CHAPTER- II

REVIEW OF RELATED LITERATURE

This chapter contains research findings of other researchers related to the variables of this research work, which have been presented parameter-wise in the subsequent paragraphs.

2.1 On Physiological Potentiality

2.1.1 Heart Rate

The resting heart rate of an adult depends greatly upon the individual’s physical conditions. Usually, some loss of condition occurs with aging and the resting heart rate may increase by a small amount over the adult life span. (Shephard, 1988).

McArdle et al. (1996) have mentioned that no significant change in resting heart rate occurs with aging. However, one well documented change in cardiovascular function with age is a decline in the maximum exercise heart rate. Regular moderate to vigorous physical activity may produce physiological improvements regardless of age. Of course the magnitude of the changes depends on several factors including initial fitness status, genetics and the specific types of training.

Ryan et al. (1994) have analyzed the heart rate dynamics during 8-minute segments of continuous electrocardiography recording in healthy young (20-39 years), middle aged (40-64 years) and elderly (65-90 years) men (N=40) and women (N=27) while performing spontaneous and metronomic (15 breaths/min) breathing. It has been observed the mean heart rate does not differ between the age group or gender. High frequency heart rate power and the high/low frequency power ratio decreases with age in both men and women (P<0.05). The high/low frequency power ratio during spontaneous and metronomic breathing is greater in women than men.
Saltin (1986) has observed the ability to speed up the HR markedly impaired in the individuals with advancement of age. A young person has the ability to speed up the heart rate to about 180-200 bpm, which reduced to 140-160 bpm at the age of 70-75 years. The ability to increase the heart rate is stable for a given age and cannot be influenced by, for example, physical training although the cardiac output at a given heart rate can improve.

The resting heart rate of an adult depends greatly upon the individual’s physical condition is also mentioned by Shephard (1988). Usually, some loss of condition occurs with aging and the resting heart rate may increase by a small amount over the adult life span (Shephard, 1988).

Heart rate response to a standard sub-maximal exercise has long-been utilized as a measure of physical fitness (Montoye et al 1968). In some tests, heart rate during exercise is employed but in the most widely employed sub-maximal tests recovery heart rate is used. The recovery heart rate of older people has been reported to be higher and their fitness is poorer in such tests (Simonson, 1953).

The higher post exercise heart rate of older individuals can be due to a higher heart rate during the exercise, a slower recovery after the exercise, or a combination of both. (Simonson, 1953)

Montoye et al. (1968) have observed the relationship between age and post exercise heart rate of male and female between ages 10 to 69 years. They have made comparisons between males and females (N=5448) and different age groups of either sex in exercise heart rate and concluded that the heart rates were higher before, during and after exercise in children below age 15 than in subject over 15. Between ages 25 and 60 in females and 15 and 60 in males, there has been a little change in exercise heart rate, including terminal exercise heart rate, but the return to pre-exercise heart rate has observed to be clearly delayed with increasing age. Pre exercise and post exercise heart rates are significantly higher in females than in males.
2.1.2 Blood Pressure

Blood Pressure (BP) has received considerable attention in the aging literature as an important and easily obtained index of health status (Elias et al., 1990; Seigler & Costa, 1985).

BP (hypertension) accounts for variance in performance that might otherwise be attributed to ‘primary aging’. Hypertension or high BP is the most common cardiovascular disorder affecting 20% of the adult population (WHO Report-1997).

Hypertension is considered as a legitimate variable in many performances attributed to ‘primary aging’ (Elias et al., 1990).

Svanborg (1996) has commented that human aging is associated with stiffening of the aoristic valves, the aorta and more peripheral arteries thickening of the vascular wall especially in smaller arteries and arterioles, plus widening and elongation of the aorta, which has obvious consequences for the elevation of blood pressure.

A significant reduction of diastolic blood pressure on middle aged men (45-56 years) with the consequence of vigorous walking for 20 weeks, 3 days per week was observed by Pollock et al. (1971). Buccola and Stone (1975) have observed the effects of jogging and cycling programme of 14 week-duration on physiological variables of aged men (N=16, age 60-79 years) and have observed a significant decrease in systolic and diastolic blood pressure level among the elderly.

Mungreiphy (2011) has studied on Naga males (N=257) of North-East India, age ranging from 20-70 years. The subjects have been divided in to five age groups to study the aging trend and they found mean systolic and diastolic BP are higher among the subjects with elevated BMI and the older ones. Minimum BP has found among underweight and maximum among obese. BP is found to be lowest among the youngest age group and higher among the elderly age groups.
WHO (2002) report shows that globally high blood pressure is estimated to cause 7.1 million - about 13% of the total deaths. About 62% of cardiovascular disease and 49% of ischemic heart disease are attributable to sub-optimal BP (SBP >115 mmHg). Overweight and obesity increase the risk of high BP, coronary heart disease, ischemic stroke, type-II diabetes mellitus and certain cancers. WHO has also reported that in developing countries, high blood pressure is one of the risk factors for cardiovascular diseases and the estimated 7.1 million deaths especially among middle, and old age adults is due to high BP.

