REVIEW OF LITRATURE

"If you do not know history, you don't know anything you are a leaf that doesn't know its part of the tree"

-Micheal Crichton

2 REVIEW OF LITERATURE

A systematic and thorough review of previous studies related to problem under study, helps in analyzing the problem, its historical status, its development and current status. The available review of literature on aspects relevant to present investigation was divided in various sub heads and presented in following sections:

1. Physiological decline in the elderly
2. Functional limitation and disabilities found in third age
3. Anthropometry of people in third age
4. Posture
5. Designing for comfort
6. Storage for the normal people and the people in third age
7. Lighting for elderly
8. Conclusion

1. Physiological decline in the elderly:

All human beings advance in age and become old if they live long enough. Old age brings with it several deleterious changes. As one reaches old age, the psychological systems become increasingly less efficient and less resistant to diseases. Consequently, the individual undergoes sufferings. There is a general belief prevailing in the society that illness is a part of being old. Old age is seen as the time in life when one's health progressively deteriorates. According to **Steiglitz (1950)** "Health is that state of being in which all the resumed capacities of the organism are at their maximum". According to him, there are no specific diseases of old age. "Any illness may occur at any age. But certain disorders increase in frequency after the peak of maturity. These disorders, while not limited to senescence, are nevertheless characteristically geriatric". In addition to the risky economic status of aged the chief causes of dependency are the chronic and degenerative diseases and the physical defects" **(Phelps and Handerson, 1952).**

Health status of the elderly people is usually defined either by the presence or absence of diseases or by the assessment of functional capacity. The former definition is more commonly used, particularly by health care providers **(Shanas and Maddox, 1976).** Every society usually takes it granted that the aged persons suffer from illness or the other and that there is nothing unusual about it. There is no denying of the fact that many of them are more susceptible to sickness. Increasing age is accompanied by decreasing bodily resistance to illness. Psychological well being (personality growth) is strongly related to good health **(Livson, 1976).** Psychological stresses supplement the suffering **(Reid and Zeigur, (1977).** Yet, it is quite surprising that society considers old age as synonymous with sickness. There is no such disease as "Old age". Some old people are severely restricted in their mobility while others are able to maintain themselves in the ordinary activities of daily living. The variation among the elderly in their physical health and in their degree of impairment in enormous.

Good health habits have positive effect on the quality of life during the later years **(Livison, 1976; Mc Glone and Kirk, 1987).** Health depends on many factors such as heredity, past life history, the emotional stresses of life and willingness to adjust with one's pattern of living to changed physical conditions **(Hurlock, 1976).**

Men of age 60 and over were more likely than were women to deny clear signs of poor health **(Maddox, 1964, Maddox and Douglass, 1973).** But, in a study in India, **Purohit and Sharma (1972)** reported that among aged persons of 60 years and over the male had more ailments than females.

Although males have higher death rates, females paradoxically appear to have poor health. **Verburugge (1977)** reported that male chronic conditions were more severe than those of females and women displayed more vitality than men in almost any group of older people, even when the women were as old as men. Women aged 65 and over reported more days of restricted activity and more days in bed for illness than men. A higher percentage of older women than men reported one or more chronic conditions **(Kovar, 1978).** Poor health especially cardiovascular disease has been shown to be related to poorer cognitive performance and that the cognitive performance of older women appeared to be less affected by psychological pathology than that of older men **(Hertzog, Schail and Gribrin, 1978).**

Health is a major topic of conversation between couples over 65 years of age. Good health in later years is both directly **(Feldman, 1964; Palmore and Luikart, 1972; Edwards and Klemmack 1973; Spreitzer and Snyder, 1974; Tornstam 1975; Medley, 1976)** and indirectly **(Markides and Martin, 1979)** related to life satisfaction.

Desai and Naik (1971) in their study of retired people in Greater Bombay, found minor ailments in about a quarter of the elderly. Nearly 2/3rd of them were found suffering from ailments like difficulties of vision and hearing, digestive complaints, high blood pressure, pains in joints etc,.

Ranade (1974) in a study of the aged in Delhi, observed that over 87 per cent of the elderly were suffering from one ailment or the other, and only 13 per cent were free from any ailment. In 56 per cent of the aged, eyesight was poor and 35 per cent complained of pain in joints. The elderly persons suffering from night blindness, cataract, insomnia, deafness, hyperacidity and asthma were found varying from 26 per cent to 10 per cent.

The report of the Medical Research Centre of the Bombay Trust Hospital **(Pathak, 1975)** on the medical problems of 1,678 aged patients (60 years and above) admitted in their hospital during the years 1970 and 1971 revealed that a good number of patients had gone through more than one major illness in the past. The average number of diseases per head was 2.5. For instance, disability to move some joints, dull aches in the back, low fever, dimness of vision, loss of hearing, indigestion and mild breathlessness were noticed in a number of cases on examination rather than on specific complaints by the patients themselves.

The prevalence of arthritis in the elderly population has been noted by **Wantz and Gay (1981)**. Postural sway has been found to increase with age **(Hasselkus and Shamber, 1975; Era and Heikkinen, 1985)**. The incidence of hip fracture in this age group increase **(Wyshak, 1981)**. Because it is well recognized that bone becomes more brittle with age related osteoporosis **(Garn, 1975; Exton-Smith, 1985).**

According to **Pitt (1982)**, ageing is a progressive decline in function and performance which accompanies advancing years. Nearly in all species the female have a tendency to live longer than the male. As an average, women live 5 years longer than men and they tend to be a little younger than the men they have married. As a result, there are more widows than widowers and this is other important factor to be considered while designing old age homes.

In a sociological study of retired public servants, **Bhatia (1983)**, found physical disability in 12 per cent of the retirees. Difficult in walking, poor eyesight and impaired hearing capacity were found to be the most common ailments.

Mahajan (1986), in his study of problems of the aged in unorganized sector, reported that approximately 13 per cent were suffering from different ailment like T.B., asthma, diabetes, blindness, cataract, pain in joints and abdomen and different other types of ailments. More female respondents (17.89%) than the male respondents (8.13 %) were found suffering from these ailments; and health problems were perceived as more serious than the psychological and economic difficulties. Shrinking health causes the aged to develop a feeling of insecurity. It has been established that "older people are more prone to chronic diseases of heart and blood vessels, brain, kidney and liver, cancers and complications of such diseases as diabetes" **(Francis, 1991).**

The fact that physiological functioning declines with age is not questioned, however, rate of aging varies among individuals **(MacRae 1989; Skinner, 1989)**. Studies have shown that various persons, who had regular physical activity as part of their life style, continue to be physically vigorous with strong muscles and bones after having passed the usual retirement age. These persons perform better in tests measuring physical capacities. In fact, by exercising regularly, the elderly can increase their flexibility, muscle strength and endurance, aerobic capacity and balance **(Holloszy, 1983).**

Physiological decline with increasing age renders the daily activities at home more difficult. Ageing emphasizes problems in the environment, since people have to face the difficulties of body decadence **(Aoyagi and Shephard, 1992; Gill et al., 1999).**

Ageing people spend a lot of time in a seated position. Sitting has a number of advantages compared to standing. The body is better sustained because there is several support surfaces including floor, seat, back rest, armrest and work surface **(Yokomizo, 1985).** Posture and movement can cause mechanical stress on the joints **(Hughes et al., 1992)** and the muscles.

The speed of muscle contraction diminishes with increasing age **(Era et al., 1992)**; consequently, the maximal volumetary strength and difficulties in the control of movement is reduced **(Aoyagi et al., 1992).**

The flexibility of joints of the body decreases dramatically with age **(Pheasant, 1988). Sanders and Mc Cormick (1993)** conclude that the types of disability receptive to the design of facilities and product for the elderly and the handicapped include poor balance, lack of coordination, limited stamina, difficulty in handling and fingering, in bending and kneeling, and inability to use the lower extremities.

Barbaccia (1995) stated that the musculoskeletal dimensions, mechanical performance, flexibility of joints, muscle strength, gait speed, bone densities are all important factors in the physiological system and changes occur in these with ageing.

