INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN: 2277-7881; IMPACT FACTOR – 6.014; IC VALUE:5.16; ISI VALUE:2.286
VOLUME 8, ISSUE 8(6), AUGUST 2019

ERGONOMIC EVALUATION OF THE RESIDENCE (PRIVATE AREAS) OF THE ELDERLY

Roopa Rao
Assistant Professor
Specialization of Community Resource Management
College of Home Science
Nirmala Niketan, Mumbai

Abstract

Population aging is a global phenomenon. Living with an elderly person at home is a delicate phase in any family's life because majority of the elderly need assistance to accomplish Activities of Daily Living. Consequently, it is at home, especially the kitchens and bathrooms, where most falls/accidents occur. In order to increase the quality of life of the elderly - safety, comfort, physical and social health, the physical environment must be free of hazards. Home modifications must take into consideration the capabilities and limitations of the elderly. It is strongly believed that most accidents can be avoided with inexpensive measures.

The objectives of the study is to: (i) determine the incidence of falls and accidents among the home living elderly, (ii) ergonomically evaluate the private areas (Bedrooms and Bathrooms) in the existing residences of the home living elderly to identify potential safety hazards that lead to falls /accidents (iii) suggest economical & affordable changes/modifications in the homes so that they can adapt in their familiar surroundings.

Data was collected from 90 participants (aged 60 years and above). Convenient (willingness to participate) and purposive sampling method was employed. The participant's background information was obtained through a self-constructed questionnaire. In addition, a survey of their residential space was conducted to observe the design modifications and suitability of interior (bathrooms, toilets and bedrooms) and exterior (corridors, ramps, handrails) facilities. The checklist HSSAT V.4.0, was used to assess the residential spaces ergonomically.

Results indicate that 31% had a fall/slip due to the physical environment in the last one year. Bathroom was identified as the most unsafe area in the home. 95.5% of the elderly could identify the unsafe areas/corners in their homes but were confident that their homes were accident free. Most common hazards are poor illumination, level changes in flooring and slippery flooring.

Keywords: Elderly, Home Modifications, Safety, Ergonomics.

"**Respect is one of the greatest expressions of Love.**"
— Miguel Ruiz, Author

Population ageing is one of the most important global trends of the 21st century and the issue has started receiving much attention from the public, media and policy makers. The phenomenon of population ageing is becoming a major concern for policy makers too, during last two decades. The increase in life expectancy has resulted in a major shift in the age group of 80 years and over, known as the 'oldest old'.

According to the report titled "Situation Analysis of the Elderly in India" (2011) by The Central Statistics Office, Government of India, both the share and size of elderly population is increasing over time. From 5.6% in 1961, it is projected to rise to 12.4% of the population by the year 2026. For a developing country like India, this may pose mounting pressures on various socio-economic fronts including pension outlays, health care expenditures, fiscal discipline, savings level etc.

In India if we divide the total population into three major age-groups, i.e. age in years 0 - 14; 15 – 59 and 60 and above, it is a clear picture that during the last few decades the number of children (age 0 -14) is decreasing from 37.6% in 1991 and is projected to be about 25% by 2021. On the other hand, the proportion of population in the working age-group (15 – 59 years) and the aged/elderly (60 years and above) both are rapidly increasing. The improvement in life expectancy and decline in age-specific death rate among the elderly are chiefly due to the improvements in public health and medical advances in the prevention of many fatal infectious diseases.

Traditionally, older adults are taken care of by their families. A caregiving crisis is predicted owing to changing gender roles, employment of women, erosion of traditional family values, and an increasing trend for nuclear families. The number of older adults living alone is increasing. With decreased family support and informal caregivers, older adults in India care for themselves (http://ajgg.org/AJGG/V9N1/2013-164-RA.pdf accessed on 14.02.18). The WHO (World Health Organization) proposes 'active ageing', which aims to extend healthy life expectancy and quality of life for all people as they age, including those who are frail, disabled, and in need of care. It emphasizes on promoting an active lifestyle, which saves substantial health care–related expenditure. (According to the WHO Global report on Falls Prevention in Older Age http://www.who.int/ageing/Publications/Falls_prevention7March.pdf acces sed on 25.12.18).

