness. Perceived physical fitness or physical ability has been compared with aerobic fitness (five studies), fitness composites (three studies), and separate indices of fitness (three studies).

All eleven studies reported significant correlations ranging from low to moderate for those studies comparing perceived fitness with aerobic fitness or with separate indices of actual measured fitness. The strongest correlations, $r =$ .48 to $r =$ .53 were reported in studies that compared perceived fitness with a composite index of actual measured fitness. Results from the one study that reported a *t*-value indicated a significant difference between perceived and actual fitness with subjects rating themselves substantially higher than physiological measures indicated.

Additional studies were found that utilized Likert-type scales of perceived physical fitness for comparison with other variables such as perceived health, amount of exercise and body composition. Results from these studies are inconclusive regarding perceived fitness as an indicator of these other variables. Furthermore, recommendations were made that perceived physical fitness receive further exploration.

Although relationships of perceived physical fitness with actual physical fitness have been investigated, reported correlations do not support or refute the hypothesis that a poor relationship exists between the two variables. Only one study could be found that examined differences among groups on the variables of perceived and actual fitness. In that study, reported previously, actual fitness was measured by a test of one fitness component, cardiorespiratory endurance. Scientists are in agreement that physical fitness is a construct of several components. Thus, the present study was designed to examine differences among groups on the two variables utilizing a composite index of measured physical fitness to answer the question, "Is perceived physical fitness a valid indicator of actual physical fitness"?

Chapter 3

Methodology

Subjects

The subjects were 55 females, mean age 43 (sd=5) and 51 males, mean age 45 (sd=6) who responded to one of several requests for subjects that appeared in a local newspaper and a campus publication (see Appendix A). Subjects knew only that it was an exercise research study for adults, age 36-55, which included a free physical fitness assessment. Tables 3-7 present the means and standard deviations of the physical characteristics of the subjects.

The subjects were Caucasian (93%), Hispanic (4%) and Black (3%). Occupations included: professional (33%), service industry (18%), paraprofessional (14%), business (8.5%), homemakers (8.5%), self-employed (7.5%) and retired (1%). Among this population, 87% had at least some college, 89% were or had been married, and had an average of less than one (.8) dependent living at home.

Subjects were classified in low, moderate or high physical activity level categories from responses to a brief questionnaire inquiring about present fitness activities (see Appendix B). Fifty-four (54) subjects were classified as high activity level, 19 as moderate activity level and 33 as low activity level. Seventy-two percent (72%) of the subjects in the high activity level group had companions that also exercised regularly. This compared to 50% in the moderate activity level group and 25% in the low activity level group.

Table 3

Females (N=55)
Means and standard deviations for all variables

Variables	Mean	SD	Minimum	Maximum
Age	43.22	4.89	36.0	54.0
Height	64.53	2.17	59.5	69.0
Weight	140.63	23.29	104.0	209.0
Percent Fat	28.27	6.59	11.0	41.0
Fitness Assessment				
Perceived	4.42	1.21	2.0	7.0
Actual	4.30	1.18	1.5	6.5
Self-Assessment	38.78	7.55	21.0	53.0
Fitness Test Scores				
Body Fat	4.25	1.85	1.0	7.0
Flexibility	4.56	2.00	0.0	7.0
Aerobic	3.22	1.64	1.0	6.0
Strength / Endurance	5.15	1.47	1.0	7.0

Table 4

Males (N=51)
Means and standard deviations for all variables

Variables	Mean	SD	Minimum	Maximum
Age	45.24	6.05	36.0	55.0
Height	70.26	2.78	63.5	76.0
Weight	180.24	28.38	124.0	257.0
Percent Fat	20.77	6.35	8.9	35.0
Fitness Assessment				
Perceived	5.55	1.08	3.0	7.0
Actual	4.37	1.16	1.8	6.8
Self-Assessment	42.55	7.58	24.0	60.0
Fitness Test Scores				
Body Fat	4.92	1.83	1.0	7.0
Flexibility	3.88	2.02	1.0	7.0
Aerobic	3.42	1.82	1.0	7.0
Strength / Endurance	5.26	2.00	1.0	7.0

Table 5

High Activity Level (N=54)
Means and standard deviations for all variables

Variables	Mean	SD	Minimum	Maximum
Age	43.76	5.29	36.0	55.0
Fitness Assessment				
Perceived	5.57	1.04	3.0	7.0
Measured	4.81	1.12	1.8	6.8
Self-Assessment	44.59	6.28	31.0	60.0
Fitness Test Scores				
Body Fat	4.92	1.83	1.0	7.0
Flexibility	3.88	2.02	1.0	7.0
Aerobic	3.42	1.82	1.0	7.0
Strength / Endurance	5.26	2.00	1.0	7.0

Table 6

Moderate Activity Level (N=19)
Means and standard deviations for all variables

Variables	Mean	SD	Minimum	Maximum
Age	45.63	6.63	37.0	55.0
Fitness Assessment				
Perceived	5.05	0.97	3.0	7.0
Measured	4.16	1.10	2.3	6.3
Self-Assessment	38.84	4.36	31.0	50.0
Fitness Test Scores				
Body Fat	4.37	1.67	2.0	7.0
Flexibility	4.11	2.21	0.0	7.0
Aerobic	2.92	1.47	1.0	6.0
Strength /Endurance	5.24	1.46	2.0	7.0

Table 7

Low Activity Level (N=33)
Means and standard deviations for all variables

Variables	Mean	SD	Minimum	Maximum
Age	44.06	5.31	36.0	55.0
Fitness Assessment				
Perceived	3.91	1.13	2.0	7.0
Measured	3.65	0.91	1.5	5.5
Self-Assessment	35.06	7.83	21.0	51.0
Fitness Test Scores				
Body Fat	3.67	1.88	1.0	7.0
Flexibility	4.03	1.81	1.0	7.0
Aerobic	2.42	1.30	1.0	5.0
Strength / Endurance	4.48	1.48	1.0	7.0

Only subjects who regularly exercised strenuously at least 3 times a week (high activity level group) were asked how many years they had exercised. Among those subjects, 13% had been exercising less than one year, 35% one-four years, 24% five-ten years, 5% eleven-fifteen years and 23% had been exercising regularly for sixteen or more years.

Materials and Apparatus

Perceived Physical Fitness Index (PPFI) Several studies have utilized 5-point and 7-point Likert-type scales to measure perceived physical fitness (Hopkins & Walker, 1988; Optenberg et al., 1984; Young, 1985). In the current study, subjects were asked to rate their present level of physical fitness on a 7-point scale. Their choices were "excellent," "good," "above average," "average," "below average," "poor," or "very poor" (see Appendix C).

Percent Body Lange skinfold calipers were used to obtain four skinfold measurements. Percent fat estimate tables based on the Jackson-Pollock sum of four equation (Golding et al., 1989) were used to convert the sum of four measurements to percent fat (see Table 8 and Table 9).

Cardiorespiratory A Monark cycle ergometer was used to administer a submaximal test for cardiorespiratory capacity. Other equipment included a Graylab timer, a Polar Vantage XL heart rate monitor, a tape player and a prerecorded 100 bpm cadence tape. A workload chart (Golding et al., 1989) was utilized as a guide for setting workloads (see Figure 1).

Table 8

Percent Fat Estimates for Four Sites—Women

Sum of 4 skinfolds	Age to last year 18-22	23-27	28-32	33-37	38-42	43-47	48-52	53-57	> 58
23-27	8.6	9.3	9.4	9.6	9.7	9.9	10.0	10.2	10.3
28-32	10.0	10.7	10.8	11.0	11.0	11.3	11.4	11.6	11.7
33-37	11.3	12.0	12.2	12.3	12.4	12.6	12.7	12.9	13.0
38-42	12.6	13.3	13.5	13.6	13.7	13.9	14.1	14.2	14.4
43-47	13.9	14.6	14.8	14.9	15.0	15.2	15.4	15.5	15.7
48-52	15.2	15.9	16.1	16.2	16.3	16.5	16.7	16.8	17.0
53-57	16.5	17.2	17.3	17.5	17.5	17.8	17.9	18.1	18.2
58-62	17.7	18.4	18.6	18.7	18.8	19.0	19.1	19.3	19.4
63-67	18.9	19.6	19.8	19.9	20.0	20.2	20.4	20.5	20.7
68-72	20.1	20.8	21.0	21.1	21.2	21.4	21.6	21.7	21.9
73-77	21.3	22.0	22.1	22.3	22.3	22.6	22.7	22.9	23.0
78-82	22.5	23.1	23.3	23.4	23.5	23.7	23.9	24.0	24.2
83-87	23.6	24.3	24.4	24.6	24.6	24.9	25.0	25.2	25.3
88-92	24.7	25.4	25.5	25.7	25.7	26.0	26.1	26.3	26.4
93-97	25.8	26.5	26.6	26.8	26.8	27.1	27.2	27.4	27.5
98-102	26.8	27.5	27.7	27.8	27.9	28.1	28.3	28.4	28.6
103-107	27.9	28.6	28.7	28.9	28.9	29.2	29.3	29.5	29.6
108-112	28.9	29.6	29.7	29.9	30.0	30.2	30.3	30.5	30.6
113-117	29.9	30.6	30.7	30.9	31.0	31.2	31.3	31.5	31.6
118-122	30.9	31.6	31.7	31.9	31.9	32.2	32.3	32.5	32.6
123-127	31.9	32.5	32.7	32.8	32.9	33.1	33.3	33.4	33.6
128-132	32.8	33.5	33.6	33.8	33.8	34.1	34.2	34.4	34.5
133-137	33.7	34.4	34.5	34.7	34.7	35.0	35.1	35.3	35.4
138-142	34.6	35.3	35.4	35.6	35.6	35.9	36.0	36.2	36.3
143-147	35.5	36.2	36.3	36.5	36.5	36.7	36.9	37.0	37.2
148-152	36.3	37.0	37.2	37.3	37.4	37.6	37.8	37.9	38.0
153-157	37.2	37.8	38.0	38.1	38.2	38.4	38.6	38.7	38.9
158-162	38.0	38.6	38.8	38.9	39.0	39.2	39.4	39.5	39.7
163-167	38.8	39.4	39.6	39.7	39.8	40.0	40.2	40.3	40.5
168-172	39.5	40.2	40.3	40.5	40.6	40.8	40.9	41.1	41.2
173-177	40.3	40.9	41.1	41.2	41.3	41.5	41.7	41.8	42.0
178-182	41.0	41.7	41.8	42.0	42.0	42.3	42.4	42.6	42.7
183-187	41.7	42.4	42.5	42.7	42.7	43.0	43.1	43.3	43.4
188-192	42.4	43.0	43.2	43.3	43.4	43.6	43.8	43.9	44.1
193-197	43.0	43.7	43.9	44.0	44.1	44.3	44.4	44.6	44.7
198-202	43.7	44.3	44.5	44.6	44.7	44.9	45.1	45.2	45.4

From Golding, L.A., Myers, C.R. & Sinning, W.E. (Eds.). (1989). *Y's way to physical fitness.* Champaign, IL: Human Kinetics.