Ageing leads to demineralization of the bones, inverted thin/fat muscle relation, with a diminution of muscular and movement strength **(Steenbekkers et al., 1998).**

Even healthy elderly people may, through dietary modifications better maintain health, delay the onset of some diseases and prevent functional decline **(Bales et al., 2002).** Nutrition education and counseling thus seem to be necessary in assisting older people to comprehend new information about healthy nutrition and apply it to their own situations **(Sahyoun, 2002)**. Both obesity and underweight are common problems in older people.

2. Functional limitation and disabilities found in third age:

As most studies have focused on the independent effects of various impairment, little information is available on risk for disability that results from the combined effects of multiple impairments, or as they are termed here, co-impairments. Functional limitations may be better explained by the accumulation of deficits across multiple domains rather than by any specific impairment **(Duncan et al., 1993).**

Tinetti et al. (1995) found that when the number of impairments (lower and upper extremity, sensory and affective impairments) increased from zero to one, two and three or more, the proportion of participants experiencing functional dependence doubled from 7% to 14% to 28% to 60%, respectively. In cross sectional studies, physically inactive people often obtain poorer results in physiological and sensory motor tests on aerobic capacity, muscle strength, postural balance, psychomotor speed and bone mineral content. Physically active people on the other hand maintain a higher level of physiological function, such as muscle strength, than their sedentary counterparts **(Rantanen et al., 1997)**. Exercises have been found to maintain good mobility and independence into old age **(La Croix et al., 1993).** Among people surviving until very old age, even the period of disability prior to death has been found to be shorter among those, who were physically active earlier in life **(Leveille et al., 1999).**

Almost all the indicators of physical and cognitive functioning seem to be related to life expectancy, showing that older individual with lowered functional capacity have a significantly shorter life expectancy compared to those with good functional capacity. In addition the economic burden imposed on society by disability is great. It has been estimated that the use of social and health services increase in parallel with the increase in various disabilities **(Rice et al., 1992; Salive et al., 1997 and Tsuji et al., 1999).**

Older people with difficulties in carrying out daily activities are in a danger of losing independence when placement in a nursing home becomes a realistic alternative **(Laukkanen et al., 2000)**. Such individual need help to be able to remain in community dwelling. According to self reports by elderly people, disabilities feature among the most important determinants of diminution in quality of life.

The interaction between mobility limitation and environmental components adds further complexity to the disablement process **(Shumway Cook et al., 2003)**. People with mobility limitation often try to avoid traveling alone, climbing stairs, going to crowded places or using escalators. Walking limitations may also result from arthritis when pain predisposes people to decreased muscle strength and poor postural control.

2. Anthropometry of elder people:

Ergonomics is the study of human characteristics for the appropriate design of the living and working environment. Ergonomics researches strive to learn about, human characteristics (capabilities, limitations, motivations, and desires) so that this knowledge can be used to adopt a human made environment to the people involved. Core of ergonomics knowledge consists of four major applied sciences:

1. Anthropometry – the measuring and description of the physical dimensions of the human body.
2. Biomechanics- describing the physical behavior of the body in mechanical terms.
3. Physiology- applying physiological knowledge measuring techniques of the body at work.
4. Industrial Psychology- observing worker's attitude and behaviour at work.

The human geometry and the geometry of the product must be suitably fitted together **(Kreifeldt, 1991)** for safety as well as for functional reasons, hence, appropriate anthropometric and biomechanical applications are necessary for a "human compatible" designed product.

As a rule of thumb, if we take the smallest female or the tallest male in a population, the male will be 30 to 40% taller, 100% heavier and 500% stronger **(Grieve and Pheasant, 1992)**. Clearly, the natural variation of human populations has implications for the way almost all products and devices are designed. Some obvious examples are clothes, furniture and automobiles.

Different elderly populations show large geographic and ethnic variation in height, weight and body mass index, much of which reflects differences in lifestyle and environment over the life course, genetic difference and to an uncertain extent, differences in health status **(WHO, 1995).** Currently available anthropometry data rarely include very old persons. **NHANES II**, the most comprehensive data set for anthropometry, does not include people older than 74 years. The committee of WHO encourage to collect anthropometric data on adults aged 60 years and above. Through anthropometric surveys conducted at regular intervals, coupled with the monitoring of the health and functional status of this segment of the populations special attention should be paid to selection criteria in choosing population based samples, taking into consideration the heterogeneity of the elderly and the high prevalence of chronic conditions that may affect nutritional status.

Anthropometry is the subject, which deals with the measurements of the human external body dimensions in static and dynamic conditions **(Chakrabarti, 1997).** These include measurement of body parts, their strength, speed and their ranges of motions. External human body dimensional measurement are taken when a man is placed in a rigid and static positions, whereas dynamic anthropometry is required more than static body measurement in the yield of design. The human body is not rigid but rather, always dynamic.

Anthropometry data sets are one way of bringing the physical dimensions of users into the design process; however, there are limitations for design teams using these. Information sources are often fragmented making it difficult for the practicing designer to locate and compile relevant data. Data sources such as SAMMIE (**PORTER et al., 1999)** have tried to move beyond the average. It's human-modeling capabilities allow designers to vary anthropometry and test design scenario.

3(a) Studies related to changes in Anthropometric measurements of elder people:

Trotter and Gleser (1951), in their classic and much quoted paper, attempted to separate the effects of the secular increase from the biological aspects of the aging process. They noted that the length of the long bones such as the femur, tibia, and humerus was highly correlated with stature, but changed little, if at all, with age.

Damon et al. (1972) found upper arm circumference to decrease with age. Hand length did not change as a function of age. Neither shoulder to elbow length nor elbow-to-middle-finger length is affected by age, functional reach is diminished, at times severely, but cited no data **(Stoudt, 1981).** Arm span, however, shows significant declines **(Friedlander et al., 1977; Borkan, Hults and Glynn, 1983).**

Body breadths at the shoulder, hips and seat also change with age. Data from cross-sectional studies tend to indicate mostly decrements with age, although there are some inconsistencies such as bi-iliac diameter, which appears to increase in many studies **(Damon, Seltzer, Stoudt and Bell, 1972),** but longitudinal studies shows rather consistent increase in all breadths up to the seventies **(Friedlander et al., 1977).**

The data available on heights and weights of the elderly from Health and Nutrition Examination Survey (HANES) of the U.S. Public Health Service in 1971-73 **(Abraham, Jhonson, and Najjar, 1976)**, shows that elderly males aged 65 to 75 years are on the average 2.4 in (6.1 cm) shorter, but only 1 lb (0.45 kg) lighter than the youngest age category of adults. Elderly females on the other hand, are 2 in (5 cm) shorter, but fully 14 lb (6.4 kg) heavier, than their younger counterparts. **Stoudt (1981)** reports that elderly males weighted an average of 0.5 kg less than younger males, whereas elderly females wee 6.3 kg heavier on the average. **Friedlander et al. (1977)** found a decline in weight after age 65, but this decline was not significant. Damon and collegeagues also reported a weight decrease at about 65 years of age. Yet among institutionalized elderly, three of four were found to gain or lose 4.5 kg or more in a period of two years.

