Training and Detraining Effects on Selected Physiological Measures of Fitness in Adult Black Women.

Edwyna Pace Testerman
Louisiana State University and Agricultural & Mechanical College

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TRAINING AND DETERMINING EFFECTS ON SELECTED
PHYSIOLOGICAL MEASURES OF FITNESS IN ADULT BLACK WOMEN

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Education

in

The School of Health, Physical Education, Recreation and Dance

by

Edwyna Pace Testerman
B.S., Northeast Louisiana State College, 1959
M. Ed., Northeast Louisiana State University, 1964
May 22, 1985
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ABSTRACT

The purpose of this study was to examine training and detraining effects on selected physiological measures of fitness in adult Black women. Pre, post and detraining post measurements were made on body weight, heart rate, blood pressure, sum of skinfolds (triceps, suprailium and thigh), and predicted max $\dot{V}O_2$. The study was conducted in four stages: two training stages and two detraining. Training was either by walking/jogging or aerobic dancing 3 times per week over 11 to 12 weeks at 70-75% of age-adjusted max HR. One detraining period was for 10 weeks, a second period for 15 weeks. Data were analyzed by factorial ANOVA. Predicted max $\dot{V}O_2$ was significantly increased after training and was either maintained or reduced back to pretraining levels through detraining. Skinfold thicknesses were significantly reduced following training, and after detraining either stabilized or returned to pretraining levels. Body weight, heart rate, and systolic and diastolic blood pressure underwent almost no changes from training through the detraining period.
The emphasis on fitness during the past 15 years has brought an extraordinary resurgence of public interest and participation in various types of exercise programs designed to enhance physical fitness and to maintain health (Bruce, 1984; Surgeon General's Report on Health, 1979). Today, adult fitness programs are being offered at colleges/universities, YM/YWCAs, hospital/medical centers, industrial and business complexes, and recreational and fitness centers (Reid & Thomson, 1985), with the majority of the participants over 30 years of age (average age is 40 years) (Santa Maria & Dotson, 1977). Much of the impetus for these programs has come from the American College of Sports Medicine (ACSM) (Position Statement, ACSM, 1978). At the college/university setting the programs focus primarily on the evaluation of functional capacity, providing a basis for exercise prescription and subsequent evaluation of cardiovascular response to aerobic training. Secondary considerations for adult fitness programs often include attention to body composition and establishing a health and fitness profile. Obesity stands as one of this nation's most serious health problems. The prevalence of obesity among women in the United States appears to be related to race, educational level and income status; there are more obese Black women regardless of income and educational status (Brown, 1982).

A variety of activities has been shown to elicit a
significant improvement in aerobic fitness. These are generally known as moderate- to high-energy expenditure activities, e.g., running, swimming, fast walking, cycling, aerobic dance and rope skipping (Pollock, Wilmore & Fox, 1984). Most of the research regarding the effects of training on cardiovascular health and fitness has emerged from studies conducted on men (Mathew & Fox, 1976; Pollock et al., 1984). A limited number of studies about female subjects has reported significant improvements in cardiovascular fitness and body composition with aerobic training (Cunningham & Hill, 1975; Drinkwater, 1973; Kearney, Stull, Ewing & Strein, 1976; Smith and Stransky, 1976; Vaccaro & Clinton, 1981; and Yeager & Brynteson, 1970). Many of these studies have focused on young healthy female athletes and college females.

Relatively little research has been directed toward the adult woman in the middle years, and there is little documentation on training and detraining effects in normally sedentary adult female populations (Cunningham & Hill, 1975; Smith & Stransky, 1976). With the increasing popularity of fitness programs for older women and with more opportunities for middle-aged women to participate in these activities, additional research is needed regarding how they respond physiologically to training programs and how quick and how pronounced is detraining upon cessation of a training program. Also, research is needed on the effects of aerobic training on body composition in the sedentary middle-aged woman.
Many research reports concerning the health of women subsume the black female within such amorphous categories as "all other", "nonwhite", or "all other females", thereby undermining the significance of sex and race as they affect health (Jackson, 1982). Black women have a much higher proportion of body fat than Caucasian women (Gillum, 1982). Therefore, data gathered for one population may not be applicable to another population. Whenever results are reported about a given population, they cannot be generalized and extrapolated to other population groups without adjusting for differences in life habits, diets, psychosocial backgrounds and other pertinent factors (Jackson, 1982). Black female data should be specific to Black females. More research is needed in every aspect of the changing health needs and fitness profiles for all women, young, middle-aged and old. This study will examine training and detraining effects on selected measures of fitness in adult Black women.

Review of the Related Literature

The literature was divided into three sections: (1) studies concerning physical performance and functional aerobic capacity of women; (2) studies related to body composition; and (3) studies related to detraining effects of women.

Physical Performance and Functional Aerobic Capacity

Physical performance relates to one's functional effectiveness or fitness, and in a very broad sense physical

Functional aerobic capacity is defined as the maximal oxygen consumption (max \( \dot{V}O_2 \)) that can be attained during dynamic exercise (Bruce, 1984). It defines the functional limits of the cardiovascular system and it can be measured objectively or can be reasonably estimated by submaximal testing. Aerobic capacity varies with body weight, age and training (Astrand & Rodahl, 1977; Pollock et al., 1984). Since formerly trained persons can, in most cases, increase the maximal oxygen uptake not more than 10 to 20%, it is evident that heredity is the most important factor determining the individual's max \( \dot{V}O_2 \) (Astrand and Rodahl, 1977). It will inevitably vary for different groups and different populations. The maximal aerobic capacity does not reveal whether an individual has been physically active in the preceding year. As individuals grow older, they usually become less physically active. Therefore, part of the decrease in maximal oxygen uptake and performance is an effect of inactivity. In general, aerobic
capacity can be improved at all ages (Pollock, 1973; Pollock et al., 1984).

Relatively little is known of the middle-aged female's response to physical conditioning programs (Cunningham & Hill, 1975; Drinkwater, 1973; Hanson & Nedde, 1974). Overweight middle-aged women generally exhibit low levels of habitual physical activity (Profant, Nelson, Kusami, Hoffer & Bruce, 1972). Of the 144 healthy middle-aged women that Profant tested, using a multistage treadmill protocol, younger women who were not overweight and who were habitually active had greater capacities than did the overweight and sedentary women. Duration of exercise was highly correlated with max $VO_2$ and maximal heart rate decreased with age. Maximal heart rates were identical for active and sedentary women. Average test duration and mean max $VO_2$ of active 40-49 year old women were higher than for the sedentary 30-39 year old women; active 50-59 year old women had values similar to sedentary 40-49 year old women. This demonstrated that exercise has a protective effect of approximately one decade in active women.

Upton, Hagan, Rosentswieg, Gettman and Duncan (1984) compared the physiological profiles of 42 middle-aged women marathoners ($\bar{x}$ age = 38.2 years), 9 young female marathoners ($\bar{x}$ = 25.2 years), 10 middle-aged female 10-K runners ($\bar{x}$ = 33.1 years) and 37 middle-aged sedentary women (38.1 years). Compared to the runners, the middle-aged sedentary women had significantly higher resting heart
rates, significantly lower treadmill performance times, lower max \( \dot{V}O_2 \) and possessed a significantly greater percentage of body fat. These findings were comparable to those reported by Profant, et al (1972) and Drinkwater, Horvath and Wells (1975). The latter group failed to find a decline in maximal aerobic capacity in the 20-49 age range, but did note a substantial decline after age 50. These investigations suggested that for the 20-49 age range, habitual levels of activity, rather than age per se, determined levels of aerobic capacity.

