5.1. Summary

Aging is a universal process of growing old. It touches everyone regardless of age, gender, and socio-economic level. We are travelling at different speeds to the same destination. Knowledge of aging and the aged is dominated by myths, stereotypes, prejudice, ignorance, and personal fears of growing old. The scientific study of human development is fragmented and incomplete unless it has not received much attention on the elderly and directs the way-out for development and well-being of the increasing elderly population in the entire world.

The reduction in physical activity as a result of technological advancement significantly contributes to health and well-being thus improving degenerative diseases. Modern technology has reduced energy expenditure in both the places of occupation and the home, thereby causing a decreased physical fitness. Demographic analysis reveals that the aged population in India and in the entire world constitutes a significant sub-group within the population and the number of aged individuals is fastly growing and they are becoming one of the important segments of the population pyramid.

As a result of population aging and greater visibility of elderly persons, scientists in a number of disciplines are seeking to understand structural, biological, sensory, motor, behavioural, and cognitive changes and adaptations in the human organism over time. Much of this work on "individual aging" has been completed within the evolving fields of geriatrics and gerontology. In addition, an increasing number of individuals, in a variety of professions and occupations, are now required to develop policies or to provide services to meet the needs, interests, and concerns of the elderly population.

End of life does not come all of a sudden for most of us. Instead, we slowly wear down our looks, faculties, health declines, hair and teeth begins to
fall and our minds dim. Like all aging machines, the human body too tends to work less efficiently than when it was new. Such loss of function does not begin in old age, but in early adulthood. Most of the bodily functions show a decline of 0.8-1.0 percent per year after the age of thirty. Of course rate of this loss is low because most bodily systems have an excess capacity built into them, it is only the sixth decade of life that such decline is conspicuous. Indeed, some functions do not seem to degenerate with age. In general, the functions that involve the co-ordination activity of more than one-organ-system decline most with age and, as might be expected, changes due to the aging process are most rapidly observed when the organism is stressed. Homeostatic readjustment is considerably slower with increasing age.

No one should be surprised if he is not in quite shape when he was 25 or 30 years old. At age 40 to 50 it is perfectly normal to have only 80% of the Vo$_{2\text{max}}$, 85% of the heart rate reserve, 95% of the total body water, and 96% of the BMR. These factors, however, should not slow anyone down very much. There is one difference, though, that can be accompanied with middle age i.e., the reaction time and decision-making process may be a bit slower. This is because the nervous system is one of the most vulnerable parts of the body to aging. The cells of the CNS begin to die early in life and are not replaced, while other organs are still growing and producing new cells. Specific response to input is delayed because it takes a greater length of time for an impulse to travel across the connection linking nerve fibres.

Motor quality deteriorates with age due to deterioration of its basic components and reduction in complex combination of all the components as a whole. There are both primary and secondary factors associated with age-related declines in motor abilities. The elderly often exhibit impairments in motor performance that can affect their everyday activities. Motor skills are influenced by deficits occur before movement, such as slowing in the central processing unit, and by changes occurring during performance of the movement such as inability to properly regulate force. Regardless of the etiology of these declines, they can have a substantial effect on the independence of many elderly.
With increasing age the need for physical activity as an important component of one's life style does not decrease. Yet as we have often seen, participation in physical activity decreases with age. Moreover, a physical health problem is frequently given as a major reason for the lack of involvement in sport and physical activity during middle and later adulthood. However, older persons may actually benefit more than younger persons from an appropriate exercise or physical activity programme. Movement in the form of planned, timed, and repetitive program of exercise brings the human body to the goal of fitness in the shortest possible time.

Long-term effects of regular exercise program may help to maintain a higher level of cognitive integrity as age advances. Maintenance of high levels of fitness can aid in slowing many physiological aging processes. Fitness brings many advantages and benefits to various aspects of a person's life. It enhances an individual's ability to work with endurance and vigor and to enjoy work and leisure activities. A person who maintains fitness can usually avoid undue fatigue, so that he has energy left for hobbies, recreation, and for meeting unforeseen emergencies.

