Chapter - I

Introduction

1.1 Aging – Perspective and Process

The term ‘ageing’ refers to the patterns of change that occur with age in genetically representative organisms living under representative environmental conditions. Aging is a universal process of growing old. It touches everyone regardless of age, gender, and socio-economic level. We are all travelling at different speeds to the same destination (Birren, 2000).

Humankind speculated about ageing and the association of infirmities and death with advancing age. The processes of aging are complex, and combined with the uncertainties about death, a fertile ground for myth, fantasy, and wishful thinking has always existed. These speculations have given rise to myths about the prolongation of life and the nature of death. Some elements of these myths have been displaced by information provided by scientific research but many still remain as part of our cultural inheritance.

The study of aging being approached in many different ways. In some areas of research inquiry, aging is equated with senescence. The term senescence refers to deterioration and declines in the structure and function of an organism that take place during the period of life when the mortality rate of a population is accelerated. Senescence is associated with late life when degenerative processes overtake regenerative processes. The theorists and researchers of previous century have increasingly recognized that each period or phase of the life span is best understood by looking at it in the context of the entire life of the individual. Each developmental period may have its own distinctive characteristics and significance, but there are also similarities and continuity with earlier and later periods of the life span, however, there is no such point to which any development starts or discontinues.

The study of the phenomena of aging from a research and scholarly perspective is gerontology. It embraces studies from the biological,
behavioural, and social sciences. Gerontology is an ancient subject but a recent science and its background may be divided into several periods: (a) the Mythic period, from pre-historical period to Greco-Roman era (b) the Philosophical period, from Greko-Roman days to the Renaissance; (c) the Renaissance, (d) the early Scientific Period, from about 1600 – 1800 AD, (e) the expansion of Empirical Research, from 1800 to about 1930 AD; and (f) Modern Gerontology, about 1930AD onwards (Birren, 1996).

Myths about aging and mortality are three main types: (a) antediluvian, which hold that in the past people lived much longer; (b) hyperborean, in which it is believed that people live much longer in some remote parts of the world; and (c) the fountain type, in which healing water or substances are thought to exist somewhere. Today these myths may still underlie the popularity of healing spas, diets, exercise programs, and vitamins of special potency. This comment is not meant to express an evaluation of the validity of ways of modifying the course of aging but to express a link between these high contemporary interests and the underlying fear of old age and dying that must have preoccupied some of our preliterate ancestors and still are important to our contemporaries (Gruman, 1996).

**Historical Perspective:**

The traditional Indian view of life based on the assumption that there is a preordained cosmic order which each individual lives through stages enroute to some ultimate transcendent state. The background for Indian thought is a mixture of philosophy, religion and practices of a long existing culture; although it did not stimulate scientific research on aging. They believed man’s life passes through four stages on ‘ashrams’ (a) Brahmacharya or studenthood (birth-25 years) (b) Garhastha or householder (25-50 years) (c) Vanprastha or forest dweller (50-75 years), and (d) Sanyas or renouncer (75 years onwards). West has been influenced by the Christian view that the individual is ultimately resurrected for eternal life. Both Hinduism and Christianity regard the conditions of future existence as being a consequence of present moral behaviour (Chadha, 1997).
The Greek and Roman philosophers dealt with questions about the nature of aging and death. The contributions of philosophy and the beginnings of science derived their strength from the rigor of the reasoning and its logic but not upon data. Underlying their views is the realization from personal observations that there is a pattern to changes in life marked by stages, cycles, or seasons of a life. Increasingly in the Greco-Roman views of life there was a separation of the physical or physiological aspects from the moral or religious points of view. The Renaissance and reformation permitted a shift in attitudes that supported the growth of natural science and the gathering of systematic data.

The expansive period of science was based upon the conviction that all phenomena of nature are lawful and that these laws can be determined through scientific investigations. The first application to this point of view in the study of aging was done by a Belgian scientist Adolphe Quetelet (1796-1874). He quoted “Man is born, grows up, and dies, according to certain laws which have never been properly investigated, either as a whole or in the mode of their mutual reactions”. At the beginning of the twentieth century, a number of biologists began to write prolifically about aging. Their underlying theme was the identification of causes of aging or the transformations that occur with age in the human species. The writings of the day were surrounded by a great deal of optimism about the potency of science. No problem appeared to be beyond it’s understanding and perhaps even the extension of the human life span was potentially under human’s control (Birren, 1996).

During the beginning of the modern period of gerontology many scientists in the various disciplines took multidisciplinary approach and considered aging as multi-factorial process having both genetic and environmental basis. Earlier views of aging frequently adopted the medical model, which held that ageing is a product of disease. The current view is that manifestations of ageing involve many factors that interact to modulate mortality and morbidity.
Shortly after World War-II ended in 1945, activities in gerontology began to accelerate. Gerontological organisations have been emerged to stimulate research, teaching, and service. Of great importance to the longevity, health, well-being, and quality of life of older persons is the development of increasingly sophisticated theory and research on aging. Because of the importance of knowledge and research on aging for the well-being of present and future generations, there seems no doubt that the need for study on aging will remain a higher priority in academic and professional setting as it has crossed the threshold of individual concern (Chadha, 1997).

Never before in human history have so many survived to old age. There are no guidelines for the increasing number of elderly because they have not existed before in such large proportions. Current generations have become pioneers in time and can certainly benefit from recent discoveries in gerontechnology.