The elderly are recognized as a distinct population anthropometrically **(Fozard, 1981; Stoudt, 1981)**, but the recognition has not yet resulted in appropriate representation in anthropometric studies. The newest anthropometric reference manual uses the terms "infants", "children" and "youth" in a chapter title, but the elderly are not likewise mentioned **(Lohman, Roche, and Martorell 1988).**

Stoudt (1981) found 65 to 74 years old male subjects to be on the average 6.1 cm shorter than his young subjects (aged 18-24 years). Elderly females were about 5.1 cm shorter than the young sample. **Friendlander et al. (1977)** also found significant decreases in height, stating with the 40 to 44 years old. Other surveys also have shown that height declines with age **(Damon and Stoudt, 1963; Damon et al. 1972; Borkan, Haults and Glynn, 1983)**. Sitting height also declines with the age **(Borkan, Haults and Glynn, 1983),** and this decline parallels the declines in stature **(Stoudt, 1981)**. The major factors contributing to shorter statures in older groups relates to the biological changes that take place as part of the normal ageing process. The more important of these changes have been reported as (a) a flattening of the cartilaginous disks between the vertebrae; (b) a flattening or thinning of the bodies of the vertebrae resulting in increased convexity in the curvature of the spine (Kyphosis); (c) a general thinning of all weight bearing cartilages **(Trotter and Gleser, 1951)**; and sometimes (d) scolisosis, or a lateral deviation of the normal vertical line of the spine **(Friedlander, Costa, Bosse, Ellis, Rhoads, and Stoudt, 1977)**. **Rossman (1977)** has stated that a thinning of the discs of the spinal column appears to be the major reason for shrinking stature in the middle years, and a diminution in the height of the vertebrae the major reason thereafter. Other suggested anatomic factors related to decreased stature in the aged have been flat feet and bow legs **(Himes and Mueller, 1977)**.

3(b) Anthropometric data of elder people:

Roberts (1960) measured 78 women (average age 71 years) living in housing for the elderly in England. Means and standard deviations were reported for 33 standing and seated measurement. Roberts stressed the need for such information for applying ergonomic principles to designing for the elderly. **Word and Kirk (1967)** presented additional data on 14 of these measurement from another study made on 100 elderly women in Birmingham England.

Jones, Lawton and Myles (1964), under the joint supervision of the Department of Ergonomics and cybernetics Loughbrough and the Birmingham school of Architecture, undertook a study on 100 elderly women in the Birmingham area. The study was carried out to determine whether a sample of elderly female subjects from Birmingham was comparable in body dimensions with that of Roberts and to propose domestic design requirement. On comparing the data of both studies it was found that the variances for the two sets of data are the same, with one exception. This is dimension sacral plane to front of knee, where the variance for the Brimingham data is significantly greater ($0.01<p<.05$). Whereas the means of only three dimensions, i.e. stature seat to vertex and popliteal height from floor, do not differ significantly. The means of the Birmingham measurements are greater than those recorded by Roberts. These four exceptions were dimensions vertical arm reach, shoulder width, back of shoulder to pencil clasped in fist and popliteal height from floor.

Molenbroek (1987) conducted an anthropometric investigation in several old people' homes in The Hague, the Netherlands. Twenty five functional body dimensions of 822 elderly people were measured using method based on international standards. The result was used to compile a set of ergonomic recommendations and being implemented in an existing CAD-model called ADAPS. The findings of investigation were compared with

English results from Loughborough and with German DIN 33402. The mean value and S.D. of unshod stature and weight were 157.1 cm (8.9 cm) and 63.7 kg (14 kg) respectively for 197 male and 625 female elderly. For the male sample, these values were 165.6 cm (8.2 cm) and 67.3 kg (13 kg); and for the female sample, they were 154.3 cm (7.2 cm) and 62.6 kg (14 kg), respectively. There were no large differences from published figures from the UK and Germany, but there are with figures on younger people.

Small (1987) found that females aged 70-79 have a mean height of 1570 mm (61.8 in), S.D 560 mm (22 in). Their mean weight was 64.8 kg (144 lb), S.D.12.2 kg (27 lb). **Koppa et al (1989)** reported that the mean standing height for the 12 elder women was 1630 mm (64 in), S.D 53 mm (2.1 in). Their mean sitting height from wheelchair was 1250 mm (50in), S.D 380 mm (15.2 in).The mean age was 72.6 years, S.D 5.3 yrs. Their average weight was 66.2 kg (146 lbs) S.D 13.0 kg (28.6 lb).

Kothiyal and Tettey (2000) presented anthropometric data of 171 elderly people in Australia. The data set consists of 22 body dimensions relevant to design of living facilities, equipment and workplaces for the elderly people. The study was carried out in metropolitan Sydney, New South Wales, Australia on 33 males and 138 female subjects. The mean age of elderly male and female subjects were 76 years (S.D= 7, range 65-92) and 77 years (S.D= 8, range 65-92) respectively. A comparative analysis shows that elderly male and female Australian are different in many body dimensions from the British elderly male and female populations.

Kashyap (2007) conducted a study on old age homes. Thirty anthropometric dimensions of elder males and females were measured. The mean height of males and females was 154.2 and 141.6 cm. respectively. The mean weight of males and females was 68.3 kg and 53.3 kg respectively. The average body surface area of males and females was 1.16 and 0.96 square metres, respectively. The findings of correlation coefficient (r value) showed significant relations between the height, weight and body surface area of elderly male sand females at 5% level of significance.

Study conducted by **Kaur (2008)** on designing of toilet chair for people in third age. Various measurements in sitting position were taken for the study. The mean sitting height of the elder males and females was 80 cm and 75.5 cm respectively. The mean sitting shoulder height of elder males and females was 55 cm and 54 cm respectively.

4. Posture

What is posture?(bussinessballs.com/workplaceposture.htm)

Posture is a static state - 'A position of the body' or 'An attitude' (dictionary.com), 'Posture is arrested movement' (Bobath). By itself it's a word which is often qualified - defensive, poor, bad, aggressive, happy - and is often used in related ways, with overtones of opinion towards something, sometimes with a meaning of falsehood. What distinguishes it from 'position' is the inclusion of a mental ingredient, particularly mood or emotion; ie., **posture is a 'position with attitude'**, so to speak. We always have a posture of some kind or another, even if the mental intention behind it is subconscious. And, of course, it is well documented that body language plays a large part in communication.

Our bones hold us up, our joints link our bones, our muscles move the bones around the joints and our nerves facilitate control of the whole. The key to good posture is correct joint alignment, but muscle activity, balance and nerves are all part of the picture.

Posture - joint alignment

'Joints' are not just the obvious ones such as those on the arms or legs, but the term apply to any links between bones including the spine, shoulders and hips and weight-bearing joints in the feet. There are about 230 mobile and semi-mobile joints in the body. Our bodies evolved for certain purposes and our joints move in particular ways to fulfill those purposes most efficiently. When alignment is 'correct' - that is, in the evolved position - our body is in balance and our muscles and joints are working with least effort.

This actually applies to movement as well as to static posture. If our joints are used differently from their 'designed' position, we say they are 'out of alignment'. One of the effects of using joints out of alignment is at least discomfort, which can manifest as pain and eventually become injury.

The degree of mal-alignment is material; a very slight amount and the effect is not immediately serious. A greater degree and we know about it instantly. If a joint is both mal-aligned and under stress, something gives and a break or a tear ensues. **'Something gives'** can mean quickly or over a period of time if the stress is lower level but repetitive - hence repetitive strain injury. This can occur anywhere in the body.

Mal-alignment leads to muscle imbalance. Muscles adapt; for instance, an arm in plaster cannot be stretched immediately when the plaster comes off. The same effect happens when a joint is held in the wrong position over a period of time, which is why some people have round backs or slumped shoulders.

Posture - muscle activity

There are two kinds of muscle in the body, each with their own function. The first kind, **postural or 'slow twitch' muscle**, is for holding us in the 'correct' position; these muscles are short and in the deepest layers. The other kind, **movement or 'fast twitch' muscles**, are for moving us, lie over several joints and are closer to the surface than slow twitch muscles. We need both in varying degrees to perform properly.

Posture - balance

A contributory factor to holding a posture is balance. Balance can be used in two ways when talking about posture. It can mean the balance of opposing forces - for instance, are the muscles holding the shoulders back strong enough in comparison with those pulling the shoulders forward? If not, the result is a round back. Secondly, it can mean balance in the sense that if it is not right, the person falls over.

A person with good muscle balance will be able to hold an unstable position for longer because they recruit the postural muscles in the correct alignment and their movement muscles are less involved. A person with poor balance will move a lot and have to use the movement muscles to try to get back to balance. These muscles will get tired quickly and the correct posture will be lost.