Lakatta (1987) opines that an increase in stiffness of the heart and vasculature is an important aging change in the cardio-vascular system that influences BP regulation. In the large vessels it is due to a reduction in plastic tissue and increased amount of collagen and probably results in elevated SBP, increased pulse wave velocity, increased cardiac load and moderately increased left ventricular wall thickness.

BP values increase with age in westernized societies (Gavras & Gavras, 1983) and there is evidence that risk of CVD and death rises with increase in BP across the full range of human BP values (Kannel, 1974).

2.2 On Body Composition

2.2.1 Percentage Body Fat

Schwartz et al. (1990) have observed the changes in fat distributions in normal aging when they examined and compared the fat distribution of very healthy young of 18-30 years and older men of 60-85 years and have found significantly higher fat deposition on the extremities in younger group. On the contrary, significantly higher central and/or intra-abdominal fat in the older group is considered as an independent predictor of obesity-related metabolic abnormalities.
Mott et al. (1999) have measured percentage body fat in a sample of 1324 volunteers, aged 20-94 years by using a 4-component model of body composition. Four ethnic groups studied are Asians, Blacks, Puerto-Ricans and Whites and regression models are developed for fat mass and fat percentage as functions of age. They have found in all but one of the groups, a highly significant curvilinear relation between age and body fat, indicating a peak amount of body fat in late middle age and lower amounts of body fat at younger and older ages (F<0.001). The age at which maximum body fat is predicted in the various groups ranged from 53 to 61 years for fat mass and from 55-71 years for fat percentage. In Puerto-Rican men there is no significant relation between age and fat mass, and the relation between age and fat percentage is also linear and positively correlated.

Pochlman et al. (1995) have studied 427 healthy men (age 17-90 years) and 293 women (age 18-88 years). They have measured body fatness by hydrostatic weighing, central adiposity from the waist circumference, peak volume of oxygen utilization (VO2 max) from a tread mill test, leisure time physical activity (LTA) from a questionnaire, resting metabolic rate and respiratory quotient from indirect calorimetric and energy intake from three days food diaries. It has been observed that fat mass is increasing with age, and the rate is higher in women (r =.61, slope = .25 kg/year; P<.01) than in men (r =.43; slope = 0.16 kg/year; P<.01); increasing fat mass in men and women is most strongly associated with declines in peak VO2 and LTA. Controlling for these variables has reduced the increase in fat mass from 17% to 3% per decade in men and from 26% to 5% per decade in women. The increase in waist circumference with age is also greater in women (r=.53; slope = 0.28 cm/year) than in men (r=.39; slope=0.18 cm/year; P<.01).

Increasing waist circumference with age in men and women is most strongly associated with declines in LTA and peak VO2max respectively. Control for the variables is reduced the age related increase in waist circumference from 2% to 1% per decade in men and from 4% to 1% per decade in women (Pochlman et al. 1995).
2.2.2 Body Mass Index

According to WHO (2000), individuals are classified as underweight, overweight and obese if they have BMI \(< 18.5\ \text{kg/m}^2\), BMI \(\geq 23\ \text{kg/m}^2\) and BMI \(\geq 25\ \text{kg/m}^2\) respectively.

Forbes (1999) has predicted the effect of aging on fat distribution, changes in BMI that occur with increasing age. Changes in body weight and BMI are strongly related to changes in fat free mass, and explain 54% of the variance in those changes. Welch & Sowers (2000) conclude that the association of BMI with percent body fat is curvilinear; the slope is steeper at lower BMI’s than at higher BMI’s. Cartwright et al. (2007) have observed that percent body fat may remain constant or increase with age, but aging is associated with substantial redistribution of fat tissue among depots.

Arngrimsson et al. (2009) have observed the relation between change in BMI and percentage body fat (%BF) in the elderly women (67.6 ± 6.0 years) varying in race (black, N=53 and white, N=144) who undergone the measurements of BMI and %BF at baseline and after two years. The group does not markedly change in body composition over two years. Change in BMI determines the change in FM (r=0.90, P<0.001) but is less predictive of change in %BF (r=0.64, P<0.001).

The study of Gill el al. (2003) indicates that BMI, WC and WHR could be used independently to identify overweight and obesity. Ghosh (2007) comments that it is not clear which of these measures is the best predictor of total body fat.