Table 9

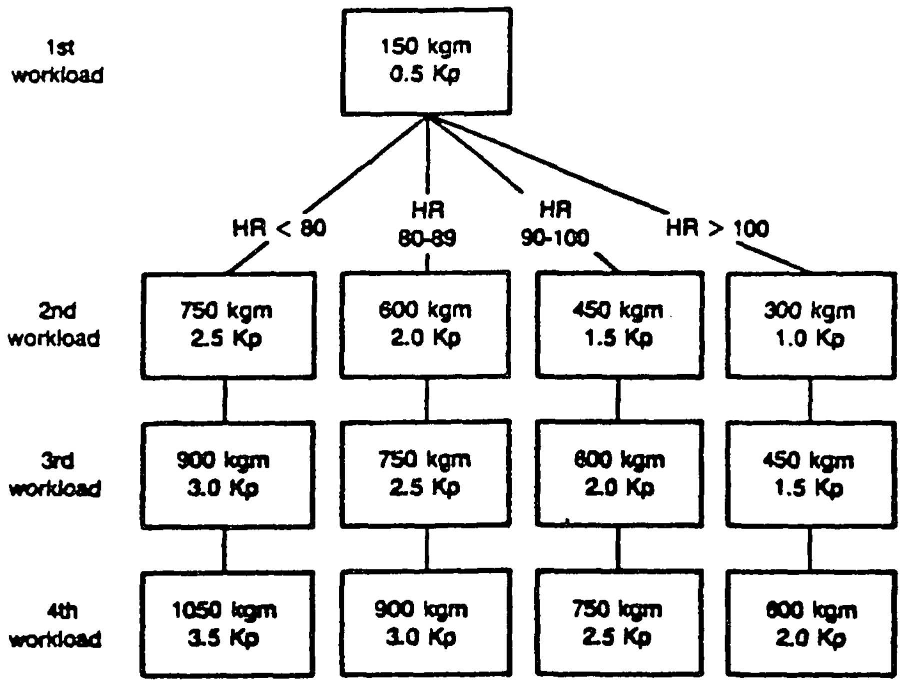
Percent Fat Estimates for Four Sites—Men

Sum of 4 skinfolds	Age to last year								
	18-22	23-27	28-32	33-37	38-42	43-47	48-52	53-57	> 58
13-17	1.7	2.5	3.3	4.1	4.9	5.6	6.4	7.2	8.0
18-22	3.1	3.9	4.6	5.4	6.2	7.0	7.8	8.6	9.4
23-27	4.4	5.2	6.0	6.8	7.6	8.4	9.2	10.0	10.7
28-32	5.7	6.5	7.3	8.1	8.9	9.7	10.5	11.3	12.1
33-37	7.0	7.8	8.6	9.4	10.2	11.0	11.8	12.6	13.4
38-42	8.3	9.1	9.9	10.7	11.5	12.3	13.1	13.9	14.6
43-47	9.6	10.3	11.1	11.9	12.7	13.5	14.3	15.1	15.9
48-52	10.8	11.6	12.4	13.2	13.9	14.7	15.5	16.3	17.1
53-57	12.0	12.8	13.6	14.4	15.1	15.9	16.7	17.5	18.3
58-62	13.1	13.9	14.7	15.5	16.3	17.1	17.9	18.7	19.5
63-67	14.3	15.1	15.9	16.7	17.5	18.2	19.0	19.8	20.6
68-72	15.4	16.2	17.0	17.8	18.6	19.4	20.2	21.0	21.8
73-77	16.5	17.3	18.1	18.9	19.7	20.5	21.3	22.1	22.8
78-82	17.6	18.4	19.2	20.0	20.7	21.5	22.3	23.1	23.9
83-87	18.6	19.4	20.2	21.0	21.8	22.6	23.4	24.2	25.0
88-92	19.6	20.4	21.2	22.0	22.8	23.6	24.4	25.2	26.0
93-97	20.6	21.4	22.2	23.0	23.8	24.6	25.4	26.2	27.0
98-102	21.6	22.4	23.2	24.0	24.8	25.6	26.4	27.1	27.9
103-107	22.5	23.3	24.1	24.9	25.7	26.5	27.3	28.1	28.9
108-112	23.5	24.2	25.0	25.8	26.6	27.4	28.2	29.0	29.8
113-117	24.3	25.1	25.9	26.7	27.5	28.3	29.1	29.9	30.7
118-122	25.2	26.0	26.8	27.6	28.4	29.2	30.0	30.8	31.6
123-127	26.0	26.8	27.6	28.4	29.2	30.0	30.8	31.6	32.4
128-132	26.9	27.7	28.4	29.2	30.0	30.8	31.6	32.4	33.2
133-137	27.7	28.4	29.2	30.0	30.8	31.6	32.4	33.2	34.0
138-142	28.4	29.2	30.0	30.8	31.6	32.4	33.2	34.0	34.8
143-147	29.2	29.9	30.7	31.5	32.3	33.1	33.9	34.7	35.5
148-152	29.9	30.7	31.5	32.2	33.0	33.8	34.6	35.4	36.2
153-157	30.6	31.3	32.1	32.9	33.7	34.5	35.3	36.1	36.9
158-162	31.2	32.0	32.8	33.6	34.4	35.2	36.0	36.8	37.6
163-167	31.8	32.6	33.4	34.2	35.0	35.8	36.6	37.4	38.2
168-172	32.5	33.3	34.0	34.8	35.6	36.4	37.2	38.0	38.8
173-177	33.0	33.8	34.6	35.4	36.2	37.0	37.8	38.6	39.4
178-182	33.6	34.4	35.2	36.0	36.8	37.6	38.4	39.2	39.9
183-187	34.1	34.9	35.7	36.5	37.3	38.1	38.9	39.7	40.5

From Golding, L.A., Myers, C.R. & Sinning, W.E. (Eds.). (1989). *Y's way to physical fitness.* Champaign, IL: Human Kinetics.

Figure 1

YMCA Bicycle Ergometer Workload Chart



Directions:

1. Set the first workload at 150 kgm/min (0.5 Kp).
2. If the HR in the third min is
   - less than (<) 80, set the second load at 750 kgm (2.5 Kp);
   - 80 to 89, set the second load at 600 kgm (2.0 Kp);
   - 90 to 100, set the second load at 450 kgm (1.5 Kp);
   - greater than (>) 100, set the second load at 300 kgm (1.0 Kp).
3. Set the third and fourth (if required) loads according to the loads in the columns below the second loads.

---

kloads on bicycle ergometer.

Adapted from Golding, L.A., Myers, C.R. & Sinning, W.E. (Eds.). (1989). *Y's way to physical fitness.* Champaign, IL: Human Kinetics.

<u>Strength</u> A conventional weight bench 14 in wide, 50 in long and 17 in high was utilized for the bench press test (Golding et al., 1989). The bench was equipped with two attached brackets for ease of unracking and racking a barbell. A 35 lb barbell was used for female subjects and an 80 lb barbell for male subjects. A metronome set at 60 bpm was used for cadence.

<u>Flexibility</u> A commercially made trunk flexion instrument was utilized for the sit-and-reach test. The instrument is made by Leflar, P.O. Box 19581, Portland, Oregon.

Procedures

Prior to testing, the research proposal was submitted to and approved by the Human Subjects Research Board at the University of Nevada, Las Vegas. Testing consisted of one 45-minute session conducted in the Exercise Physiology Laboratory at the University of Nevada, Las Vegas.

Subjects rated their perception of their personal physical fitness on the Perceived Physical Fitness Index (PPFI) scale. Heaps (1972) noted that a person's perception of physical fitness changed with physiological information about their fitness level, therefore, subjects rated their PPFI without any comment or prompting. Their only instruction was to respond to the question, "How do you rate your physical fitness"? Subjects responded by choosing a fitness level from the previously described 7-point scale.

Subjects then completed a Physical Activity Readiness Questionnaire (PAR-Q) which was developed by the British Columbia Ministry of Health (Chisholm et al., 1975) to identify those individuals for whom physical activity might be inappropriate. Due to the age group in this study, 36-55, the PAR-Q

(see Appendix D) was utilized to identify subjects that might be put at risk if tested. Three volunteers were not tested due to positive responses concerning heart and blood pressure problems.

Subjects read and signed a consent form which included an explanation of the study (see Appendix E). Following the consent form, subjects completed the Abadie Perceived Physical Fitness Scale (1988), a detailed self-reporting instrument to assess personal physical fitness. Because this scale has reported validity and reliability, it was utilized in this study for concurrent validity, retitled as "Physical Fitness Self-Assessment" (see Appendix F). The scores range from a low of 12 to a high of 60. The scale and the scoring key are presented in Appendix G.

A questionnaire (see Appendix B) was administered to record subject's occupation, marital and education status, and several answeres to questions regarding their present physical activities. The questions regarding physical activity were the same as used by Haskell et al. in a 1980 international lipid research study of 4386 adult men and women (Lamb & Brodie, 1990). The short, 2-question procedure was used to classify subjects in low, moderate or high physical activity level categories. Subjects were asked, "Do you regularly engage in strenuous exercise or hard physical labor"? If the answer was positive, they were then asked "Do you labor or exercise strenuously at least three times a week"? Subjects answering positive to both questions were classified as high activity level, whereas those answering negatively to the first question were classified as low activity level. Subjects answering positive to the first question and negatively to the second question were classified as moderate activity level.

Subjects were also asked several other questions regarding exercise habits, for example, how long they have exercised regularly (at least three times a week) and if their spouse or partner exercised regularly. Age and gender were recorded on each subject's data form (see Appendix H).

On completion of the brief questionnaire, subjects removed their footwear to allow measurement of height and weight. Height was measured in inches to the nearest half-inch with a wall-mounted stadiometer. A Toledo Physician's Scale was utilized to measure weight in pounds to the nearest half-pound. Subjects were then tested for body composition (percent body fat), cardiorespiratory endurance, muscular strength and endurance, and flexibility.

Percent Body Fat

Skinfold measurements were obtained at the abdomen, ilium, triceps and thigh according to the method described by Golding et al. (1989). Percentages for men and women were estimated from tables based on the Jackson-Pollock prediction equations for four skinfold sites (Golding et al., 1989). Estimated percent fat was recorded on each subject's data form.

Cycle Ergometer Test

The procedures for completing the cycle ergometer test were explained to each participant. Subjects were then fitted with a heart rate transmitter mounted on a strap and fitted around the chest. The accompanying receiving monitor was strapped on their wrists.

Cycle seat height was adjusted until subjects, with the ball of their foot on the pedal at its lowest point, could straighten their knees and legs. A prerecorded tape of a metronome with a cadence of 100 bpm was started and

subjects were given an opportunity to pedal with no workload until they demonstrated the correct pace, that is, either foot in the down position at each beat of the metronome resulting in 50 rpms. During this brief warm-up period, the administrator checked the calibration of the cycle assuring that the red line on the pendulum weight was in line with the 0 (zero) on the workload scale.

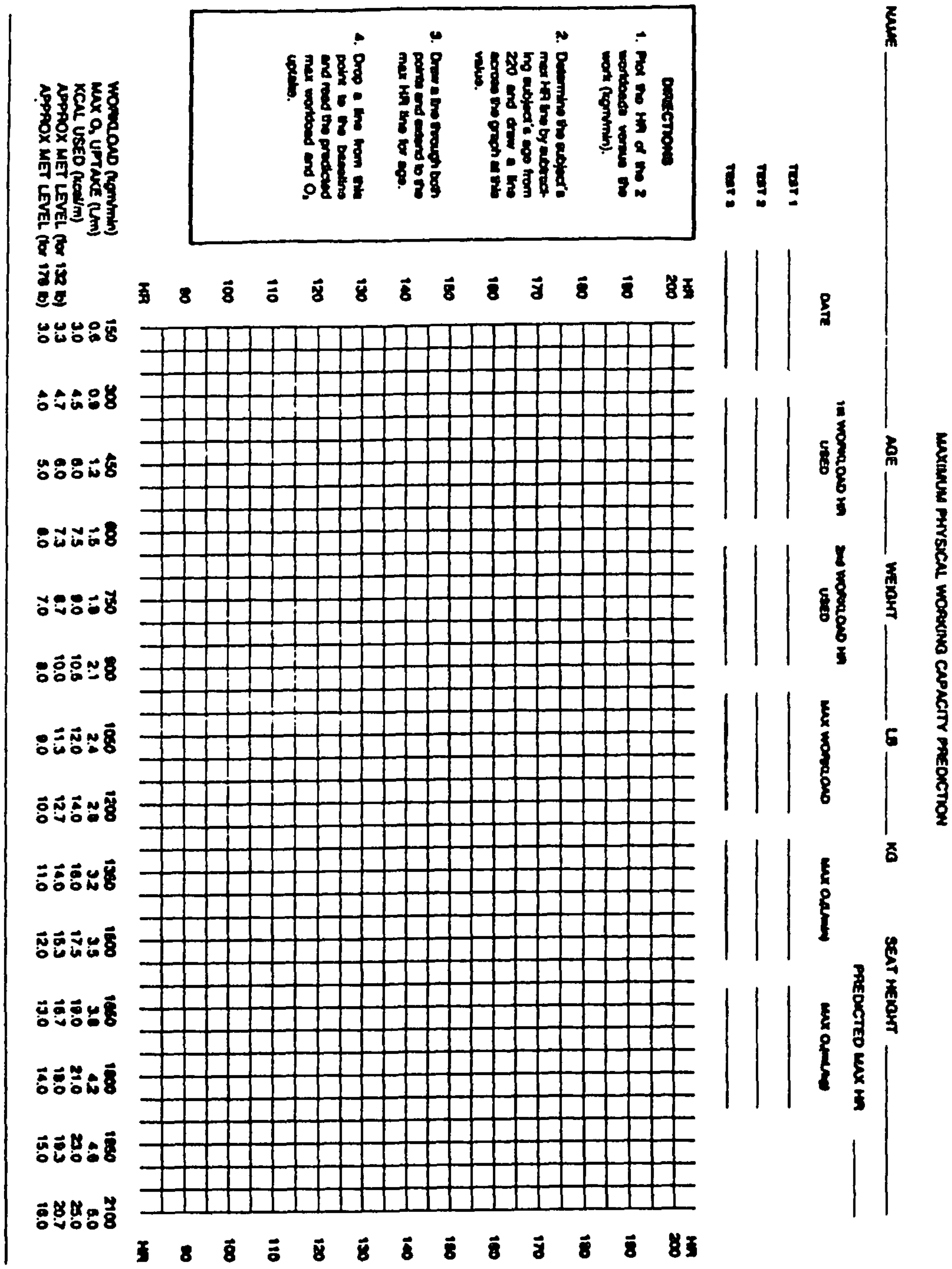
The timer and the first workload of 150 kgm/min were then set. Subject's heart rate, at two minutes and again at three minutes, was recorded. If the difference did not vary by more than five beats, the workload was increased according to the workload chart. However, if the heart rate did vary more than 5 beats, the ride was extended for another minute or until a stable heart rate (less than 5 beats difference) was obtained. This procedure was repeated until successive workloads elicited two steady state heart rates between 110 bpm and 150 bpm. On completion of the test, subjects were allowed to cool down by riding with no resistance until heart rate returned to approximate pre-exercise levels.