Aging Process:

Many of the processes and mechanisms of aging are universal in that similar changes of human behaviour can be observed at roughly the same age across persons. Many of these processes are controlled by “biological clocks”. The term primary aging refers to changes that occur with aging in the absence of disease. The effects of primary aging on physiological or behavioural functioning are relatively predictable for all individuals. In contrast to the consequences of many disease processes that are relatively abrupt and affect primarily one system or organ, the consequences of primary aging are more gradual, cumulative and insidious.

Despite the ubiquity and universality of primary aging processes, one of the most remarkable characteristics of human aging is the wide range of heterogeneity in the expression of the consequences of aging. Secondary aging factors such as stress, trauma, exposure to toxins, and disease influence the rate of primary aging processes. In addition to large inter individual heterogeneity; there is also considerable inter-individual variability across various dimensions of biological and behavioural functions. Individuals become more unique as they grow older in part because of particular histories of life experience.
The life spans of all multi-cellular organisms including man are believed to be genetically programmed. Since the expressions of genes are influenced by environment, a number of factors such as nutrition, physical exercise, stress, lifestyle etc. are known to modulate the rate of aging process. While some of the factors such as dietary restriction, physical exercise, and improvement and moderation in lifestyle have shown beneficial effects; the stress factors (physical and or mental) in general accelerate the rate of ageing (Patnaik, 1998).

Good general health at any age seems to be most important when it is maintaining cognitive integrity with age, and in speaking of fitness and the aging process. It has to maintain the partiality of all physiological systems as being interlinked through the central nervous system and circulo-endocrine system (Powell, 1975).

1.2. Population Aging

The number of the older people is rising faster than any other segment of the population. The onset of demographic transition takes place with the reduction in mortality rate, which eventually produces an older age distribution. The decline in mortality is associated with (a) the changing pattern of death due to the control on certain fatal diseases, (b) better medical services and (c) together with better sanitation and nutritional levels have increased the longevity of the individuals (Kumar & Khan, 1997).

The population in India is growing enormously due to the demographic transition occurring in the second half of the last century. Consequent to this transition, the age structure of the population will undergo a profound change. We are moving into a time when older people will out-number children. In 2001 census of India 6.7% of the total population was above 60 years, which was 5.1% in 1981. The surviving trend is not toward a population with an increasing number of centenarians but rather toward increasing numbers of people surviving the young adults and middle aged to approach more nearly their full potential life span (Kinney, 1982).
The demographic projections given by United Nations Organization (1990) as the phenomenal increase of the elderly population (above 60 years) would increase from 60 million in 1990 to nearly 150 million in 2020. The elderly population in India ranks fourth among the countries of the world. When the entire elderly population is compared with the total population of several individual countries in the world, it is surprisingly to note that 151 countries (out of 171 countries) have the total population less than the elderly population of India. If it is taken elderly population in absolute terms the present elderly population in India is only second to China. In view of the decreasing trend in population growth in China through successful family planning measures, it is estimated that by the year 2025 AD India will be the country with the highest number of elderly people in the world (Mahadevan et al., 1992).

The growing interest in aging and the aged is the outcome of two major factors: (i) the proportion of the aged in the total population has been increasing at an accelerated rate and (ii) the increase in the aging population has been at a higher rate than the increase in the general population. This is mainly due to the life expectancy from a mere 23.63 years for males and 23.96 years for females in 1901 to 63.9 and 66.9 years respectively in the year 2001 (India 2005: A Reference Manual). The family and kinship bonds, which offered improvised social security system for the care of the old, have gradually weakened under the process of industrialization, urbanization, modern education, and the like (Dak, 1997).

The greater longevity of the elderly people demands greater attention by family members, it requires more expenditure on health care and nutritious food, on recreational facilities and more comfortable houses. If these needs in a modern society are not fulfilled life would be dry and tedious not only for aged, it would cast darkness in the entire family and on the related kins and friends. Life of elderly people without all the necessities of a good life, more importantly without the sympathy, love, and respect from near and dear ones may cripple the entire society. Quality of life of aged people mainly depends on the personal autonomy of an individual and this personal autonomy is achieved through a delicate balance of physical, economic, psychological, and
social factors. This balance is easy to disrupt in old age. Acute and chronic illness, inadequate housing and income, inaccessible public services, and insufficient social support are some of the factors that lead to dependency in old age. This dependency ultimately weakens the social status of the aged both in the family and society (Kumar, 1997).

The older population is growing at a faster rate than other segments of the population. There has been a fourfold increase of elderly people over last 50 years and will be more than four times again over the next 50 years. The percentage of older persons in projection to be triple over the next half century. These phenomena are expected to create major issues in future in respect of providing social, material and practical services to this segment of population. To meet the challenges of the 21st century and to solve the socio-economic problems of the elderly, it is high time for preparing an effective plan not only to meet the challenges of the elderly, but also to utilize their potentialities for prosperity of the nation (Chakraborty, 1997).

1.3. Consequences of Aging

Survivorship of man grows approximately double in last hundred years than it was at the start of the Christian era. However, life span potential and the rate of aging have remained unchanged in last 100,000 years and the potential life span became fixed. Brain size increased over a similar time course, and this has led to the notion that the brain plays some central role in the aging process (Culter, 1976).

It is appropriate to specify that there are three different varieties of death that terminate the process of aging (a) trauma and accidents (b) disease that overwhelm the defense or repair system of the body and (c) consequence of reduced ability to maintain an equitable internal environment to external environmental stresses. This decreased ability to maintain homeostasis as one age is universal. Large brain does not make man more homeostatically efficient, rather its advantage is related to the external rather than to the internal environment by improving the ability to accumulate information and communicate it within the species; provided by a large brain, justifies the long life even after productive period of life (Kinney, 1982).
Plasticity and resiliency is found in function throughout the lifespan of an individual. Aging is multi-dimensional and multi-directional in that there is variability in the rate and direction of change for different characteristics within the individual and across individuals. It is a product of the interactive effects of biogenetic processes and the historical and socio-cultural contexts in which change takes place; the contributions of environmental and biological influences vary for different dimensions at different points in the life span. Some combinations of biogenetic and environmental influences may be uniquely synergistic (Vercruyssen et al., 1996).