The traditional Indian society and the age-old joint family system have been instrumental in safeguarding the social and economic security of the elderly people. However, with rapid changes in society and the emergence of nuclear families in India in recent years, the elderly is likely to be exposed to emotional, physical and financial insecurity in the years to come.

A few problems faced by the Indian elderly are:

- Economic Insecurity: Less than 11% of older Indians have a pension of any sort, according to national surveys (World Bank 2001; Uppal and Sarma 2007). Saving is difficult or impossible for a majority of Indians because earnings are low.
- Isolation and Neglect: Isolation, or a deep sense of loneliness, is a common complaint among many elderly. They often feel neglected because the young family members may be busy with their life, demanding jobs, distractions such as Television, Social Media etc. The elderly, especially those who are weak and/or dependent, require physical, mental and emotional care and support. When this is not provided, they suffer from neglect. Isolation is a terrible feeling that, if not addressed, leads to tragic deterioration of the quality of life
- Lack of Preparedness for Old Age: A large number of people enter 'old age' with little, or no, awareness of what this entails. While demographically, it is accepted that a person is considered to be old when they attain the age of 60 years but there is no clear indicator available to the individual. For each person, there is a turning point after which they feel physiologically or functionally 'old'. This event can take place at any age before or after the age of 60 years. Unfortunately, in India, there is almost no formal awareness program for people to prepare for old age (http://www.helpageindiaprogramme.org/Elderly%20Issues/problems_of_the_elderly/index.html accessed on 17.02.19).
- Living Arrangement and Social Security: More than four in five older Indians live in multigenerational households with their children. But surveys find that the share of older Indians living with only a spouse or alone doubled between the early 1990s and the mid-2000s (http://www.prb.org/Publications/Articles/2012/india-older-population.aspx accessed on 26.10.18). A number of trends may explain these changes in living arrangements, including declining fertility leaving fewer children available to care for older parents, rural-to-urban migration for employment that separates families, and changing social expectations regarding intra-family obligations. Security at night a particular issue for many elderly, especially for those living alone.
- Failing Health: As people get older, two major challenges impact on their ability to engage in everyday tasks. The first is a gradual decline in hearing, vision, and mobility (which includes walking, and movement of the arms and body). The second challenge is a high probability, which increases with age, of having one or more chronic diseases, such as arthritis, cataracts, or heart disease. These chronic diseases often lead to additional impairment.

(http://www.helpageindiaprogramme.org/Elderly%20Issues/problems_of_the_elderly/index.html accessed on 02.10. 17).

Falls/Accidents among the Elderly: Falls is a major cause of injuries associated with old age. In a Multi-centric Community Study, evaluating Health Problems in the Elderly (2003), in 10 states across India, covering a total population of 10,200 elderly with equal rural and urban distribution, the incidence of falls (History of a single fall in the last 6 months) was found to be 14% (http://www.who.int/ageing/projects/SEARO.pdf accessed on 10.09.18).
History of fall and fall frequency was seen to be significantly associated with disability and psychological distress. Higher disability and consequent increasing distress was noted among those with a prior history of fall after 60 years of age and those with a history of three or more falls. Falls and fall related injuries are among the most serious and common medical problems experienced by older adults. Nearly one-third of older persons fall each year, and half of them fall more than once. (http://www.who.int/ageing/publications/Falls_prevention7March.pdf accessed on 23.01.19). Falls occur as a result of a complex interaction of risk factors. The main risk factors reflect the multitude of health determinants that directly or indirectly affect well-being. These risk factors are categorized into four dimensions: Biological, Behavioural, Socioeconomic and Environmental factors.

Ergonomics: Ergonomics is the science and practice of designing the workplace, equipment, machines and environments keeping in mind the capabilities and limitations of the human users. The goal is to design jobs and tasks to remove incompatibilities between the work and the worker that hinder safe work performance. This allows person to prevent injuries, illnesses, and mistakes and improve overall worker health and business performance. The inclusion of ergonomics dedicated to safety may seem unusual, but there are a variety of issues that can crop up if seniors are living in a place that is not as accommodating to their particular condition. For instance, if an elderly resident has to overexert his or herself for simple tasks like reaching for dishes or doing laundry, it could lead to falls, pulled muscles or torn ligaments. According to the NSC (National Safety Council), overexertion is the third-leading cause of unintentional injuries in the India.