Posture - nerves

We control our movement through our nerves. Messages are passed in both directions between the brain to and from the extremities, the muscles and the joints. If this passage of information is disturbed, we cannot have proper movement. Nerves are physical entities and just as subject to maltreatment as bones and muscle; they can be affected by blows, by stretching, by pressure, by twisting. They pass between muscles, along bones and joints on paths developed, like the rest of the system, during evolution. So again it follows that if alignment is not right, the nerves may be affected.

Poor posture effects

What happens if posture is poor? In each of the areas of joints, muscles and nerves there can be effects of mal-alignment. These ill effects may start out as very slight, they may remain at a very low level, but if the cause does not disappear, they will get worse and may become intolerable.

Mal-aligned joints and ligaments may just feel uncomfortable, may ache, or hurt. Shear forces (that is, across rather than along) the spine may affect the discs, putting pressure on the nerves that fan out from the spine.

Muscles will suffer through lack of circulation, which may manifest itself as discomfort, ache or pain as well as lack of performance, getting tired quickly. The body's healing process is impeded when blood-flow is restricted.
Pain may arise when nerves are stretched or inflamed by mal-alignment. Again, the range of symptoms may be from discomfort, through tingling, pins and needles, hot or cold feeling or numbness to pain. A characteristic of nerve damage is that sometimes the symptom is not in the place where the damage is being caused. For instance, a nerve being damaged in the lower back may cause tingling in the thigh or pain around the ankle.

Poor posture causes

Why do we have poor posture? There are two sides to this, physical and mental. Physically, the short answer, going right back to fundamentals, is that we are hunter-gatherers, with our roots on the savannah, evolved to spend our days wandering in search of berries or pursuit of prey. We no longer do what we evolved to do. We are emphatically not designed to spend our day sitting on our bottoms staring fixedly at a computer screen or in a car seat staring at the road ahead, or for any of the other activities of our modern life that are so far from our origins.

Mentally, we have unnatural pressures that bear on us all the time. No doubt the link between posture and attitude derives from relationships within our hunter-gatherer community - authority, submission, joy, sadness and so on - but today life is complicated by the sheer variety and duration of circumstances and information that affect us. Thus a person with an oversized mortgage, an unpleasant commute and an unhappy job will tend to have a worn-out demeanour with the posture to show it: round shoulders and a curved spine.

Posture discomfort and pain - remedial actions

What can we do to relieve discomfort and pain? There are three main steps:

1. understand that you can take control
2. listen to the body
3. take action

1 - Take control

Mind and body are closely linked. In many instances we are, without realising it, in control of the conditions that give rise to pain and are therefore in a position to get rid of it. Once we understand this and consciously take control, we can achieve quite remarkable advances and be very much happier. It's as much a mental as a physical approach. We know a happy person when we see one - we talk of 'a spring in their step, head up, chest out.' We know instinctively what such a posture means.

Our brain controls our posture through the nerves. Our mind can control our brain one way of implementing that control is to alter our posture positively. Think positively about improving your physical posture.

When people understand why and how to take control, their health improves.

2- Listen to the body

The second step is to listen to the body. Why do people 'grin and bear it'? Because they are not listening, discomfort and pain are telling you something. In particular, with musculo-skeletal matters, the pain and discomfort are telling you that something is not right, something is out of alignment, or something is moving in an incorrect way. Analyze the feeling, look for the root cause and seek ways of changing.

Pain is subjective. There are many cases of people with quite severe injuries that they hardly notice, whilst other people with injuries in the same area but to a lesser degree may be in agony. It is noticeable that when a person is concentrating, they may even temporarily put themselves in the position of not feeling the pain. Indeed, it can take a very long time for the body to 'get through' to the mind and make the point that something is not right. Unfortunately, all this time the damage is getting worse. So it is worth treating the messages of discomfort and pain positively, by listening to them.

3 - Take action

The third step is taking action. There is nothing to be gained from inaction, from grinning and bearing it. The best action is prevention. Not the lazy form of prevention, expecting ergonomic equipment on its own to solve the problem - anyone can habitually slump in even the best chair in the world. The principles and outlines of human bio-mechanics combined with movement training and exercises are an effective and long-lasting form of prevention, requiring a degree of application.

Even if we are not in direct control of our discomfort - for instance, our equipment is ill-designed - we are usually in a position to talk to someone who is in charge so that something can be done.

In other cases a solution may be easy; many people do play around with their circumstances and find that a change removes the pain. Unwittingly, they have achieved the right result. Sometimes people may not be so perceptive or their circumstances are more complicated and they might need some postural re-education. To change posture is a more mental than physical challenge. We all have our own posture ingrained in our brains as being 'correct' either by habit or by upbringing. However, in cases in which posture is in fact incorrect, the brain needs to be re-programmed to accept the correct messages; training with constant reminders and repetitions in the early stages is required. This need not be particularly time consuming. Complete postural re-education for people who have problems should, with weekly professional help, take no more than 4-6 weeks; the effects can last a lifetime.

5. Designing for comfort:

The home should be fitted to the physical and psychological characteristics of the elderly person **(Willcocks, et.al. 1982).**

Sanoff (1990) claimed that "All designers who are concerned with improving the quality of their efforts and the quality of everyday life should consider participation through user involvement"

Designing for the people with disabilities, including the infirmities that follow the process of ageing, means that the functional requirements of the user determine which design criteria must be met in the final product or environment. The ultimate objective is to develop products that will maximize the use of a person's functional abilities **(Benktzon, 1993).**

There are many age related changes in physiological sensory, perceptual, motor and cognitive abilities that may impact on how older people interact with their home related furniture. These changes include the following: relevant declines in ability, decreased mobility, decreased strength, more rapid onset of fatigue, visual deterioration, reduced ability to process information slowed reaction time; and hearing loss **(Smith *et al.,* 1993).**

Environments and products designed for the elderly will reduce disability if they increase the individual's capacity to be independent. **(Fisk, 1993).**

The increased life expectancy of the elderly may require substantial redesigning of environments in order to accommodate age-related body changes. One of the most important aspects allowing the elderly to function independently is the ability to reach for items comfortably during daily activities. Designing for an independent elder requires knowledge of reach measurements that determines the optimal design of working/living environments **(Wright, Kumar, and Mital, 1994).** The house should be designed to promote familiarity and orientation of the elderly with the environment **(Caterina and Pinto, 1994).**

In commercial terms, it is crucial for designers and manufacturers to produce products, systems and services that are suitable for older and disabled users in mainstream design. Although this is beginning to happen, progress is slow without the necessary legislation: the US currently has the strongest legislative climate; in the UK, although the Disability Discrimination Act (DDA) is leading to consideration of services and access to public buildings, there is currently no statutory requirement to design accessible products. A study by **Ashworth *et al.* (1994)** gives some indication of the extent to which older and disabled people are being 'designed out'. They report that 21% of their sample of US 65-74 year olds and 55% of 85 year olds, had at least some difficulty with activities of daily living (ADL's cooking, bathing and toileting, cleaning etc) both at home and in the community. In addition, **Clark *et al.* (1990)** in their study of 60 older and disabled people aged between 55 and 93 found that 53% were unable to shop, 45% were unable to prepare meals and 28% were unable to bath unaided.

Fox (1995) performed a study to (1) determine whether the use of architectural modifications in the homes of the elderly with disabilities can reduce the level of disability, (2) estimate the degree of need for environmental modifications, and (3) determine the predictors of the use of architectural modifications. The author concluded that there is a substantial need for environmental modifications in the homes of the elderly with disabilities. Furthermore, architectural modifications should be made available at a low cost.

As the users representatives in the product creation process, human factors specialists should concern themselves with wider issues than just usability. The integration of human factors throughout the product creation process is something which appears to be becoming organizations **(Jordan *et al.*, 1995)**.

Traditionally, user centered design has tended to concentrate on 'usability'. Manufacturers increasingly see usability as an area where they can gain advantages over their competitors **(Jordan *et al.*, 1996)**.

Richardson and Poulson (1996) believed that designing for the elderly and disabled people was designing for everyone.

