Chapter I

INTRODUCTION

Humans are meticulously designed for physical activity, yet our modern mechanical age has eliminated many of the opportunities we once had to incorporate moderate physical activity as a natural part of our lives.

Life long participation in physical activity is currently promoted by several agencies for two main reasons. The first argument in support of the promotion of regular habits of exercising is based upon the contribution of physical activity to health and fitness. In recent years, interest in fitness for health rather than for optimum performance has grown significantly. It has been generally accepted that regular exercise may enhance normal health, and may contribute to the prevention of disease, in particular heart disease.

The second argument in favour of increasing participation levels in physical activity is that people should be encouraged to make good use of their leisure time.¹

For most people the age of forty marks the zenith of their performance and experiential capacities. From then on it's all downhill runs the refrain, and some, looking back, will have to admit that this unfortunately, is also true in their own case.

Heart attacks among people under forty are surprisingly numerous. One adult in three has a major or minor cardiac circulatory ailment. Especially affected by this are the men and women in managerial positions for whom the problem of "fitness over forty" frequently decides the success or failure of a career. Today we know that proper amounts of physical exercise have restorative effects on an impaired circulation. Even among people with a risk of heart attack, cardiac exercise, when properly administered, pays off.²

Maintenance of a relatively high degree of physiological fitness can play an important role in human

well being. Although opportunities for participation in vigorous physical activities have long been available to men, the involvement of women in such fitness oriented program is relatively new.³

In the present competitive world, women are visible, but then active involvement in physical activity is not yet pervasive. They are entering new roles in the society, which expects them to move equally with their male counterparts. The main focus should be on the lives of the "everyday women", who has ever thought of participating in fitness programmes or other forms of physical recreation.

The Indian middle aged women are beginning to notice the condition that determine their lives call for a significant extension of their phase of full intellectual and physical fitness.

Also, their high degree of potential experiences makes it desirable to maintain an optimal phase of vitality as long as possible.

The middle age being the transition period; they are exposed to new risks to their health, for e.g.: systemic hypertension, premature menopause, high level of blood lipids, diabetes, arthritis, obesity, and a genetic influence on the development of atherosclerosis. Women do exhibit some risks not seen in men, such as decreased bone mineral content, which leads to an increased risk of osteoporosis at old age, due to amenorrhea/ oligomenorrhea and hyperestrogenamia in young to middle aged women, which is due to physical in activity and calcium deficiency.\textsuperscript{4}

The desire to extend the human life span is almost as old as man himself, but not one that is likely to be fulfilled in the foreseeable future. To a greater extent, medicine has done all it can in banishing the epidemic diseases that once saw off most people by middle age and in the last century, has more than doubled life expectancy. But the conquest of further diseases is unlikely to extend the average human life span of people in the

developed world significantly.5

Physically, middle age should be pleasant plateau - a time to look back on a vigorous youth, enjoy an active present, and prepare for a ripe old age. Middle age should not be measured by chronological age but by biological age, the conditions of the various parts of the body.6

Every change in a person's condition or course of life pre-supposes abilities or energies that can effect these changes. Obviously, this applies to the speeding up or slowing down of a mechanical clock, but it is equally true of the course of our own biological clock, the aging process. We have to invest energy, do something, if we want to retard the aging process.7

---


7 Noder, Speaking of: Fitness Over 40, p.12.
Physical activity plays an important role in preventing loss of human functional capacity with age. Each system of the human body has demonstrated an enhanced functional capacity through physical activity. The combination of increased physical activity and life style modification will enable the older adult to enjoy a high quality of life.\textsuperscript{8}