Throughout the test, the workload setting was monitored regularly to assure that the proper workload was maintained. In addition, each subject was monitored for external signs of unusual stress.

The cycle ergometer test results were computed as follows: a horizontal line was drawn at the subject's predicted maximum heart rate (220-age) on a graph used for the bike test (see Figure 2). The final heart rate at the two workloads between 110 bpm and 150 bpm and the respective workloads were then plotted on the graph. A straight line was drawn through the points and extrapolated to the subject's maximal heart rate line. A perpendicular line was then dropped from this point to the baseline. Predicted maximum physical working capacity and predicted maximum VO2 (in liters) was read below the

Figure 2

YMCA Maximum Physical Working Capacity Graph



Adapted from Golding, L.A., Myers, C.R. & Sinning, W.E. (Eds.). (1989). *Y's way to physical fitness.* Champaign, IL: Human Kinetics.

baseline. VO2 in liters was converted to ml/kg/min. The VO2 in ml/kg/min was used as the score for the cardiorespiratory fitness component.

Bench Press Test

The instructions for performing the bench press test were given and then demonstrated (Golding et al., 1989). Subjects were instructed to position themselves in a supine position on the bench with the chest 8 in to 12 in from the upright supports with knees bent and feet flat on the floor. They were instructed to keep the low spine in contact with the bench during the test.
The barbell was taken with elbows flexed and hands (palms up) shoulder-width apart in the down (starting) position. Subjects extended elbows fully to press the barbell upward and then returned the barbell to the original down position. This was considered one repetition. Rhythm was kept by a metronome (60 bpm), each click representing a movement up or down. The test was terminated when the subject was unable to make a full extension of the elbows or unable to keep in time with the cadence of the metronome. The total number of legal repetitions was recorded.

Sit-and-Reach Test

The procedures for the sit-and-reach test were given and then demonstrated (Golding et al., 1989). With shoes off, a brief warm-up period of gentle stretching, that is, bending at the waist, was performed by each subject prior to sitting on the apparatus. Subject's hands were placed on top of each other with fingertips aligned. While keeping knees straight, subjects pushed the sliding component of the apparatus with their fingertips until their final position

was reached. The best score of three trials was recorded in inches to the nearest half-inch.

Evaluation

The fitness scores for each subject from each test were recorded on an evaluation form which included an explanation of the importance of the four fitness components (see Appendix I). Each score was then plotted on an age/gender-dependent norm chart used by the YMCA as a physical fitness evaluation profile (see Appendix J). Both forms were informational and were intended to provide the subject with a fitness evaluation. In addition to this "mini" fitness evaluation, subject's received recommendations for target weight.

Scoring

Scores from the four fitness tests, skinfold measurements, cycle ergometer, bench press, and sit-and-reach, were converted to a score on a 7-point scale that coincided with the age/gender-dependent ranking on the YMCA norm tables (see Appendix J) for percent body fat, VO2, bench press, and flexibility. Scores earning an "excellent" rating on the norm chart were worth 7 points, followed by "good" (6 pts.), "above average" (5 pts.), "average" (4 pts.), "below average" (3 pts.), "poor" (2 pts.), and "very poor" (1 pt.). A mean value from the four scores was utilized as the composite score. PPFI scoring, as described previously, also used a 7-point scale.

Statistical Design

A 2 (gender) x 3 (activity level) x 2 (fitness assessment method) factorial Analysis of Variance (ANOVA) with repeated measures on the last factor was

the statistical technique used for data analysis. A Pearson Product Moment Correlation Coefficient was computed to determine the degree of relationship between perceived physical fitness and separate indices of actual physical fitness to determine which components of fitness were used as a basis for the subjects' perception of fitness. The relationship between the Perceived Physical Fitness Index (PPFI) and Abadie's Perceived Physical Fitness scale was also investigated.

Chapter 4

Results and Discussion

The purpose of this study was to investigate the perception of personal physical fitness in men and women by comparing an index of perceived physical fitness with a composite index of actual physical fitness. Sub-problems relating to the investigation of perceived physical fitness included: 1) a comparison of perceived physical fitness with actual physical fitness using gender and physical activity level as independent measures; 2) an examination of the criteria used by a sample adult population for the perception of their personal physical fitness; and 3) a cross-validation of the Perceived Physical Fitness Index (PPFI) using the Abadie Perceived Physical Fitness Scale.

Subjects

Subjects in the present study came from a variety of socioeconomic levels, but the population was limited to those people who responded to local announcements and were interested in obtaining a free fitness evaluation. In addition to demographic differences, there may be other differences between a population volunteering to have their fitness assessed compared with a random sample taken from the general public that may limit the generalizability of the results.

In the present study physiological measures for both males and females indicated that actual fitness levels were similar, that is, the composite fitness

mean was 4.37 and 4.30, respectively. According to the YMCA age and gender adjusted evaluation profiles (Appendix J) this classifies their fitness as "average." Although it has not been shown what level of fitness is necessary for positive health, it can be surmised that adults in this age group need to improve their physical fitness.

An interesting statistic was revealed from the questionnaire regarding exercise adherence/compliance. Seventy-two percent (72%) of the subjects in the high activity level group had companions or spouses that also exercised regularly (together or separately). This compared to 50% in the moderate activity level group and 25% in the low activity level group. These results indicate that exercise adherence may be reinforced by a " buddy system."

Perceived Physical Fitness vs. Actual Physical Fitness

A 2 (gender) x 3 (activity level) x 2 (fitness assessment method) factorial Analysis of Variance (ANOVA) with repeated measures on the last factor was the statistical technique used for data analysis. The fitness assessment methods (perceived fitness as measured by the PPFI and actual fitness as reflected in the composite fitness score) were reported on 7-point scales. The analysis revealed significant main effects for all three factors. F and p values are presented in Table 10.

Table 10

ANOVA Table of Relevant Main Effects and Interactions

Main Effects	*df*	*F*	*p*
Gender	1,100	13.56	0.0004
Activity Level	2,100	28.71	0.0001
Assessment Method	1,100	31.30	0.0001
Interactions			
Gender x Method	1,100	21.88	0.0001
Activity x Method	2,100	2.56	0.0824

The significant main effect for gender and the significant main effect for fitness assessment method are of little value by themselves due to the significant gender x assessment method interaction. The significant main effect for activity level indicates that the three activity levels do not score the same on a combined measure of the two fitness assessment methods. This result by itself, however, does not answer any relevant question of this study.

The significant main effect for fitness assessment method indicates that a significant difference exists between the PPFI mean and the composite fitness mean for both genders. These findings suggest that perceived fitness is not a valid indicator of actual fitness for men and women supporting the hypothesis that there is a poor relationship between perceived and actual fitness. However, since there was a significant gender x fitness assessment method (perceived/actual) interaction, further examination was necessary. Therefore, the question, "Are perceived and actual fitness the same for all subjects in the study"? cannot be answered by this statistic alone.

The significant gender x fitness assessment method interaction indicates that the difference between perceived and actual fitness was not consistent for males and females. Figures 3 and 4 illustrate this interaction. For females there was no significant difference between the PPFI mean and the composite fitness mean. For males, there was a significant difference between the PPFI mean and the composite fitness mean. Thus, accuracy in estimating one's own fitness level is dependent on gender. Furthermore, results indicate that females were able to estimate their fitness level more accurately than males. Males tended to over-estimate their fitness level. Thus, perceived physical fitness appears to be a valid indicator of actual fitness for females but not for males. The results obtained from the males support the stated hypothesis that there is a poor relationship between perceived and actual physical fitness.

These results support, in part, those of McCollum and Golding (1992) in a perceived fitness study of 137 employees participating a health promotion program. A significant difference existed between perceived and actual fitness for the entire sample. Men and women were not examined separately on the perceived and actual fitness variables. In the present study, there was a significant difference between the two variables for men but not for women. Women were able to estimate their fitness level accurately but men were not. There may be another reason why the results differed between the two studies. Actual fitness in the previous study did not include a measure of cardiorespiratory fitness but was limited to body composition, grip strength and flexibility.

The present study did not support the conclusions by Optenberg et al. in a 1984 study of 206 clerical and white collar employees ($\overline{X}$ = 36 years of age). Optenberg's study reported that a significant difference between perceived

Figure 3

Gender at Fitness Assessment

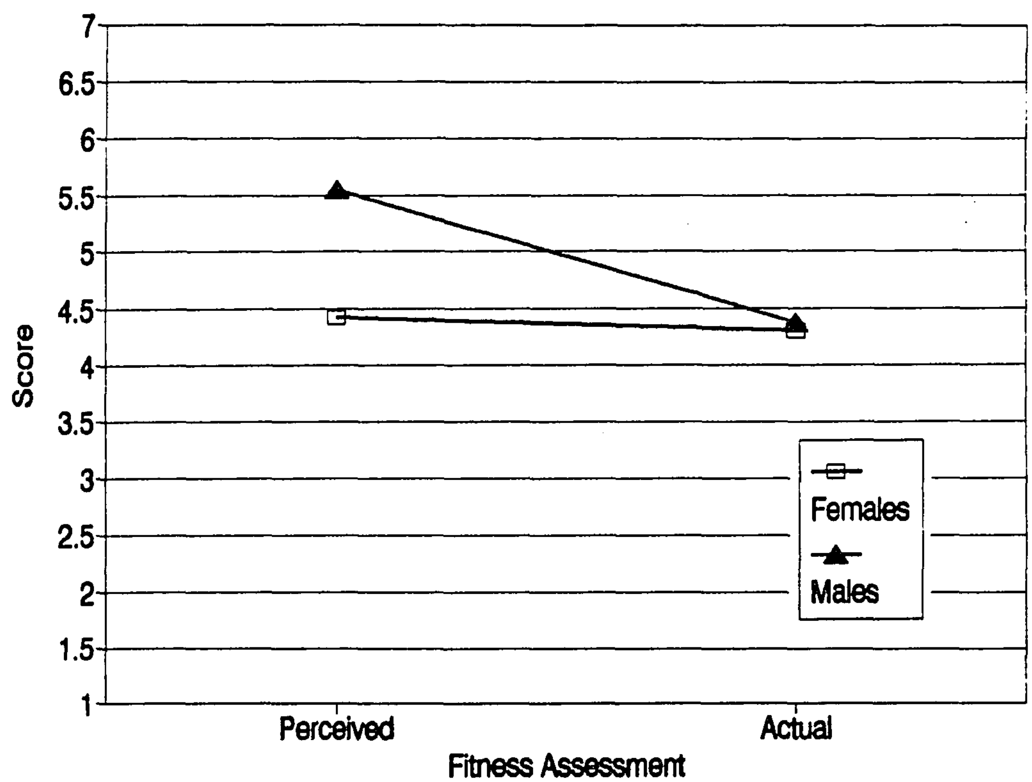
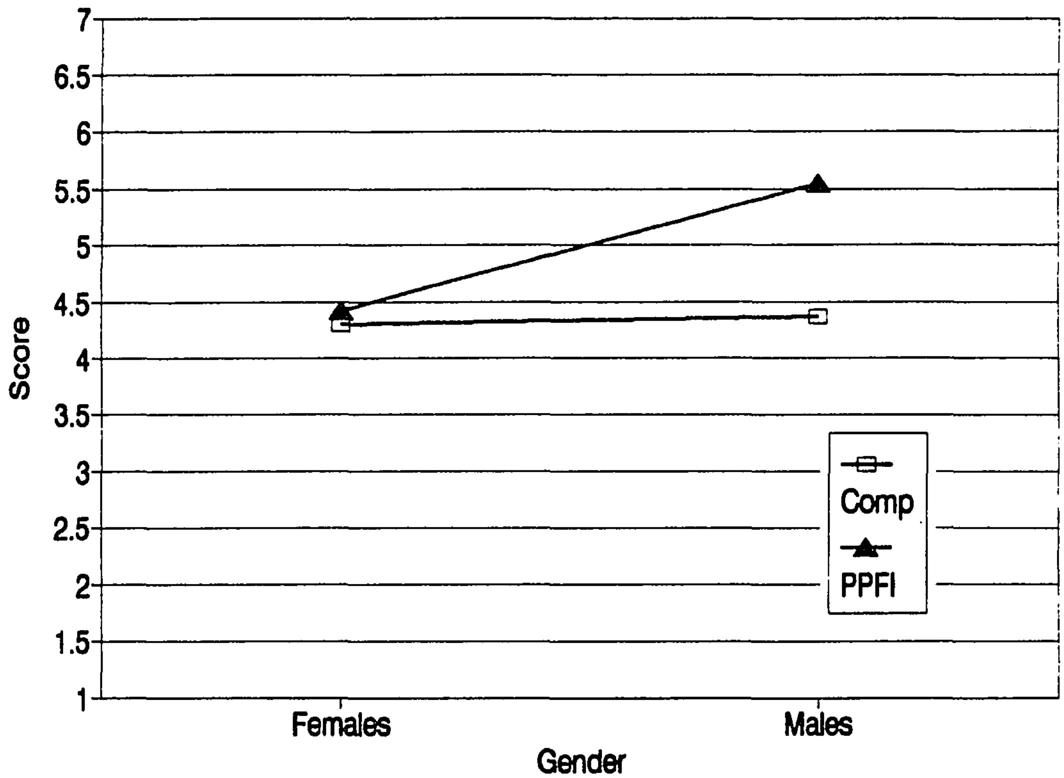