Slowness of behaviour is perhaps one of the most obvious changes perceived in and by the elderly. Not only is it apparent in their motor responses, but also it is also evident in the highest decision making neural structures of the central nervous system. These deficits become increasingly more obvious with increasing complexity of behaviour resulting from health status, life habits (including exercise), familiarity with the task to accomplish (Norman et al., 1987).

Composition of bodily tissue components changes throughout the life span and physiological functional capacities diminish with growing old. Even, as people age, a reduction in leisure time activity tends to occur with physical training. In many cases, these changes in life style patterns occur due to technological, socio-economic and socio-cultural influences, which may influence on various dimensions of aging (Ruder, 1989).

Over the course of a year, the reduction in energy expenditure due to this change would be equivalent to about 0.5 kilograms of fat. Over ten years a positive energy balance of this magnitude could increase a person’s body weight by five kilograms. This magnitude of “creeping obesity” is associated with significant increase in blood pressure, plasma triglyceride concentrations, insulin resistance, and lower high-density cholesterol levels (Pi-Sunyer, 1993).

As people age, the prevalence of chronic disabling illness increases dramatically. Such conditions place older individuals at great risk for loss of independence, disengagement from society, and life long dependency. Upto
age 18, the prevalence of such disabling conditions is about 10%; in adulthood, it is about 20%; in the 65-75 age group it is about 40%; and in the 75+ age group it is about 60%. By contrast, the prevalence of acute recoverable illness (such as infections) is actually not too different across the life span, although older individuals tend to have more serious episodes and more complications from them. A common accompaniment to aging is chronic illness, and many chronic illness cause permanent disability (Kinney, 1982).

Life at any age is, after all, more than a matter of filling in time and meeting the expectations of others. At best, it involves taking action that gives a sense of competence, worth, and ability. Older persons do not graduate from this perspective. Simply filling time and being entertained does not tend to produce high levels of satisfaction with the self or with life.

1.4. Functional Loss

End of life does not come suddenly for most of us. Instead, we slowly wear down our looks, faculties, health declines, hair and teeth begins to fall out and our minds dim. Like all ageing machines, the human body too tends to work less efficiently than when it was 'new'.

In case of human beings, such loss of function does not begin in old age, but in early adulthood. Most bodily systems show a decline of 0.8-1.0 percent per year after the age of thirty (Hayflick, 1977), of course rate of this loss is low and because most bodily systems have an excess capacity built into them. It is only the sixth decade of life that such decline is conspicuous. It is observed that the decline is greater in complex bodily functions than in simple ones, probably because in a complex function the loss is more than sum of the loss in simple components constituting the complex one. Many changes observed in the elderly could possibly be due to disease rather than aging per se. It is quite difficult to exclude the cumulative effects of diseases contracted earlier in life (Birren et al. 1963).

So far the functional loss is concerned, at tissue level, there is loss of collagen; at the cell level, a decline in the efficiency of mitochondria (which generate energy within the cell); and at the molecular level, DNA might mutate
resulting inefficient cell replacement or even its cessation. These changes have deleterious impact upon the bodily systems (Mahajan, 1997). For example:

- Slowing and reduced efficiency of urinary system at excreting toxins and other body waste.
- Reduced efficiency of gastrointestinal system in extracting nutrition.
- Reduced capacity of respiratory system to take inadequate quantity of oxygen; and
- Diminished output of the cardiovascular system, due to heart’s decreased strength and/or hardening and shrinking of arteries (average 75 year old person’s cardiac output is nearly 70% of average 30 years old).

There is some experimental evidence that many of these changes can be lessened by appropriate diet and behavioural changes. Decline in some of these functions in turn may have severe repercussions on the:

- Functioning of the brain. Decline in efficiency of respiratory and cardiovascular systems results in restriction of oxygen supply and energy to the brain, creating conditions for diminished psychological performance.
- Moreover, normal senescent decline and cardiovascular diseases can result in restriction of blood supply to certain sections of the brain resulting in death of brain tissues (as in stroke).
- Insufficient urinary system can result in accruals of high level of toxins which can become serious if an elderly is also undergoing drug therapy. The failure to excrete drugs may cause over dosing problems, a state of confusion or even delirium.
- Inefficient gastrointestinal system may result in lowering of an elderly person’s interest in food, which in turn can cause malnutrition with serious psychosomatic consequences (Weg, 1983).

Many of these consequences can have serious implications for psychosocial performance and individual’s perception on health and well-being. The senses are an individual’s means of contact with the
surrounding environment. Age related decrease in perception through senses often starts in late adulthood, but cumulative effects in advanced years could be significant.

Nervous system is believed to play a crucial role in regulating various physiological and psychological functions. The basic constituent of the nervous system is the nerve cell or the neuron. Nervous functions may deteriorate due to injury in neurons, inadequate neurotransmitters through which neurons transmit information, lack of oxygen due to failure of localized blood supply, and the damage caused by disease. Despite such damage to the nervous system, most elderly persons can and do compensate for behavioural deficits in memory, fine motor coordination or the learning of new information by relying upon their experience, planning, and skills to maintain effective functioning (Mahajan, 1997).