2.2.3 Waist-to-Hip Ratio

The study of Bose (2006) has conducted on Bengali elderly (aged > 55 years) and has been found the relationship between BMI and WHR, and the BMI is suppose to have the higher relations with WC than of WHR in both men and women. In another study by Kusuma et al. (2008) it is observed that among the
individuals of low socioeconomic status from the southern part of India provides evidence that BMI and WHR are having significant correlations.

Shimokata et al. (1989) have determined from their longitudinal studies that there is a significant increase in waist circumference with age per year, which is of similar magnitude in all age strata indicating that older adults continue to exhibit progressive increases in waist circumference.

The study of Ford et al. (2003) has shown that waist circumference increases with age and is larger in older than in younger adults of both sexes up to the age of 70 years. Shimokata et al. (1989) has found in the Baltimore longitudinal study of aging that age related differences in WHR are also reported in all BMI categories in both men and women. Lahti-koski et al. (2007) have found the changes in waist circumference are followed up in Finish adults (9025 men and 9950 women, aged 25-64 years) and mean waist circumference is seen to increase by 2.7 cm in men and 4.3 cm in women over a 15 years period. BMI also has increased over the study period, but the changes are relatively small (<1.2%/5 years period) in all but the youngest age category (25-34 years) while increases in waist circumference are seen in every age group. The study also examined the effects of weight change on changes in fat distribution. The study finds changes in waist and hip circumferences and those are correlated directly with the changes in weight, but there are differences in the pattern of change by sex. In men, waist circumference changes are greater than their hip circumferences, whereas in women those are at par. This has resulted in weight changes in men having a larger effect on waist-hip ratio. On an average, with a 4.5 kg weight gain in men corresponds to a 4 cm increase in waist circumference and a 2.5 cm increase in hip circumference.

2.3 On Health-Related Physical Fitness

2.3.1 Muscular Strength

Francis Galton coined the term ‘human machine’, is an outstanding pioneer of the nineteenth century has studied on age and strength relation of males and
females aged 5-80 years during 1880 (Birren,1996). This is to consider a large step forward because it enables the researchers to separate factors according to the degree to which they are related to age.

Clement (1974) has repeatedly measured grip strength in a French population of 369 men and 162 women twice over 5 years. Among them 109 men and 55 women are retested a third time. Extrapolating the data, longitudinal loss in grip strength has estimated to be about 60% from age 25-90 years and to accelerate with very old age.

Bassey and Harries (1993) have examined the longitudinal changes in grip strength over 4 years in 620 men and women ages 75 years and older. Over the course of the study, grip strength has found to decline by 12% in men and 19% in women.

Kallman et al. (1990) has revealed from the longitudinal study of aging that grip strength declines with age from age 20 to 90 years, again with losses in strength accelerating in very old age. However, not all subjects has lost their grip strength as they aged; 48% of subjects less than age 40 years, 29% of those aged 40-49 years and 15% of those older than 60 years have not found to decline in grip strength over nine years. Interestingly, the stronger are the subjects initially, the greater is the percentage of decline in strength over time.

Larsson et al. (1979) measured in 114 male subjects with age between 11 and 70 years and have found isometric and dynamic strength have increased up to the third decade, remained almost constant up to the fifth decade, and then decreased with increasing age.

Lauretani et al. (2003) and Forrest et al. (2005) have observed that hand grip is reduced with increasing age in men. Forrest et al. (2005) have performed a cross-sectional and a longitudinal study of 7 years duration with men between 51 and 84 years and have observed that the subjects over 75 years of age are having 27.6% less strength than those less than age 60 years. Possible cause of the age related loss of strength is beyond the decline in muscle mass. There are a number
of known or potential age changes that can contribute to the loss of grip strength with age. These include chronic diseases osteoarthritis of the hand, decreasing physical activity, decreasing motivation, and charges in aging muscle itself. Disease that is common in older individuals, such as coronary artery disease, chronic obstructive pulmonary disease, and malignancy can explain some of the loss of strength with age, but two considerations point away from the effect of disease.

Two known changes in muscle tissue with age may account for the observed loss of strength in excess of the decline in muscle mass; alternations of muscle fiber composition, and motor neuron abnormalities. The changes in muscle fiber composition with age are controversial. It is unclear whether the proportion of fast-twitch (Type-II) muscle fibers declines with age; however, it is agreed that fast-twitch fibers decrease in size in older subjects (Grimby et al., 1982, 1984; Aniansson et al., 1981; Clarkson, 1978) when elderly subjects undergo a program of strength training, gains in strength are paralleled by an increase in fast twitch fiber size (Aniansson, et al 1981, 1984). Thus, the decreased size and possibly decreased percentage of fast-twitch fibers may lead to a loss of strength out of proportion to the decline in muscle mass.