Home Modifications: Home modifications are changes made to adapt living spaces to meet the needs of people with physical limitations so that they can continue to live independently and safely. These modifications may include adding assistive devices/technology or making structural changes to a home so that the elderly can independently perform ADL (Activities of Daily Living).

Modifications can range from something as simple as replacing cabinet doorknobs with pull handles to full-scale construction projects that require installing wheelchair ramps and widening doorways. The main benefit of making home modifications is that they promote independence and prevent accidents. Most Indians want to age in their homes (Aging-in-place), but most homes are not designed to accommodate the needs of people over age 65 years. Most of them live in homes that are more than 20 years old. As these buildings get older along with their residents, they may become harder to live in or maintain. A house that was perfectly suitable for a senior at age 55, for example, may have too many stairs or slippery surfaces for a person who is 70 or 80 years.

A good home modification plan should improve the following features of a home:

- ✓ **Accessibility:** Making doorways wider, clearing spaces to make sure a wheelchair (if need be) can pass through, lowering countertop heights for sinks and kitchen cabinets, installing grab bars, and placing light switches and electrical outlets at heights that can be reached easily.
- ✓ **Adaptability:** Changes that can be made quickly to accommodate the needs of seniors or disabled individuals without having to completely redesign the home or use different materials for essential fixtures. Examples include installing grab bars in bathroom walls and movable cabinets under the sink so that someone in a wheelchair can use the space.
- ✓ **Universal Design:** Universal design features include appliances, fixtures, and floor plans that are easy for all people to use, flexible enough so that they can be adapted for special needs, sturdy and reliable, and functional with a minimum of effort and understanding of the mechanisms involved.

Assistive Technology: Assistive Technology is, any service or tool that helps the elderly or disabled do the activities they have always done but must now do differently. These tools are also sometimes called “Adaptive Devices.”

Justification for the study: Although India will be the youngest country in the world by 2020 with an average age of 29 years, the number of elderly people is likely to increase significantly. According to the 2014 “State of Elderly in India” report released by a non-profit organization, there will be 143 million elderly in our country by 2021. Presently, the elderly in divided into three categories: the young old (60 – 70 years), the middle-aged old (70 – 80 years) and the oldest old (80 plus years). While the overall population of India will grow by 40% between 2006 and 2050, the population of those aged 60 and above will increase by 270%. Out of this, the oldest old segment, which is the most vulnerable on account of suffering from disabilities, diseases, terminal illness and dementia, is also the largest growing segment of the elderly population, at a rate of 500%. (http://www.livemint.com/Politics/z6BacVOwf5SvmpD9P1BcaK/20-of-

population-to-be-elderly-by-2050-HelpAge-India-repor.html accessed on 04.10.18).

It is our responsibility to create a society where people are not worried about getting old. In order to increase the quality of old people lives, safety, comfort and physical and social health, must be taken care of. It is thus important that the home they live in has a safe, comfortable and healthy living environment as long as possible. This study was conducted to provide practical solutions to help the home-living elderly live well at home and safeguard their health and independence.

Aims and Objectives: The overall aim of this study is to assess the home safety measures and practices adopted by individual families in Mumbai city and its suburbs and to plan/create/design a safe, accident free home environment for the elderly. The specific objectives are to:

1. Determine the incidence of falls and accidents among the home living elderly
2. Ergonomically evaluate the private areas (Bedrooms and Bathrooms) in the existing residences of the home living elderly to identify potential safety hazards that lead to falls /accidents.
3. Suggest economical & affordable changes/modifications in the homes so that the elderly family members can adapt themselves in spite of their failing strengths.

Methodology: A descriptive study was conducted to assess the residences of the home-living elderly aged 65 years and above. The study was conducted on ninety residences of the home-living elderly in Mumbai city and its suburbs to understand the current condition of the elderly due to improper design at home.