Figure 4

Fitness Assessment at Gender



fitness and actual measured fitness existed for both men and women. Two reasons may explain why results differed between the Optenberg study and the present study. First, Optenberg's study population, employees of one company, was a homogeneous group. Therefore, the employee's ratings of perceived fitness may have been made by comparing themselves to a consistent group, that is, their work peers. In the present study subjects represented a wide range of occupations. Secondly, actual physical fitness in the Optenberg study was evaluated by one aerobic fitness test as opposed to a composite of several fitness components used in the present study.

The remainder of the perceived physical fitness (or physical ability) studies cited in Chapter 2 report relationships, not differences, between perceived physical fitness and actual measures of physical fitness and therefore cannot be compared with the present study.

Differences between perceived and actual fitness by activity level were also determined from the 2 x 3 x 2 factorial ANOVA. The fitness assessment method (PPFI/composite) x activity level interaction approached significance ($p = 0.0824$). It appears that activity level may have an effect on accuracy in estimating one's fitness level. The use of uneven sample sizes for the activity level variable in the statistical analysis may have masked a true interaction effect. Figures 5 and 6 illustrate the relationship between activity level and fitness assessment (PPFI/composite). It appears that the PPFI and composite means are different for the high and moderate activity level group but not for the low activity level group. These findings suggest that high and moderately active individuals have a tendency to over-estimate their fitness level whereas inactive individuals are more accurate in estimating their fitness level.

Figure 5

Activity Level at Fitness Assessment

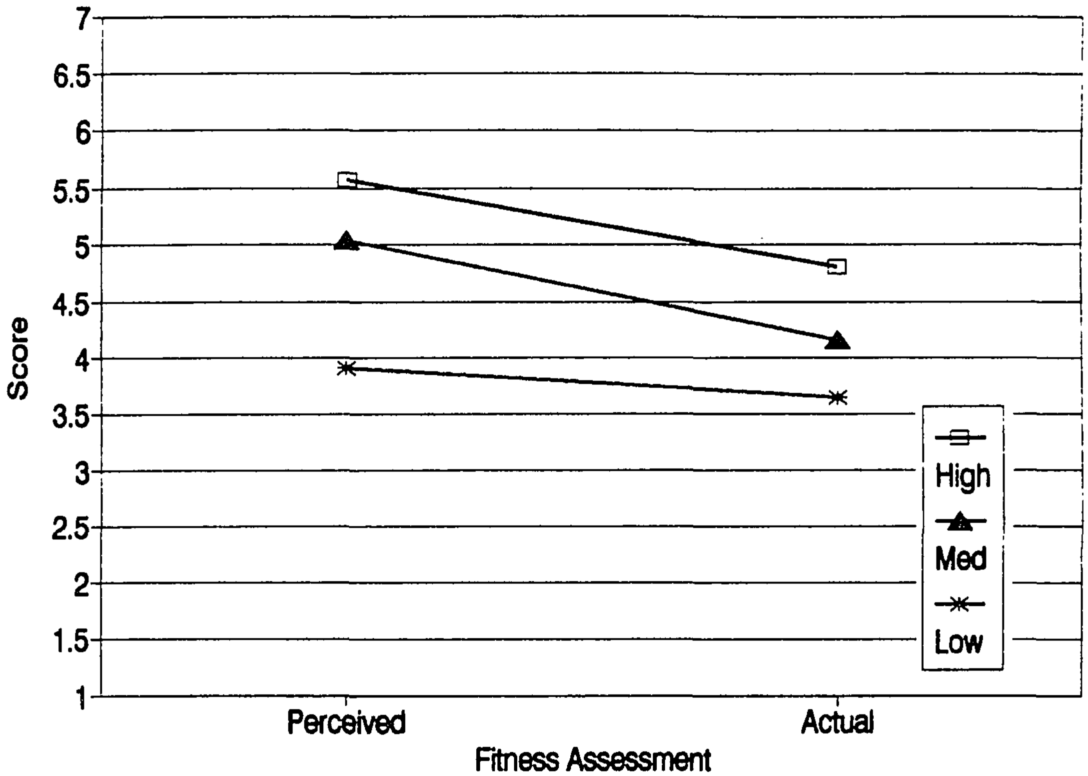
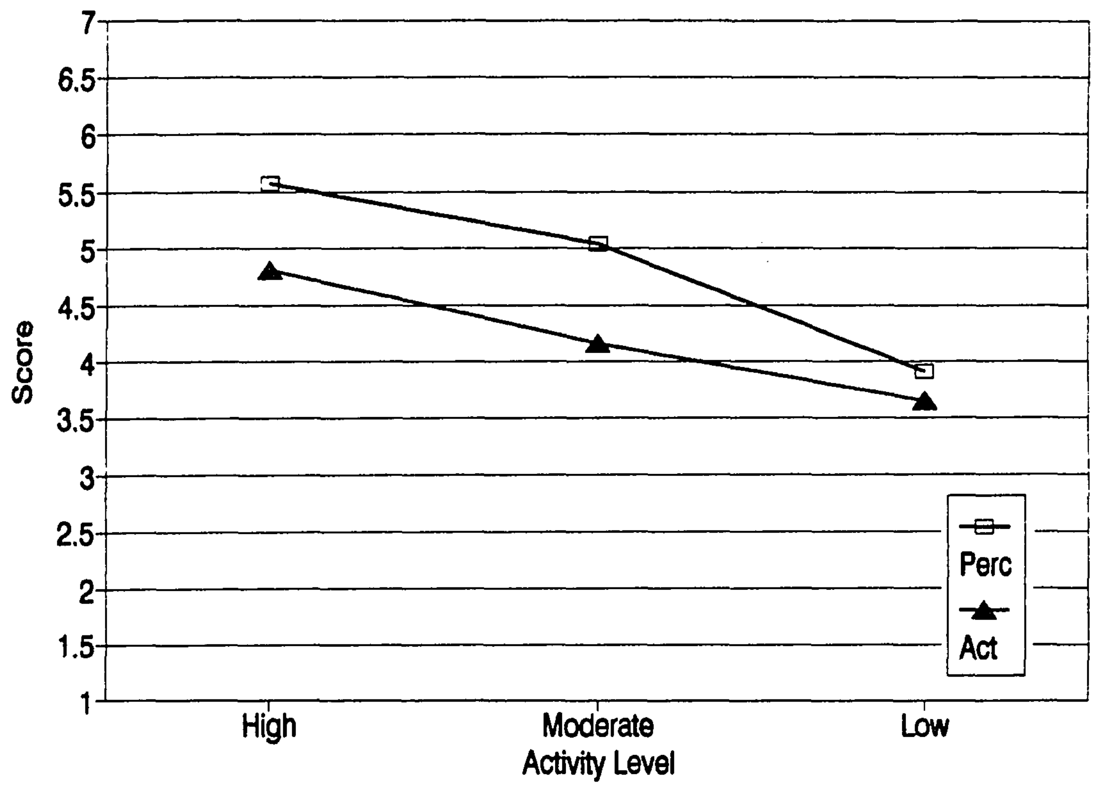


Figure 6

Fitness Assessment at Activity Level



These findings are corroborated by results of the study by McCollum and Golding (1992) where significant differences were found between perceived and actual fitness for individuals who reported high and moderate habitual activity but not for individuals who were inactive. The reason that significance was found in the previous study but only "approached" significance in the present study may be due to a different statistical treatment. Separate correlated t-tests, used in the previous study, were replaced by a more sophisticated factorial ANOVA.

Basis for Perception of Physical Fitness

A Pearson Product Moment Correlation Coefficient was used to determine the degree of relationship between the PPFI score and separate indices of measured physical fitness. Indices from the four fitness test components were compared with the Perceived Physical Fitness Index (PPFI) score for the entire sample and by gender. The four indices of measured physical fitness were gender and age-dependent scores earned from tests of the following health-related fitness components: body composition, cardiorespiratory endurance, muscular strength and endurance, and flexibility. Indices for both the PPFI and the measured physical fitness were based on 7-point scales.

Correlation matrices are presented in Table 11 for the entire sample and reported by gender. For the entire sample, the relationship between PPFI and body fat ($r = .46$, $p < .01$) was moderate but significant as was the relationship between PPFI and aerobic fitness ($r = .40$, $p < .01$). In addition, a low but significant relationship was found between the PPFI and the strength/endurance component ($r = .21$, $p < .05$). There were no significant

Table 11

Correlation of Perceived Fitness (PPFI) with Individual Indices of Measured Fitness

	PPFI	
	r	p
Entire Sample (N = 106)		
Body Fat Score	.46	<.01
Aerobic Score	.40	<.01
Strength/Endurance Score	.21	<.05
Flexibility Score	.14	ns
Females (N = 55)		
Body Fat Score	.49	<.01
Aerobic Score	.48	<.01
Strength/Endurance Score	.38	<.05
Flexibility Score	.25	ns
Males (N = 51)		
Body Fat Score	.35	<.05
Aerobic Score	.35	<.05
Strength/Endurance Score	.10	ns
Flexibility Score	.23	ns

correlations between PPFI and flexibility. (Note: A higher body fat score indicates a lower percentage of body fat).

The data was next analyzed by gender. For females, moderate but significant relationships were found between PPFI and body fat ($r = .49$, $p < .01$) and between PPFI and aerobic fitness ($r = .48$, $p < .01$). In addition, a fair but significant relationship was found between PPFI and strength/endurance ($r = .38$, $p < .05$). There was no significant correlation between PPFI and flexibility. For males, fair but significant relationships were found between PPFI and body fat ($r = .35$, $p < .05$) and between PPFI and aerobic fitness ($r = .35$, $p < .05$). No significant correlations existed between PPFI and strength/endurance or flexibility.

For the entire sample and for each gender, body fat and aerobic fitness had a higher relationship with perception of personal physical fitness than the other fitness components. The significant relationship that was found for the entire sample between PPFI and muscle strength/endurance was due to the females since there was no relationship for males. For this age group and this sample of subjects, it appears that body fat and aerobic fitness are given more emphasis as criteria in formulating a rating of personal physical fitness than muscular strength and endurance or flexibility.

Body fat and aerobic fitness were also found to have high relationships with perceived fitness in a study by Thornton et al. (1987) who compared an index of perceived physical ability (PPA) with individual indices of health-related physical fitness on 135 adult men and women. For the entire sample, the relationship between PPA and % body fat ($r = -.26$, $p < .001$) and aerobic fitness ($r = .24$, $p < .001$) were fair but significant. However, the relationships that Thornton et al. found between PPA and strength and flexibility were not

consistent with those reported in the present study. The relationship between PPA and flexibility was low but significant ($r = .15$, $p < .05$). The relationship between PPA and strength was not significant.

The perceived ability/strength relationship in the Thornton study may have differed from the perceived fitness/strength relationship found in the present study because different tests were used to measure strength. A grip strength test was used in the Thornton study and a bench press test was used in the present study. In addition, the perceived fitness instruments also differed. The PPA (perceived physical ability) was utilized in the Thornton study as the self-assessment instrument whereas the PPFI (perceived physical fitness index) was used in the present study. However, the difference in the perceived fitness/flexibility relationship between the two studies may be explained by the use of the different perceived fitness instruments. Both studies utilized the sit-and-reach test to evaluate flexibility.