Kilbom (1971) provided data on the effects of short-term training of Swedish females across a wide range of ages. The women were divided into three age groups: 19 to 31, 34 to 48 and 51 to 64 years. For 7 weeks they trained on a bicycle ergometer at 70% of the max \( \dot{V}O_2 \), alternating 3 minutes of work with 2 minutes of rest for a period of 30 minutes. As the effect of training was noted in a decreasing heart rate, the intensity of work was increased to keep the training heart rate constant. A second group of 16 women worked at 50% of max \( \dot{V}O_2 \), either on a bicycle ergometer or by walking in a park at a predetermined speed. A comparison of responses to the same submaximal workloads before and after training revealed significantly lower heart rate following training for all groups except one, the walkers. Increases in max \( \dot{V}O_2 \) following training were significant for all age groups. These increases in max \( \dot{V}O_2 \) were inversely related to age and were greater for women who had lower aerobic capacities.
prior to training and for those who trained at 70% max $\dot{V}O_2$. There were large inter-individual differences which were independent of age, initial capacity, or training intensity. For example, several of the oldest subjects did not respond to the training program, yet the oldest woman increased her aerobic capacity by 15%. Kilbom (1971) hypothesized that these individual variations in reaction to training may be due to childhood patterns of activity, the individual's state of training at the start of the study, or the degree of physiological aging.

Since the work of I. Astrand (1960), not a great deal has been added to the knowledge of how aging affects an adult woman's response to exercise. Astrand's 44 subjects, primarily housewives who were regular participants in organized calisthenics, were divided into age groups and tested on a bicycle ergometer at increasing submaximal loads until exhaustion was reached. With each successive decade, there was a decrease in all physiological variables, except ventilatory efficiency, at the maximal level. Not all differences between successive decades were significant, but the trend across age was consistently downward. However, Astrand (1960) was very careful to point out that there was a large variability within each age group and that some women in the oldest group had a max $\dot{V}O_2$ higher than some in the 20-29 group. She specifically warns that one must be careful in drawing conclusions from average values and that "... when selecting individuals for certain jobs, or vice versa, it is certainly
very important to test the capacity of the individual" (Astrand, 1960, p. 81). At submaximal workloads, women of all ages had approximately the same values for steady state $\dot{V}O_2$ (l/min), heart rate, ventilatory efficiency, and blood lactates. However, all of these values represented higher percentages of the maximal capacities of the older women (Astrand, 1960).

Studies of middle-aged men have shown that the typical age-related decrease in aerobic capacity and physical performance can be partially forestalled by regular physical activity (Pollock et al., 1984; Tzankoff, Robinson, Pyke & Brawn, 1972; and Wilmore, Royce, Girandola, Katch, F. & Katch V., 1970). Pollock, Cureton & Greninger (1969) demonstrated that 8 to 20 weeks of conditioning can significantly improve aerobic power and 2-mile running performance of middle-aged men. Pollock, Demoneck, Miller, Kendrick, Linnourd (1975) reported that 38 sedentary middle-aged men significantly improved cardiovascular function and body composition with either walking, running, or bicycle training regimens for 20 weeks of training for 30 minutes, three times a week at 85 to 90% of maximal heart rate. Improvement was independent of mode of training.

Most of the data concerning the age-related decline in physical performance and work capacity are cross-sectional. There is considerable evidence that cross-sectional studies underestimate the actual decrement in aerobic capacities and physical performance (Harris, 1970; Hodgson and Buskirk, 1977).
This low estimation may be represented in older samples (Misner, 1978). On the other hand, studies that analyze peak track-and-field performance with age perhaps overestimate decrements. Naturally well-conditioned participants are seen at all ages, but there are fewer older participants, and socioeconomic factors may eliminate certain individuals (Misner, 1978).

The most striking and consistently reported effect of training on the physiological response to submaximal exercise has been a decrease in heart rate at a standard work load (Astrand and Rodahl, 1977; McArdle et al., 1981; Pechar, McArdle, Katch, Magel & Delusa, Jr., 1974). Flint, Drinkwater and Horvath (1974) reported an 8% drop in heart rate for seven females, ages 23-49, after a 6-week program of physical training by walking on a treadmill for 30 minutes, three times a week at a constant speed (90cm/min). The training heart rate was maintained at 75% to 80% of HR max by adjusting the grade of the treadmill. The 8% drop in heart rate noted for the women in this study compared closely with a 9% decrease reported by Kilbom (1971). Generally, physical activity lowers the resting heart rate, and working performance is increased at a given heart rate (Masironi, 1978).

**Body Composition**

Skinfold thicknesses have been used extensively as a measure of obesity and have shown good correlation with body fat in middle-aged women (Nappa, Anderson, Bengston, Bruce & Isaksson, 1979). Skinfold thicknesses vary considerably between different
locations on a given individual and also vary with age (Cronk & Roche, 1982; Novak, 1972; Siervogel, Roche & Himes, 1979). For females, there is greater variability within individuals in average skinfolds than among individuals (Himes, Roche & Siervogel, 1979). From a 1971-73 National Center for Health Survey, racial differences indicate the need for separate sets of reference charts for Blacks and Whites (National Center for Health Statistics, 1973).

After the developmental years, body weight and fat as a percentage of body weight increase with age (Bortz, II, 1982; Jeffay, 1982; Novak, 1972; Parizkova, 1963). Persons become less active after 18-22 years of age, and they slowly begin to add weight. With age, women in their fourth and fifth decades of life average 29% to 35% fat (Pollock et al., 1975; Young, Blondin, Tennsuan & Foryer, 1963).

Weight gain over time and pandemic obesity are particularly noticeable in black women in the United States (Gillum, 1982). Khoury, Morrison, Mellies and Glueck (1983) reported weight increases after 18 years of age in 30 to 55 year old Whites and Blacks; Black women had greater weight gain than Black men and nearly twice the weight gain of White women. These average changes in weight gain do not necessarily mean the trend should be interpreted as being "normal" (McArdle et al., 1981). If one could maintain his/her body weight and fat ratio from early adulthood, most obesity would be eliminated in later life (Mayer,
It appears that adult-onset obesity is strongly related to activity patterns and not just overeating (Astrand and Rodahl, 1977; Pollock & Jackson, 1977). Evidence in the literature suggests that this type of fat development does not have to occur (Bortz, II, 1982; Pollock, 1973; Pollock et al., 1974; Wilmore et al., 1970).

The greatest interest today in the application of body composition research is the delineation of exercise-related benefits to be gained by the middle-age population (Holland, 1980). The research summarized by the position statement of the American College of Sports Medicine (1978) supports the notion that aerobic training in adults generally reduces total body weight and absolute fat, while lean body weight remains about the same or increases slightly. These findings have special meaning to physical educators and fitness leaders involved in directing exercise programs, because of the important role that exercise can play in effective weight control (McArdle et al., 1981).

The significance of body composition modification through various modes of exercise is apparently well established. When the relative training effects of walking, running, or bicycling on body composition are evaluated, each mode of exercise is found to reduce significantly body weight, body fat, skinfold thicknesses, and girths. Also, each training mode is equally effective in altering body composition (McArdle et al., 1981). Johnson, Mastropaolo, and Wharton (1972) reported that the sum of four
skinfold thicknesses were substantially reduced from an initial value of 24.9% to 22.8% in 32 college women who participated in a 10-week cycle ergometer training program 30 minutes per day, 5 days per week. Body weight was unchanged. Lewis et al. (1976) had 23 obese women (mean age 44) participate in a 17-week jogging/walking program twice a week. Additional activities such as walking, swimming and tennis were supplemented on an individual basis. A mean relative body fat reduction of 5% was achieved, and resting heart rates were significantly lowered at the time of the re-evaluation.

Various studies have investigated the impact of exercise protocols upon the body composition and performance of obese subjects. Buskirk and Taylor (1957) investigated the aerobic efficiency of fat and normal college males. Gross differences were observed in maximum oxygen consumption between the two groups, but the differences were negligible when corrected for fat weight. This agrees with the assumption of Katch, McArdle, Czula and Pechar (1973) that percent body fat is negatively related to aerobic endurance performance in college women. Wilmore et al. (1970) suggested that relative fat is a significant variable in any performance which involves the maximum ability to move total body mass.