Aging is an irreversible biological process. Voluntary activity cannot but slow the process and can give meaning to life, setting back the time when the citizen of our post-industrial society was unable to care for himself. Proper physical exercise and activity programs can counter balance the age related decrease in work capacity and physical performance; develop, maintain, and improve range of motion; muscle strength, flexibility, balance, and endurance; and reduce the damage and disability of associated cardiovascular, musculo-skeletal, and other organ systems in aging. It also improves the independence, quality, and enjoyment of life. Exercise programs to develop lifetime fitness and performance skills are best beginning in early life, but at no age are they contraindicated. Physical activity not only enhances physical capacity but also maintains and improves wellness, lifestyle, and health at all ages.

'Quality of life' is an important phrase in our overall living. It is generally meant by an overall positive feeling and enthusiasm for life.
Fatigue and exhaustion from routine day-to-day work prevents us from increasing the quality of our lives. On the other hand an increased level of fitness enables us to perform these routine tasks without undue fatigue and thereby allows us to participate in the activities we most enjoy.

Young muscles that are not used come to resemble the muscles of the aged. To a very considerable extent, the reverse of the statement is also true. Symptoms of aging may in fact be symptoms of disuse. Many senior citizens who exercise can hold off these symptoms and succeed in preserving a youthful appearance, psyche, and level of fitness. A fit older person has a degree of independence than that his less fit neighbour.

All people are not beautiful or handsome, but nearly everyone can have the kind of attractiveness and vitality that comes from good health. The health of individual depends upon the kind of body he inherits and the care he gives it. Good health can be thought of as a state of social, physical, and mental well-being, a goal virtually everybody can attain if the responsibility for maintaining one's own health, with occasional help from the health experts, is accepted.

Senior citizens are going to be a significant and sizeable portion of our population. This is because of decrease in morbidity and mortality, conscious nutrition and advancement of medical sciences. One may raise the question of utilizing the wisdom and experience of this portion of our population. It is assumed that, if these senior citizens can maintain healthy and abundant lifestyle may be very useful in the society by their wisdom and experience towards maintaining a desirable standard of our society in all spheres of life. In the present study an attempt has been made not only to understand their lifestyle, level of health, and fitness but also to understand the way they are involved for the betterment of the society.

In the recent study the researcher made an attempt to observe the influence of long-term exercises on motor tasks of the elderly with increasing age. Human performance in any area is the manifestation of complex combination of many other qualities. Therefore, a few other qualities, which
suppose to contribute indirectly in performing motor tasks, were also considered in this study.

Details of related literature as far as the researcher could collect have been reviewed extensively on the perspectives, processes, and consequences of aging. The review has done under the variables selected for the study presented in Chapter II of this dissertation.

The subjects (40-69 years) of the present study were randomly selected from the Kalyani sub-division of district Nadia, West Bengal. The subjects were divided into three groups (A, B and C) according to age and in each group there were an experimental (E) and a control (C) sub-groups. For the purpose of understanding the ability in motor task, motor ability, body composition, physiological state, blood bio-chemical state, cognitive ability, psychological state, and gait pattern were considered as criteria.

Seven motor ability components namely agility, flexibility, strength, endurance, muscular strength-endurance, co-ordination, and balance were measured. All the parameters were tested twice — pre-test, at the onset of the experimental period, and at post-test at the end of the period, for both experimental and control groups to predict the exercise effect and also aging effects on the selected variables. The duration between two tests (pre and post test) was one year when experimental subjects underwent in an exercise program and control subjects remained sedentary. The details of the exercise programme has been described in Chapter-III.

Standard and appropriate tests were selected considering the age of the subjects. Reliability and validity of the tests were established adopting standard procedures. The data collected from various tests before and after the experimental period were arranged group-wise. Means and standard deviations of all the variables and analysis of data adopting standard statistical procedures i.e., ‘t’ test, correlation, and Wilcoxon two-sample tests are duly presented in tabular form in Chapter-IV.

Detail analysis of the results and critical discussions on findings has been made in Chapter-IV of the dissertation. The major highlights of the findings are presented here.
Analyzing the data it appears that the abilities in general were improved to a considerable extent in the subjects of the experimental groups and it was found to reduce to a varied extent in the control subjects according to their age group.