There is a pronounced plasticity and adaptability in the structural and/or functional properbies of cells, tissues, and organs, systems in the human body when exposed to various stimuli. While there is unanimous agreement that regular exercise is essential for optimal function of the human body, it is evident that extrinsic factors, such as diet and exercise habits, are reflected in the morbidity and mortality statistics especially in the aged. Aging is obligatory associated with reduced maximum aerobic power and reduced muscle strength, i.e. with reduced physical fitness. As a consequence of diminished exercise tolerance, a large and increasing number of elderly persons will be living below, at, or

just above "thresholds" of physical ability, needing only a minor intercurrent illness to render them completely dependent. Physical training can readily produce a profound improvement of functions essential for physical fitness in old age. Adaptability to regular physical activity serves to cause less disruption of the cell's "milieu interieur" and minimise fatigue, thereby enhancing performance and the economy of energy output during exercise.\(^9\)

A properly designed programme, primarily aerobic in nature, will remove one risk factor, - physical inactivity. Additionally, aerobic exercise may have a healthful effect on other risk factors as well.\(^{10}\)

Of all the different exercise programs available, those that stress aerobic exercise appear to possess the greatest potential for improving one's health. Haskan has recently noted that although aerobic type exercise by itself is obviously not a panacea for all diseases, the available research data support its use as a treatment for

---


various medical conditions and its value in an overall program of health promotion. In this latter regard, aerobic exercise may also serve as a catalyst to other life-style changes, such as nutrition, weight control, and smoking. In a sense, then, aerobic exercise is medicine.\textsuperscript{11}

Aerobic fitness (cardio-vascular respiratory efficiency) is the single most important health component of physical fitness. It involves the interaction of four physiological functions - respiration, central circulation, peripheral circulation, and muscle metabolism. The four key components of an aerobic program are mode, intensity, duration, and frequency of exercise. According to the American College of Sports Medicine (ACSM), the minimum amount of exercise for aerobic fitness is an intensity level of 60 to 90 percent of the heart rate reserve, for a duration of 15 to 60 minutes, at a frequency of 3 to 4 times per week. Recent research has revealed that lower levels, 45 to 50 percent, may also be effective, particularly in individuals with poor levels of physical fitness.\textsuperscript{12}


\textsuperscript{12}Williams, Lifetime Fitness and Wellness: A Personal Choice, p.29.
Aerobic exercise is the foundation of any fitness program. They are the heart of the matter. They improve and sustain the cardio-respiratory system, which is the key to the vitality of the entire body. These exercises help in sending a rich supply of oxygen through the blood to the muscles so the muscles can then produce energy. How much oxygen the lungs inhale, how much blood the heart pumps, and how much oxygen the muscles use, when exercising vigorously are the best measure of overall fitness. This measure is called the "maximum breathing capacity." It's the aerobic power.

In addition to its positive effects on the heart, aerobic exercise multiplies the number of oxygen-carrying cells in our body and improves the ability of the enzymes in our muscles to extract this oxygen. It increases the number of capillaries - the smallest blood vessels - that bring blood to the muscles. It also enlarges the arteries - the largest blood vessels. As a result the blood pressure decreases. The blood's ability to dissolve harmful clot is improved. And levels of harmful fats in the blood are reduced while levels of healthful fat substances, HDLs, are increased. These are the high-density lipoproteins that speed harmful fats and
cholesterol through the blood stream before they can be deposited as plaque inside the blood vessels.\textsuperscript{13}

An elevated blood cholesterol count is a major risk factor for CHD (Cardio-vascular heart disease). Most doctors now believe that forty years old should aim for blood cholesterol level below 220 and the lower the better with risk of CHD (Cardio-vascular heart disease).\textsuperscript{14}

The degree of improvement is related to the dosage, although the relationship is not linear and is affected by age, level of fitness and genetic predisposition.\textsuperscript{15}

Haemoglobin (Hb) is the compound found in red blood cells that carries most of the oxygen from the lungs to


\textsuperscript{15}Fardy et al., \textit{Cardiac Rehabilitation: Adult Fitness and Exercise Testing},p.170.
the skeletal muscles. Also, the greater the blood volume, the greater the Hb. Thus, both Hb and blood volume are directly related to the amount of oxygen transported, and hence to the functional size of the aerobic or oxygen system, i.e., to the max VO₂. The total amount of Hb, total blood volume, and Hb concentration for males and females, the differences in these variables are minimal at the younger ages before puberty and are maximal after puberty, being much lower in the female. The lower Hb concentration of the adult female is sometimes associated with iron deficiency anemia. Anemia represents a subnormal Hb concentration and indicates a negative iron balance (more iron being lost than taken in). Iron deficiency in some adult females is related to menstrual bleeding.  