The duration of exercise has an effect on fat loss with training. Milesis, Pollock, Baker, Ayers, Ward and Linnourd (1976) determined the effects of 15, 30, and 45 minutes of walking/
running performed three days/week at approximately 85% to 90% of maximum heart rate (HR) on maximum performance and cardiorespiratory fitness variables and body composition for three groups of men. The control group showed no significant change over the 20-week training period. Compared to the control group, all three groups made significant reductions in resting HR, total skinfold fat, % fat, and waist girth, and increased in max VO\(_2\). Body weight was also significantly lowered with exercise except for the 10-min group, whose weight remained static. The 45-min group lost a greater percentage of body fat than either the 30- or 15-min exercise groups.

Many studies have shown that physically active individuals have less body fat than sedentary ones. Persons who continue to be physically active throughout life or become involved in aerobic exercise programs maintain or lose body weight and can expect to lose fat (McArdle et al., 1981; Pollock & Jackson, 1977). Studies have shown that participation in vigorous physical activities after age 35 can retard the "average" increases in body fat in both sexes (McArdle et al., 1981). With respect to body composition alterations with exercise, there do appear to be slight decreases in total body weight, increases in lean body weight, and decreases in fat weight. The magnitude of these changes will vary directly with the intensity and duration of the activity or with the total daily caloric expenditure. Exercise does appear to be a major factor in both the prevention and the

Detraining

If subjects who have become conditioned to aerobic forms of exercise stop training, most of the benefits of training may be lost within 10 weeks to 3 months (Brynteson & Sinning, 1973; Drinkwater & Horvath, 1972; Fringer & Stull, 1974; Lamb, 1984; Michael, Evert & Jeffers, 1972). Values of max \( \dot{V}O_2 \), heart rate response to submaximal exercise, heart rate recovery after exercise, and resting heart rates usually revert to pretraining levels faster than the total capacity for submaximal work (Lamb, 1984). A 50% reduction in improvement of aerobic capacity has been shown in just 4 to 12 weeks of detraining (Fringer & Stull, 1974). This data shows that the loss of aerobic capacity is rapid but quite variable in rate among individuals after cessation of training. Factors such as level of fitness, age, and length of time in training add to this variability (Pollock et al., 1984).

Michael, Evert and Jeffers (1972) tested 10 girls from a high school track team during the 1st, 3rd, 5th, 7th, and 23rd weeks of posttraining, using a 2-minute step test and a treadmill run. The heart rate response to the lighter work efforts of the 2% and 4% grade runs changed with detraining, and so did the recovery heart rate from the step test, which also was a light exercise. The greatest changes that occurred followed 7 weeks of detraining. The period of time between weeks 7 and 23 occurred in the summer;
it may be possible that the activities in the summer resulted in the leveling off of detraining effects. The study did not ascertain the amount of exercise undertaken during detraining except that six girls played softball.

Drinkwater and Horvath (1972) tested seven female track athletes, ages 15 to 17, for maximum aerobic capacity during the final month of the track season, and again 3 months after cessation of formal training. Maximal values for oxygen consumption decreased significantly (47.8 ml·kg·min to 40.4 ml·kg·min). There were no differences in either trained or detrained systolic or diastolic blood pressure. Weight increased significantly \((p < .05)\) from 50.8 kg to 52.2 kg. The physiological cost of submaximal walking was significantly higher in the detrained state. They concluded that 3 months without formal training sessions had reduced the cardiorespiratory fitness of these young track athletes to the levels found in nonathletic girls of the same age.

Following a 10-week twice-weekly intermittent work task on a bicycle ergometer, Fringer and Stull (1974) had 44 college women (17-28 years) randomly assigned to 5- or 10-week detraining periods. Detraining caused decrements in cardiovascular fitness gains. When averaged across both the 5-week and 10-week detraining periods, there was a significant increase in resting HR of 4.4 bpm from the posttest to the retention test. By the end of the 10 weeks of detraining, the gains in max \(\dot{V}O_2\) had disappeared
completely (from 42.5 ml·kg·min to 35.6 ml·kg·min). After 5 weeks of detraining, the subjects had retained 32% of the training gained in max VO₂ during training. No alterations occurred in gross body weight. Other studies such as Cunningham & Hill (1975) and Drinkwater & Horvath (1972) tend to support the findings of significant decreases in max VO₂ as a result of detraining.

**Summary of Literature Review**

In general, aerobic capacity can be improved at all ages, and functional aerobic capacity varies with age, body weight, and training (Astrand & Rodahl, 1977; Lamb, 1984; Pollock et al., 1984). Relatively little is known about the middle-aged female's response to physical conditioning programs. Research suggests that for women (ages 20-49), habitual levels of physical activity determine aerobic capacity more than age per se (Astrand, 1960; Drinkwater et al., 1975; Kilbom, 1971; Profont et al., 1972; Upton et al., 1984).

Women in their fourth and fifth decades of life average 29% to 35% fat (Pollock et al., 1975; Young et al., 1963). Black women have nearly twice the weight gain of White women in the 35-55 year olds (Khoury et al., 1983). Body composition research indicates that exercise training does produce significant decrements in % body fat (Johnson et al., 1972; Lewis et al., 1976; Moody et al., 1971; Pollock et al., 1984).

A reduction in aerobic capacity has been shown in just 4 to 12 weeks of detraining (Brynteson & Sinning, 1973; Drinkwater &
A reduction in aerobic capacity has been shown in just 4 to 12 weeks of detraining (Brynteson & Sinning, 1973; Drinkwater & Horvath, 1972; Fringer & Stull, 1974; Michael, Evert & Jeffers, 1972). Level of fitness, length of time in training and age are important factors that will influence how quickly the loss of aerobic capacity occurs.

Statement of the Problem

The primary purpose of this study was to examine training and detraining effects on selected physiological measures of fitness in adult black women. Specifically, the study investigated changes in aerobic capacity, sum of skinfolds, heart rate and blood pressure of these women during programs of training and detraining.

Operational Definitions

1. **Functional aerobic capacity** - was defined as maximum aerobic capacity ($\max \dot{V}O_2$), predicted from Astrand's nomogram.

2. **Sum of skinfold** - was defined as the sum of the triceps, suprailium and thigh skinfold thickness measurements.

3. **Detraining** - referred to the time between the end of the 11-week and the 12-week training programs and the follow-up (15 weeks later in experiment two; 10 weeks later in experiment four).
Research Hypotheses

The research hypotheses were:

1. The exercise training programs would result in a significant increase in functional aerobic capacity.
2. Total body weight would remain approximately the same throughout the training.
3. Training would result in reduction in the sum of skinfolds.
4. Training would result in a decrease in resting heart rate.
5. Benefits accrued during training would be lost during the periods of detraining.

Limitations of the Study

The study was limited to Black females, ages 25-60, from the general population in and around Lafayette, Louisiana. Participants were recruited by announcements in the newspaper. There is always the potential for sampling bias in a study using volunteers, because the women who volunteered may be more physically active and may exercise more than the general population, and they may have a more positive attitude toward fitness and exercise. Therefore, these women may represent a more health-conscious subpopulation than the general population. A further limitation may be the frequency of exercise each week. Training three times per week may not be as effective as training every day.
Subjects were instructed to refrain from all vigorous activity prior to being tested and were advised not to eat, drink alcoholic beverages, or to smoke for at least 4 hours prior to testing. However, this could not be controlled during the course of this study. Motivation and fatigue were variables which were impossible to totally control and possibly had some effect on the amount of effort expended during the programs of training.

**Significance of the Study**

To date, this investigator found no experimental studies involving only Black adult women with regard to aerobic training and exercise and body composition. In general, research about adult women has involved Caucasians. For example, in the study by Profant et al (1973) in which the responses of 144 healthy middle-aged women of variable age, weight, and habitual activity to maximal exercise were measured, only one Black was included. Gibbons et al. (1983) examined associations between physical fitness and risk factors for coronary heart disease (CHD) in more than 3900 healthy women, ages 18-65. More than 99% of the women were White. Data are extremely limited about Black female subjects. This study was not undertaken to compare Black women with White women per se. Black women were chosen because of their recognized greater amount of fat and presumably their low level of physical condition. Hence, race was controlled rather than studied as a variable.