Electrophysiological studies of Campbell et al. (1973) Brown (1972) and histological studies of Grimby et al. (1982) Tomonaga (1977) show that motor neuron disease becomes increasingly more prevalent in older subjects. The numbers of functioning motor units in both hand and foot muscles decline with age (Campbell et al., 1973; Brown, 1972). The remaining motor units are enlarged and tend to have fewer fast-twitch fibers. These enlarged motor units partially maintain muscle mass even while strength deteriorates.

Strength losses are partially explained by decline in muscle mass, the remaining other, yet undetermined, factors beyond declining muscle mass to explain some of the loss of strength seen with aging (Kallman et al., 1990).

Rikli and Edwords (1991) have observed that grip strength is maintained somewhat equally for both active and inactive subjects due to participation in
normal household chores and other activities of daily living which involve use of the hands and wrists in the activities like opening jars, cleaning, scrubbing and gardening.

Kallman et al. (1990) have extensively studied 864 subjects of age 20-100 years both cross-sectionally and longitudinally. The purpose of their study have been to (a) determine whether the results of the longitudinal and cross sectional analysis of grip strength do age (b) examine the distribution of individual rates of change of grip strength with age (c) excerpt whether declines in grip strength can be explained by the decreasing muscle mass that often occurs with age. The study concludes that the cause of age related decline of strength is unresolved. However, it has been attributed to several factors including declining muscle mass (Martin et al., 1985), increasing muscular fibrous tissue (MacLennan et al., 1980), alterations in muscle fiber type (Campbell et al., 1973) in older people. Other age changes, such as chronic disease, osteoarthritis, or decreasing physical activity may also be the contributing factors.

The study of Simonson (1947) reveals to decline of leg strength is more rapid with age than hand grip strength.

After studying 604 men Shock (1962) has observed that the strength of the dominant hand drops from 44 kg of pressure at the age of 35 years to 23 kg at age 90 years on a grip strength measuring device.

Studies of Shephard (1969) and later Kallman (1990) reveal the result of slow or imperceptible decrease from the twenties to the forties and then an accelerated decline in strength.

2.3.2 Muscular Strength-Endurance

Strength is the ability to apply a force and overcome a resistance. It is the ability of the neuromuscular system to produce force. The term usually refers to maximum or absolute strength, which is the maximum force a person can exert in one effort with one/more muscle groups. It is considered as a primary component
of general health. Several instruments have been developed to measure static strength as well as dynamic strength. In this study hand grip strength test (Phillips & Homak, 1979) was used to measure static strength only.

Lenmarken et al. (1985) Izquierdo et al (2001) have reported decreased muscle endurance among the aged, other have shown no difference in the fatigability of aged and young muscle. As with muscle quality, much of the variability in the findings concerning muscle endurance can be attributed to differences in methodologies. For example, endurance can be assessed by quantifying the drop-off in force production during a series of maximal effort contraction, the duration which one can sustain a relative (percentage of peak force) sub-maximal contraction or even the amount of time taken to recover peak force production following a prolonged maximal effort.

2.3.3 Flexibility

In the long back Curaton (1941) has recommended flexibility as an aspect of physical fitness. Spirduso (1995) has observed a decline in flexibility begins in both males and females as early as adolescence and continues throughout the lifespan. Loss of flexibility because of aging is, in part, due to decreased use of certain muscle groups. Flexibility is an important measure of physical fitness as it provides an indication of a joint strength and stability, and poor flexibility is an indicator of age-related diseases such as osteoarthritis.

The study of Chui (1950) concludes that the application of weight training for improvement of flexibility improves not only flexibility but also strength of the subjects.

Clarke (1975) has propounded the sit-and-reach test as the objective field test of static flexibility, which provides a simple measure of flexibility in the hip, spine and hamstring muscles and it is the sole test of flexibility adopted in a number of large scale representative population surveys that is commented by Shephard et al. (1990).
The study of Buccola and Stone (1975) has revealed a significant change in flexibility of 60-90 years old men after fourteen weeks of training.

Sapega et al. (1981) has suggested that long duration static stretching carried out with elevated body temperature is optimal for improvement in flexibility.

Shephard (1984) has defined flexibility is impaired by collagen cross linkage, arthritis and joint ankylosis.

Shephard et al. (1990) have concluded that in the elderly, as in younger people, no single measurement indicates the loss of flexibility at all joints. However, the sit-and-reach test is more reliable than other simple measures, and provides the data that correlate with other information on trunk flexibility.