Those who concentrate on cardio-respiratory fitness often neglect the importance of flexibility in a general training program. A supple body may be of no direct benefit to your heart and lungs, but it allows the body to

---

exercise aerobically with greater ease. The joints have a natural tendency to lose mobility from adolescence onward and, without the benefit of regular exercise, normal forms of exercise become increasingly hard to perform. By putting all the main joints in the body through their full range of movements every day, one can help to maintain the function and possibly even prevent arthritic problems later in life.\textsuperscript{17}

Flexibility is the degree to which body segments can move or be moved around a joint. The flexibility or range of motion around a particular joint is determined by the configuration of bony structures and the length and elasticity of ligaments, tendons, and muscles surrounding the joint. Although there are no research data to support the concept that flexibility aids in co-ordinated movement, it certainly makes sense that by allowing free movements without unnecessary restriction, the body's efficiency and grace would be increased and the potential for injury reduced.\textsuperscript{18}

\textsuperscript{17}Jackson et al., The BUPA Manual of Fitness and Well Being, p.102.

\textsuperscript{18}Mary L. O'Toole and Pamela S. Douglas, "Fitness: Definition and Development" cited by Shangold and Mirkin, Women and Exercise: Physiology and Sports Medicine, p.4.
The structural limits to flexibility are (i) bone, (2) muscle, (3) ligaments and other structures associated with the joint capsule, (4) tendons and other connective tissues, and (5) skin. Limitations by bony structures are confined to certain joints. In all the joints, including the hinge, the so-called soft tissues provide the major limitation to the range of joint movement. The joint capsule and associated connective tissues plus the muscle provide the majority of resistance to flexibility. At the extremes of joint motion, the tendons have a more limiting effect. Since flexibility can be modified through exercise, so also can these soft-tissues limitations. The reason for this, at least in part, is related to the elastic nature of some of the tissues.\(^1^9\)

\(^{19}\) Fox; Bowers and Foss, The Physiological Basis of Physical Education and Athletics, p.189.
can be attributed to the fact that training results in improved pulmonary function and therefore in larger lung volumes.\textsuperscript{20}

\checkmark Vital capacity and total lung capacity are related to body size and vary approximately as the cube of a linear dimension, such as body height, up to the age of twenty-five. The individual dimensions are, however, not exclusively decrease for the size of the lung volumes. The lung volumes are about 10 percent smaller in women than in men of the same age and size. Training during adolescence will eventually increase the vital capacity and total lung capacity. After the age of about thirty, the residual volume and functional residual capacity increase and the vital capacity usually decrease.\textsuperscript{21} Astrand et al. noted a similar attainment in the vital capacity at the age of forty to forty five as twenty years earlier from the observations in a longitudinal study.\textsuperscript{22}

\textsuperscript{20}Ibid.


Several cross-sectional studies have shown a loss of muscle strength with age, beginning after the third decade of life and amounting to a decline of 16.5% or greater. The loss is greater in women. This loss of muscle tissue is related to a number of important metabolic activities.²³

General muscular strength in the female is approximately two-thirds that of the male. It is noticed that the strength differences vary among different muscle groups. For example, in comparison with men, women are weaker in the chest, arms, and shoulders and strongest in the legs. The reason for this is more than likely related to the fact that both sexes use their legs to a similar degree, e.g., standing, walking, running, climbing stairs, and cycling. On the other hand, females, at least heretofore in American Society, have had little opportunity to use their upper limb muscles.²⁴