Data specifically concerned with changes produced by regular
physical exercise in middle-aged women are unavailable (Gibbons et al., 1983). Little research attention has been devoted to realistic physical expectations of middle-aged women and the effects of training on cardiovascular fitness. Limited data are available comparing the various modes of training on middle-aged women. More information is needed concerning the relationship between physical activity and obesity. Research is sorely needed to quantify training modes and to point out the relative value of these activities in producing cardiovascular fitness changes. Moreover, few investigations have been published which have been concerned with the retention of enhanced levels of aerobic fitness for adult women following specific training programs (Drinkwater, 1973; Drinkwater et al., 1975; Smith & Stransky, 1976). An important consideration would seem to be the long-term effects of a training program with persons who are basically sedentary. Once again, this was a primary reason for selecting Black middle-aged women.

Research findings indicate that sedentary adults tend to be older, less well-educated and less affluent than those who are physically active (Morgan, 1977). The physical educators at the university level, through program opportunities and research, must constantly seek new ways to help improve the quality of life for all people. Scientific investigation is the most desired means of evaluating various training programs' effectiveness when identifying various populations to modify coronary-risk profiles.
Today many students returning to the university are mature adult women (Dib, 1978). Many are in adult fitness classes. This provides a new and expanding area of professional service and provides a meaningful link between the practitioners of physical education and medicine (Santa Maria & Dotson, 1977). Foster (1980) states that the physical educator often becomes the resident expert by default because the potential exerciser, before starting an exercise program, may not have been screened by a physician. Curriculum offerings must expand their concepts of educational purpose. Additional knowledge about adult women is crucial for accurate assessments of the exerciser's training prescription program and coronary-risk profile. Hartung (1980) states that programs of weight reduction and exercise may be key factors in future attempts to modify CHD risk. If this is true, then this study will be significant.
CHAPTER II

Methods

Subjects

Black adult women, ranging in ages from 25 to 55 years, volunteered to serve as subjects. All were from the general population in or near Lafayette, Louisiana. They represented a wide range of body types and weights, although no effort was made to select them on this basis. These subjects were heavier (above 70 kg) than the sedentary women reported in previous studies (average 59 kg) (Profant et al., 1972; Jackson et al., 1980; and Drinkwater et al., 1975). Normal blood pressure, a willingness to participate, and presentation of the results of a current medical examination were the only criteria other than race.

Study one. Seventeen subjects, mean age 37.9 yrs. (SD ± 7.5) and mean weight 71.6 kg (SD ± 14.3) completed this phase. Five hypertensives were screened out and 12 others dropped out.

Study two. Nine subjects completed all parts of this experiment, and three hypertensives were rejected. The mean age was 39.0 yrs. (SD ± 7.5) and the mean weight was 73.9 kg (SD ± 13.4).

Study three. Thirty-six subjects finished this part of the experiment; 22 dropped out, and 3 were screened out on the basis of hypertension. The mean age was 39.0 yrs. (SD ± 7.5) and the mean weight was 74.4 kg (SD ± 15.8).
Study four. Thirty subjects completed testing and 6 were unable to schedule the detraining posttest. The mean age was 39.0 yrs. (SD ± 7.5) and the mean weight was 74.1 kg (SD ± 16.3).

Instruments

Monark Bicycle Ergometer, Model 850

The Monark Bicycle Ergometer, Model 850, was used for the predicted max \( \dot{V}O_2 \) test during the bicycle work bout. The instrument provides an exact measurement of the performed external work, and therefore a graded and measurable load can be applied to the subject. The braking power (kp) set by adjustment of belt tension, multiplied by distance pedalled (m), gives the amount of work in kilopond meters (kpm). Work is started with a slack brake belt. Thereafter the belt should be stretched with the aid of the handwheel until the required work load is obtained (1 kp = 300 kpm/min, 2 kp = 600 kpm/min, and so on, provided that the pedalling frequency is 50 turns per minute. (Per-Olaf Astrand, Work Tests with the bicycle ergometer, Monark-Cresent AB, Sweden).

Nomogram for the prediction of maximal \( \dot{O}_2 \) uptake

A nomogram developed by Astrand (1960) was used for the prediction of maximal \( \dot{O}_2 \) uptake from submaximal pulse rates (120 to 170). The increase in HR with increasing workload (and oxygen uptake) is linear within a wide range and involved use of a correction factor for age. Generally speaking, the nomogram represents an extrapolation to a maximal pulse rate typical for
the subject's age (Astrand, 1960).

**Burdick EK-5A Electrocardiograph**

The Burdick EK-5 single channel Electrocardiograph with 12 lead capabilities was used to produce diagnostically accurate records with maximum definition and fidelity. Waves of electrical activity associated with physical activity of the heart are amplified by the electrocardiograph and recorded on heat-sensitive paper. The electrocardiogram is then studied and compared with known normals for wave amplitude, duration, intervals and heart rate (The Burdick Corporation, Milton, WI 53563).

**Aneroid Sphygmomanometers**

A Trimline aneroid sphygmomanometer (PyMaH Corporation) with standard-sized cuff and a BMS sphygmomanometer with large-sized cuff with aneroid gauge, both calibrated to 300 mmHg, were used to measure blood pressure readings during the bicycle test. Both sphygmomanometers had a self-attachable quick-fit cuff and automatic pressure release valve (Buffalo Medical Specialties Mfg. Inc., St. Petersburg, FL 33714).

**Lange Skinfold Caliper**

A Lange skinfold caliper was used for measuring the thickness of the three skinfold measurements. The scale permits reading up to 60 mm accurate to 0.5% of full scales (Cambridge Scientific Instrument, Cambridge, MD 21613).
Procedures

Orientation

Each subject was oriented as to the purposes and procedures peculiar to the study in which she was to participate. Following the detailed explanation, each subject signed an informed consent paper. Subjects attended three separate laboratory sessions to practice pulse counting and to acquire the necessary concepts related to training at 70% of age-adjusted predicted maximal heart rate. Each was given a 15-minute session of practice on the bicycle ergometer.

Laboratory testing: measures at rest

During a visit to the University of Southwestern Louisiana Exercise Physiology Laboratory, determinations were made of weight and skinfold thicknesses. Body weight was measured to the nearest 0.1 Kg. with a calibrated physician's balanced scale. The subjects wore lightweight shorts and t-shirts.

All skinfold measurements were taken on the right side of the body with the subject standing. A minimum of two measures were made at each site, with the average value being recorded. Subjects were measured at three skinfold sites on both pretests and posttests by the same experienced investigator: (1) triceps -- a vertical fold on the posterior midline of the upper arm (over the triceps muscle), halfway between the acromion and olecranon processes; the elbow was extended and relaxed; (2)
suprailium -- a diagonal fold above the crest of the ilium at the spot where an imaginary line would fall from the anterior axillary line to just above the iliac crest; and (3) thigh -- a vertical fold on the anterior aspect of the thigh, midway between the hip and knee joints. Because of the lack of validated method of predicting percentage fat from skinfolds for this specific population, only the sum of skinfolds was reported.

**Laboratory testing: exercise**

Subjects were instructed to refrain from vigorous physical activity on the day of the exercise test. They were advised not to eat, or to drink beverages containing alcohol or caffeine, and to refrain from smoking for at least 4 hours before testing. All wore comfortable gym shoes, shorts and t-shirts.

Immediately prior to the work test, an ECG trace was obtained using CM5 lead placements, heart rate was calculated from the ECG, and blood pressure was determined by standard auscultatory methods. If any abnormality was discovered which was considered a contraindication to either exercise testing or participation in a regular program of physical exercise, the subject was excluded from the study. Specific criteria for excluding subjects included: multifocal premature ventricular contractions (PVC), more than 3 PVC per minute, ST segment elevation or depression, heart rate of 100 beats per minute or more, systolic blood pressure of 160 mmHg or greater, and diastolic blood pressure of 90 mmHg or more.
In preparation for the exercise, the bicycle seat height was set for each individual so that only a slight bend in the knee was evident at full leg extension on the downstroke. An electronic metronome was used to control rate of pedalling at 50 rpm.