Cross-Validation of the Perceived Physical Fitness Index (PPFI)

A Pearson correlation between Perceived Physical Fitness Index (PFFI) and the Abadie Perceived Physical Fitness Scale was calculated for the entire sample and by gender. The correlation matrix is presented in Table 12.

The relationship between the Perceived Physical Fitness Index (PPFI) and the Abadie Perceived Physical Fitness Scale was significant for the entire sample and across gender. The highest correlation was found for females ($r = .80$, $p < .01$) and for the entire sample ($r = .73$, $p < .01$). Among males, the relationship was moderately high ($r = .61$, $p < .01$). Thus, the Perceived Physical Fitness Index (PPFI) scale used in the present study showed a high relationship

with the Abadie Perceived Physical Fitness scale, indicating that the scale has good concurrent validity.

Table 12

Correlation of Perceived Physical Fitness Index (PPFI) with the Abadie Perceived Physical Ftness Scale

	PPFI	
	r	p
Abadie Scale		
Entire Sample (N = 106)	.73	<.01
Females (N = 55)	.80	<.01
Males (N = 51)	.61	<.01

Chapter 5

Summary and Conclusions

Summary

The physical fitness movement begun in the late 1960's continues to be popular, particularly with an aging public who now realize that fitness can make a difference in the quality of life. Much of this is due to an increase in public awareness of physical fitness through information dispensed by exercise scientists who have defined and explained fitness and its benefits through a variety of media outlets. Current research has established that the public are very interested in having their fitness evaluated but are frequently surprised by a discrepancy in a fitness rating produced by a fitness test and their personal perception of fitness. Although the public may have a general concept of "physical fitness" it was hypothesized that there is a poor relationship between an individual's self-assessed fitness and actual fitness.

Historically, perceived fitness has been studied primarily as it relates to psychological variables. Recently, studies have focused on identifying the reference group that is used by an individual when rating personal fitness or how perceived fitness relates to the public's concept of physical fitness. The question, however, of perceived physical fitness as an indicator of actual physical fitness still remained unclear.

The current study was designed to investigate the perception of personal physical fitness in adult men and women by comparing an index of perceived

fitness with a composite index of measured fitness. Perceived fitness was measured by the Perceived Physical Fitness Index (PPFI), a 7-point Likert-type scale ranging from "excellent" to "very poor." Actual fitness was defined as a composite of four components: body composition, cardiorespiratory endurance, muscular strength and endurance, and flexibility.

A 2 (gender) x 3 (activity level) x 2 (fitness assessment method) factorial Analysis of Variance (ANOVA) with repeated measures on the last factor was the statistical technique used for data analysis. The analysis revealed significant main effects for all three factors. Initial results indicated that perceived fitness was significantly different than actual measured fitness supporting the hypothesis that there is a poor relationship between perceived and actual fitness. However, a significant gender x fitness assessment (perceived/actual) interaction indicated that the difference between perceived and actual fitness was not consistent for males and females. Further analysis indicated that females were able to estimate their fitness level more accurately than males. Males tended to over-estimate their fitness level. Thus, perceived physical fitness appears to be a valid indicator of actual fitness for females but not for males.

An examination of the criteria used by adult men and women when formulating a rating of their personal physical fitness and a cross-validation of the Abadie Perceived Fitness Scale were also conducted. For the entire sample, percent body fat and aerobic fitness had a higher relationship with PPFI (r = .46 and .40, $p<$ .01, respectively) than the other fitness components, suggesting that body fat and aerobic fitness are given more emphasis as criteria in formulating a rating of personal physical fitness than muscular strength/endurance or flexibility. The relationship between the Perceived

Physical Fitness Index (PPFI) and Abadie's Perceived Physical Fitness Scale was also significant (r = .73, p< .01) indicating that the perceived fitness instrument used in the present study has good concurrent validity.

Conclusions

Based on results from this study, the following conclusions were reached:

1. Perceived physical fitness is not a valid indicator of actual physical fitness for men. Men rate their fitness level higher than physiological measures indicate.
2. Perceived physical fitness is a valid indicator of actual physical fitness for women. Females are able to estimate their fitness level accurately.
3. Body fat and aerobic fitness are given more emphasis by this age group as criteria for perception of personal physical fitness than muscular strength and endurance or flexibility.
4. The Perceived Physical Fitness Index (PPFI) has high concurrent validity with the Abadie Perceived Physical Fitness Scale.
5. According to National norms, physiological measures indicate that physical fitness for this age group is considered "average."
6. Individuals who demonstrate high activity level (i.e., high physiological fitness) are more likely to have companions who exercise regularly.

Recommendations

Based on conclusions from the present study, the following recommendations are offered:

1. All adult men between the ages of 36 and 55 should have their fitness assessed because their fitness level is likely to be lower than they realize. Fitness evaluations can provide realistic information about the status of their

physical fitness. Inactive men can use this information as a baseline for formulating a fitness program. For men already participating in a fitness program, evaluations can rate effectiveness and help monitor progress.

2. Both men and women in this age group need to improve their physical fitness.

3. Both men and women should seek and/or encourage companions to exercise for positive reinforcement and motivation for continued participation in activities that promote fitness.

Recommendations for Further Research

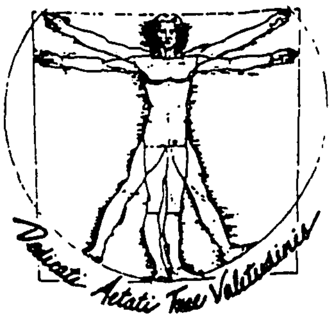
1. It is recommended that the present study be extended, specifically to study an equal number of subjects per activity level to determine if a significant difference exists between activity levels on the variables of perceived and actual fitness.

2. The relationship between health-related fitness and health (absence of disease) needs to be further examined (i.e., what levels of fitness are necessary to promote health).

Appendix A

Publicity

FREE % BODY FAT & FITNESS EVALUATION*



*for participating in a study on adult physical fitness

WHO: Adult Men and Women, age 36-55

WHAT: Approximately 40 minutes; Assessment includes aerobic fitness, flexibility, muscular strength/endurance and % body fat

WHERE: UNLV Exercise Physiology Lab
P.E. Building, Room 206

WHEN: November 1 - December 14, 1991

HOW: For information or to schedule an appointment, call Pat McCollum, 597-4102 or 739-3767

PRESS RELEASE

RELEASE DATE: October 28, 1991

FOR INFORMATION: Call Pat McCollum, 4102 or 3767

The UNLV Exercise Physiology Laboratory is conducting a study on the physical fitness of adult men and women 36 to 55 years of age. For participating, subjects will receive a fitness evaluation. One session of approximately 30 minutes is required and will be scheduled at the participant's convenience.

The four areas of physical fitness selected for evaluation are aerobic fitness, flexibility, muscular strength and endurance, and body composition (percent body fat). During the session subjects will be asked to perform three tests widely used for physical fitness assessment. They are a submaximal bicycle ergometer test, a sit-and-reach test of flexibility and a bench press test for strength. Each test will be explained and demonstrated.

Since body composition (percent body fat) is related to physical fitness, body composition will also be measured. Percent body fat will be predicted by measuring skinfolds at the abdomen, hip, tricep and thigh with skinfold calipers.

Aerobic fitness is important in cardiovascular health. People who perform aerobic exercise regularly have less risk of cardiovascular disease.

Flexibility is easy to increase and maintain at any age, but is also rapidly lost through sedentary living or physical inactivity. Good flexibility has been related to reduced injuries, good posture, less low back pain and good physical performance.

Muscular strength and endurance, developed through resistance training at a moderate intensity, is necessary for successful daily living and is a protection against sprains and strains.

A body composition analysis is important because it is generally accepted that a lean body performs better, looks better and is less of a health risk than an overweight body.

Information obtained from this study may affect how individuals exercise to maintain optimal health. In addition, subjects are expected to develop an awareness of their present condition and hopefully a desire to improve.

For further information or an appointment, call 739-3767.

UNLV Update
November 4, 1991

VOLUNTEERS NEEDED
The UNLV Exercise Physiology Laboratory is conducting a study on the physical fitness of adult men and women ages 36 to 55. Faculty and staff who participate will receive a fitness evaluation. Assessment includes body composition (percent body fat), aerobic fitness, flexibility and muscular strength, and endurance. One session of approximately 30 minutes is required and will be scheduled at the participant's convenience. For an appointment, contact Pat McCollum at Ext. 4102 or leave a message with the Exercise Physiology Lab at Ext. 3767.

Las Vegas Sun
November 11, 1991

■ FITNESS STUDY - The UNLV Exercise Physiology Laboratory is seeking volunteers for two physical fitness studies. For the first study, in which a 30-minute session is required, men and women 36-55 years of age are needed. For the second study, which requires two 15-minute sessions, women 21-35 years of age and 45-65 years of age are needed. In exchange for participating, subjects will receive a fitness evaluation. Call 739-3767.

Las Vegas Review-Journal
November 10, 1991

Exercise study volunteers needed

The UNLV Exercise Physiology Laboratory is seeking volunteers for two physical fitness studies.

For the first study, men and women from 36 to 55 years of age are needed. For the second study, women from 21 to 35 years of age and from 45 to 65 years of age are needed.

The first study will measure four areas of physical fitness — aerobic fitness, muscular strength and endurance, flexibility and body composition. The body composition portion of the study will determine each participant's percentage of body fat.

One 30-minute session is required and will be scheduled at the participant's convenience.

In exchange for participating, subjects will receive a fitness evaluation. To schedule an appointment or to obtain further information, call Pat at 739-3767.

Participants in the second study, which is a strength reliability study, will be required to participate in two 15-minute sessions.

To schedule an appointment or to obtain further information, call Aliza at 739-3767.

Appendix B

Questionnaire

COLLEGE OF HUMAN PERFORMANCE AND DEVELOPMENT
EXERCISE PHYSIOLOGY LABORATORY

Questionnaire

Subject # ____________

Name ____

Address ____

Occupation____

Any college education?__________

Currently married? __________Previously married? __________

How many dependents living at home? __________

Does your spouse/significant other exercise regularly?__________

Do you regularly engage in strenuous exercise or hard physical labor?________

If yes, please answer the following:

Do you labor or exercise strenuously at least 3 times a week?________

If yes, please answer the following:

How long have you exercised regularly (at least 3 times a week)?____________________________

Appendix C

Perceived Physical Fitness Index

PERCEIVED PHYSICAL FITNESS INDEX

How do you rate your physical fitness?

Excellent

Good

Above Average

Average

Below Average

Poor

Very Poor

Appendix D

Physical Acitivity Readiness Questionnaire

Physical Activity Readiness Questionnaire (PAR-Q)*

NAME OF PARTICIPANT ______________________

SIGNATURE ______________________

DATE ______________________

PAR Q & YOU

PAR-Q is designed to help you help yourself. Many health benefits are associated with regular exercise, and the completion of PAR-Q is a sensible first step to take if you are planning to increase the amount of physical activity in your life.

For most people physical activity should not pose any problem or hazard. PAR-Q has been designed to identify the small number of adults for whom physical activity might be inappropriate or those who should have medical advice concerning the type of activity most suitable for them.

Common sense is your best guide in answering these few questions. Please read them carefully and check (✓) the ☐ YES or ☐ NO opposite the question if it applies to you.

YES	NO	
☐	☐	1. Has your doctor ever said you have heart trouble?
☐	☐	2. Do you frequently have pains in your heart and chest?
☐	☐	3. Do you often feel faint or have spells of severe dizziness?
☐	☐	4. Has a doctor ever said your blood pressure was too high?
☐	☐	5. Has your doctor ever told you that you have a bone or joint problem such as arthritis that has been aggravated by exercise, or might be made worse with exercise?
☐	☐	6. Is there a good physical reason not mentioned here why you should not follow an activity program even if you wanted to?
☐	☐	7. Are you over age 65 and not accustomed to vigorous exercise?

If You Answered

YES to one or more questions

If you have not recently done so, consult with your personal physician by telephone or in person BEFORE increasing your physical activity and/or taking a fitness appraisal. Tell your physician what questions you answered YES to on PAR-Q or present your PAR-Q copy.

programs

After medical evaluation, seek advice from your physician as to your suitability for:

- unrestricted physical activity starting off easily and progressing gradually
- restricted or supervised activity to meet your specific needs, at least on an initial basis. Check in your community for special programs or services.

NO to all questions

If you answered PAR-Q accurately, you have reasonable assurance of your present suitability for:

- A GRADUATED EXERCISE PROGRAM – a gradual increase in proper exercise promotes good fitness development while minimizing or eliminating discomfort.
- A FITNESS APPRAISAL – the Canadian Standardized Test of Fitness (CSTF).

postpone

If you have a temporary minor illness, such as a common cold.