There were seven motor ability components namely agility, flexibility, grip strength, endurance, strength-endurance, coordination and balance were measured. There were a few common features in the findings of almost all the tests:

(i) Following chronic exercises the three experimental groups improved significantly in all the seven motor tests, except experimental C group in agility performance, where improvement was not significant.

(ii) During one year experimental period all the three control group subjects deteriorated their performance significantly.

(iii) During pre-test there were almost no difference between experimental and control subjects. However, the difference was significant in most of the test performances during post-test. Difference between experimental and control group subjects was more profound in senior citizen group than comparatively younger age groups.

(iv) Physical activity is an effective intervention with respect to reversing or at least slowing certain age related declines in motor performance.

Among the three experimental groups significant reduction in % of body fat was observed in BE groups (50-50 years experimental group). On the other hand control group subjects of A group increased significantly after the experimental period. Change in % of body fat may happen with the process of aging but regular exercise can help to maintain a desirable body fat %. Significant reduction in LBM was found in all the three control groups. On the contrary, significant increase was observed in the three experimental groups after the experimental period. With the advancement of age LBM may be reduced mainly due to disuse, however, programmed exercise may increase LBM.
Following chronic exercises resting heart rate of all the three experimental groups reduced significantly. Exercise heart rate reduced significantly during post-test of the three experimental group subjects. However, exercise heart rate was significantly higher during post-test of the three control group subjects. Physiological demand to a certain workload is expected to be more with advancement of age, particularly among sedentary persons.

Systolic blood pressure decreased significantly following chronic exercises among the three experimental groups. There was almost no change of systolic blood pressure in control groups after the experimental period. For diastolic blood pressure similar results i.e. significant changes were observed in experimental groups (except AE). Among the control groups diastolic blood pressure was almost unchanged.

Following chronic exercises blood glucose level was significantly reduced in the experimental subjects of A and C groups but in-group B the reduction was not significant. Only in A & B all control group subjects' blood glucose level increased significantly during post-test. Regular exercise may be a key factor in reducing blood glucose level in the elderly. Blood cholesterol level was decreased significantly in all the three experimental groups following chronic exercises. On the contrary, in all control groups cholesterol level increased significantly. Less active persons have the tendency to increase cholesterol level but participation in regular exercise may reverse the process.

There were three tests to measure cognitive ability and results in all the three variables were identical. Following chronic exercises SRT, CRT, and visual perception of all the three experimental group subjects improved significantly. However, the improvement was not significant in experimental BE group (50-59 years experimental) in CRT and visual perception. In all the three parameters of cognitive ability performance of the three control groups deteriorated during the experimental period.

There were three parameters for assessment of psychological state. These were state and trait anxiety, and depression. Following chronic exercises all the three experimental group subjects reduced significantly in the three
tests, that means, a general improvement of psychological state. However, the scores were significantly higher in case of control group subjects during post-test than that of pre test. Physical activity of chronic nature is capable of reducing depression and anxiety or other emotional disorders.

There were three kinematic factors considered in this study as gait parameters and these were free walking speed, stride length, and step frequency. In all the three experimental groups walking speed was increased, however, it was significant in B and C groups only. All the control group subjects found to reduce their walking speed significantly after the experimental period. Stride length of all the three experimental groups increased significantly following one-year exercise programme. However, in control groups it was reduced significantly.

Step frequency was significantly increased only in experimental C group (40-49 years). In control groups the step frequency reduced after the experimental period, however, it was significant only in-group B. With the advancement of age a general deterioration in gait pattern may occur in sedentary person and, it is intensified and profound among the more aged persons. Regular exercise can be a better option for intervention of gait pattern with increasing age.

The major analysis on the basis of findings are narrated here in summary. The specific conclusions on the basis of findings are presented in chapter 5.2.

5.2 Conclusions

The present study has its own limitations. Considering this, on the basis of the findings specific conclusions are drawn and presented parameter-wise hereunder.

5.2.1. On Motor Ability

(i) Agility:

(1) Following one year chronic exercise program agility performance was significantly improved in AE and BE groups. In case of CE group the improvement was not significant in ‘t’ test, however, significant improvement was observed in Wilcoxon signed-rank test on the same group.
(2) All the three control group subjects showed significant reduction following experimental period.