1.5. Physiological Aspects

The fundamental process of aging occurs at the cellular level leading to functional change and manifestations are seen in both the conformation and the composition of the body.

In men body weight tends to increase to the middle 50s and thereafter to decline. The rate of weight loss accelerates in the late 60s and 70s. In women, body weight continues to increase into the 60s and then to decline, but at a rate slower than that in men. The increase in body weight in middle, the "middle-age spread" appears to be the product of reduced physical activity in an environment where food is plentiful, since members of more primitive societies did not show this change (McArdle, Katch, & Katch, 1996).

Although most of the loss of lean body mass occurs in muscle, virtually all organs participate in this age related loss of mass, though to varying degrees. On the other hand, the lungs show no loss of weight or, in fact, may show an increase; on the other hand the liver and kidneys lose one third of their weight between ages 30 and 90. An exception to this pattern of loss is the prostate, which doubles in weight between youth and old age (Kinney, 1982).
Morphological and biochemical changes occur in the cells and tissues of the body. Increased fragility is observed in red blood cells. Total blood volume is well maintained in persons until they reach approximately 80 years of age. However, hemoglobin concentration tends to reduce after age 65 due to inadequate nutrition or decreased interest in food, lack of mobility, and some chronic diseases. Changes are observed in supporting tissues and connective tissues. Loss of bone is a common phenomena though it is unequal between the sexes and women are prone to loss more bones: reasons claimed for are – hormonal change and difference, diet, and nature and level of activity. The aging process contributes a loss of muscle mass, which may amount to a 30% loss between ages 30 and 80. The loss of muscle mass is due to a reduction in both the number and the size of the muscle fibres. Changes in the overall muscle strength begin at approximately age 35, but the degree of loss differs widely among muscle groups following a law of use and disuse. Appearance of skin exhibits marked difference and delicate function of the skin depreciated (devries & Housh, 1994).

Physiologic and performance measures generally improve rapidly during childhood and reach a maximum between the late teens and 30 years of age. Functional capacity then declines with age. Although all measures decline with age, not all decline at the same rate. Nerve conduction velocity, for example, declines only 10 to 15% from 30 to 80 years of age where as resting cardiac index (ratio of cardiac output to surface area) declines 20 to 30%; maximum breathing capacity at age 80 is about 40% that of a 30 years old. Maximum strength of men and women is generally achieved between the ages of 20 and 30 years. The cumulative effects of aging on central nervous system functions are exhibited by a 37% decline in the number of spinal cord axons, a 10% decline in nerve conduction velocity, and a significant loss in the elastic properties of connective tissue. These changes may partially explain the age-related decrement in neuro-muscular performance as assessed by both simple and complex reaction and movement times. When reaction time is partitioned into central processing time and muscle contraction time, the central processing time is affected most by the aging process. Thus, aging
affects the ability to detect a stimulus and process the information to produce a response (McArdle et al., 1996).

Both static and dynamic measures of lung function generally deteriorate with age. Aerobic capacity at age 80 is about 40% of 30 years old. The greatest decrements show with age in coordinated activities of the cardio-vascular, nervous, muscular, and respiratory systems. Cardiac output decreases approximately 1% per year in the age range of 20 to 80, while the stroke volume decreases 0.7% per year. The maximum heart rate that can be achieved, however, does change in a linear fashion with age [Maximum HR = 220 – Age in years] (McArdle et. al. 1996). Cardiac index falls 30%; and vital capacity and renal blood flow fall by 50% in a lifetime. Basal metabolic rate (BMR) follow the average about 20% between ages 30 and 90, and cellular enzyme activities drop about 15% in a lifetime (Watkin, 1982).

1.6. Psychological Aspects

Old age is characterized by an utter sense of hopelessness towards the world. A sense of loss shadowed by loneliness, lack of care, respect of self and others. The feeling of insecurity coupled with high expectation, which are often childlike. Conflict arises when the sick, tired mind and body cannot cope with psychological stress.

Psychological stress refers to the state of an organism in any situation where he perceives that his well-being is endangered and he must devote all his energies to its protection. Psychological stress responses are anxiety, subjective feelings of distress, defensive behaviour, withdrawal and hopelessness. The psychological problems faced by the elderly are complex and numerous. Of these, stress is one, which again becomes manifested in the form of helplessness and hopelessness (Dutta Ray & Chakraborty, 1997).

Three sources are account for the increase in major psychological problems (Harba et al. 1997), because older people can -

(i) Become exposed to the stress of poor health due to their reduced physical and mental functioning.

(i) Become exposed to economic stress due to fixed and reduced income with which to meet rising medical expenses.
(iii) Lose social support because of the death of spouse and friends, and disengagement from social life.

From middle age onward the person confronts changes in the social environment and in his physical body, which require readjustment on his behavioural pattern. Old age is a state of life that increases the likelihood of psychological problems of low self-esteem, anxiety, and depression. However, these problems can be tampered by the adequacy of the individual's social support. Friends, fellow workers, family and neighbours can ease the burden. But if one cut off from work (retirement), from children, and from spouse (widowhood), the changes of personal trauma increase manifold (Chadha & Khuble, 1997).

1.7. Sociological Aspect

Present day offers new opportunities for reclaiming the moral and spiritual dimensions of later life, for bridging the gap between existential mystery and scientific mastery, for reconciling the modern value of individual development with the ancient virtues of accepting natural limits and social responsibilities. Socio-cultural features of modern industrial society have resulted in declining levels of habitual physical activity among adults and aged, suggesting that physical de-conditioning, which is potentially reversible could contribute to a decline in all the structural and functional aspect of an individual.