Coleman (1997) pointed out the importance of consulting elderly people during the design process, because they claimed that elderly people are surrounded by things which do not work well for them, or that they simply cannot find the things that they want. **EUFRP (1997)** is one of them, where years of experience, knowledge, and wisdom of the elderly were used to create new designs in the field of virtual communication and web use. **Wolff *et al.* (1997)** conducted researches oriented towards the construction of housing for the elderly identified: senior housing, sheltered housing, nursing houses, community dwellings, and so on for old age people.

It is well known that the world's population is aging, with more developed regions leading the process, because of increasing survival to older ages as well as smaller number of births **(United nations Population Division, 1998 revision)**. Consequently, the support of this ever-expanding elderly population has come of increasing concern. Another consequence of the demographic shift is the need to give greater attention to the design of products and services for older consumers who now exercise the power of the so called 'grey poand' **(The Henley Centre and Design Age, 1997)**.

A wide spectrum of professions is concerned with life span design (universal design) for an ageing population, design, engineering, gerontology, ergonomics and architecture. All try to support ageing in place so that independence, freedom of choice and life style are promoted. Designs considering the data related to both physical and psychological characteristics of people can improve the quality of life by promoting independence, as well as safety, usability and attractiveness of the residence **(Demirbilek and Demirkan, 1998)**.

Ergonomic data are fundamental to the design of safe and usable products **(Norris and Wilson, 1997)**, and the benefits of using these data in the early stages of the design process are widely recognized. It was in response to this need for ergonomics data that the University of Nottingham, in association with the Consumer Affairs Directorate of the UK Department of Trade and Industry (DTI), recently produced a series of publications that bring together all available design related data into a compendium of easy to use design resources. The three publications on children, adults and older adults (Childata, 'Adultdata' and 'older Adultdata') **(Norris and Wilson, 1995; Peebles and Norris, 1998 and Smith *et al.,* 2000)** contain the most up to date anthropometric and physical strength data for countries around the world.

A home of personal safety evaluation may uncover many high risky conditions. The team may lean about near misses and remove hazards. Some risks are easily remedied, but others may require major home modifications. A person might not make the necessary house renovations because they cannot afford it or cannot do it themselves **(Bayer and Harper, 2000)**. They may also have no one else to do it for him or her. **Steinfeld and Shea (2001)** reported that obstacles to recommended renovations or remodeling might include the stress of managing the project of denial that the modification was needed.

The elderly dealing with changed capacity, reduced ability and increased needs require the same accommodations and compensations in late life that they found in earlier years. Universal design is a concept that extends to a broad diversity of users who have to interact with the built environment

(Steinfeld and Danfort, 1993; Story *et al.*, 1998; Sandhu, 2001 and Scott *et al.*, 2001).

Two surveys were conducted : one of UK practicing designers to investigate knowledge of inclusive design **(Gyi *et al.*, 2000)**; and the other to understand the requirements and preferences of older and disabled people with regard to their interaction with everyday products, systems and services **(Oliver *et al.*, 2001)**. The Kansei Engineering framework was developed apparently to incorporate customers feeling into the design of the product by translating these feelings into the design elements **(Matsubara and Nagamachi, 1997 and Nagamachi, 1995 & 2002)**.

The research of **Aurelio (2000)** has shown that many designers find it difficult to appreciate the full range of problems experienced by older and disabled people. In addition, there are particular difficulties involving older and disabled people in design such as, high recruitment costs (e.g. time, transport costs); ethical consideration; and communication difficulties **(Aurelio, 2000)**. It is not the intention to completely replace users' involvement in design but rather to complement existing methodologies. Many aspects of design and development do not lend themselves to be tested in a virtual environment anyway.

Observing people's interaction with products educates the designer on critical user behaviour than can serve as into to design. An alternative to this is immersion in context which involves living with the users **(Grossley, 2004)**. Behavioural patterns obtained using these techniques may not be quantifiable but give good clues about user needs in the natural setting. The end result is a richer design concept that encompasses users conscious and unconscious aspirations about the product. This design concept however, can still be improved by using quantitative techniques to compare alternatives. It can also be tested for its potential to engender emotion.

Product design has always been in quandary as to the nature of product attributes that rigger users emotions. Emotions are compelling human experiences and designers can capitalize on this knowledge by conceptualize emotion engendering products that can sell well in the market. This entails knowing users activities, thoughts, feelings, aspirations, goals, rituals and values and translating them into a product that elicits positive emotional response. Better designs are capable of provoking positive reactions from people such as sense of achievement, inspiration and joy **(Giverchi and Velasquez, 2004).**

Intille and Larson (2004) focus on developing design strategies that meet the needs of multiple constituencies. In particular, they aim to create environments that are more flexible and that better meet the physical and cognitive needs of occupants than current environments. Four of the overarching goals of the study was to create supportive technologies that (1) help people create and customize environments and technologies that reflect their unique needs and values, (2) help people to live long and healthy lives in their homes, (3) help people reduce resource consumption, and (4) help people integrate learning into their everyday activity in the home.

Study conducted by **Myerson and Gheerawo (2004)** showed that correctly incorporating user feedback into the design process can create a better product. And when those users have special needs such as reduced dexterity or arthritis, addressing their needs in a mainstream product design brief can provide innovative triggers as well. A power tool that is designed to be easier to hold will be easier to hold for everyone who uses it - not just retired people.

6. Storage for the normal people and the people in third age:

6 (a) Storage for normal adult

Information on various dimensions for normal adult's reach, work heights and storage is presented here.

Heiner and McCullough (1946) found that a height of 72 inches can be reached without difficulty by the homemaker of average height-about 5 feet 4 inches. The measurement from the floor to the tips of the finger is about 28 inches and the maximum working area covers a slightly oval area, 48 inches across and 44 inches up and down. Items that are stored within the limits of the maximum working area or the radius of shoulder to curved fingertip grasp can be reached easily without bending over, stooping, climbing, or excessive reaching.(Figure.1).

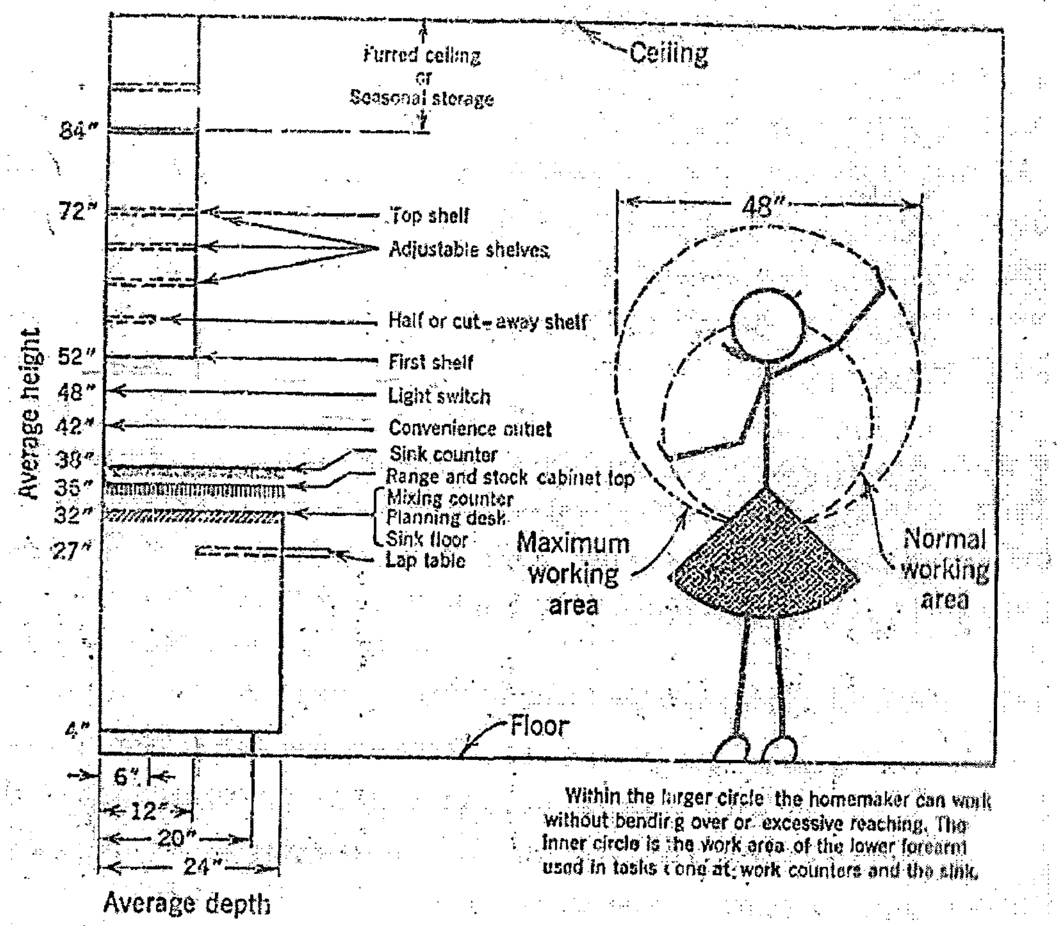

Figure 1: A guide to use in planning kitchen cabinets that fir both the worker and equipment (Source: Nickel and Dorsey, 1960)