*Developed by the British Columbia Ministry of Health. Conceptualized and critiqued by the Multidisciplinary Advisory Board on Exercise (MABE). Translation, reproduction and use in its entirety is encouraged. Modifications by written permission only. Not to be used for commercial advertising in order to solicit business from the public.
Reference: PAR-Q Validation Report, British Columbia Ministry of Health, 1978.
*Produced by the British Columbia Ministry of Health and Department of National Health and Welfare. Modifications by the American College of Sports Medicine with the expressed, written permission of the British Columbia Ministry of Health.

Appendix E

Subject Consent Form

COLLEGE OF HUMAN PERFORMANCE AND DEVELOPMENT
EXERCISE PHYSIOLOGY LABORATORY

CONSENT FOR RESEARCH PARTICIPATION
UNIVERSITY OF NEVADA, LAS VEGAS

Title of Study: The Validity of Perceived Physical Fitness in Adult Men and Women

You have volunteered to participate in a study which involves the validation of perceived physical fitness. You will be asked to participate in one session only of approximately 30 minutes.

During the session, you will be asked to perform a submaximal bike test, a sit-and-reach flexibility test and a bench press test. In addition, your body fat will be estimated by a skinfold caliper method. The test administrator will demonstrate and explain all the tests.

You will also be asked to complete a health and physical fitness self-assessment questionnaire. The questionnaire and the subsequent data that is collected will be associated only by number. Your identity will remain anonymous throughout the study and the publication of its results.

Your participation is voluntary and you are free to withdraw your consent and discontinue participation at any time. If at any time during the project you are unsure about the procedures, feel free to ask the experimenter for clarification.

YOUR SIGNATURE BELOW INDICATES THAT YOU HAVE DECIDED TO PARTICIPATE IN THE STUDY AND THAT YOU HAVE READ THE INFORMATION PROVIDED ABOVE, AND THAT ANY QUESTIONS HAVE BEEN ANSWERED TO YOUR SATISFACTION.

____________	____________________	__________________
Date	Signature of Participant	Print Name
____________	____________________	__________________
Date	Signature of Witness	Print Name

Appendix F

Physical Fitness Self-Assessment

PHYSICAL FITNESS SELF-ASSESSMENT

Directions: The following statements are designed to assess your physical fitness. Please read each statement carefully, and then select one of the five alternatives by circling your choice. Ratings are Strongly disagree, Disagree, Undecided, Agree, and Strongly agree.

1. I am in good physical condition	SD	D	U	A	SA
2. I need to alter (lose or gain) my weight in order to improve my physical health	SD	D	U	A	SA
3. I am better able to walk briskly for twenty minutes than most individuals my age	SD	D	U	A	SA
4. I am as physically strong as I need to be	SD	D	U	A	SA
5. An object that I can lift once with slight difficulty soon becomes strenuous when I attempt to lift it repeatedly	SD	D	U	A	SA
6. I possess greater muscular flexibility than most individuals my age	SD	D	U	A	SA
7. I am more overweight than most individuals my age	SD	D	U	A	SA
8. When I exercise I tire easily	SD	D	U	A	SA
9. I am more physically fit than most individuals my age	SD	D	U	A	SA
10. I am a very limber (flexible) individual	SD	D	U	A	SA
11. I possess less muscular strength than most individuals my age	SD	D	U	A	SA
12. I need to improve my present over-all physical condition	SD	D	U	A	SA

Adapted from Abadie, B.R. (1988). Construction and validation of a perceived physical fitness scale. *Perceptual and Motor Skills, 67,* 887-892.

Appendix G

Abadie Perceived Physical Fitness Scale

PERCEIVED PHYSICAL FITNESS

Perceived Physical Fitness Scale

Directions: The following statements are designed to assess your perception of your physical fitness. Please read each statement carefully, and then select one of the five alternatives by circling your choice.

	Item Content	Rating*					Scoring				
1	I am in good physical condition	SD	D	U	A	SA	1	2	3	4	5
2.	I need to alter (lose or gain) my weight in order to improve my physical health	SD	D	U	A	SA	5	4	3	2	1
3.	I am better able to walk briskly for twenty minutes than most individuals my age	SD	D	U	A	SA	1	2	3	4	5
4.	I am as physically strong as I need to be	SD	D	U	A	SA	1	2	3	4	5
5.	An object that I can lift once with slight difficulty soon becomes strenuous when I attempt to lift it repeatedly	SD	D	U	A	SA	5	4	3	2	1
6.	I possess greater muscular flexibility than most individuals my age	SD	D	U	A	SA	1	2	3	4	5
7.	I am more overweight than most individuals my age	SD	D	U	A	SA	5	4	3	2	1
8.	When I exercise I tire easily	SD	D	U	A	SA	5	4	3	2	1
9.	I am more physically fit than most individuals my age	SD	D	U	A	SA	1	2	3	4	5
10.	I am a very limber (flexible) individual	SD	D	U	A	SA	1	2	3	4	5
11.	I possess less muscular strength than most individuals my age	SD	D	U	A	SA	5	4	3	2	1
12.	I need to improve my present over-all physical condition	SD	D	U	A	SA	5	4	3	2	1

*Ratings were Strongly agree, Agree, Undecided, Disagree, Strongly disagree.

From Abadie, B.R. (1988). Construction and validation of a perceived physical fitness scale. *Perceptual and Motor Skills, 67,* 887-892.

Appendix H

Subject Data Form

COLLEGE OF HUMAN PERFORMANCE AND DEVELOPMENT
EXERCISE PHYSIOLOGY LABORATORY

SUBJECT DATA FORM

SUBJECT # ________

AGE ________
GENDER ________
Act. Level ________

HEIGHT ________
WEIGHT ________

SKINFOLDS:
Abdomen ________
Ilium ________
Triceps ________
Thigh ________

% FAT ________

S & R ________ ________ ________

Bench ________

VO2 max ________

PPFI ________
Abadie ________

% Fat ________
Flexibility ________
Strength ________
Aerobic ________

Composite ________

Appendix I

Fitness Evaluation and Information Form

COLLEGE OF HUMAN PERFORMANCE AND DEVELOPMENT
EXERCISE PHYSIOLOGY LABORATORY

FITNESS EVALUATION AND INFORMATION

Body Composition

A body composition profile is an important part of most physical fitness test batteries because it is generally accepted that a lean body performs better, looks better and is less of a health risk than an overweight body.

Your body is made up of lean body weight (bones, muscles, organs) and fat weight. Fat weight is divided into structural (essential) fat and storage fat. Storage fat is a result of excess calories eaten. Much of this is deposited directly below the skin and above the muscle. This storage fat is what the skinfold calipers measure.

The average % fat is what the average population measures. However, average does not necessarily mean desirable! The average and desirable norms for the population are listed below.

To affect a positive change in your body composition it is recommended that you increase the amount of regular exercise. If weight reduction is your goal, you can also decrease your caloric intake by reducing the amount of fat in your diet.

<u>% Fat Norms</u>

FEMALE	Average	25-32% fat	Desirable	19-23% fat
MALE	Average	15-25%	Desirable	16-19% fat

YOUR TOTAL BODY WT._______% BODY FAT_______TARGET WT._______

Aerobic Fitness

Aerobic fitness is important in cardiovascular health. People who perform aerobic exercise regularly have less risk of cardiovascular disease. Aerobic exercise does not necessarily mean aerobic dance. Aerobic exercise is any exercise that utilizes large muscle groups, exercises the heart and lungs and can be maintained for a period of time at a moderate rate. This includes walking, swimming, jogging, bicycling and climbing stairs among many others.

The American College of Sports Medicine (ACSM) recommends the following guidelines for improvement and maintenance of cardiorespiratory endurance:

Aerobic Exercise 3-6 times per week
30-60 minutes each time
60-85% of maximum heart rate

Your maximum heart rate is estimated by the formula "220-age." A good rule of thumb is to exercise at a pace you can maintain for at least 30 minutes. The secret is to find something that you enjoy so that your exercise sessions are repeated often.

Aerobic fitness can be estimated from the bicycle ergometer test which is a sub-maximal test. The two measures it provides are predicted maximum physical working capacity and predicted maximum oxygen uptake. Both measures and the National norm tables are based on your maximum heart rate of 220-age. Remember, these are only estimates.

YOUR SCORE (PWC)_______ YOUR SCORE (VO2)_______

Flexibility

Flexibility may be defined as the capacity to move a limb or body part through its range of motion. Since flexibility is essentially joint specific, a fitness program should emphasize good range of motion in all joints.

Flexibility is easy to increase and maintain at any age, but it is also rapidly lost through sedentary living or physical inactivity. Good flexibility has been related to reduced injuries, good posture, less low back pain and good physical performance.

To improve your flexibility, frequently move each joint through its range of motion. Gently stretch your muscles without a bouncing or fast motion.

Although flexibility is joint specific, many fitness test batteries use the sit-and-reach test as an indicator of general flexibility.

YOUR SCORE_______

Muscular Strength and Endurance

Resistance/strength training of a moderate intensity is an important part of any fitness program. ACSM recommends one set of 8-12 repetitions of eight to ten exercises that exercise the major muscle groups at least twice a week.

To increase strength in any muscle, an overload is necessary. Weight lifting is the usual exercise associated with strength building. However, calisthenics, which are exercises in which the body itself is used as resistance, are readily available and require no equipment. Calisthenics include sit-ups (or crunches), push-ups, leg lifts, half-squats, hopping in place and many others.

The bench press test is a good test of both muscular strength and endurance.

YOUR SCORE_______

Evaluation Profile

The National YMCA has developed population norms based on 33,000 people. These are the best "average" comparisons available so they are used to indicate your standing with individuals of your sex and age. The following page presents your fitness profile.

Thank you for participating in this study.
Patricia M. McCollum

Appendix J

YMCA Evaluation Profiles

Y's Way to Physical Fitness

Physical Fitness Evaluation Profile

Norms—Women 36-45

Name ______________________ Dates: T1 ________ T2 ________ T3 ________

Rating	% ranking	Resting HR	% fat	3-min step test	PWC max (kgm)	$\dot{V}O_2max$ (mL/kg)	Flexibility	Bench press	Sit-ups
Excellent	100 95 90	54 56 59	15 17 19	74 80 87	1780 1360 1215	66 53 46	25 23 22	46 32 28	50 38 34
Good	85 80 75	62 63 64	20 21 23	93 97 101	1135 1085 1035	44 41 39	21 20 19	25 22 21	30 29 27
Above average	70 65 60	66 68 69	24 25 26	104 106 109	980 925 880	37 36 34	19 18 17	20 18 17	26 25 24
Average	55 50 45	70 71 72	27 28 29	111 114 117	835 800 765	33 32 31	17 16 16	14 13 12	22 21 20
Below average	40 35 30	74 76 78	30 31 32	120 122 127	745 720 695	30 29 28	15 15 14	11 10 9	18 17 16
Poor	25 20 15	79 80 82	33 35 36	130 135 138	670 625 575	26 25 23	13 12 11	8 6 4	14 12 10
Very poor	10 5 0	84 88 92	39 41 48	143 146 152	530 490 470	21 19 18	10 9 6	2 1 0	6 2 1

From Golding, L.A., Myers, C.R. & Sinning, W.E. (Eds.). (1989). *Y's way to physical fitness.* Champaign, IL: Human Kinetics.

Y's Way to Physical Fitness

Physical Fitness Evaluation Profile

Norms—Women 46-55

Name ______________________ Dates: T1 ________ T2 ________ T3 ________

Rating	% ranking	Resting HR	% fat	3-min step test	PWC max (kgm)	$\dot{V}O_2max$ (mL/kg)	Flexibility	Bench press	Sit-ups
Excellent	100	54	18	76	1700	64	24	42	42
	95	56	19	88	1245	48	22	30	30
	90	60	22	93	1130	42	21	26	28
Good	85	61	23	96	1045	39	20	22	25
	80	64	24	100	980	36	19	21	24
	75	65	25	102	930	35	18	20	22
Above average	70	66	26	106	885	33	18	17	21
	65	68	27	111	850	32	17	14	20
	60	69	28	113	815	31	17	13	18
Average	55	70	29	117	790	30	16	12	17
	50	72	30	118	760	29	16	11	16
	45	73	31	120	730	28	15	10	14
Below average	40	74	32	121	700	27	15	9	13
	35	76	33	124	670	26	14	8	12
	30	77	34	126	640	25	14	6	10
Poor	25	78	36	127	610	24	13	5	9
	20	81	37	131	585	23	12	4	8
	15	84	38	133	545	21	11	2	6
Very poor	10	85	40	138	495	19	10	1	4
	5	90	42	147	430	18	8	0	1
	0	96	49	152	400	16	4	0	0

From Golding, L.A., Myers, C.R. & Sinning, W.E. (Eds.). (1989). *Y's way to physical fitness.* Champaign, IL: Human Kinetics.