Peoples images of old age are often carrying over from their parents and grand parents, who lived shorter lives in different eras with different demands. People are now living longer having life potential much preserved and maintained than ever before and the age pyramid of the society is turning upside down (more increased number of aged persons than children), still the view towards aged have not been changed. Different media are projecting elderly people as stereotyped, intolerant, dependent for it's loss of potential (Birren, 1996).

The feeling about older persons is that they are beyond the age when they could contribute to the society. They are now a sort of a burden; the sooner they left the stage the better. In a traditional society in the orient like India, the older persons were not unwanted. From the long past increasing age has,
until very recent past, been accompanied by increasing prestige. Young people would often gather around wise old men for guidance and advice. Even those among the aged who were not so much sought after could, almost certainly, have their needs met within the network of the extended family and maintain their role and status as the head of the family.

Recently, however, the picture has started changing. Development of newer technologies no longer demand that the skills of the artisans should be transmitted down through generations. With industrialization and consequent disruption of large undivided families, growth of vast metropolitan areas, changed style of building, etc. the position of the aged is no longer the same. Social structures and values are undergoing transformation from traditional to modern. There is a rapid stride in urbanization and industrialization leading to the breaking up of joint families and property. This ultimately weakened the so-called traditional familial social position and status of the aged in the family. Modern methods of teaching through books, radio, films, and computers learning has become comparatively a quicker process. Hence the aged can no longer is necessarily associated with imparting knowledge and wisdom to the young (Chakraborty, 1997).

As old age advances, events at home too may contribute to the problems. The 'empty nest' feeling arising as a result of the grown up children leaving the houses, daughters departing as a result of wedlock and sons leaving station in pursuit of higher education or job may make the aged more lonely. The loneliness also arises because of premature loss of spouse. This would deprive the person of a long-standing emotional security. The loss, whenever it might occur in the later years leaves the individual terribly lonely and at the mercy of sons and daughters-in-law. Added to these the increasing gap and interactional stress and strains in the family, that may leave the elderly without peace of mind. The elderly as a result of these developments feel marginalized alienated and left out of the mainstream. As a person grows old he tends to discourage and withdraw him from social role in younger life (Jamuna, 1992).
1.8. Aging and Motor Quality

Substantial declines occur in sensori-motor processing as individuals grow older and motor performance often becomes slower and more variable (Birren, 1996). The elderly show:

(a) The increase in response initiation time.
(b) An increase in movement duration
(c) A reduced capability for decelerating movements and
(d) An inability to calibrate appropriate force levels.

Motor quality deteriorates with age due to deterioration of its basic components and reduction in complex combination of all the components as a whole. It has been hypothesized that there are both primary and secondary factors associated with age-related declines in motor abilities. Primary factors, like genetics, would lead to an inevitable decline in neuronal function within a particular subsystem. Secondary factors include such things as nutrition, exercise, insults, and pathologies (Woollacott, 1996).

With age strength is seen higher between 25 and 30 years. A slow and imperceptible decrease from the twenties to the forties and accelerated decline occurs after age 50. Leg strength decreases at a faster rate than handgrip strength. Contributing factors to strength loss are reduced muscle mass, increasing muscular fibrous tissue, alteration in muscle fiber type and motor neuron abnormalities, chronic disease, osteoartheritis, or decreased physical activity with increasing age. Reduction in strength more influenced by degeneration of CNS than muscular atrophy (Simonson, 1947).

Flexibility is the most important element of fitness in older adults, is recognized as an "indispensable prerequisites of mobility" decreased by 23% in men and 18% in women through 65 years of age. Flexibility is impaired by collagen cross-linkage, arthritis, joint stiffness, loss of elastic tissue, and poor peri-articular blood supply to the joint. Flexibility reduced as aging proceeds because connective tissues lose their elasticity with age, and this in turn seems to be related to many of the aches and pains of old age (Shephard, 1984).
Speed is also an important aspect to perform a motor task. Manifestation of any speedy movement requires a good co-ordination between the body parts, which are seen to perform the movement and regulating part, that is, neurological and biochemical part. Simple reaction time increased about 0.5 ms per year, and choice reaction time increased 1.7 ms per year. Choice reaction time requires an additional attribute i.e., stimulus discrimination time, which increased more rapidly than motor time (Birren, 1996).

Changes in reaction time and speed of movement is probably an effect of the aging of the central nervous system because the slowing is common to several sensory modalities and to several pathways. The cumulative effects of aging on central nervous system function are exhibited by a 37% decline in the number of spinal cord axons, a 10% decline in nerve conduction velocity and a significant loss in the elastic properties of connective tissue. These changes may particularly explain the age-related decrement in neuromuscular performance as assessed by both simple and complex reaction and movement times (devries & Housh, 1996).

Agility reduces substantially as it requires speed, dynamic balance, strength and bi-lateral vision. Studies on age-related changes in balance control have shown changes in the neuro-muscular response characteristics including decreased muscle strength, a slowing of response latencies, occasional disruption in response organization, and an increased co-activation of agonist and antagonist muscles when responding to threats to balance. In addition, older adults showed more problems than young adults when balancing under conditions in which sensory inputs were reduced or absent. Similarity, in research on gait, studies have reported a reduction in walking speed and in stride length, with an increased double support phase. This was accompanied by increases in co-activation of muscles around the ankle joint. Older adults show less power generated by the planter flexor muscles at push-off, which could cause the reduced stride length. The reason for the weaker push-off could be reduced muscle strength (Woolacott, 1996).
The elderly often exhibit impairments in motor performance that can affect their everyday activities. Motor skills are influenced by deficits occurring before the movement, such as slowing in central processing unit, and by changes occurring during performance of the movement such as inability to properly regulate force. Some of these declines can be partially mitigated with practice. However, speed, variability, and kinematic profiles of motor responses usually do not reach levels seen in younger adults suggesting that the declines may represent basic limitations in motor performance capacity for the elderly. The causes of these motor performance declines are not well understood. Regardless of the etiology of these declines, they can have a substantial effect on the independence of many elderly (Seilder & Stelmach, 1996).