The subject pedalled for 3 minutes without any load, after which the test began with an initial load being set at 300 kgm/min. Depending on heart rate response, the work load was then adjusted so as to induce a heart rate of about 130-140 beats per minute at steady state. The test ordinarily was terminated at 6 minutes. As a safety measure, if the heart rate exceeded 150 in any subject over 40 years of age, the test was terminated and rescheduled on another day with a lighter work load. The ECG and ST segment criteria used at rest were also applied during exercise. The ECG strips were run during the last 15 seconds of each minute and used to calculate heart rate. Blood pressures were determined during the last 15-20 seconds every 2 minutes by the same experienced technician. A nomogram was used for the prediction of maximal oxygen consumption from steady state heart rate and work load (Astrand, 1960).

**Training Program: aerobic dance**

A qualified technician supervised aerobic dance classes in the University of Southwestern Louisiana McLaurin Gymnasium on Monday, Tuesday, and Thursday afternoons from 4:30 to 5:30 p.m. Each training session included 10-15 minutes of warmup exercises, 30 minutes of aerobic dance at an intensity of 70-75% of
individual age-adjusted maximal heart rate (220 - age), and 10-15 minutes of cooldown activity. Training intensity was monitored several times during the workout by carotid artery pulse palpation by the technician and/or the subjects.

Training Program: Walking/Jogging Aerobic Work

The investigator supervised the subjects participating in this activity. The subjects met on Monday, Wednesday and Thursday afternoons on the USL McNaspy Stadium track. In event of inclement weather, the class moved into the Earl K. Long Gymnasium, also on the USL campus. Each training session included 10-15 minutes of stretching and light calisthenics, 30 minutes of walking and/or jogging at 70-75% of individual age-adjusted predicted maximal heart rate, and 10 minutes of cooldown activity. Training intensity was monitored by pulse rate as described for the aerobic dance training group.

Detraining

Subjects were given no specific instructions for the detraining period. Physical activity was individually ad libitum.

Design

The design for the 4 studies is shown in Table 1. The design consisted of: (a) a pretesting period during which body weight, sum of three skinfolds (triceps, suprailic and thigh), resting HR, resting SBP and DBP were recorded and a 6-minute submaximal test was performed on the bicycle ergometer to predict max \( \dot{V}O_2 \); (b) an interim training period of 11 weeks of walking/jogging
(Study One) and an interim training period of 12 weeks of walking/jogging and aerobic dance (Study Three); (c) posttesting identical to the pretesting was administered at the conclusion of the training period for Study One and Study Three. A minimum of one week intervened between the final training session and the posttesting; (d) a detraining period of 15 weeks (Study Two) followed the posttesting in Study One and 10 weeks of detraining (Study Four) followed the posttesting in Study Three; (e) a detraining posttesting period identical to the pretesting and posttesting periods.

Statistical Analysis

Means and standard deviations were computed for all measures. Overall statistical differences between pre- and posttraining were determined with a randomized block design with subjects as the blocking factor. Data for the pretest, posttest and detraining posttest were analyzed by factorial ANOVA with repeated measures across tests and time periods with each test for each study. Because of the colinearity among test items, separate ANOVAs were used rather than MANOVA. A significant F statistic was followed by a Newman-Keuls test of ordered means to determine where significant differences were found between tests or time periods.
Table 1
Design For The Four Studies

<table>
<thead>
<tr>
<th>Study 1 (n = 17)</th>
<th>Study 2 (n = 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>Posttest</td>
</tr>
<tr>
<td>11 weeks walking/jogging program</td>
<td>15 weeks detraining</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study 3 (n = 36)(^a)</th>
<th>Study 4 (n = 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>Posttest</td>
</tr>
<tr>
<td>12 weeks walking/jogging/aerobic dance</td>
<td>10 weeks detraining</td>
</tr>
</tbody>
</table>

Note: \(^a\)walk/jog, n = 20; aerobic dance, n = 16
CHAPTER III

Results and Discussion

Study 1

This study was undertaken to determine whether 11 weeks of walking/jogging would elicit changes in physical fitness variables of predicted max $\dot{V}O_2$, sum of three skinfolds, heart rate (HR) and/or systolic and diastolic blood pressure (SBP and DBP). Twenty-two Black females (64%) completed the training program. Five hypertensive subjects were eliminated from the study.

There was a highly significant increase in predicted max $\dot{V}O_2$ $F(1,16) = 11.19, p<.01$ following the training regimen (Table 2) (Figure 1). There was a highly significant decrease in the sum of the skinfolds $F(1,16) = 19.55, p<.01$ (Figure 2) and a significant decrease in DBP $F(1,16) = 5.17, p<.05$. Although there appeared to be a decrease in SBP, the change was just short of being significant $(p<.058)$. There were no significant changes in body weight or HR.

The predicted max $\dot{V}O_2$ mean for the 17 subjects in this study prior to training was 25.1 ml·kg·min (Table 3). Following the 11 weeks of walking/jogging, the predicted max $\dot{V}O_2$ increased to 28.0 ml·kg·min. Although the initial fitness level in this study was lower, the gains were comparable to other studies with sedentary women, e.g. Profant et al, (1972). Profant reported a maximal aerobic capacity of 27 ml·kg·min for sedentary women and 40 ml·kg·min for active women over 30. Upton et al (1984) reported a max $\dot{V}O_2$ in sedentary women $(n = 37)$ of 31.4 ml·kg·min as compared to
**figure 1.** Predicted max \( \dot{V}O_2 \) across 11 weeks of walking/jogging in Study One.

**figure 2.** Sum of 3 skinfolds across 11 weeks of walking/jogging in Study One.
middle-aged marathoners (n = 42), who averaged 55.5 max $\dot{V}O_2$ ml·kg·min. Brownell, Bachorik and Ayerle (1982) reported a significant increase in max $\dot{V}O_2$ from 30.5 ml·kg·min to 33.3 ml·kg·min after 10 weeks of aerobic training, three sessions per week, by 37 women (20-51 years).

Table 2
Means and Standard Deviations for Physical Fitness Variables for Pre- and Posttraining Tests in Study One (n = 17)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pretraining</th>
<th>Posttraining</th>
<th>Mean Differences</th>
<th>Differences (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>71.6 ± 14.3</td>
<td>71.1 ± 14.2</td>
<td>-0.5</td>
<td>1</td>
</tr>
<tr>
<td>Sum of 3 skinfolds (mm)</td>
<td>89.0 ± 30.2</td>
<td>82.1 ± 30.0</td>
<td>-6.9**</td>
<td>8</td>
</tr>
<tr>
<td>Heart Rate (bpm)</td>
<td>83.3 ± 10.3</td>
<td>79.8 ± 9.1</td>
<td>-3.5</td>
<td>4</td>
</tr>
<tr>
<td>Systolic Blood Pressure (mmHg)</td>
<td>126.1 ± 16.1</td>
<td>120.4 ± 17.5</td>
<td>-5.7</td>
<td>5</td>
</tr>
<tr>
<td>Diastolic Blood Pressure (mmHg)</td>
<td>81.3 ± 7.3</td>
<td>79.2 ± 7.3</td>
<td>-2.12*</td>
<td>2</td>
</tr>
<tr>
<td>Predicted max $\dot{V}O_2$ (ml·kg·min)</td>
<td>25.1 ± 7.4</td>
<td>28.0 ± 7.3</td>
<td>+2.9**</td>
<td>12</td>
</tr>
</tbody>
</table>