(3) In all the three age groups there was no significant difference between experimental and control groups during pre-test. However, in post test significant differences between experimental and control subjects were observed in A and B groups only.

(ii) **Flexibility** :

(1) All the three experimental groups improved their flexibility scores following chronic exercise programme.

(2) In case of three control group subjects significant reduction was observed following the experimental period.

(iii) **Strength** :

(1) Significant improvement was observed in all the three experimental groups following chronic exercises.

(2) Significant reduction was observed in all the control groups during post-test from that of pre test.

(3) Significant differences were observed in strength between experimental and control groups subjects of A and B groups during post-test.

(iv) **Endurance** :

(1) Following chronic exercises endurance performance was improved significantly in the three experimental groups.

(2) In control subjects significant reduction was observed in all the three groups.

(3) The difference between experimental and control subjects in each age group was significant during post-test, because experimental subjects improved and control subjects deteriorated during post-test.

(v) **Muscular Strength-Endurance** :

(1) Following chronic exercises muscular strength-endurance performance was improved significantly in all the three experimental groups.
(2) In control group subjects significant reduction was observed in A and B groups.

(3) Difference between experimental and control group subjects was significant only in A group and that to in post test.

(vi) Co-ordination :

(1) Following chronic exercises co-ordination performance was improved significantly in all the three experimental groups.

(2) The performance of control group subjects was significantly reduced in all the three groups during post-test.

(3) The differences between experimental and control groups were significant in A and B groups only during post-test.

(vii) Balance :

(1) Following chronic exercises balance performance was improved significantly in all the three experimental groups.

(2) The performance of the control group subjects was significantly reduced during post-test from that of the pre-test.

(3) The differences between experimental and control groups were significant during post-test for A and B groups only.

5.2.2. On Body Composition

i) Body Fat % :

(1) Following chronic exercises body fat % decreased significantly only in experimental-B group.

(2) Among the control subjects significant reduction was observed only in A group.

(3) Only in group C the difference between experimental and control group was significant at post-test.

(ii) Lean Body Mass :

(1) Significant improvement in LBM was observed among all the three experimental groups as evidenced from the post-test.

(2) On the contrary, significant reduction in LBM was observed in all the three control groups at the end of the experimental period. This may be attributed to the theory of use and disuse.
5.2.3. **On Physiological State**

(i) **Resting Heart Rate** :

(1) Following chronic exercises resting heart rate was significantly reduced in all the three experimental groups.

(2) There was almost no change in the three control group subjects during the experimental period.

(ii) **Exercise Heart Rate** :

(1) Following chronic exercises resting heart rate was significantly reduced in all experimental groups.

(2) On the other hand, in same test exercise heart rate was increased significantly during post-test in all the three control group subjects.

(3) Exercise heart rate of all the three experimental groups were significantly lower than their corresponding control groups.

(iii) **Systolic Blood Pressure** :

(1) Following chronic exercises systolic blood pressure of all the three experimental groups reduced significantly.

(2) There was almost no change in the systolic blood pressure of control group subjects at the end of the experimental period.

(3) Significant difference between experimental and control subjects of A and B groups was observed during post-test

(iv) **Diastolic Blood Pressure** :

(1) Diastolic blood pressure was also significantly reduced following exercise only in B and C group's experimental subjects.

(2) In case of control subjects there was almost no change after the experimental period.

5.2.4 **On Blood Bio-chemical State**

(i) **Blood Glucose** :

(1) Blood glucose level of AE and CE groups reduced significantly following chronic exercises. In case of BE group the reduction was not significant.
(2) In case of control group subjects, increment of blood glucose level was observed in all the three control groups and it was significant in case of AC and BC groups only.

Exercise influence on blood glucose level was more profound in A group, i.e., senior citizen group.

(ii) Serum Cholesterol:

(1) Blood cholesterol level was significantly lower during post-test than that of pre test in all the three experimental group subjects. Chronic exercises had a strong influence on reduction of blood cholesterol level.

(2) Control group subjects had no exercise programme, and may be therefore their blood cholesterol level increased significantly during post-test in all the three groups.

(3) The difference of cholesterol levels between experimental and control group subjects were significant during post-test in groups B and C only.