1.9. Exercise, Motor Ability and Aging

Exercise may in fact postpone age related degradation of psychomotor reactivity and that it may do this, at least in part, by preserving the nigrostriatal dopaminergic system (Spirduso et al., 1988).

Aging in terms of one’s physiologic capacities is affected not only by cellular deficiencies characteristic of advancing years, but also by one’s habitual physical activity level. The middle aged and elderly population experience losses in skeletal, neuro-muscular, and cardio-respiratory capacity as well as changes in body composition.

Young (1986) has astutely emphasized that the progressive decrease in cardio-respiratory capacity and muscular strength with age and disease results in a critically compromised ability of the elderly to perform what would seem to be routine activities.

In general, the effects of a properly prescribed exercise-training programme in the elderly is to reverse body structure and functional de-conditioning effects induced by hypokinesis. On the other hand there is little evidence that exercise training alters the process itself (Holloszy, 1983).

Flexibility or range of motion in various joints of the body increases significantly in the elderly following 6-12 weeks of stretching, general calisthenics, and rhythmic activities. Low resistance high repetition strength
training has been shown to elicit some increase in size of type-I fibres in older individuals, as well as greater size increases in type-II fibres. Strength training in previously sedentary older individuals appears to produce about the same percentage increase in strength as that incurred by their young adult counterparts. Appropriately prescribed exercise training can produce significant functional improvements in the middle aged and elderly adults' muscular strength and endurance, flexibility, movement efficiency and cardio-respiratory capacity (Adams, 1991).

1.10. Aging and Trainability

Regular vigorous physical activity produces physiologic improvements regardless of age. Of course, the magnitude of the changes depends on several factors that include initial fitness status, age, specific type of training, nutrition, and motivation of the person. With regard to the age factor the optimum training regimen for an elderly person is marked by safety, effectiveness, a strong motivational appeal and low unit cost. Regular physical activity, following the said principles, on adult and above age group acts as an effective intervention with respect to reversing or at least slowing down certain age-related declines in both cognitive and motor performances.

With regard to the age factor, it has generally been held that older individuals are not able to improve their strength and endurance capacity to the same extent as younger people. The reason for these decreased "trainability" were not well understood, although it was attributed to a general decline in neuromuscular function and the age related impairment in the cells' capability for protein synthesis and chemical regulation (McArdle, Catch, & Catch, 1996).

Expected improvement from physical conditioning for people of different ages is depends on their initial fitness level at the start of training. Essentially when a person, young or old, has a relatively high functional capacity at the start of training, there is less room for improvement compared to someone who starts at a lower level and has considerable room for improvement. At the same time, ability to improve may be age-related; older
persons have often shown less improvement when they begin to training later in life than younger counterparts who start training at the same initial level of fitness. However, large and rapid improvement in physiologic function can occur in the healthy elderly, often at the rate and magnitude recorded for younger individuals. This occurs with relatively intense training that is continuously adjusted to keep pace with training improvements. Recent research indicates that healthy older adults show no negative metabolic or hormonal responses or maladaptations to regular exercise that would contraindicate participation in standard exercise-training program (deVries & Housh, 1994).

Several studies have demonstrated that endurance training began by individuals in their fifties and sixties reversed declines in aerobic power to that of a healthy 25-year old. Specific areas of improvement include improved stroke volume, circulation and maximum VO\(_2\), and lowered blood pressure and heart rate. Personality changes are associated with aging and tend to be the same traits that are positively changed with improved fitness. Psychological well-being, self-esteem, problem solving, and memory can be increased through improved fitness and health (Ruder, 1989).

For older people a combination of 70% endurance, 20% coordination and 10% strength training has suggested. Isometric strength improvement exercises and exercises with heavy weight should be avoided. However, isotonic strength improvement exercises may start with 2 kg and to gradually increase the workload, without exceeding the 10 kg level (Straugenberg, 1981).

With easily manageable exercise duration of 30-40 minutes, an intensity of 50% of maximum oxygen intake is the lower effective threshold (heart rate more than 110 beats/minute). Marked effects are obtained with intensities ranging from 60-80% of maximum oxygen intake. As the adaptability to training is reduced so much in the elderly even minimal training (30-40% of maximum heart rate) may produce favourable changes in aerobic capacities in older individuals over 60 years of age. Higher-intensity exercise may contribute sufficiently to increase exercise tolerance in individuals who are capable of
improved central circulatory parameters. However, higher intensity exercise may be more detrimental than beneficial to those who have decreased cardiac adaptability, and as a result, lower-intensity exercise would be safer and more beneficial (Bandenhop et al., 1983).

As to the frequency of training there is a consensus that the best effects are obtained when training is performed 5 to 7 times a week. But even with 2 to 3 times per week, significant functional improvement can be achieved. Frequency and duration of the exercise are closely inter-related. With 5 to 7 times training per week, a minimum duration of 6 minutes is enough to cause visible adaptations. This time is however the lowest time. With only 3 times training a week, the maximum duration is 15 minutes. Training performed twice a week calls of 20 to 30 minutes (Straugenberg, 1981).