* P<.05; ** P<.01
Table 3.
Study One. Changes in Max \( \dot{\text{V}}\text{O}_2 \) With Aerobic Training in Related Studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Duration</th>
<th>Initial ( \dot{\text{V}}\text{O}_2 )</th>
<th>Final ( \dot{\text{V}}\text{O}_2 )</th>
<th>Difference</th>
<th>Difference (%)</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Study 1)</td>
<td>11</td>
<td>25.1</td>
<td>28.0</td>
<td>2.9</td>
<td>12</td>
<td>walking</td>
</tr>
<tr>
<td>(Study 3)</td>
<td>12</td>
<td>24.6</td>
<td>28.0</td>
<td>3.4</td>
<td>14</td>
<td>walking</td>
</tr>
<tr>
<td>(Study 3)</td>
<td>12</td>
<td>30.4</td>
<td>33.5</td>
<td>3.2</td>
<td>10</td>
<td>aerobic dance</td>
</tr>
<tr>
<td>Brownell, et al (1982)</td>
<td>10</td>
<td>30.5</td>
<td>33.2</td>
<td>2.7</td>
<td>9</td>
<td>walking</td>
</tr>
<tr>
<td>Frey, et al (1982)</td>
<td>10</td>
<td>28.5</td>
<td>33.0</td>
<td>4.5</td>
<td>16</td>
<td>bicycle</td>
</tr>
</tbody>
</table>

Profant, et al (1972) | 27.0     | 30.5                                   | 3.5                                  | 13         | cross-sectional |

The evidence about the effect of exercise training on resting blood pressure is extensive, but not conclusive. Female data are lacking in most of these studies (Tipton, 1984). Small decreases
in SBP and DBP have been reported in a few uncontrolled studies (Boyer & Katch, 1970; Choquette & Ferguson, 1973), and are in general agreement with the result of the present study. Interestingly, in the present study, DBP underwent a small (2.6%) but significant reduction, while the change in SBP (4.6%) was not significant. This might be attributed to the greater variability in the SBP measurements.

Reduction in resting HR after 11 weeks of training was not significant. This finding is not in agreement with other studies (Drinkwater et al., 1974; Eickhoff, Thorland & Ansorge, 1983; Frey, Doer, Lauback, Mann & Guleck, 1982; White et al., 1984) and cannot be explained on the basis of data collected. Perhaps a longer period of training might continue the trend (-3.5 bpm) and ultimately result in significant levels of change.

Exercise seemed to have little or no effect on body weight. This observation has been reported in the literature (Cunningham & Hill, 1975; Frey et al., 1982; Johnson et al., 1972). This finding suggests that the caloric cost of aerobic work for 30 minutes three times per week for 11 weeks is not enough to change weight without accompanying dietary control. A rough estimation of the total metabolic cost of this program reveals that, with no dietary alteration, a mean fat weight loss of about 1.0 kg could be expected. The mean loss was 0.5 kg. It could be that there was some increase in lean body mass which would offset some of the fat loss. There was some loss of fat, as evidenced by significant
reduction in skinfolds. Because of the relatively heavy body weights at the onset, one might surmise that the walking/jogging would not only be more costly in a metabolic sense than for smaller subjects, but might be at a level of higher relative intensity, so that more than the usual increase in lean weight could have occurred. Although body weight will usually decrease over long periods of time, i.e., 3 months or longer, it is not unusual for body weight to change very little during the initial months of training (Pollock et al., 1984). Pollock further states that this lack of substantial change in the early phases of an exercise program is primarily the result of alterations in body composition, i.e., losses in body fat accompanied by similar gains in lean body weight.

Examination of the pre- and post means indicated that all changes were in a positive direction, with respect to health and fitness status. One would expect the reductions in skinfolds to contribute, at least indirectly, to the increased aerobic capacity. Ordinarily, one sees cardiovascular changes at rest as well. However, measures taken at rest are more variable, being subject to more external influences as well as emotional factors. The fact that the normotensives' SBP did not change significantly was not too surprising, but the failure of the resting HR to decrease was unexpected.

**Study 2**

The purpose of this study was to examine the effects of 15
weeks of cessation of a training program. Nine females who had completed Study One were retested 15 weeks after the completion of their training program.

A clear indication of a detraining effect is shown in Table 4 and Figure 3 with respect to body fat measurement (sum of three skinfolds). While there was no change in body weight, the trend toward the beneficial loss of fat that occurred with training (Study One) was reversed after 15 weeks of detraining, as evidenced by a 10% increase in skinfold thicknesses. As in any study of body composition, one can ascribe changes to caloric intake and/or caloric expenditure. Christmas holidays occurred during the detraining period and could have been a contributing factor. It would appear that these particular subjects did not maintain the activity level and/or the dietary pattern that they had during the training period.

No changes occurred in HR, SBP, DBP, or predicted max $\dot{V}O_2$. The important aspect of this finding is the maintenance of aerobic capacity (Figure 4), an important element of cardiovascular fitness and health. Ideally, following a training program one would hope for continued training, including gradual escalation of intensity and/or duration, resulting in continued gains in fitness. One of the often-stated goals of adult fitness programs is education and motivation, resulting in lifestyle changes. With only nine subjects the results of this study have to be viewed cautiously and the degree to which Study Two was a success
Table 4

Study Two. Fitness Measures After Detraining, With Pretraining Data for Reference (n = 9)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-training</th>
<th>Post-training</th>
<th>Post Detraining</th>
<th>Mean Differences (Post to Post Detraining)</th>
<th>Mean Differences (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>73.9 ± 13.4</td>
<td>73.7 ± 25.0</td>
<td>73.3 ± 12.9</td>
<td>-0.4</td>
<td>0</td>
</tr>
<tr>
<td>Sum of Skinfolds (mm)</td>
<td>87.9 ± 25.0</td>
<td>82.5 ± 25.0</td>
<td>91.8 ± 30.0</td>
<td>+9.3*</td>
<td>10</td>
</tr>
<tr>
<td>Heart Rate (HR)</td>
<td>85.0 ± 10</td>
<td>80.9 ± 10.7</td>
<td>81.6 ± 5.9</td>
<td>+.7</td>
<td>0</td>
</tr>
<tr>
<td>Systolic Blood Pressure (mmHg)</td>
<td>127.8 ± 17.±</td>
<td>121.6 ± 20.9</td>
<td>117.3 ± 6.1</td>
<td>-4.3</td>
<td>4</td>
</tr>
<tr>
<td>Diastolic Blood Pressure (mmHg)</td>
<td>82.2 ± 6.9</td>
<td>79.8 ± 7.6</td>
<td>79.3 ± 5.2</td>
<td>-0.5</td>
<td>0</td>
</tr>
<tr>
<td>Predicted max $\dot{V}O_2$ (ml·kg·min)</td>
<td>22.8 ± 6.2</td>
<td>26.0 ± 6.2</td>
<td>27.3 ± 7.6</td>
<td>+1.3</td>
<td>5</td>
</tr>
</tbody>
</table>

* p<.05
**Figure 3.** Sum of skinfolds across 15 weeks of detraining in Study Two.

**Figure 4.** Predicted max \( \dot{V}O_2 \) across 15 weeks of detraining in Study Two.
is argumentative. Certainly, it was not optimal as evidenced by the gain in fat, but there was some benefit if maintaining the gain in aerobic fitness is the criterion. From these data a strong recommendation would be for subjects to continue in a structured supervised program of group activity and education for more than 11 weeks. The major challenge would be to make exercise more attractive to all population groups and to provide additional assistance in developing healthy life habits.

**Study 3**

The purpose of this study was to determine whether there were differences between two modes of aerobic training -- walking/jogging and aerobic dance -- on selected physical fitness variables after 12 weeks of training. Thirty-six Black females (60%) completed the training program, 16 in the aerobic dance group and 20 who trained by walking/jogging.

There were no statistically significant differences between the responses of the two groups on any of the variables. This was not surprising in view of the strict control over training intensity and structure of the workout period. Both trained at the same relative HR and both groups were given the same time regimen for warmup, training stress, and cooldown. Both programs were comprised of almost continuous activity, with only momentary pauses between aerobic dance routines. Comparisons between walking/jogging and aerobic dance should not be made unless the protocols are equivalent as in this particular study. This
figures 5-7. Comparisons between Study One and Study Three of sum of skinfolds, body weight, and predicted max \( \dot{V}O_2 \).
finding is supported by other studies in the literature. White et al. (1984) examined the effects of a 6-month aerobic dancing and walking program in 51 post-menopausal women. They reported that both groups significantly increased cardiovascular fitness \(p<.05\). Vaccaro and Clinton (1981) examined the effects of 10 weeks of aerobic dance conditioning on the body composition and \(\dot{V}O_2\) max of 10 college women. Results of their study indicated that the aerobic dance training period was of sufficient intensity, frequency and duration to elicit favorable changes in \(\dot{V}O_2\) max \(p<.05\).