5.2.5 On Cognitive Ability

(i) Simple Reaction Time:

(1) Significant reduction was observed in SRT of all the three experimental groups after the experimental period.

(2) Post-test SRT was significantly higher than that of pre-test of all the three control groups.

(3) A and B group experimental subjects' SRT was significantly lower than their respective control group subjects at post-test.

(ii) Choice Reaction Time:

(1) In CRT, experimental subjects of A and C groups reduced significantly.

(2) All the three control groups CRT significantly increased at post-test.

(3) The difference between experimental and control group was
significant at post-test in A and B groups and at pre-test in C group.

Reaction time increases with advancement of age, however, chronic exercises may inhibit the deteriorating effect.

(iii) Visual Perception:

(1) The CFF score was significantly reduced in A and C group subjects following one-year chronic exercises.

(2) However, after the experimental period CFF score was significantly increased in control subjects of A and B groups only.

Visual perception decreases with advancement of age. Chronic exercises may influence to decelerate the negative changes in cortical activity.

5.2.6 On Psychological State

(i) State Anxiety:

(1) Following chronic exercises all the three experimental group subjects could reduce state anxiety levels significantly.

(2) In case of control group subjects of A and C groups, state anxiety levels increased significantly at post-test.

(3) State anxiety levels of experimental groups were significantly lower than their corresponding control groups.

(ii) Trait Anxiety:

(1) Following chronic exercises trait anxiety levels were significantly reduced among the experimental subjects of A and C groups. In case of B group the reduction was not significant.

(2) In all the three control group subjects significant increase in trait anxiety was observed during post-test.

(3) Trait anxiety scores of all the three control group subjects had higher trait anxiety scores than their experimental counterparts.

(iii) Depression:

(1) Following chronic exercises depression scores of all the three experimental groups reduced significantly.

Level of depression was considerably higher in senior citizen group than other two groups.

(2) On the contrary, all the three control group subjects increased their depression score after the experimental period.
5.2.7 On Gait Pattern

(i) Free Walking Speed:

(1) Following chronic exercises free walking speed improved in all the three experimental groups, but it was significant for B and C groups only. Training influence on walking speed was more profound in younger age groups.

(2) Among the control groups free walking speed was significantly reduced in all the three age groups.

(3) Experimental groups were significantly higher than the control groups at post-test only, except in C group.

(ii) Stride Length:

(1) Following chronic exercises stride length of all the three experimental group subjects increased significantly.

(2) In case of control groups significant reduction was observed in all the three age groups.

(3) Experimental subjects of A and B groups appeared to be significantly higher in stride length during post-test only.

(iii) Step Frequency:

(1) Following chronic exercises step frequency improved significantly only in CE group. However, in Wilcoxon test the improvement was also significant in BE group.

(2) In case of control group-subjects significant reduction in step frequency was observed in-group B and C only.

(3) In inter group analysis only experimental subjects of B group found to be significantly higher from their control counterparts both in pre and post-tests.

Gait analysis reveals that influence of chronic exercise on kinematic factors were more intense among the younger age groups than the aged.
5.3. Recommendations

An interested researcher after going through the present dissertation may find it worthwhile to study further on the following aspects of aging and exercise:

1. Such a study on aging and motor performance should have been done on a larger population sample. Larger sample may throw light on specificity of a particular population.

2. Due to various reasons the present study was restricted to male subjects. It would be worthwhile to conduct similar study on female population.

3. In the present study, age range of the subjects was 40 to 70 years. Similar study may be conducted from 30 to 90 years age group.

4. Psycho-social aspects contribute to a very important area of gerontological studies. In the present study only a few psychological parameters were considered. A lot more variables on psychological and sociological perspectives may throw new light and perhaps motor performance find some correlates on psycho-social aspects.

5. Similar study may also be conducted on longitudinal basis to have more authentic information and thereby the ways and means of monitoring may be evolved.

6. Due to lack of facilities and paucity of fund physiological and blood bio-chemical studies on aging was restricted. There are ample scope for further studies in this area with latest technology covering many other parameters.

7. Present study has definitely proved that programmed exercise may be considered as one of the health care processes among the elderly adults and senior citizens. Concerned persons of government and non-government agencies may take into consideration this aspect and can plan for better ‘quality of life’ of increasingly aged population.