Knowles (1946) found that women of the same body height might have elbow heights varying as much as 3 inches. The same was true with waist and hip heights and the length of the arms. These variations are more important than the body height when considering a working height. Larger women have a problem quite different from that of slender women.

McCullough (1951) suggested the total cabinet space requirement. The table shows the dimensions:

Table 1: Total cabinet space requirement

Individual Centers	**Combined Centers**	**Dinnerware for Specified Numbers**			
AMPLE SPACE		4	6	8	12
Liberal supplies					
Wall 7'9"	5'6"	2'0"	3'0"	4'0"	6'0"
Base 13'6"	13'6"				
Limited supplies					
Wall 6'3"	4'6"	2'0"	3'0"	4'0"	6'0"
Base 11'0"	11'0"				
MINIMUM SPACE					
Liberal supplies					
Wall 6'3"	4'6"	1'9"	2'6"	3'6"	5'0"
Base 11'0"	11'0"				
Limited supplies					
Wall 5'3"	3'6"	1'9"	2'6"	3'6"	5'0"
Base 8'6"	8'6"				

Nickel and Dorsey (1960) stated that arranging supplies and equipment within easy reach saves needless walking, reaching and stretching. The normal and easy working area of a person helps determine the maximum heights and depths of storage shelves (Figure 2a and b).

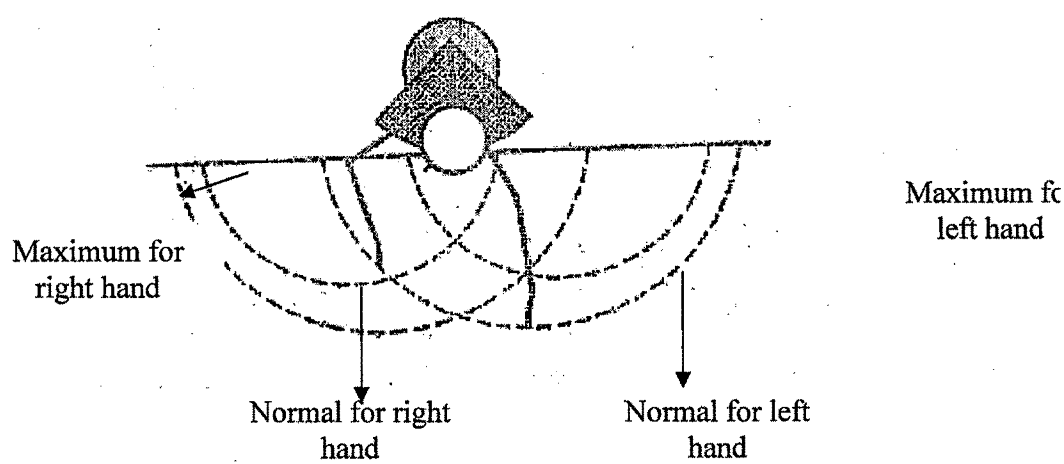

Figure 2 (a): Normal and Maximum Working areas- Horizontal Planes

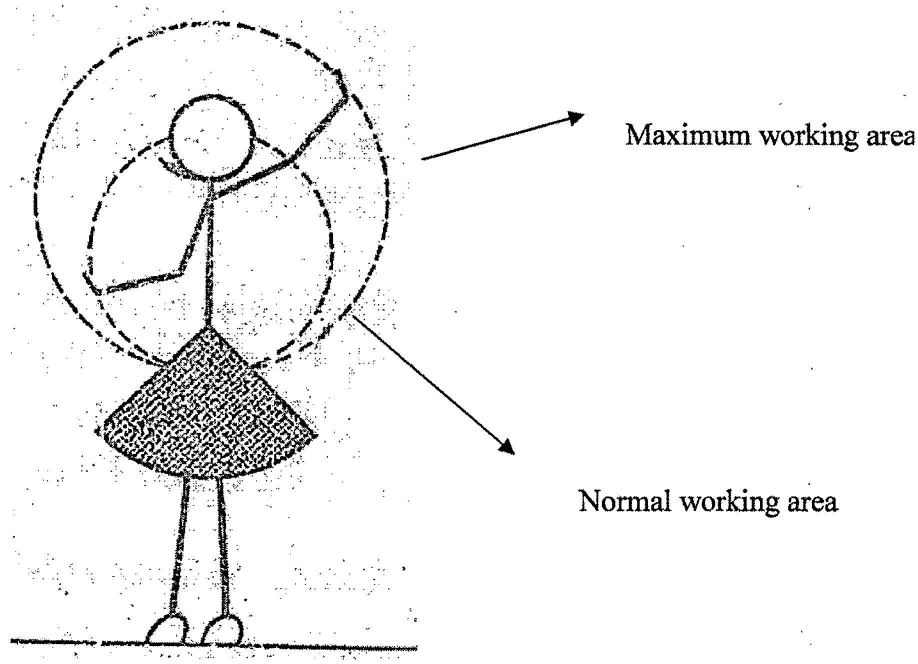

Figure 2(b): Normal and Maximum Working areas- Vertical

Woodson and Conover (1964) stated that for determining the limits of reach and clearance requirements, the dimensions of smaller (5th percentile) and larger (95 th percentile) operators were used, respectively.

Bhavnani (1965) conducted a study on selection of body reaches of Kymore home makers to develop guides for designing of kitchen storage and working centers. The recommended dimensions for storage were:

S.no.	Shelves	Dimension
1	Top most shelves	68" or less from the floor
2	Shelves for frequently used articles	38" from the floor
3	Shelves under the working counter/built in wall	20" from the floor
4	Top most shelves over the working counters	62" from the floor
5	Depth of the counters	21"
6	Working counter for standing position	35"' from the floor
7	Working counter sitting position	25" from the floor

Konz (1967) concluded from the experimental results that the best working height for a standing operator is about 2.5 cm below the elbow, nevertheless the working height can vary several centimeters up or down without any significant effect on performance.

According to **Steidl and Bratton (1968)** many tasks require a variety of supplies and tools but not all are needed at the same time. Tasks done at a particular center also vary in content from time to time and this is reflected in the items used. Storage should be such that there is sufficient holding space for all items needed for a group of related tasks done at the same place, the space should permit ready access to each item. They also suggested some principles and guides for functional storage. **The principles of the storage are**:

(1) Store frequently used items at place of first use,

(2) Place items so they are easy to see, reach, grasp and replace, and

(3) Determine the worker's limits of reach.

As well as to put the three principles into practice, a number of guides are also given by them. Such as:

(1) Sort items to be stored according to the function of the center.

(2) Store unlike items one row deep and one layer deep.

(3) Stack only those items having the same dimensions.

(4) Provide sufficient clearance for grasping and replacing items.

(5) Place frequently used, heavy items, within normal reach.

(6) Organize items within the storage space to reduce the search and facilitate the flow of motions.

These principles and guides give direction to the designing of storage units in any area.