The sum of three skinfolds was reduced significantly in both groups following training (Figure 5), which is in agreement with results from Study One. Percentage losses for the sum of three skinfolds were 10.5% (walk/jog) and 8.6% (aerobic dance). The changes in skinfold thickness were expected on the basis of previous findings (Eickhoff, Thorland & Ansorge, 1983; Johnson et al., 1972; Moody, et al., 1969). Because training protocols were identical for Studies One and Three and the durations were nearly the same (11 and 12 weeks), one might expect the percentages of fat loss to be similar.

Unlike the findings in Study One, weight losses by both groups in Study Three were significant (Figure 6). Percentage changes were small (1.3% and 2.2% for walk/jog and aerobic dance), but they were about twice that found for the walking/jogging program in Study One (0.7%). As previously discussed, the
### Table 5.
Means and Standard Deviations for Physical Fitness Variables for Pre- and Posttraining Tests in Study Three

<table>
<thead>
<tr>
<th></th>
<th>Walking/Jogging (n = 20)</th>
<th></th>
<th>Aerobic Dancing (n = 16)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre (kg)</td>
<td>Post (kg)</td>
<td>Mean Difference</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>76.8</td>
<td>75.8</td>
<td>-1.0*</td>
</tr>
<tr>
<td></td>
<td>±15.9</td>
<td>±15.9</td>
<td></td>
</tr>
<tr>
<td><strong>Sum of Skinfolds (mm)</strong></td>
<td>95.3</td>
<td>85.3</td>
<td>-10.0**</td>
</tr>
<tr>
<td></td>
<td>±30.9</td>
<td>±24.7</td>
<td></td>
</tr>
<tr>
<td><strong>Heart Rate (HR)</strong></td>
<td>87.4</td>
<td>82.6</td>
<td>-4.8*</td>
</tr>
<tr>
<td></td>
<td>±10.0</td>
<td>±10.4</td>
<td></td>
</tr>
<tr>
<td><strong>Systolic Blood</strong></td>
<td>122.6</td>
<td>119.0</td>
<td>-3.6</td>
</tr>
<tr>
<td></td>
<td>±13.7</td>
<td>±12.9</td>
<td></td>
</tr>
<tr>
<td><strong>Diastolic Blood</strong></td>
<td>77.4</td>
<td>77.7</td>
<td>+0.3</td>
</tr>
<tr>
<td></td>
<td>±6.5</td>
<td>±9.7</td>
<td></td>
</tr>
<tr>
<td><strong>Predicted max VO₂</strong></td>
<td>24.6</td>
<td>28.0</td>
<td>+3.4**</td>
</tr>
<tr>
<td></td>
<td>±6.7</td>
<td>±8.6</td>
<td></td>
</tr>
</tbody>
</table>

* p<.05; ** p<.01
offsetting gains in lean body mass and losses in fat weight very often result in no real change in total body weight. Of course, weight loss in these subjects would be desirable, but without longer and/or more intensive training, along with reduction in caloric intake, no significant weight change would have been expected. The long-term cumulative effects of exercise training are more important than the short-term effects when body weight loss is the objective (Brownell, 1982; Gwinup, 1975; Pollock et al., 1984).

The increases in predicted max $\dot{V}O_2$ in both training groups in Study Three were significant and were similar, quantitatively, to the change observed in Study One (Figure 7). The data are in good agreement with previous studies done mostly on Caucasian populations in walking/jogging training (Brownell et al., 1972; Drinkwater et al., 1975; Frey et al., 1982; Profant et al., 1972; Upton et al., 1984). Apparently, in a period of 10-12 weeks of aerobic training by walking/jogging, one can expect a 10-12% increase in predicted max $\dot{V}O_2$. Vaccaro and Clinton (1981) reported a 10% increase in max $\dot{V}O_2$ in college women following 10 weeks of aerobic dance training. It would appear that, from the present data and from other research findings, one can expect significant increases in max $\dot{V}O_2$ from aerobic dance training, similar in magnitude to those found in walking/jogging, if the programs are comparable in terms of overload factors.

As in Study One and in general agreement with the literature
on normotensive subjects, DBP and SBP remained unaffected by the aerobic training in the walking/jogging group, but the aerobic dance group had a significant increase (5 mmHg) in resting SBP. This finding is contrary to other reports in normal subjects with training (Tipton, 1984). Tipton states that seldom will exercise training result in higher resting pressures, although the possibility is higher when using direct methods. However, it should be pointed out that although SBP increased in the aerobic dance group, the posttest value of 117.1 mmHg was still well within normal accepted ranges. Also, the study was unable to control physical activity possibly performed prior to testing.

The overall findings in Study Three are consonant with those of Study One. That is, aerobic training will result in Black women experiencing gains in aerobic power and losses in body fat, with no consistency in findings on HR and BP measures taken at rest. There is a trend toward loss of body weight, but changes are small and not always predictable. Finally, under the conditions of these studies, for Black women, when training stresses are controlled and equivalent, one can expect similar adaptations from aerobic dance and from walking/jogging training regimens.

Study 4

This study was designed to investigate the effects of 10 weeks of detraining after 12 weeks of aerobic training by walking/jogging and aerobic dancing. Data were pooled from both groups,
30 females who had completed Study Three being retested 10 weeks after completion of their respective training programs. No specific instructions or recommendations concerning exercise or dietary lifestyles had been given to the subjects after post-training effects at the end of Study Three.

Studies on detraining are summarized in Table 6. Because the focus of this study was on middle-aged women, only studies about female subjects were included in the Table. Detraining data concerning women are very limited. As in Study Two, no significant detraining effects occurred in body weight, HR, SBP or DBP (Table 7). However, in contrast to the results of Study Two in which the sum of skinfolds increased 10% between the posttest and the post detraining test, no significant changes occurred in skinfold thicknesses in Study Four (Figure 8). Cunningham and Hill (1975) reported a 9% increase in the sum of 4 skinfolds after a year of detraining in 4 sedentary females. In Study Two, holidays and diet may have been contributing factors for the increase in fat. The results of these findings merit additional research about diet and body composition and training/detraining.

The significant loss in predicted max \( \dot{V}O_2 \) (30.3 ml·kg·min to 27.7 ml·kg·min) following 10 weeks of detraining is supported by other research (Table 6). The 9% decrease is less than reported in the other studies, but the fact that the subjects in this study were older, more sedentary, less fit and more obese than the younger subjects probably explains some differences in the
### Table 6.

Summary of Studies About Detraining in Female Subjects

<table>
<thead>
<tr>
<th>Female Studies</th>
<th>Description</th>
<th>Sum of Skinfolds % Change</th>
<th>Body Weight % Change</th>
<th>Pred. max $\dot{V}O_2$ Difference</th>
<th>Pred. max $\dot{V}O_2$ % Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cunningham &amp; Hill (1975)</td>
<td>4 females; (mean age 31 yrs); exercised 2 times per wk for 9 wks; bicycle ergometer at 3 work levels up to 80% max aerobic capacity; exercised 2 times per wk on own. Stopped exercising regularly for 1 yr.</td>
<td>9%</td>
<td>NS</td>
<td>-3.6</td>
<td>10</td>
</tr>
<tr>
<td>Drinkwater &amp; Horvath (1972)</td>
<td>7 female athletes (15-17 yrs); daily training 3-4 months; tested 1, 3, 5, 7 &amp; 23 wks later. Detraining more pronounced after week 7.</td>
<td>no data</td>
<td>3.0</td>
<td>-7.4**</td>
<td>15</td>
</tr>
<tr>
<td>Fringer &amp; Stull (1974)</td>
<td>42 college women (17-32 yrs); exercised 2 times per wk for 10 wks on bicycle ergometer; &quot;all-out effort&quot;; 5 wks of detraining and 10 wks of detraining but averaged across both groups.</td>
<td>no data</td>
<td>NS</td>
<td>-6.9</td>
<td>16</td>
</tr>
<tr>
<td>Testerman - Study Two (present study)</td>
<td>9 black females (mean age 39.0); walk/jog 3 times per wk for 11 wks at 70-75% age-adjusted max HR; 15 wks of detraining.</td>
<td>12%</td>
<td>NS</td>
<td>0.7</td>
<td>NS</td>
</tr>
<tr>
<td>Testerman - Study Four (present study)</td>
<td>30 black females (mean age 39.0); walk/jog and aerobic dance for 12 wks; 3 times per wk at 70-75% age-adjusted max HR; 10 wks of detraining.</td>
<td>NS</td>
<td>NS</td>
<td>-2.6</td>
<td>9</td>
</tr>
</tbody>
</table>