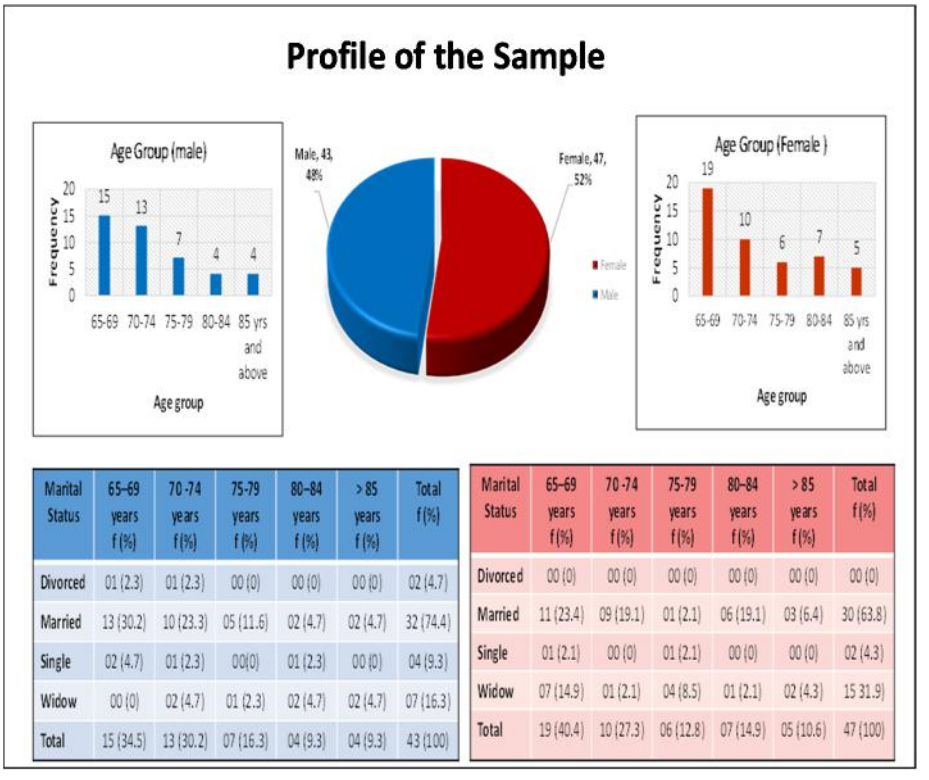
The checklist HSSAT V.4.0 i.e. Home Safety Self-Assessment Tool was used to assess the residential spaces ergonomically. Data was collected by structured and open-ended interviews during home visits without affecting the self-esteem or emotional status of the elderly. Observation was also used as a tool to identify accident-prone areas in their residences. Certain questions were asked to the elderly in order to know the areas that the elderly perceived are the most dangerous in the house and what preventive measures could be taken.

Based on the knowledge of the population and the purpose of the study, purposive (willingness to participate) and convenient sampling technique was employed. Descriptive Statistics of Mean, Standard Deviation, Percentages and Frequencies were calculated for all variables using MS Excel.

Results and Discussions: Of the ninety elderly participants, 43 (48%) were males and 47 (52%) females. Extreme care was taken to not hurt their sentiments

or bring back painful memories if any. 57 (63.3%) were the Young – Old in the age group of 65 to 74 years; 24 (26.6%) were the Old in the age bracket of 75 to 84 years and 9 (10%) respondents were the Oldest – Old. The average age of the sample is 73.43 years.