2.3.4 Cardio-Respiratory Endurance

Some of the changes of aging start as early as the third decade of life. After age 25-30, for example, the average maximum attainable heart rate declines by about one beat /minute / year, and the peak capacity of heart to pump blood drifts down by 5%-10% per decade. That’s why a healthy 25 years old individual’s heart can pump 2'/2 quarts of oxygen a minute, but for a 65 years old heart can’t get above 1'/2 quarts, and on 80 years old, heart can pump only about 1 quart, even if it is disease free. In everyday terms, this diminished aerobic capacity can produce fatigue and breathlessness with modest daily activities.

Hawkins and Wiswell (2003) described the age related changes in maximal oxygen consumption (VO_{2\text{max}}) their study supports a 10% per decade decline in VO_{2\text{max}} in men and women regardless of activity level. High intensity exercise may reduce this loss by up to 50% in young and middle aged men, but not older men, if maintained long term. Middle aged and older women do not appear to be able to reduce loss rates in VO_{2\text{max}} to less than 10% per decade, which may be related to estrogens status. Age related loss of VO_{2\text{max}} seems to occur in a non-linear fashion in association with declines in physical activity. In sedentary individuals this non-
linear decline generally occurs during the twenties and thirties whereas athletic individuals demonstrate a non-linear decline upon decreasing or ceasing training.

Robinson (1938) has observed loss rate in VO$_{2\text{max}}$ with age in men is approximately 10% per decade. Astrand (1960) observes the absolute rate of decline in women is lower and relative age related loss rates in VO$_{2\text{max}}$ in women are similar to those reported for men. A world-wide basis in cross sectional study, the value of 10% decline per decade has been observed in sedentary and physically active men and women (Schiller et al., 2001). VO$_{2\text{max}}$ is seen to be highest at the age of 20 years, but it gradually decreases and at the age of 65 years it reduces by thirty percent (Quinn, 2011).

Hawkins et al. (2003) have observed that the influence of cardio-respiratory fitness as a functional independence, quality of life, and cardiovascular disease and all cause mortality. This research work supports a 10% per decade decline in VO$_{2\text{max}}$ in men and women regardless of activity level. High intensity exercise, if maintained long term, may reduce this loss by up to 50% in young and middle aged men, but not in older men. Middle aged and older women do not appear to be able to reduce loss rates in VO$_{2\text{max}}$ to less than 10% per decade, which may be related to estrogens status.

2.4 On Movement-Related Physical Fitness

2.4.1 Movement Speed

An early study of Miles (1931) has reported a greater loss of speed of movement in older subjects than their speed of reaction and it has later confirmed by Pierson and Montoye (1968).

Scilder and Stelmach (1996) have commented that typically as individuals get older they experience substantial decline in sensory-motor processing. Motor performance often becomes slower and more variable with increasing age. Their findings are (a) an increase in response initiation time, (b) an increase in movement duration (c) a
reduced capability for decelerating movement and (d) an mobility to calibrate appropriate force levels.

Hodjkins (1962) has observed the results that reaction time and movement time are uncorrelated in all age level groups of the study, with one exception, that of the group between the ages of 22-37 years, reaction time is found to improve with age up to age 19 years, remains constant to age 26 years and then decelerates with age. Movement time has observed to improve with age up to age 15 years, remains constant to 19 years and decelerates thereafter.

2.4.2 Agility

Agility is “a rapid whole body movement with change of velocity or direction in response to a stimulus”. It requires a combination of motor qualities, such as coordination, speed, strength and stamina. It is the union of dynamic balance or the ability to maintain balance under changing conditions and speed and thus it influences any motor task or performance to a large extent (Sheppard & Young, 2006).

The study of Miyamoto et al. (2008) refers to the ability to rapidly change direction or velocity of body movement in response to some stimulus that is known as ‘agility’ tends to decrease after age 50, which has been linked to the potential for falls. However, this research suggests that declines in agility appear to be a separate factor from increased falls due to a loss of muscle strength or balance.

The study findings of Miyamoto et al. (2008) indicate that the speed of completing the Ten-Step Test has in direct relationship with the number of falls a person experiences. In other words, participants who have completed the test more quickly reported fewer falls exercises to reduce decline in agility may prove valuable to reducing falls. Additionally, findings indicate that the Ten-Step Test is a reliable measure of agility in older adults and can be useful in predicting the risk for falls.
2.4.3 Balance

Woolacott (1996) defined balance control as the maintenance of person’s center of mass within their stability limits, which are defined as their base of support. Balance control thus indicates the ability to regulate one’s static upright posture or to recover from unexpected threats to balance - such as the balance threat that occurs when standing on a bus that starts to move.