NS = Not Significant; ** $p<.01$
## Table 7

### Study Four. Posttraining to Post Detraining, With Pretraining Data for Reference (n = 30)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-training</th>
<th>Post-training</th>
<th>Post Detraining</th>
<th>Mean Differences (Post to Post Detraining)</th>
<th>Differences %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>76.2</td>
<td>74.7</td>
<td>74.4</td>
<td>-0.28</td>
<td>0.00</td>
</tr>
<tr>
<td>Sum of Skinfolds (mm)</td>
<td>97.1</td>
<td>87.4</td>
<td>87.9</td>
<td>+0.45</td>
<td>0.04</td>
</tr>
<tr>
<td>Heart Rate (hpm)</td>
<td>86.4</td>
<td>80.9</td>
<td>83.5</td>
<td>+2.63</td>
<td>3.00</td>
</tr>
<tr>
<td>Systolic Blood Pressure (mmHg)</td>
<td>116.5</td>
<td>118.1</td>
<td>117.3</td>
<td>-0.80</td>
<td>0.06</td>
</tr>
<tr>
<td>Diastolic Blood Pressure (mmHg)</td>
<td>75.5</td>
<td>75.3</td>
<td>76.9</td>
<td>+0.55</td>
<td>0.07</td>
</tr>
<tr>
<td>Pred max (\dot{V}O_2) (ml•kg•min)</td>
<td>27.0</td>
<td>30.3</td>
<td>27.7</td>
<td>-2.6</td>
<td>9.00</td>
</tr>
</tbody>
</table>

.005 p<.01; .025 p<.05
Figure 8. Sum of skinfolds across time of training and detraining.

Figure 9. Predicted max \( \dot{V}O_2 \) across time of training and detraining.
findings. Also, the rate at which detraining initially occurs may be slower in sedentary subjects as compared to well-trained athletes. Drinkwater and Horvath (1975) concluded that 3 months of detraining had reduced the cardiorespiratory fitness of female track athletes to the levels found in non-athletic girls of the same age. Cunningham and Hill (1975) reported a 9% decrease in max \( \dot{V}O_2 \) in sedentary women after 1 year of detraining. The important point resulting from the findings is that some aerobic capacity was lost during the detraining and, in some cases, as quickly as 10 to 12 weeks.

The findings of Study Four are in contrast to the findings of Study Two (Figure 9). Predicted max \( \dot{V}O_2 \) was maintained during the 15 weeks of detraining in Study Two. A contributing factor may have been the weather. During Study Four the weather was much hotter, more humid and more uncomfortable as compared to the weather during Study Two, in which the weather was cooler and more conducive to continued walking/jogging activities after the training period. There is general agreement that some measure of fitness is retained, but that subjects probably need a longer training period to ingrain good habits or that more attention must be given to motivation and/or education following cessation of training to make the establishment of a more healthy lifestyle more probable.

**Exercise Adherence**

The following reasons were given by the subjects who did not
complete the various studies:

1. The time of day was inconvenient.
2. Transportation problems occurred.
3. There was lack of support from family and friends.
4. There was interference by health problems.
5. Vacation time caused conflict.
6. There was simply lack of motivation.

Among individuals who voluntarily enter a supervised exercise program by self-selection, it is common to observe a 50% dropout within 6 months (Dishman, 1982; Morgan, 1977). Subjects in this study averaged a 46% dropout. Oldridge, Wicks, Hanley, Sutton and Jones (1978) reported that those who drop out of exercise programs have initially higher CHD risk profiles. Several studies have shown an inverse relationship between a heavy or fat body composition and exercise (Brownell, 1982; Dishman, 1981; Gwinup, 1975).

Summary and Conclusion

This series of studies was undertaken to examine the responses of middle-aged Black females to aerobic training and to subsequent detraining. Previous studies on women have generally ignored Blacks, and data on detraining of females are sparse. Training was by either walking/jogging or aerobic dance over 11-12 weeks and detraining periods of 10 and 15 weeks were used. Protocols for both training media were identical in terms of
warmup time, time and intensity of training stress, and cooldown time.

The cardiovascular measures of resting HR, SBP, and DBP as well as body weight underwent almost no changes from training through the detraining period. On the other hand, skinfold thicknesses were reduced from training and either stabilized or returned to pretaining levels following detraining. One of the presumed differences between Black and White adult women is the higher incidence of obesity in Blacks. A plausible reason for this is certainly the high carbohydrate/high fat diets of Black women. Diet was not controlled or studied in this investigation. It is possible that during an exercise program, the normal diet patterns may have changed to a more healthful regimen due to the motivation inspired by the exercise program. Then, during detraining the subjects returned to their former eating patterns. This area represents a need for further study. It also may be that skinfold thicknesses respond quite quickly to eating patterns.

Predicted max VO\textsubscript{2}, possibly the most important measure of health-related fitness, increased following training and was either maintained or reduced following detraining. There was consistency in the overall training effect of walking/jogging and aerobic dancing. Middle-aged Black women respond to aerobic training in a fashion similar to that of other women reported in previous studies. There was consistency in detraining in that
only part of the benefit gained through training was maintained in the period to follow. Aerobic capacity was maintained in one case and reduced back to the pretraining level in the other.

Unless structured fitness programs can result in longer-lasting lifestyle changes, they will not be beneficial. Apparently there is a need for more attention to education and motivation at cessation of training. Innovative and effective programs are needed for all population groups, especially the poor, the less educated, and the less advantaged. Considerably more opportunities and research need to be devoted to these population groups who oftentimes are far less healthy, and whose economic status generally prevents their participation in these health-enhancing activities. Because exercise is one of the healthful measures available to women, it is recommended that efforts be made to provide information about exercise training and detraining, body composition, diet and weight control, and to provide exercise programs that are affordable, accessible, and appealing to those women who need fitness the most. Further research is needed in every phase of the health and fitness needs of middle-aged women.
References


VITA

Edwyna Pace Testerman was born on January 11, 1939, in Spencer, Louisiana. She graduated from Linville High School in 1956 and attended Northeast Louisiana State in Monroe, Louisiana from 1956 to 1959, graduating with a B. S. degree in Health, Physical Education and Recreation with a minor degree in English.

Following graduation from Northeast, Dr. Testerman was employed with the Lake Charles City School System. She was an Elementary Physical Education Specialist teaching third through eighth grade.

In 1963 Dr. Testerman returned to Northeast Louisiana State University as a graduate assistant in Physical Education and began working toward a Master of Education degree with the major emphasis in Physical Education. With the completion of this degree in 1964, she accepted a position at the University of Southwestern Louisiana in Lafayette, Louisiana.

Dr. Testerman is an Associate Professor of Health, Physical Education and Recreation and has been employed at the University of Southwestern Louisiana for the past twenty years. During this time, she enrolled in the Doctor of Education degree program offered by the School of Health, Physical Education, Recreation and Dance at Louisiana State University in Baton Rouge, Louisiana. The Doctor of Education degree was awarded in the area of Professional Preparation in Physical Education during the Spring semester, 1985.
DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Edwyna Pace Testerman

Major Field: Physical Education (Professional Preparation)

Title of Dissertation: Training and Detraining Effects on Selected Physiological Measures of Fitness in Adult Black Women

Approved:

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

EXAMINATION COMMITTEE:

Date of Examination:

May 2, 1985