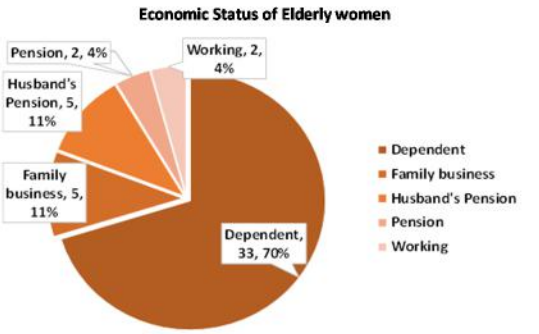
The percentage of elderly women married [30 (63.8%)] was lower than the percentage of men married [32 (74.4%)] and 15 (31.9%) women were widowed as against [7 (16.3%)] men who lost their spouses. This may be due to the prevalent practice of men getting married to women of relatively much lower age-groups, especially in the good old days. 45 (50%) of elderly live with either their children or with their children and grandchildren, this shows that the family structure is still strong in these households. 26 (28.9%) of elderly live with their spouse. The depressing fact is that 17 (18.9%) live alone. Of these 2 (2.2%) were very frail and feared that no one would notice them if they died, coz they had practically no visitors. About 25% [(11 (25.6%)] of the elderly men and about 30% [14, (29.7%)] of the women live with their children. More than 35% of the elderly men live with their spouse as compared to 25% of elderly women, which again reflect the differences in their marital status.



Marital Status	65–69 years f (%)	70 -74 years f (%)	75-79 years f (%)	80–84 years f (%)	> 85 years f (%)	Total f (%)
Divorced	01 (2.3)	01 (2.3)	00 (0)	00 (0)	00 (0)	02 (4.7)
Married	13 (30.2)	10 (23.3)	05 (11.6)	02 (4.7)	02 (4.7)	32 (74.4)
Single	02 (4.7)	01 (2.3)	00(0)	01 (2.3)	00 (0)	04 (9.3)
Widow	00 (0)	02 (4.7)	01 (2.3)	02 (4.7)	02 (4.7)	07 (16.3)
Total	15 (34.5)	13 (30.2)	07 (16.3)	04 (9.3)	04 (9.3)	43 (100)

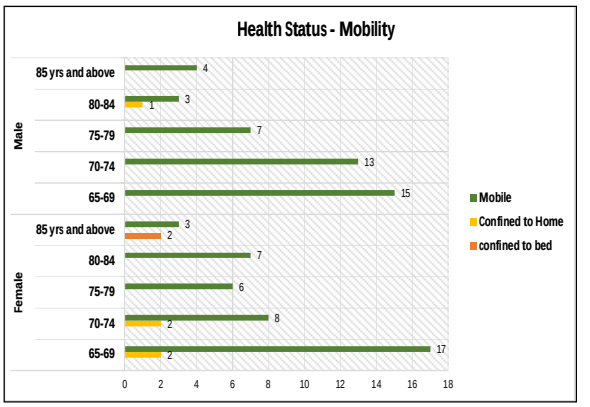
Marital Status	65–69 years f (%)	70 -74 years f (%)	75-79 years f (%)	80–84 years f (%)	> 85 years f (%)	Total f (%)
Divorced	00 (0)	00 (0)	00 (0)	00 (0)	00 (0)	00 (0)
Married	11 (23.4)	09 (19.1)	01 (2.1)	06 (19.1)	03 (6.4)	30 (63.8)
Single	01 (2.1)	00 (0)	01 (2.1)	00 (0)	00 (0)	02 (4.3)
Widow	07 (14.9)	01 (2.1)	04 (8.5)	01 (2.1)	02 (4.3)	15 31.9)
Total	19 (40.4)	10 (27.3)	06 (12.8)	07 (14.9)	05 (10.6)	47 (100)

The economic independence reveals the problem of day-to-day maintenance of livelihood of the elderly. The distressing fact here is the high proportion of elderly females and males were totally dependent on their family members About 43 (47.8%) of the elderly had to depend on others for their day-to-day maintenance. Less than 30% [14 (29.8%)] elderly women but majority [33 (76.7%)] of elderly men were economically independent.