The researcher has reported that for many elderly subjects, the aging process is inevitably accompanied with restriction of the ability of independent movement and loss of balance; and adequate postural control depends on the integration of vestibular, somato-sensory and visual information of the body motion.

Stumicks et al. (2008) has observed the balance or equilibrium disorders are common in the elderly. Balance is a significant risk factor for falls and is affected by the gradual loss of sensory motor function associated with increasing age. Deficiencies in proprioception, sight, vestibular sense, muscle function and reaction time all contribute to balance disorders.

Hausdorff et al. (2001) has defined aging is often accompanied by balance disorders or age related pathologies, for example osteoarthritis, stroke, Parkinson’s and Alzheimer’s disease, which hinder independent mobility and lead to postural instability. It is estimated that one third to one half of the population over 65 years posses some problems with balance control.

Grimston et al. (1993) has observed that in the lower body, the movement range of the knee joint tends to decrease with increasing age, which affects the balance ability.

Ernes (1979) has observed the effect of a regular light exercise programme on seniors and has found a noticeable improvement in balance among them.

Fernie et al. (1982) and Maki et al. (1994) described maintaining balance is simple yet essential physical task required for independence. In the elderly, especially, loss of balance has been associated with decreased functional ability and increased incidence of false, often resulting in fractures and other injuries.

2.4.4 Reaction Time

Reaction time (RT) can be defined as ‘the time from the onset of a stimulus until initiation of a volitional response’. Reaction time has two components i) pre motor
reaction time and ii) motor reaction time. Pre motor reaction time is the duration from onset of a stimulus until appearance of electromyographic activity. On the other hand, motor reaction time is the time interval between the appearances of electromyography activity until movement initiation (Seidler & Stelmach, 1996).

Woodworth and Scholsberg (1976) has described the typical process RT measurement in terms of the time elapsing between the person taking of a stimulus which is often a brief visual or auditory signal, and/or discrete response such as the press or release of a response key, the initiation of a movement, or the emission of a vocal response.

The first systematic assessment of the relation between adult age and RT has done by Galton in the late 1880s, although analysis of his data not published much later. There are sporadic investigations of the relations between age and reaction time until about 1950s, when interest in this topic has increased because on assumption that an individual’s RT may be informative about the status of his or her neurological system (Salthouse, 1996).

RT to light has been studied for more than 100 years. Some of the experiments have shown age decrements and others have shown that RT can be improved with practice regardless of age (Leonard, 1953; Rutherford, 1894).

RT is an important topic on aging mainly for three reasons: i) the speed with which a simple response can be produced is a very elementary behavioural measure and may function as a relatively direct indicator of an individual’s neurological status, ii) studies of RT have revealed moderately large age relations and these relations are among the most consistent and robust in all of the behavioural sciences, and iii) RT measures have been found to be related to measures of higher cognitive functioning. Between age 20 to 90 years the simple reaction time increase about 0.5 ms per year and for choice reaction time it is 1.7 ms per year (Salthouse, 1996).

Birren et al. (1980) has mentioned that RT, especially choice RT, is considered to be a primary indicator of overall cerebral functioning. Throughout the development stage up to about 25 years of age, in an individual, RT decreases at first rapidly and then more slowly following the same type of growth functions. Emery and Gatz (1990) reports RT is one of the measures of cognitive functioning and adults those who remain physically active for major part of their lives have faster reaction time than the inactive adults.
Luria (1932) has observed that young children are having a very short RT. On complex reaction time tasks, involving more than one stimulus or response, older adults are slower than younger adults (Goldfrab, 1941).

Hull (1942) has noticed the difference in RT from individual to individual and also in the same individual from day to day, even from event to event. He further opines that, this behavioural oscillation is an overall characteristic of the organism, which not to be explained by any single factor.

Pierson and Montoye (1958) have studied 400 male subjects and concluded that RT is significantly related to chronological age.

Clarkson and Kroll (1978) and Spirduso (1988) have observed proportionately greater effect of exercise on choice RT than on simple RT. They have concluded that the impact of exercise is more in CNS than in the peripheral part of the mechanism. Laboratory induced supplemental oxygen has resulted to improve RT performance (Spirduso, 1980).

Researchers like Baylor and Spirduso (1988), Rikli and Busch (1986), Sherwood and Selder (1979) have agreed that choice RT has proportionately larger percentage of pre-motor area than simple RT, i.e., the central part of the nervous system, is largely influenced by physical activity level.

Spirduso (1988) has experimented on aged motor function with reference to time. They have observed 8-11% better time in younger age group (20-29) than elderly group (50-59 years). These differences are consistent with Dustman et al. (1984) who observes an 8-11% difference between physically active and sedentary groups of men and women.