The association of obesity with increased risk for developing hypertension, diabetes, cardio-vascular disease, and cancers has made it a complex health problem. Exacerbating the problem is the realisation that there are multiple factors both physiological and psychological, that interact to induce obesity, as well as a myriad of components that may be useful in the curtailment of obesity. It is generally accepted that genetic, hormonal, and metabolic factors play an etiological role in the development of obesity, while an imbalance between energy intake and energy expenditure is the major pathophysiological disturbance that results in increased body fat deposition.\textsuperscript{25}

Body composition makes an important contribution to an individual's level of physical fitness performance, particularly in activities that require one to carry, one's body weight over distance, will be facilitated by a large proportion of active tissue (muscles) in relation to

a small proportion of inactive tissue (Fat).  

Body composition changes usually require sustained physical activity. Physical training also can counter the increase in body fat that accompanies aging. Although exercise alone produces a modest loss of body fat, much greater losses can be accomplished when exercise is accompanied by caloric restriction. Conversely, a significant reduction in physical activity - such as the interruption of training or a shift to a sedentary lifestyle results in an increase in body fat, even if caloric intake is significantly reduced. In fact such a reduction in habitual activity is accompanied by a disproportionate increase in body fat.  

The females can expect the following changes in body composition as a result of physical training. They can expect (1) a sizeable decrease in body fat (e.g., 2.5 to 3.0 kg.), (2) a small increase in lean body weight (3) a

---

26 O'Toole and Douglas, "Fitness: Definition and Development" cited by Shangold and Mirkin, Women and Exercise: Physiology and Sports Medicine, p.4.

small decrease in total body weight after a physical training program consisting of jogging, walking and running. These changes, particularly fat loss, are more pronounced for the obese than for the "lean" female. In addition, it is evident that modifications in diet must also be involved in a comprehensive weight-loss program in order to obtain an optimal weight-loss level.  

To promote continuing research as well as effective practical application of research findings, medical professionals must join in harmony with those who can provide leadership in marrying the "medical" domain with exercise science specialists who are also keenly interested in bridging the gap. The ivory towers of the university will always exist, but the modern day clinician can go a long way in unlocking previously restricted territories.  

The profile of physical activity for women is also of concern. Most of the studies on the beneficial effects

---


of physical activity for women is also of concern. Most of the studies on the beneficial effects of physical activity have been done primarily with young and middle aged men. Studies in women and youth have been limited and not sufficiently extensive to produce conclusive results. There is a considerable need to expand the base of scientific knowledge about the physiology, epidemiology of physical activity especially in women and youth, and to expand the base of knowledge about interventions that are effective for various population subgroups. Therefore it is high time that the sedentary life style of the Indian women, specially the middle aged (40-45 years) as well as that of the senior citizens too be probed into and expose them to appropriate fitness programme.

Based on the background of the literature provided, and the existing sedentary conditions of the Indian middle aged women, the investigator felt a high need to probe into the sedentary life style of these women who are entering into new roles in the society, that expose them to new risks to their health. As a result, the research scholar has taken up the project to bring about a general awareness of the existing relationship between exercise participation and prospective health benefits.
Statement of the Problem

The purpose of the study was to investigate the effect of twelve weeks of aerobic exercise programme on physical and physiological parametric changes in middle aged women of age group forty years to forty five years.

Delimitations

1. For the purpose of the study the age level of the subjects ranged from 40-45 years.

2. The study was further delimited to the physical variables namely cardio-vascular fitness (Cooper's 12 minute run/walk test), muscular strength (Grip strength, back and leg strength), flexibility (Modified sit and reach test, shoulder and wrist elevation).

3. The selected physiological variables were resting heart rate, resting blood pressure, body composition, vital capacity, peak flow rate or flow rate, haemoglobin and cholesterol.

Limitations

1. The study was confined to the selected investigating method because of the availability of the selected instruments required for these investigation.

2. The effect of uncontrollable factors like dietary habits, and daily routine work which might have influenced the results of the study was considered as another limitation of this study.
Hypothesis

It was hypothesized that a twelve week aerobic exercise program will significantly improve the selected physical and physiological parameters in the middle aged women of the age group 40-45 years.