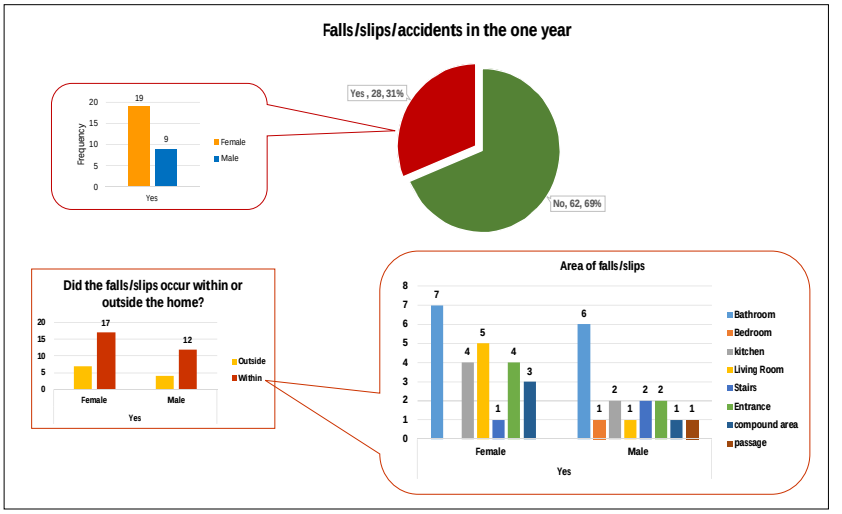
As a large proportion of the elderly women 25 (53.2%) were found to be economically dependent on their children/family members. 2 (4%) women continued their job despite difficulty faced in travelling to and from workplace because they had no other option. 5 (11%) said they barely managed to survive and buy the basics with their husband's pension amount. Among the economically dependent elderly men, 2 (4%) were supported by their spouses, who were still in the working people bracket.

While assessing a person's health condition is important to take into consideration the perception of the individual about his/her health. A person may be considered to be in good health is he/she feels so.



The study sought information on the state of physical health of the elderly as to whether they are mobile or confined to home or confined to bed only.

92.2% of the (sample population) elderly were mobile and enjoyed evening walks and a chat with building/colony friends. More than 50% [46 (51.1%)] of the respondents self-rated their health as being fair and 31 (33.8%) rated themselves as having excellent or very good health. 15 (16.7%) had no medical concerns, whereas the remaining respondents mentioned about taking medication for either or and BP (high/low), diabetes, problem of joints, fatigue/tiredness, breathlessness, respiratory problems or arthritis.



28 (31%) respondents had a fall/near fall, slips or trips in the last one year. When asked the reason for the accident, they stated negligence of their part, poor lighting etc.

The bathroom was identified by the elderly as the most unsafe room, with multiple hazards. The elderly women felt that the living room because of the furniture and clutter was the next unsafe room in their residences. All respondents were aware that falls, slips, trips are the most common accidents in old age. 39 (43.3%) stated that the incident occurred due to slippery flooring, 17 (18.9%) said that if there was something to catch or hold on to (such as a grab bar) the incident wouldn't have occurred. The elderly respondents were able to identify instantly at least one modification they could make to prevent such accidents. Although many of the elderly recognized what could be done to prevent falls/slips/trips in general terms, they had not made these recommended changes to make their homes safer. It was often indicated that they would plan eliminating the hazards in the future when they needed to make them. 86 (95.5%) of the older people in this study did not think their homes were unsafe. They rated their homes as being very safe, fairly safe and safe, although they were found to quite hazardous during the home visits and observation.

Safety hazards that lead to falls /accidents among the home living elderly

The safety check for accident prone areas in the homes of the elderly was conducted through home visits. Ergonomic Assessment of environment/physical hazards in each room or area of older people's homes (including outside areas) was conducted using the modified checklist (adapted from the HSSAT V 4.0.)

The checklist focused on identifying physical hazards in the home environment in common areas, furniture arrangement or incidents associated with falls (or the prevention of falls) in older people. The checklist consists of potential hazards which may increase the risk of falling, slipping or tripping (e.g. scatter rugs on slippery surfaces, inadequate lighting) and the absence of safety devices which may prevent such incidents (e.g. grab rails in the bathroom and toilet, and night lights). Criteria and instructions for deciding if the article/layout/arrangement was hazardous was predetermined for each item being assessed.

A thorough inspection of each part of the elder person's house was completed. A decision was made about each item and a 'hazard' scored if a potential hazard was present or safety device absent. If a hazard item area was not there to be assessed (e.g. no stairs outside, no dining room) then the hazard items were scored as 'not applicable.