Welford (1977), Jevas and Yan (2001), Luchies et al. (2002), Rose et al. (2002), Der and Deary (2006) have observed simple reaction time shortens from infancy in to the late 20s, then increases slowly until the 50s and 60s, and again lengthens faster as the person gets in to his 70s and beyond.

Study findings of MacDonald et al. (2008) reveal that RT variability in older adults is usually associated with slower reaction times and worse recognition of stimuli, and suggest that variability is a useful measure of general neural integrity. Redfern et al. (2002) has described that when troubled by a distraction, older people also tend to devote their exclusive attention to one stimulus, and ignore another stimulus, more completely.
than younger people. Myerson et al. (2007) have found that older adults’ adaptation ability is at par to younger people for assimilating information, but they take longer time to react.

Jevas and Yan (2001) have reported that age related deterioration in reaction time is the same in men and women.

Compared to old and younger groups, psychomotor speed in seniors are more of a function of their fitness level (Spirduso, 1975) and the complexity of the task itself (Clarkson, 1978; Spirduso, 1980).

Simple RT is somewhat diminished with aging (Weiss 1965), but if the movement response required is extremely simple the simple RTs in older persons have been found only slightly longer than in younger subjects (Gottsdanker, 1982).

Grew (1959) has observed that in movement complexity, older people require progressively more time after interpretation of the signal, whereas younger individuals appear to interpret the signal and prepare for the response simultaneously.

### 2.5 On Psychological State

#### 2.5.1 Anxiety

According to Martens (1972) state anxiety is characterised by “consciously perceived feeling of apprehension and tension, accompanied by arousal of the autonomic nervous system”. And trait anxiety is “an acquired behavioural disposition that predisposes on individual to perceive a wide range of objectively non dangerous circumstances as threatening, and to respond with state anxiety reactions disproportionate in intensity to the magnitude of the objective danger”.

To counter anxiety Morgan et al. (1980) used exercise as a relaxation technique. They found state Anxiety increased in a fairly linear fashion throughout the first half of both run and walk, then reached a plateau and remained stable for second half of the exercise.

Blumenthal et al. (1989) have studied aged men and women (60-83 years) in terms of the effects of an aerobic exercise programme (3 days / week for 16 weeks) and yoga for same duration with a sedentary group. The anxiety level of
the subjects has measured by STAI of Spielberger et al. (1970) and the average score of the three groups altogether is 31.3 at the beginning of the study and a significant decrease in trait anxiety in men and state anxiety in women who undergone into the exercise programme and the control men subjects are found to increase the anxiety levels.

In his conclusion Singer (1992) has made the comment that exercise can help reduce state anxiety and long term exercise can help reduce trait anxiety. Ekkekakis et al. (1999) measured state anxiety in the context of acute exercise. They have found that alter am aerobic exercise session state anxiety level of young subjects was changed.

2.5.2 Purpose in Life

Purpose in life is one of six key dimensions of psychological well-being and in the context of well-being, purpose in life refers to the sense that life has meaning and direction and that one’s goals and potential are being achieved or are achievable (Ryff & Keyes, 1995).

Greater purpose in life is associated with a reduced risk of all cause mortality among community dwelling older person (Boyle et al., 2009).

Most of the existing literature defines health as the absence of disease or illness, and studies examining potentially modifiable determinants of positive health outcomes are limited (Gruenwald et al., 2007; Pitkala et al., 2004).

Samman (2007) Ryff and Keyes (1995) Wrosch et al. (2003) have commented that greater purpose in life has been shown to be associated with several psychological outcomes, including a more positive outlook on life, happiness, satisfaction, and self-esteem.

Frankl (1963), in the long past and later Ryff et al. (2004) in the recent past have concluded that purpose in life is an important determinant of physical health and vitality. However, prospective data regarding the association of purpose in life with mortality are lacking. In the present study, purpose in life is operationally
defined as a complex, multidimensional construct that reflects the tendency to derive meaning from life's experiences and possess a sense of internationality and goal directedness that guides behaviour.

Study of Hadberg et al. (2010) indicates that the very old people are feeling indecisive about their purpose in life and that feelings are linked with poorer psychological health and for this reason, the purpose in life must be discussed and taken into consideration in the care of the elderly.

Frankl (1958) has commented that everyone struggles to find meaning in life and the desire to find meaning is the primary driving force for all human beings. Those who fail to find a purpose in life may experience total meaninglessness, the occurrence of an existential vacuum.

In the recent past Ventegodt et al. (2003) has described the purpose in life as the meaning in life which creates a connection between persons inner depth and their outer world, which could mean that if the outer world perceives elderly people as a homogeneous group suffering from functional and cognitive declines, it can influence the rising generation to see them as a burden. And for many of the people it is difficult to find a purpose in life in very old age (Tomstam, 2007).