Mitter (1971) conducted a study on development of guides for setting up storage cabinets at the serving and cleaning centers in kitchen. She recommended liner space required for storage cabinet: (1) the grand total liner space requirement for storage act the wall cabinet of the serving centre is 284.5 centimeters. The corresponding figure for the base cabinet is 392 centimeters. The liner space requirements of both the base and the wall cabinet taken together are 674 centimeters. (2) The grand total liner space requirement for storage at the shelf under the sink at the cleaning centre is 47.5 centimeters.

Nadvi (1971) in her study recommended guides for storage unit at Cooking and Preparation centers. According to her (1) the height of wall shelves should be 135 centimeters, and for base cabinets it should be 80 centimeters. Dimensions of wall shelves should be 70x30, and for base cabinet at cooking centre should be 75x60 centimeter, at preparation centre it should 90x60 centimeters. (2) The total linear space needed in the base cabinet at cooking centre is 418.8 centimeters. When shelves are 3 and arrangement is done into rows then 69.65 centimeters are recommended.(3) The total linear space recommended for wall shelf at coking is 138.3 centimeters, when arrangement is done in two rows 69.15 centimeters space is required in each row. (4) The total liner space for wall shelf at preparation centre is 146.1 centimeters, when arrangement is done in 2 rows then 73.5 centimeters will be required in each row. (5) For base cabinet at preparation centre the total linear space recommended is 332.2 centimeters. When two shelves are provided and arrangement is done in rows then 83.05 centimeters space is needed in each row.

Ward (1971) shows the recommendations of work surface height for standing posture in a kitchen (in.) (for normal adults).

Sr. No.	Sources	Sink	Work Surface
1.	Work in the Home, Steidl and Bratlon (1968)	32-33	31.5-36.5
2.	Space in the Home, MOHLC Bulletin, No. 6(1965)	36	34
3.	Provision of space for Domestic kitchen Equipment BS 3705 (1964)	36	34
4.	Kitchen storage and working Height, J. Long (1964) Thesis, Birmingham School of Architecture	30-39	28-39
5.	Woningbouns, Pouwcentru, Holland (1963)	35.5-36.5	35.5-37
6.	Council of scientific Management in the Home (1961)	36	33

7.	Kork, Planering Inredning Swedish Consumer Institute (1961)	35.5	33.5-35.5
8.	The kitchen, Joan Wally (1960)	36	36
9.	Management in the Home, Gilbreth (1956)	38	34
10.	The kitchen Book, R.R. Hawkins, USA, (1953)	-	32-36
11.	Birmingham Anthropometric Survey (1951)	-	33
12.	Kitchen fitments and Equipment, BS 1195 (1948)	36	36
13.	Gas Industry (1965)	36	32-36
14.	Ascot Limited (1963)	33-39	33-39
15.	Total Range	30-39	28-39

According to Hertzberg (1972) for determining design dimensions, the necessary anthropometric measurements that were used were total or standing height, body height (sitting), eye level height (standing), as well as (sitting), shoulder height (standing) as well as (sitting), body depth, elbow- to- elbow breadth, thigh clearance, forearm length, arm reach, elbow height both standing and sitting, and popliteal height (sitting). The essential anthropometric measurements were obtained for the 5th, 50th and 95th percentile for male and female.

M. R. C. report (1975) gives the upward grasp level for the young British women as 173.3 cm; 'Guide to user activity measurement in health building' **(M. I. L. 1967)** recommended 169 cm. for the 'small' women; **Grandjean (1973)** suggests 183 cm. as the upward reach of women of 161 cm. in stature **(Cited in Ward, 1984)**

Ward (1984) stated that from the ergonomics point of view, optimum control zones are recommended to be between the elbow and shoulder levels of the seated or standing operator. The lower margin of control zones should therefore be the elbow height of the smallest operator, say, the 25th percentile women.

Deshpandae (1985) recommended that the width of the wall cupboards should be between 2 ½ to 3 feet and its bottom should be at least six inches above the floor level. The top shelf should not be higher than say 5'-9" above floor so that a person of medium height should easily reach it with his hand. There should be four or more rows of shelves in it; the lowest shelf should be 1'-3" high so as to easily accommodate bulky and heavy things and tall bottles. It is desirable that battens should be built into the side walls inside the cupboards projecting about ¾ inch out side for the plaster and the shelves should simply rest on them to facilitate their easy withdrawal for cleaning.

Varghese, *et al.* (1989) reported the work surface heights for various activities as proportionate distance below the elbow height. (Elbow-height – 96 cm.).

Activities	Convenient Height		Distance below elbow	
	cms.	inches	cms.	inches
Chopping	85	34	11	4.4
Cooking	87	35	9	3.6
Kneading dough	87	35	9	3.6
Rolling and Roasting	87	35	9	3.6
Dish Washing	78	32	18	7.2

Faulkner and Faulkner (1994) states that the sizes given for counter space in each of the five work centers will ensure enough storage space for the average kitchen if wall and base cabinets are placed above and below the counters. According to these formula, the counter space provided by the work center totals at least 10 lineal feet. If the work centers are placed alongside one another, all counters between appliances can be eliminated except the largest counter, which then should be made 1 foot wider than usual. Accessible frontage for base and wall cabinets is lessened by installation of appliances, windows and hard to reach locations (in corners and above 72 inches). Recommended standard from The Small Council at the University of Illinois are 6 feet minimum and 15 feet maximum total counter frontage to prevent either too cramped to too excessive distances between centers. Space located above the maximum reach of a given person (69 inches for women, 72 inches for men if over base cabinets) can be consider dead storage since a stool or ladder would be required to reach articles kept their. For accessibility of often-used items, the area within most comfortable reach is from approximately 24 to 60 inches off the floor (12 to 48 inches for someone wheelchair-bound).

Sumangala (1995) developed kitchen standards for work surface and storage heights and depth based on anthropometric measurements of women residing in Dharwar city of Karnataka. She recommended that an L-Shape kitchen plan being 300 cm × 360 cm in size is good. The lowered work counter height was preferred to accommodate the height of gas stove mounted on a stand as well as height of cooker. The mean height and depth of storage shelves were found 48.2 cm and 55.6 cm, respectively.

In the study of **Paul, *et al.* (1995)** the self selected height was compared with two guideline heights for manual work: a guideline for working surface height, i.e. 10-15 cm under elbow height **(Grandjean, 1980)** and a guideline for working height of the hands, i.e. 5 cm under elbow height **(Schuffel 1989)**. The working height of the hands minus the object size (9 cm) resulted in a working surface height of 14 cm under elbow height, which is within the range recommended by **Grandjean (1980)**.

Oberoi, *et al.* (1996) studied the kitchen layout of 200 families. Based on the anthropometric data collected for 200 homemakers, maximum and minimum values of dimensions for kitchen workplace were worked out. According to them, the storage area and work counters were not within the normal reaches of homemakers and that was one of the reasons for discomfort.

According to **Vijayan (1997)** the height of kitchen counter top from floor to work surface should be 36" and width of the platform should be 24". maximum total height from the floor to overhead cabinets should be 78"(inches).

Sangwan, *et al.* (2001) studied that 42.5 per cent of the respondents fulfilled the standards of the counter height and counter depths. Regarding counter width of cooking centre and preparation centre 78.3 per cent of the respondents fulfilled the standards. Similarly 83.3 per cent of the respondents fulfilled standards for counter width, both at right and left side of the counter. 55.8 per cent of the respondents fulfilled length (side by side) of the sink and 60.8 per cent fulfilled the width of the sink.

Verma (2001) reported that L- shape kitchen based on anthropometric measurements was found to be the best in terms of lower ergonomic cost and highest work efficiency and productivity with minimum cardiovascular stress, energy expenditure and muscular stresses. And also recommended the most comfortable kitchen design based on the study of experimental kitchen designs.

Kishtwaria, *et al.* (2004) design a comfortable kitchen by assessing the existing work centers with prevalent set standards and evolve the kitchen counter heights on the basis of anthropometric data and ergonomic cost of kitchen activities at three main work counters i.e. preparation, cooking and sink.