Private Areas

A bedroom should be a place in which one feels relaxed, comfortable and safe. The ambience is as important as the functionality of the room. As people age, home modifications are more directed towards safety. Elderly homes should include modifications to keep the seniors living on their own sufficient, mobile, safe, secure and comfortable. Without certain modifications, seniors could wake up in the middle of the night to use the bathroom or get a drink and accidentally fall. These falls could be extremely dangerous.

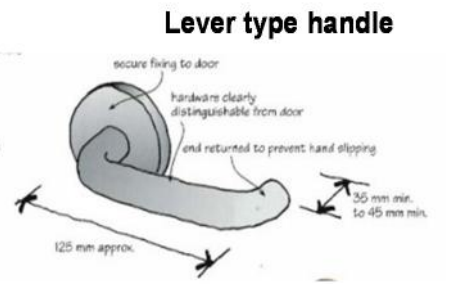
Home Safety Audit (Private Areas)							
	Details	Female (n = 47)		Male (n = 43)		Total (n = 90)	
		Yes	No	Yes	No	Yes	No
1.	Easy to find way to bedroom	1 (2.1%)	46 (87.9%)	7 (16.8%)	36	8 (8.9%)	82 (91.1%)
2.	Privacy maintained	4 (8.5%)	42 (89.5%)	4 (9.3%)	39 (90.7%)	8 (8.9%)	82 (91.1%)
3.	Door can be locked from inside and unlocked from outside when needed.	22 (46.9%)	25 (53.1%)	20 (46.5%)	23 (53.3%)	42 (46.7%)	48 (53.3%)
4.	Door handles/knobs ease to operate	7 (14.9%)	40(85.1%)	6 (14%)	37 (86%)	13 (14.4%)	77 (85.6%)
5.	Wide doors	9 (19.1%)	38 (80.9%)	5 (11.6%)	38 (88.3%)	14 (15.6%)	76 (84.4%)
6.	Windows are easy to operate	4 (8.5%)	43 (91.5%)	3 (7%)	40 (93%)	7 (7.8%)	83 (92.2%)
7.	Flooring is in good condition (even, matt finish, non-slip and clutter free)	3 (6.4%)	44 (93.6%)	3 (7%)	40 (93%)	6 (6.7%)	84 (93.3%)
8.	Lighting in all areas is consistent so the elderly are not moving from darker to lighter areas	2 (4.3%)	45 (95.6%)	5 (11.6%)	38 (88.3%)	7 (7.8%)	83 (92.2%)
9.	Glare and excess light avoided	13 (27.7%)	34 (72.3%)	9 (21%)	34 (79%)	22 (24.4%)	68 (75.6%)
10.	All switches are easy to operate	23 (49%)	24 (51%)	18 (41.9%)	25 (58.1%)	31 (34.4%)	59 (65.6%)
11.	Access to emergency bell/phone	40 (85.1%)	7 (14.9%)	36 (83.7%)	7 (16.3%)	76 (84.4%)	14 (15.6%)
12.	Furniture is secure to support the elderly if they try to balance with help of it.	5 (10.6%)	42 (89.4%)	7 (16.3%)	36 (83.7%)	12 (13.3%)	78 (86.7%)
13.	Height of the bed is appropriate	12 (25.5%)	35 (74.5%)	5 (11.6%)	38 (88.4%)	17 (18.9%)	73 (81.1%)

The essential features of a suitable bedroom are

- sufficient space to move around
- close proximity to bathroom
- good natural lighting and ventilation
- well considered clothes storage, furniture and other fittings