Walking at a quick pace or slow jogging is the most suitable training mode especially for older people because

(i) It is the simplest form of exercise; it is as natural to the human body as breathing.
(ii) It takes no monetary cost.
(iii) It is a muscular symphony; a rhythmic activity.
(iv) It involves all the foot, leg, and hip muscles and much of the back musculature. The abdominal muscles tend to contract and support their share of the weight, and the diaphragm and rib muscles increase their action. There is automatic action of arm and shoulder involves muscles of these regions. Shoulder and neck muscles hold the head erect. Even the eye muscles are exercised as the walker look about himself. Such involvement of large amount of muscle mass in an exercise is cardio protective in nature and requires gradual increase of metabolic function of the body.
(v) Bradicardia at rest, being one of the most outstanding phenomena of adaptation, may be elicited through long endurance exercise (like waking with faster pace) with relatively low intensity (Straugenberg, 1981).
1.11. Delaying of Consequences of Aging Through Exercise

It is fair to observe that *Homo sapiens* has never had the opportunity to test the hypothesis relating exercise to longevity. Survival for the fittest to an advanced age is really untested. Through the long eons in which our fore-bearers were physically active as a necessity of survival. They died of starvation, injury, and infection. In our current golf-cart age in which two of these major historic killers, i.e. starvation and infection, are largely controlled. We die of degenerative diseases, on which the impact of our physical inactivity may be considerable.

In middle age most of us stop performing various forms of exercises other than that we enjoy doing. In other words, we find it easier to bend an elbow than lift weights. This is unfortunate, because in middle age most of us need regular exercise to maintain both physical and mental fitness and to increase agility, strength, and endurance. In middle and later age there is gradual decrease in breathing capacity, cardiac output, and metabolic rate, yet exercise cannot reverse the process to a great extent still phenomenal change is observed in delaying the inevitable process of aging. The more often the normal heart and circulatory systems are required to move blood to active regions of the body through exercise or movement, the more efficient they become. Protracted exercise also improves the work of the lungs by increasing their ability to expand more fully, take in more and utilize a greater proportion of the oxygen in the inhaled air.

While exercise cannot eliminate obesity in the middle age and loss of lean body mass from middle age through later age, it can help prevent obesity by burning extra calories and prevent loss of lean body mass by following the laws of use (McArdle, Catch, & Catch, 1996).

Regular exercise can act as a process of rehabilitation or may compensate, to some extent, into the consequences of "Years of Inactivity". In the form of improvement of physical and physiological condition, blood biochemical composition, cognitive function, behavioural pattern, and social integration those incorporates in the unique process of aging. As people age,
many develop new medical, functional and social problems. Exercise habit can prevent or may reduce a varied degree in these situations. High quality living can be best represented by enjoyment of task undertaken, maintenance of functional capacity, and relief of the symptoms of chronic diseases. Benefits of exercise are mainly tri-folded, thus it (i) avoids disease (ii) promotes health and (iii) implies satisfaction with living, to maintain a 'quality of life' (Paffenberger & Lee, 1996).

Physical activity participation by older adults is associated with improved quality and quantity of life thus it may provide to obtain following benefits (U.S. Dept. of Health and Human Services, 1996).

- Reduces risk of dying from coronary heart disease and of developing high blood pressure, colon cancer, and diabetes.
- Helps people with chronic disabling conditions improve their stamina and strength.
- Reduces anxiety and depression; improves mood and feelings of well-being.
- Helps maintain healthy bones, muscles, and joints.
- Helps control joint swelling and pain associated with arthritis.
- Helps maintain ability to live independently; reduces risk of falling and fracturing bones.

Regular exercise improves mood. When vigorous exercise gets blood flowing to the brain, the chemical make-up within the brain changes. It also triggers to release endorphins, the hormones that produce a sense of well-being which reduces stress (the Telegraph, June 29th, 2006).

Good physical fitness, as the consequence of habitual physical exercise upto old age, not only is a physical advantage but also proves to be of great importance for older people as far as their psychological and social situation is concerned. A high degree of physical adaptability, good reactivity, mobility, and co-ordination are prerequisites to a wider range of action and lead to a more comprehensive sphere of experience. These features substantially contribute to enrich life in old age and are counteracting loneliness and
dependency. It helps to restore self-reliance, vigor, and pleasure. Regular engagement in sport and physical activity is one of the best means to achieve the substantial advantages of a sound physical and physiological condition within the limits of genetic program and to maintain it up to old age. Regular physical exercise does not necessarily mean to add years to life but it always means to add life to years (Wagman, 1996).

Considering various aspects of aging, it appears that chronic exercise may be good investment and cost effective in maintaining health at old age. Research related to this area are limited to the developed countries and in developing countries like ours, it is few and far between. Hence the present research is an attempt to explore possibility of chronic exercises on our population.

1.12 Statement of the Problem

Present investigation is concerned with Influence of Aging on Motor Tasks with Reference to Chronic Exercises on elderly adult people. The consequences of aging and benefits of exercises on elderly adults have been studied in this project.

1.13 Purpose of the Study

1. To observe motor performance of various levels of aged persons.
2. To look into the physical characteristics of aged persons with advancement of age.
3. To compare the motor performance and physical characteristics of sedentary and active aged persons.
4. To compare the physiological parameters of sedentary and active aged persons.
5. To observe the effects of chronic exercises on aged persons in relation to motor task.
6. To observe the effects of chronic exercises on aged persons in relation to level of anxiety and depression.
7. To look into the effects of chronic exercises on aged persons in selected blood bio-chemical variables.
8. To understand the level of cognitive functioning of different age groups with special reference to age.
9. To compare the gait pattern of different age groups.
10. To observe the effects of chronic exercises on gait parameters.
11. To observe positive change, if any, among the elderly adults on overall quality of life.