Y's Way to Physical Fitness

Physical Fitness Evaluation Profile

Norms—Men 36-45

Name ______________________ Dates: T1 ________ T2 ________ T3 ________

Rating	% ranking	Resting HR	% fat	3-min step test	PWC max (kgm)	$\dot{V}O_2max$ (mL/kg)	Flexibility	Bench press	Sit-ups
Excellent	100 95 90	50 53 56	10 12 14	72 74 81	2250 2055 1815	77 60 53	24 21 19	40 34 30	50 46 42
Good	85 80 75	60 61 62	16 17 18	86 90 94	1725 1640 1565	49 46 44	19 17 17	28 25 24	40 37 36
Above average	70 65 60	64 65 66	19 20 21	98 100 102	1500 1440 1375	42 41 40	17 15 15	22 21 20	34 32 30
Average	55 50 45	68 69 70	22 23 24	105 108 111	1325 1280 1235	38 37 35	15 14 13	18 17 16	29 29 28
Below average	40 35 30	73 74 76	25 26 26	113 116 118	1190 1140 1090	34 33 32	13 11 11	14 13 12	26 25 24
Poor	25 20 15	77 80 82	27 28 29	120 124 128	1045 995 945	30 28 27	11 9 9	10 9 8	22 20 18
Very poor	10 5 0	86 90 96	30 32 38	132 142 168	860 745 700	25 21 19	7 5 1	5 2 0	16 9 4

From Golding, L.A., Myers, C.R. & Sinning, W.E. (Eds.). (1989). *Y's way to physical fitness.* Champaign, IL: Human Kinetics.

Y's Way to Physical Fitness

Physical Fitness Evaluation Profile

Norms—Men 46-55

Name ______________________ Dates: T1 ________ T2 ________ T3 ________

Rating	% ranking	Resting HR	% fat	3-min step test	PWC max (kgm)	$\dot{V}O_2max$ (mL/kg)	Flexibility	Bench press	Sit-ups
Excellent	100	50	12	78	2150	60	23	35	50
	95	53	14	81	1940	54	20	28	41
	90	57	16	84	1645	47	19	24	36
Good	85	59	18	89	1520	43	17	22	33
	80	60	19	93	1450	42	17	21	30
	75	63	20	96	1385	40	16	20	29
Above average	70	64	21	99	1335	38	15	17	28
	65	65	22	101	1285	36	15	16	26
	60	67	23	103	1240	35	14	14	25
Average	55	68	24	109	1205	35	13	13	24
	50	69	24	113	1165	34	12	12	22
	45	71	25	115	1130	32	12	10	22
Below average	40	73	26	118	1090	31	11	10	21
	35	75	27	120	1055	30	10	9	20
	30	76	28	121	1020	29	10	8	18
Poor	25	79	29	124	950	28	9	6	17
	20	80	30	126	935	27	8	5	16
	15	83	31	130	885	26	7	4	13
Very poor	10	85	32	135	830	23	6	2	12
	5	91	34	145	750	22	4	1	8
	0	97	38	158	700	18	1	0	4

From Golding, L.A., Myers, C.R. & Sinning, W.E. (Eds.). (1989). *Y's way to physical fitness.* Champaign, IL: Human Kinetics.

Appendix K

Raw Data

Raw Data

Variable ID:

Column	Variable	Column	Variable
1	Subject	8	Self assessment
2	Gender	9	Fat score
3	Age	10	Flexibility score
4	Activity Level	11	Aerobic score
5	Height (in)	12	Strength score
6	Weight (lbs)	13	Composite score
7	Perceived fitness score	14	Percent fat

1	F	38	1	64.5	121.5	5	51	7	7.0	5.0	6.0	6.25	7.5
2	M	46	1	69.5	153.0	7	47	7	1.0	7.0	1.0	4.00	12.3
3	M	52	1	67.5	177.0	5	47	2	4.0	2.0	7.0	3.75	30.0
4	F	47	3	67.0	157.0	5	41	2	4.0	3.0	5.0	3.50	36.0
5	F	51	2	67.0	162.0	6	43	2	4.0	2.0	5.0	3.25	36.0
6	M	52	1	71.0	190.0	5	53	4	5.0	2.0	7.0	4.50	30.0
7	M	43	1	74.0	198.0	6	36	3	3.0	4.0	4.0	3.50	25.0
8	F	43	3	65.5	188.0	3	41	2	6.0	2.0	6.0	4.00	36.0
9	F	36	3	64.5	209.0	3	24	1	4.0	1.0	6.0	3.00	41.0
10	F	39	2	63.5	141.0	3	31	3	5.0	3.0	5.0	4.00	39.0
11	F	37	2	62.0	115.0	6	35	4	5.0	1.0	7.0	4.25	28.0
12	M	54	3	68.5	212.0	5	36	1	4.0	2.0	5.0	3.00	35.0
13	M	36	1	70.5	160.0	5	44	6	6.0	7.0	3.0	5.50	15.5
14	M	55	2	67.0	164.0	7	41	5	5.0	1.0	5.0	4.00	22.1
15	F	40	3	64.0	156.0	5	34	1	4.0	1.0	5.0	2.75	37.7
16	F	45	2	65.5	126.0	6	50	6	7.0	5.0	7.0	6.25	22.6
17	F	42	3	63.5	156.0	3	24	2	6.0	1.0	3.0	3.00	37.7
18	M	55	3	63.5	124.0	4	30	6	3.0	4.0	2.0	3.75	18.7
19	F	38	3	68.0	170.0	5	36	1	1.0	1.0	5.0	2.00	38.0
20	F	41	3	63.5	161.0	2	21	2	3.0	2.0	6.0	3.25	35.6
21	F	47	3	64.0	125.0	4	38	4	7.0	5.0	4.0	5.00	29.2
22	F	39	3	67.0	138.0	3	34	4	5.0	3.0	5.0	4.25	28.0
23	M	52	3	67.5	162.0	4	25	3	2.0	1.0	4.0	2.50	28.2
24	F	48	3	65.0	132.0	3	31	5	3.0	4.0	1.0	3.25	28.3
25	F	54	2	62.0	116.0	5	42	6	3.0	6.0	4.0	4.75	22.9
26	F	39	1	65.5	116.0	6	46	7	6.0	6.0	7.0	6.50	11.0
27	M	40	2	74.0	220.0	5	36	3	2.0	2.0	7.0	3.50	25.7
28	F	42	2	65.0	122.0	4	40	6	6.0	4.0	6.0	5.50	23.5
29	F	40	3	63.5	125.0	4	36	5	2.0	4.0	4.0	3.75	26.8
30	M	45	2	72.0	184.0	4	38	4	5.0	1.0	4.0	3.50	22.6
31	M	52	3	76.0	206.0	7	42	5	6.0	3.0	7.0	5.25	22.3
32	M	40	1	71.5	170.0	6	48	5	1.0	6.0	7.0	4.75	20.7
33	F	41	1	63.5	150.0	4	37	2	7.0	2.0	5.0	4.00	33.8
34	F	38	1	67.0	131.0	6	51	7	6.5	5.5	7.0	6.50	18.8
35	M	47	1	66.0	160.0	7	45	7	6.0	7.0	7.0	6.75	14.7
36	M	44	1	73.0	190.0	7	60	7	6.0	7.0	7.0	6.75	11.0

37	F	46	3	62.0	144.0	3	31	3	6.0	2.0	3.0	3.50	35.0
38	F	44	3	63.5	148.0	4	36	2	3.0	3.0	5.0	3.25	35.1
39	M	54	1	66.0	173.0	6	48	5	2.0	3.0	7.0	4.25	22.1
40	F	36	1	68.5	140.0	6	49	5	6.0	4.0	6.0	5.25	26.0
41	F	45	1	64.5	136.0	5	39	4	4.0	3.0	7.0	4.50	27.1
42	F	51	2	65.0	162.0	5	39	3	7.0	3.0	3.0	4.00	34.2
43	M	50	1	70.0	175.0	6	50	6	3.0	2.0	3.0	3.50	20.0
44	M	47	1	65.5	150.0	6	55	7	6.0	4.0	7.0	6.00	12.3
45	F	42	1	65.0	140.0	5	43	5	5.0	3.0	7.0	5.00	26.8
46	F	48	3	61.5	146.0	4	35	3	4.0	1.0	6.0	3.50	33.3
47	M	51	3	69.5	155.0	5	50	5	3.0	1.0	4.0	3.25	23.4
48	M	36	1	69.5	164.0	4	34	7	6.0	5.0	6.0	6.00	14.4
49	F	37	2	68.0	158.0	4	32	4	0.0	2.0	4.0	2.50	28.9
50	F	52	1	65.5	135.0	6	50	5	7.0	3.0	7.0	5.50	27.2
51	M	54	2	74.5	182.0	6	43	7	1.0	3.0	4.0	3.75	16.3
52	F	43	1	61.0	127.0	5	40	4	7.0	2.0	7.0	5.00	27.1
53	M	37	1	72.5	193.0	5	43	6	4.0	7.0	4.0	5.25	18.9
54	F	36	1	69.0	135.0	5	48	6	6.0	5.0	6.0	5.75	22.0
55	M	42	1	76.0	210.0	4	56	6	4.0	2.0	7.0	4.75	17.5
56	F	46	3	67.0	175.0	2	28	4	6.0	2.0	4.0	4.00	31.2
57	M	40	1	71.5	169.0	6	40	5	6.0	4.0	2.0	4.25	19.7
58	F	49	1	69.0	150.0	6	47	6	4.0	5.0	6.0	5.25	25.0
59	M	44	1	70.5	156.0	7	50	7	7.0	4.0	1.0	4.75	14.7
60	F	42	1	63.5	104.0	3	38	6	1.0	5.0	3.0	3.75	20.0
61	F	38	2	62.5	144.0	4	39	2	3.0	3.0	6.0	3.50	33.8
62	F	40	1	64.5	120.0	5	37	6	1.0	1.0	3.0	2.75	20.0
63	M	46	1	71.0	167.0	6	43	4	5.0	5.0	7.0	5.25	24.6
64	F	50	1	63.0	130.0	6	53	5	6.5	4.5	6.0	5.50	26.0
65	M	52	1	73.0	186.0	6	44	4	5.0	3.0	7.0	4.75	25.4
66	F	43	3	62.5	124.0	4	37	6	3.0	3.0	4.0	4.00	20.2
67	M	39	3	67.5	132.0	6	51	7	7.0	3.0	5.0	5.50	8.9
68	F	39	1	64.5	127.0	5	38	6	3.0	5.0	5.0	4.75	23.5
69	F	49	1	64.0	137.0	4	42	4	6.0	2.0	6.0	4.50	31.3
70	M	44	1	71.0	214.0	6	37	1	1.0	2.0	6.0	2.50	30.0
71	M	44	2	74.0	224.0	5	36	3	4.0	3.0	7.0	4.25	25.6
72	F	42	1	62.5	123.0	5	42	6	6.0	4.0	4.0	5.00	23.5
73	M	41	3	72.5	173.0	4	40	5	4.0	3.0	3.0	3.75	19.7
74	F	41	3	64.0	116.0	4	43	6	2.0	5.0	3.0	4.00	21.2
75	M	42	1	70.0	174.0	6	43	7	6.0	6.0	7.0	6.50	14.0
76	M	36	1	73.0	216.0	7	51	4	1.0	4.0	7.0	4.00	24.0
77	M	37	1	70.0	189.0	5	37	5	3.0	2.0	7.0	4.25	21.0
78	M	44	1	68.5	222.0	5	40	1	2.0	2.0	2.0	1.75	32.4
79	F	47	1	62.0	112.0	7	50	6	7.0	6.0	5.0	6.00	23.7
80	F	53	3	64.0	190.0	3	28	3	7.0	1.0	7.0	4.50	33.3
81	F	43	3	63.5	166.0	2	24	1	2.0	1.0	2.0	1.50	37.2
82	F	42	3	66.5	162.0	3	32	2	2.0	1.0	7.0	3.00	32.9
83	F	40	3	64.0	118.0	5	50	6	6.0	3.0	5.0	5.00	23.5
84	M	55	1	68.0	139.0	5	43	7	4.0	6.0	4.0	5.25	13.9
85	M	46	3	69.5	170.0	4	38	6	2.0	5.0	4.0	4.25	20.5
86	F	44	1	60.5	111.0	6	40	6	2.0	4.0	5.0	4.25	22.6
87	M	38	3	70.5	257.0	3	24	2	3.0	1.0	6.0	3.00	27.5
88	M	46	1	69.0	225.0	5	39	3	2.0	2.0	7.0	3.50	26.5
89	F	54	2	59.5	108.0	5	41	6	4.0	6.0	5.0	5.25	25.2
90	M	53	1	72.0	205.0	7	53	5	6.0	2.0	7.0	5.00	22.1