Definition and Explanation of the Terms

Aerobic Exercise

Aerobic exercise is exercise that is vigorous enough, lasts long enough and is done regularly enough to keep the heart and lungs in good shape.

Physical Parameters

Flexibility

Flexibility is the range of motion around a joint.

Muscular Strength

Muscular strength may be defined as the force a muscle or a muscle group can exert against resistance in one maximal effort.


31 Ibid., p. 135.
Cardio-vascular Fitness

The ability of the lungs and heart to take in and transport adequate amount of oxygen to the working muscle, allowing activities that involve large muscle masses to be performed over long period of time.\(^{32}\)

Physiological Parameters

Resting Heart Rate

The distension of the arterial wall at the beginning of systolic ejection of blood is not confined to aorta but travels down the arteries as a wave followed by a wave of recoil. The arteries that lie close to the body, such as the radial artery of the wrist, the arrival of the wave of distention and subsequent recoil may be felt as a distinct throb pulse which offers a convenient method of counting the heart rate.\(^{33}\)

Resting Blood Pressure

The driving force that moves blood through the circulatory system. Systolic pressure is obtained when

\(^{32}\)Ibid.,p.545.

\(^{33}\)Laurence E. Morehouse and Augustus T. Miller, Physiology of Exercise (St. Louis: The C.V. Mosby Co.,1976),p.67
blood is ejected into the arteries, diastolic pressure is obtained when the blood drains from the arteries.\textsuperscript{34}

**Body Composition**

Body composition is the proportion of the lean body mass and depot fat, and it is one of the most important morphological features characterising human organism.\textsuperscript{35}

**Body Fat**

Fat is the most variable tissue in the body and is distributed throughout the body primarily under the skin and in the abdominal cavity.\textsuperscript{36}

**Lean Body Mass**

The body weight minus the weight of the body fat.\textsuperscript{37}

\textsuperscript{34} Mathews and Fox, *The Physiological Basis of Physical Education and Athletics*, p. 548.


\textsuperscript{37} Fox, Bowers and Foss, *The Physiological Basis of Physical Education and Athletics*, p. 698.
Vital Capacity

Maximal volume of air forcefully expired after maximal inspiration.36

Air Flow Rate

Maximal amount of air that can be expelled out (in one minute) after a forceful inspiration is known as air flow rate.

Peak Flow Rate

Rate of flow of air per minute of the peak expiratory condition is known as peak flow rate.

Cholesterol

The lipids are a heterogeneous group of substance having in common low polarity and very limited solubility in water. The plasma lipids include cholesterol and triglycerides. Cholesterol is derived partly from the diet and it is also synthesized in most tissues. The greater part of the cholesterol in the blood is in low density lipoprotein.37

36 Fox, Bowers and Foss, The Physiological Basis of Physical Education and Athletics, p.705.

Haemoglobin

A complex molecule found in red blood cells, which contains iron (heme) and protein (globin) and is capable of combining with oxygen. 38

Significance of the Study

1. The pre-test results will help in establishing a selected physical and physiological fitness profile of the sedentary Indian middle aged women of 40-45 years.

2. The outcome of the study would be useful in evaluating the degree of adaptive changes that are brought about by aerobic exercises.

3. The results of the study will help us to assertain the kinetics of physical and physiological changes resulted from aerobic exercise in relation to duration of exercise programme.

4. An integrated approach will help to define the relationship in women between longevity and exercise prescription and various markers for health (i.e., blood profiles, maximal and sub-maximal physiological parameters).

38 Fox, Bowers and Foss, The Physiological Basis of Physical Education and Athletics, p.696.
5. The findings will help to define optimal standards for body composition in relation to health and physical performance of middle aged Indian women.

6. The study shall help the physical education professionals, doctors, physiotherapists to plan out a suitable training/conditioning/treatments for middle aged women of forty to forty five years of age.