Tomstam (2005) has revealed that very old people are a part of a society that allows them to continue to develop and discover new perspectives of aging. Based on a psychological theory of aging, namely gerontotranscendence the perspective of aging develops from a cosmic dimension, a solitude dimension and a coherent dimension. In this point of view Tomstam (1997a) has mentioned that all the three dimensions are important for human development which is a life-long process that continues even into very old age.

Antonovsky's (1979) definition of sense of coherence includes the components - manageability, comprehensibility and meaningfulness. The sense of coherence theory intends to describe a personality construct that protects people against the potential harm of stressors to health. There is a distinction between Frankl's will to meaning and Antonovasky's sense of coherence but also
similarities as Frankl's concept is narrower in scope than Antonovsky's and does not address the larger question of how purpose in life operates to promote health and well-being (Sullivan, 1993).

Low PIL scores have been observed among the people with depression by Klaas (1998), with high anxiety by Thomason et al. (2003) and among older individuals (Sarvimäki, & Stenbock 2000)

2.5.3 Depression

Depression is a measure of psychological well being of an individual (Emery & Gatz, 1990).

Koening and Blazer (1996) defined depression as the state of mood that involves symptoms of sadness, discouragement, and feelings of hopelessness, as well as loss of appetite, difficulty sleeping, and loss of energy. Although depression can be a transient state for some, for others it may last many months and sometimes many years. Besides impairing 'quality of life' and producing severe emotional pain, depression also impacts adversely on other health outcomes and on use of health services. Older persons with major depression and physical illness experience increased mortality when compared to non-depressed persons.

According to Kaplan and Shock (1998) depression symptoms are present in about 15% of older adults and common symptoms are reduced energy, lack of concentration, sleep problems, decreased appetite, weight loss and somatic complains in the elderly. The symptoms may be different in older depressed patients from those seen in younger adults because of an increased emphasis on somatic complains in older people.

Matt and Dean (1993) have studied depression of elderly persons from social support aspect and found enhanced depression in old age influenced largely by loss of social support because of death of spouse, friends and disengagement in social life.

Three sources of stress account for increase in depression with aging. Those three sources are poor health, economic stress and less social support (Harba et al. 1997).
Miroswky and Ross (1989) have argued that sense of control (mastery) is the most important psychological resource with which to cope with stress when feeling in control of individuals' lives.

The relationship between depression level and personality disorder is highly related to an individual (Reich, 1999).

Depression is the commonest and the most reversible mental health problem in old age. It is associated with physical illness and disability, life events, social isolation and loneliness. Depression in old age carries an increased risk of suicide and natural mortality. Recognition and simple intervention can reduce morbidity, demand on health and social services and the cost of community care. Despite a favourable response to treatment, depression remains largely undetected and untreated (Anderson, 2001).

Loneliness is related to poor psychological adjustment, dissatisfaction with family and social relationship (Hansson et al., 1987). It may lead to serious health-related consequences and is one of the three main factors leading to depression, and an important cause of suicide and suicide attempts (Green et al., 1992).

According to Kennedy (1996) the prevalence of depressive symptoms increases with age. Depressive symptoms not only have an important place as indicators of psychological well-being but are also recognized as significant predictors of functional health and longevity. Penninx et al. (1998), after a longitudinal study has concluded that increased depressive symptoms are significantly associated with increased difficulties with activities of daily living.

Suzane et al. (2000) have tried to find out longitudinal relationship between depressive symptoms and health in normal older and middle aged adults on a large sample of 1,479 individuals. Their finding are (a) different duration of depressive symptoms have different relationship to health, (b) health has an impact on short term increase in depressive symptoms and a weaker impact on health (c) long term depressive symptoms have clear impact on health. Their conclusion is that physical illness can affect depressive states and depressive traits, but not states can affect illness.

Reich (1999), after examining the relationship between depression level and personality disorder, has commented that depression is highly related to personality of an individual. Miroswwky and Ross (1992) have reported the symptoms of depression are
found to be peak in late teens and drop off with age until the 60 years, and increase again with old age. However, older people cope better with any stress that increases with age (Mirosnk, 1995).

Geriatric depression has a wide range of genetic, psychosocial and acquired biological determination. There are many reasons why one would expect depressive disorders to be especially common among older adults. Late life can be a time of loss and disturbing change in health, activity level, social roles, friendship and family networks, and financial circumstances. Impaired cerebral function due to vascular disease or age associated degenerative diseases increase depression among elderly. Older persons with major depression and physical illness experience increased mortality when compared to non depressed person (Koening and Blazer, 1996).