91	M	40	1	70.0	140.0	7	48	7	7.0	3.0	1.0	4.50	10.2
92	M	47	1	70.0	182.0	7	52	6	7.0	6.0	7.0	6.50	18.2
93	M	45	1	65.5	167.0	7	46	4	3.0	5.0	7.0	4.75	23.6
94	F	42	1	68.0	158.0	5	39	4	7.0	6.0	7.0	6.00	27.9
95	F	38	1	66.5	192.0	3	34	2	3.0	1.0	6.0	3.00	35.6
96	M	36	1	73.5	166.0	7	46	7	1.0	4.0	7.0	4.75	11.9
97	M	47	1	71.5	244.0	4	31	3	1.0	2.0	7.0	3.25	27.4
98	M	40	2	71.5	184.0	5	35	3	1.0	3.0	6.0	3.25	25.7
99	M	40	2	69.5	149.0	6	41	7	7.0	2.5	6.5	5.75	8.9
100	F	44	3	64.0	116.0	4	36	5	2.0	3.0	3.0	3.25	24.9
101	M	54	2	67.0	172.0	5	39	3	2.0	2.0	2.0	2.25	28.1
102	M	44	1	68.0	148.0	6	41	7	2.0	2.0	7.0	4.50	14.7
103	F	47	1	63.0	123.0	5	44	7	4.0	5.0	6.0	5.50	20.2
104	M	47	2	68.0	168.0	5	37	6	7.0	3.0	6.0	5.50	20.5
105	M	36	3	72.5	182.0	5	38	5	4.0	2.0	4.0	3.75	21.0
106	F	39	3	66.0	140.0	4	43	6	7.0	3.0	5.0	5.25	22.3

Bibliography

Abadie, B.R. (1988). Construction and validation of a perceived physical fitness scale. *Perceptual and Motor Skills, 67*, 887-892.

Abadie, B.R. (1988). Relating trait anxiety to perceived physical fitness. *Perceptual and Motor Skills, 67,* 539-543.

Adams, W.C. (1991). *Foundations of physical education, exercise, and sport sciences.* Philadelphia: Lea & Febiger.

American Alliance for Health, Physical Education, Recreation and Dance. (1980). *Lifetime health-related physical fitness test manual.* Reston, VA: AAHPERD.

American Alliance for Health, Physical Education, Recreation and Dance. (1984). *Technical manual. Health-related physical fitness.* Reston, VA: AAHPERD.

American College of Sports Medicine. (1988). *Resource manual for guidelines for exercise testing and prescription.* Philadelphia: Lea & Febiger

American College of Sports Medicine. (1991). *Guidelines for exercise testing and prescription* (4th ed.). Philadelphia: Lea & Febiger.

Astrand, P.O., & Rodahl, K. (1986). *Textbook of work physiology* (3rd ed.). New York: McGraw-Hill.

Bailey, D.A., Shephard, R.J., Mirwald, R.L., & McBride, G.A. (1974). A current view of Canadian cardiorespiratory fitness. *Canadian Medical Association Journal, 111,* 25-30.

Bailey, D.A., Shephard, R.J., & Mirwald, R.L. (1976). Validation of a self-administered home test of cardio-respiratory fitness. *Canadian Journal of Applied Sport Sciences, 1,* 67-78.

Balke, B. (1963). A simple field test for assessment of physical fitness. *Civil Aeromedical Research Institute Report*, 63-66.

Barney, R.K. (1972). An historical reinterpretation of the forces underlying the first state legislation for physical education in the public schools of the United States with special attention to the role played by the early California Turnvereine. *Proceedings of the Second Canadian Symposium, The History of Sport and Physical Education* (pp. 267-273). Ottawa, Canada: Sport Canada Directorate, Department of Health and Welfare.

Blair, S.N., Kohl, H.W., Paffenbarger, R.S., Clark, D.G., Cooper, K.H. & Gibbons, L.W. (1989). Physical fitness and all-cause mortality. A prospective study of healthy men and women. *Journal of the American Medical Association, 262*(17), 2395-2401.

Bowerman, W.J., & Harris, W.E. (1968). *Jogging.* New York: Grosset & Dunlap.

Brodie, D.A., Lamb, K.L., & Roberts, K. (1988). Body composition and self-perceived health and fitness among indoor sports participants. *Ergonomics, 31*(11), 1551-1557.

Brown, B. (1990, May 3). Spring Fitness Test. *USA Today,* 12C.

Bucher, C.A. (1968). *Foundations of physical education.* St. Louis, MO: C.V. Mosby.

Caspersen, C.J., Powell, K.E., & Christenson, G.M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health related research. *Public Health Report, 100,* 126-131.

Chisholm, D.M., Collis, M.L., Kulak, L.L., Davenport, W., & Gruber, N. (1975). Physical activity readiness. *British Columbia Medical Journal, 17,* 375-378.

Clarke, H.H. (1966). *Muscular strength and endurance in man.* Englewood Cliffs, NJ: Prentice-Hall.

Cooper, K.H. (1977). *The aerobics way.* New York: Bantam Books.

Cureton, K.J. & Warren, G.L. (1990). Criterion-referenced standards for youth health-related fitness tests: a tutorial. *Research Quarterly for Exercise and Sport, 61*(1), 7-19.

Cureton, T.K., Jr. (1947). *Physical fitness appraisal and guidance.* St. Louis: C.V. Mosby.

Cureton, T.K., Jr. (1951). *Physical fitness of champion athletes.* Urbana: University of Illinois Press.

Cureton, T.K., Jr. (1965). *Physical fitness and dynamic health.* New York: Dial Press.

Dacuma, N. & Golding, L.A. (1992). *The reliability of the bench press test for strength and muscular endurance assessment.* Unpublished manuscript.

Decker, J.I., Orcutt, G., & Sammann, P. (1989). *Y's way to fitness walking.* Champaign, IL: Human Kinetics.

Fleishman, E.A. (1964). *The structure and measurement of physical fitness.* Englewood Cliffs, NJ: Prentice-Hall.

Fox, K.R., Corbin, C.B., & Couldry, W.H. (1985). Female physical estimation and attraction to physical activity. *Journal of Sport Psychology, 7,* 125-136.

Freeman, W.H. (1982). *Physical education and sport in a changing society.* Minneapolis: Burgess Publishing Co.

Gayton, W.F., Matthews, G.R., & Burchstead, G.N. (1986). An investigation of the validity of the physical self-efficacy scale in predicting marathon performance. *Perceptual and Motor Skills, 63,* 752-754.

Gerber, E.W. (1971). *Innovators and institutions in physical education.* Philadelphia: Lea & Febiger.

Golding, L.A. & R.R. Bos. (1967). *Scientific foundations of physical fitness programs.* Minneapolis: Burgess Publishing.

Golding, L.A., & Lindsay, A.R. (1989). Y's way revised: testing strength and muscular endurance. *Perspective, 6,* 30-33.

Golding, L.A., Myers, C.R. & Sinning, W.E. (Eds.). (1989). *Y's way to physical fitness.* Champaign, IL: Human Kinetics.

Green, M. (1986). *Fit for America: Health, fitness, sport and American society.* New York: Pantheon.

Heaps, R.A. (1972). Actual and perceived fitness: their relationship to psychological functioning. *Proceedings of the 80th Annual Convention of the American Psychological Association, 7,* 193-94.

Heaps, R.A. (1978). Relating physical and psychological fitness: a psychological point of view. *Journal of Sports Medicine, 18,* 399-408.

Hopkins, W.G. & Robinson, S.M. (1988). An exercise performance test does not measure physical fitness for the average person. *New Zealand Medical Journal, 101,* 512-4.

Hopkins, W.G. & Walker, N.P. (1988). The meaning of "physical fitness." *Preventive Medicine, 17,* 764-773.

Jackson, A. & Langford, N.J. (1989). The criterion-related validity of the sit and reach test: replication and extension of previous findings. *Research Quarterly for Exercise and Sport, 60*(4), 384-387.

Johnson, B.L. & Nelson, J.K. (1986). *Practical measurements for evaluation in physical education.* Minneapolis: Burgess Publishing.

Knapik, J. (1989). The Army physical fitness test (APFT): a review of the literature. *Military Medicine, 154*(6), 326-9.

Lamb, K.L. & Brodie, D.A. (1990). The assessment of physical activity by leisure-time physical activity questionnaires. *Sports Medicine, 10* (3), 159-180.

Leonard, G. (1991, September). The new fitness. *Self,* 141-151.

Leonardson, G.R. (1977). Relationship between self-concept and perceived physical fitness. *Perceptual and Motor Skills, 44,* 62.

Leonardson, G.R. & Gargiulo, R.M. (1978). Self-perception and physical fitness. *Perceptual and Motor Skills, 46,* 338.

Lindsay, A.R. (1988). *Maximum oxygen uptake predicted from submaximal tests.* Unpublished master's thesis.

Massey, B.H. (1970). Measurement: Historical review. In H.J. Montoye (Ed.), *An Introduction to Measurement in Physical Education: Vol. 1. Principles and Operational Practices* (pp. 21-33). Indianapolis, IN: Phi Epsilon Kappa Fraternity.

Mathews, D.K. (1973). *Measurement in physical education.* Philadelphia: W.B. Saunders.

McAuley, E. & Gill, D. (1983). Reliability and validity of the physical self-efficacy scale in a competitive sport setting. *Journal of Sport Psychology, 5,* 410-418.

McCloy, C.H. & Young, N.D. (1954). *Tests and measurements in health and physical education.* New York: Appleton-Century-Crofts.

McCollum, P.M. & Golding, L.A. (1992). *The validity of perceived physical fitness in adult men and women: a pilot study.* Unpublished manuscript.

Neale, D.C., Sonstroem, R.J., & Metz, K.F. (1969). Physical fitness, self-esteem, and attitudes toward physical activity. *The Research Quarterly, 40*(4), 743-749.

Netz, Y. (1987). Relationship between exercise and perceived fitness among middle-aged women and men. *Perceptual and Motor Skills, 64,* 758.

Optenberg, S.A , Lairson, D.R., Slater, C.H. & Russell, M.L. (1984). Agreement of self-reported and physiologically estimated fitness status in a symptom-free population. *Preventive Medicine, 13,* 349-354.

Paffenbarger, R.S., Hyde, R.T., Wing, A.L. & Steinmetz, C.H. (1984). A natural history of athleticism and cardiovascular health. *Journal of the American Medical Association, 252,* 491-495.

Pate, R.R. (1988). The evolving definition of physical fitness. *Quest, 40,* 174-179.

Pollock, M.L., Wilmore, J.H., & Fox, S.M. (1978). *Health and fitness through physical activity.* New York: John Wiley & Sons.

Redmond, G. (1988). Historical aspects of fitness in the modern world. In R.M. Malina & H.M.Eckert (Eds.), *The American Academy of Physical Education Papers, No. 21, Physical Activity in Early and Modern Populations,* 22-33. Champaign, IL: Human Kinetics.

Ryckman, R.M., Robbins, M.A., Thornton, B., & Cantrell, P. (1982). Development and validation of a physical self-efficacy scale. *Journal of Personality and Social Psychology, 42(*5), 891-900.

Safrit, Margaret J. (1986). *Introduction to measurement in physical education and exercise science.* St. Louis: Times-Mirror/Mosby College Publishing.

Sharkey, B.J. (1991). *New dimensions in aerobic fitness.* (Current Issues in Exercise Science Series, Monograph No. 1). Champaign, IL: Human Kinetics.

Shephard, R. J. (1977). *Endurance fitness.* Toronto: University of Toronto Press.

Sonstroem, R.J. (1974). Attitude testing examining certain psychological correlates of physical activity. *The Research Quarterly, 45*(2), 93-103.

Sonstroem, R.J. (1976). The validity of self-perceptions regarding physical and athletic ability. *Medicine and Science in Sports, 8*(2), 126-132.

Thornton, B., Ryckman, R.M., Robbins, M.A., Donolli, J. & Biser, G. (1987). Relationship between perceived physical ability and indices of actual physical fitness. *Journal of Sport Psychology, 9,* 295-300.

U.S. Department of Health and Human Services. Public Health Service. Centers for Disease Control. (1989). Progress toward achieving the 1990 national objectives for physical fitness and exercise. *Morbidity and Mortality Weekly Report (MMWR), 38*(26), 449-453.

Young, M.L. (1985). Estimation of fitness and physical ability, physical performance, and self-concept among adolescent females. *Journal of Sports Medicine, 25*, 144-150.