1.14 Delimitation of the Study

1. Despite a remarkable heterogeneity in genetic endowment, socio-economic status, diet, habits and culture the study was delimited to the male subjects of Kalyani sub-division of Nadia district, West Bengal, India.

2. The subjects of the study were further delimited to three different age groups, namely 40 to 49 years, 50 to 59 years, and 60 to 69 years; however, in each age group there was one experimental and one control group.

3. The study was restricted to measure only seven motor ability qualities i.e. agility, flexibility, strength, endurance, muscular strength-endurance, co-ordination, and balance.

4. Variables along with motor abilities considered in this study were physical characteristics, physiological state, blood bio-chemical state, cognitive ability, psychological state, and gait pattern.

5. The programme of chronic exercises adopted in the present study was delimited to only a few types of exercises, which has been indicated later in the third chapter. However, there are other forms of exercises, which were not considered in this study.

1.15 Limitations of the Study

1. Since the study was experimental in nature and the treatment was of exercise programme on aged people for one-year duration, the researcher had to restrict to a small sample size of a small area.

2. More parameters could be incorporated to predict motor task ability, but due to paucity of fund, time, and facility other parameters which could contribute to motor task ability were not considered in the study.
3. Above 70 years and below 40 years individuals were not considered in the study, though aging effects are also pronounced in these age groups.

4. Aging process and impact of exercise on motor ability of women could not be investigated.

5. Exercise programme was in control of the researcher but factors like diet, habits, daily life activities and psycho-sociological factors were not in control of the researcher.

6. Despite sincere effort of the researcher to build positive attitude and motivation towards participation in the programme from the subjects' end, there could have been lack of keeping same degree of thought in their mind for all the subjects as a result of wear and tear of life.

7. Lack of sophisticated instrument and facilities limited the study to select the parameters mentioned for the research work.

1.16. Definition and Meaning of Important Terms

**Aging** : The process of change or transformation of the young to the old organism. The term 'aging' refers to the patterns of change that occur with age in genetically representative organisms living under representative environmental conditions.

**Gerontology** : The study of the phenomena of aging from a research and scholarly perspective. It embraces studies from the biological, behavioural, and social sciences.

**Motor Ability** : The present acquired and innate ability to perform motor skills of a general or fundamental nature, exclusive of highly specialized sports or gymnastic techniques.

**Motor Task** : Any task or body movement that is performed by an individual involving nerve and muscle is generally referred as motor task. It is generally a structured and planned movement.
| **Exercise** | Exercise is movement oriented and is a stress. As a consequence heart rate increases which is an indicator of intensity of exercise. Generally, exercise is planned, structured, repetitive, and purposeful. |
| **Chronic Exercise** | When exercise is performed with a definite purpose for a desirable period, intensity, and frequency to have a relative change or benefits of the physiological system is referred to as chronic exercise. The opposite of the chronic exercise is acute exercise. In many research endeavours now-a-days the term 'training' is replaced by 'chronic exercises'. |
| **Body Composition** | Body composition is the proportion of the three major tissue components i.e., bone, muscle, and fat, of the human body. |
| **Physiological State** | Physiology is the study of functions of the organs of the body. Body tends to maintain its internal environment within a short range. However, due to stress, exercise, or some other reasons, the internal environment changes to cope with the demand of the stress. Some parameters are easily observable and changes can be noticed, for example, heart rate, and blood pressure. Understanding of these changes due to exercise stress or chronic exercise is referred to physiological state in this study. |
| **Blood Bio-chemical State** | Muscle contraction is a chemical-mechanical energy transaction. In the process of metabolism biological oxidation takes place in the cells and biochemical ingredients appeared in the blood at rest and also during exercise. Some bio-chemical agents are readily available in the blood i.e., glucose, cholesterol and fatty acids, lactic acid, etc. The quantum of these substances do change with the change of certain conditions. Measurement of these bio-chemical agents is referred to as blood bio-chemical state in this text. |
| **Cognitive Ability** | Mental representation or internal template for the production of a response and a standard for making response corrections based on feedback is the domain of cognitive ability. Cognition is related to perception of personal competence and perception of self-control, which again related to degree of intrinsic motivation. |
| **Reaction Time** | The time from the onset of a stimulus until initiation of a volitional response. |
| **Visual Perception** | The stimuli received by ophthalmic senses and the process through which information is translated into conscious meaning of the brain. |
| **Psychological State** | It refers to the general behavioral pattern and psychological make up of a person. It is the total aggregates of human responses that the persons make to both internal and external stimuli. Performance in physical activity is concerned with psychomotor abilities and response capabilities of the individual, which is again dependent on innate neuro-motor make-up, physical structure, and typical level of activation. |
| **Anxiety** | Anxiety encompasses both some degree of activation and unpleasant emotional state. The term anxiety is used to describe the combination of intensity of behaviour and direction of affect or emotion. The direction of affect characteristic of anxiety is negative in that it describes subjective feelings that are unpleasant. |
| **Depression** | A disorder of mood that involves symptoms of sadness, discouragement, and feeling of hopelessness, as well as loss of appetite, difficulty sleeping, and loss of energy. |
| **Gait Pattern** | Gait pattern refers to a walk with specific combination of kinematic factors i.e., speed, step length, and step frequency. |
| **Free Walking Speed** | A walk in which a person adopts whatever speed, step length, and step frequency one chooses. |