6 (b) Data on storages for the people in third age

According to BSI, 4467 (1969), in furniture with under cupboards, the highest shelf may be placed at 1400 mm because the user is farther away from it. More over the cupboard shelves should not be lower than 1200 mm from the floor.

Craig and Rush (1969) say that Closets with double or sliding doors are ideal for bedroom because all the contents are revealed at a glance when the doors are opened. A long narrow closet is never used to best advantage. On the outside of double or single doors, a full length mirror is an added convenience. This leaves the inside of the door for a rod, for ties or belts and a rack or bag for shoes and shoes-cleaning equipment. If the closet is deep and narrow, sliding garment rods that may be pulled out into the room are desirable. A shallow closet may have a garment rod parallel with the door.

Grandjean (1973) recommended 80-85 cm height for work counter in kitchen, highest kitchen shelf without under cupboard should be at 160 cm and shelf with under cupboard should be placed at 140 cm as well as the lowest kitchen shelf should not be below than 30 cm. for aged women.

Bostadstyrelsen (1982) has pointed out that the height of 900 mm for base unit surfaces is acceptable for both the elderly and the people who help them.

According to **Kirvesoja et. al (2002)** 1600 mm height seems to be a good recommendation for the top shelf of the upper cupboard, as it suits almost all the elderly selected for the study. As well as the work surface heights of both 800 and 900 mm were considered to be quite suitable. The lowest kettle shelf in the base unit can be considered to be good at 300 mm, but not lower, for the elderly.

7. Lighting for Elderly

Demographically, the elderly population is increasing due to advancing medicines and people living healthier life style. To accommodate the needs of elderly people, who tend to be more dependent on their immediate environment changes in interior lighting design needs to be made.

Blackwell and Blackwell (1971) experimented with a large group of visually healthy subjects with ages between 23 to 68 years old, and measured visual performance on a threshold visibility task. They concluded that large differences existed in visual performance capability both among individual observers of the same age and between the averages of different age groups.

Using Supra-threshold task, **Smith and Rea (1978)** asked subjects to perform a proof-reading task under different illumination conditions, and compared visual performance between a group of young adults (ages 18 to 22) and a group of older adults (ages 49 to 62). They concluded that there was a large difference in performance between the two subject groups, and the older subjects were more strongly affected by changes in luminance an in print quality than were the younger subjects.

Manning (1996) opined that in houses built specifically for the elderly, like an assisted-living complex, architects and interior designers plan residential and public areas that are user-friendly for older people. They make sure that lighting levels are brighter, more balanced and come with less chance of glare. Designers are coming to understand that good illumination has an impact on quality of life, improving a sense of security, lessening anxiety, and reducing chances of slips and falls. Achieving even, balance light throughout the living space is the first priority for seniors living at home. Brighter and consistent ambient illumination allows older eyes the ability to adopt better because contrast in the form of shadows is eliminated. Indirect lighting in individual rooms with more tasks lighting. This lighting is specifically aimed at surfaces where tasks are performed, such as kitchen counters, workbenches and reading/hobby areas. Track lights that can be adjusted to direct their light with precision and lights under the kitchen cabinets to light the counters are simple and relatively inexpensive improvement. In the bathroom, lights affixed on either side of the mirror, centered at eye level, eliminate shadowing. For hallways, install wall scones to light a path to the bathroom or the next room. Dimmers with timers or motion sensors to turn on lights in a hallway or room also improve both home safety and security. Elderly homeowners should be advised that adding track lights and wall scones, and installing dimmers could all be accomplished.

Pomeranz founded Light Tech in 1997 in order to provide "creative lighting design and technical support for custom home and corporate client". According to him, lighting in elderly homes has a profound effect on the quality of their lives. As people age, he said, they become more dependent on their environment to compensate for increasing sensory loss. Visual clues become critical to all aspect of life. As early as people 40's, they begin to lose the visual acuity of earlier years. And although people are all affected differently, it is safe to say that as people age, their eyesight and their perception of light diminishes. Proper illumination may compensate for many age-related changes in the visual system. Lighting makes a significant contribution to elderly physical and psychological functioning. Good lighting can help increase personal independence, promote health and well being, and prevent injuries. In general provide higher levels of illumination throughout the entire house. This includes not just the major spaces, but ancillary areas including hallways, stairs, and closets. Every area should have general illumination in addition to task lighting. Day-lighting and dimmable fluorescent are good indirect ambient light sources. An ambient light level 2 to 3 times "normal" is considered appropriate, with additional carefully designed task and accent lighting. As age, patterns of activity change. The visual tasks associated with a normal life (i.e. matching clothing colours, grooming) all need to be considered in the lighting design. Kitchens, bathrooms and bedrooms particularly need better lighting because work there is detailed. Reading small print on a medicine bottle in the middle of the night is standard and not being able to do this is potentially hazardous.

Kairiukestiene (1998) determined whether lighting designed according to the lighting principles can truly help the elderly to see and whether the lighting demonstrates an improvement in the visual environment to these people. It was hypothesized that advanced lighting design is better in terms of visual performance, visual comfort and appearance of space and energy efficiency than the conventional lighting. The illuminances were several times higher with the advanced lighting design than with the conventional lighting. It was concluded that the principles of lighting for the elderly work in real life and lighting designed according to these principles could enhance the quality of life of elderly.

He had also suggested some practical recommendations for the elderly people.

1. Ceilings reflectances should be as high as possible (70 to 90 per cent) to bring the ceiling lightness close to the brightness of ceiling light fixtures.
2. Walls reflectance's should range from 40 to 60 per cent.

3. Desk and table tops should have light (but non-specular) finishes with a reflectance range of 35 to 50 per cent. Most light wood furniture falls in this range
4. Brightness of wall, furniture and other reflecting surfaces in a space should be within a 3 to 1 ratio.
5. Indirect lighting should be used whenever possible. It can increase the overall illumination level with less chance of inducing glare.
6. Lighting design must always accommodate the eye level of wheelchair-bound as well as ambulatory residents.
7. Residents' control of illumination levels is almost always desirable.

Jaju (1999) concluded that the level of visual performance and perceived level of visual comfort of the elderly subjects consistently, declined with decreasing illuminances.

According to **Manning (1999)**, "good illumination has an impact of quality of life: increase light levels, minimize glare, increase contrast, balance light levels and improve colour perception".

Figueiro, director of Light and Health Program at the lighting Research Centre, Troy (2001), opined that as people age, their eyes change. Older people need more light to see well than younger people do. In fact, a 60-year-old person needs two to three times as much light as a 20-year-old person to achieve the same visual performance. Older people have a more limited ability to respond to change in brightness. They may also loss some sensitivity to colour and have trouble discriminating between colours. In addition to these normal changes, aging eyes may develop cataracts, macular degeneration, or diabetic retinopathy. Changes in the visual system caused by age or visual impairment can interfere with an older person's ability to live independently. Good lighting, however, helps compensate for visual problems and supports more comfortable and effective performance of tasks. Unfortunately, people often have little knowledge of how to adjust the lighting within their homes for deteriorating vision. Their solution is usually to double or triple the wattage of common incandescent light bulbs used in existing fixtures, resulting in double or triples the cost the electricity used to light their homes. Also, because of the heat produced by incandescent or halogen lamp, there is an increased risk of injury from burns or fires. Not only is this practice costly and potentially dangerous, but increasing the amount of light without regard to light distribution and control can actually make visibility worse than it was under the original lighting conditions. It would make people that they can improve their daily lives through lighting.

Conclusion

After reviewing the extensive literature it was found that although many researches have been conducted on elderly and their problems, there is a dearth of information and researches on anthropometric measurements of Indian elderly especially women, problems faced by elder women, designing for elderly. Information on storage design for elderly was difficult to find.

Therefore a need was felt to conduct a study on elder women to find out their problems- their health status, physiological problems, problems related to existing storage units and anthropometric and reach measurements so as to provide guidelines for functional and ideal storage units in kitchen and bedroom for elder women.