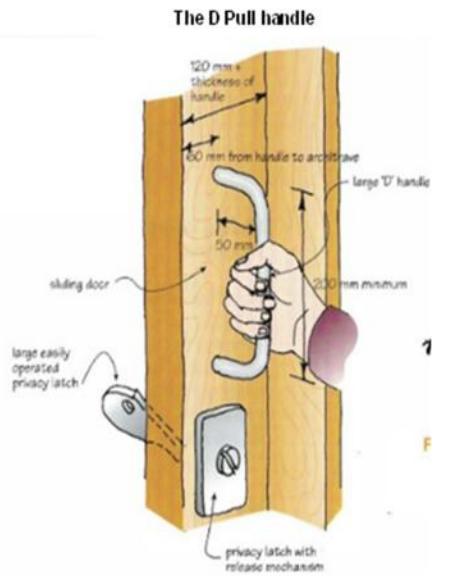
Observations made were as follows:

Door and door handles: 48 (53.3%) homes did not have door that can be unlocked from outside. It is always recommended for the elderly to use door that can be locked from inside but unlocked from outside if required. Some older adults were not even aware of such type of doors.



- Most [77(85.6%)] find it difficult to operate door handles/knobs because of smooth rounded knobs. They did not have adequate grip strength to twist and turn the knobs with force for it to open. They thus preferred the simple traditional latch and door handles, which did not match to the décor of their houses. A few door handles had sharp edges which are which are unsafe and not recommended for elders due to tender sensitive skin.

It is recommended that door handles must be easy to grip and operate with one hand. Handles should be placed at a height (preferable at 105mm from floor level) that is reasonable for walking adults, people in wheelchairs and, where appropriate children.



The D pull handle is ideal for use by the elderly. The door knobs that are traditionally used are difficult to grip and rotate. Lever handles as seen in fig 6. Is easier to use. The preferred shape has a long lever with a turned-in end. Lever handles enable a person to open a door with as little effort as leaning on the handle with their handle or elbow.

Windows: Windows and glazing must enable occupants a view but must also cut out the heat gain in the house. It should compromise on the security and even dangerous in the event of breakage.

- Excessive brightness can produce glare. Glare maybe irritating and, in some cases, disable vision. Glare causes discomfort to the eye and also causes irritation. Many elderly [68 (75.6%)] could not avoid glare in their residences. It was reported that many of them faced problems due to glare at their residences.
  - They specifically stated that they feel giddy or dizziness and a sudden black-out which was very dangerous.
  - It was suggested that lightweight curtains, adjustable blinds, tinted glass, sunscreen films can help reduce the glare without affecting the illumination levels inside.

Lighting: Artificial lighting can define the ambience in the house and is very important for clarity in vision. Adequate lighting becomes increasingly important as a person grows older. They will require about 2 to 3 times more illumination than a younger person.

- General or background lighting is usually provided in most homes through fluorescent tube lights. These do not produce shadows and resembles daylight making it the ideal option for the elderly.
- Task lighting provides focused illumination for specific activities in set locations. It improves visual clarity and offsets tiredness. Reading and work areas in bedroom requires task lighting.
- Decorative or aesthetic lighting accents certain features or draws attention to the picture, fittings etc.

Light switches must be placed near the entrance to the room and at the same side of the door handle. They must be installed at a comfortable height between 600 - 1200 mm from floor level. Switches must be easy to use. Large rocker-type switches are ideal especially for people with arthritis. Illuminated switches help people find them in the dark. Too many switches on one plate can create confusion and two or three switches on a single plate is the maximum number recommended. The wall switches should be in contrast colour so that it is easy to recognize and locate.

- 59 (65.6%) stated that the switches were difficult to operate especially due to its placement and colour. The switch boards merged with the wall colour to make it obscure.
- In many homes the switches were difficult to reach because they were hidden behind sofa sets or wall units/cupboards etc.
- They also reported facing problems of locating switches in the dark. None of the homes had light switches near the door and on the side of the door handle.
- It was also found that elderly faced problems in locating the switches in darkness.
- 39 (43.3%) of the older adults had problems in locating switches at night or in darkness.

Communications: Modern communications are almost essential for everybody but can be a lifeline for the elderly. Cordless and mobile telephones make it possible for people to telephone from anywhere in the house. The position of eh main telephone point is not so important. For those who have difficulty holding a phone in one hand and dialing with the other, a fixed keypad should be installed in a suitable location in house. Computers with internet facilities allow people to communicate across the world, gather information and work from home. To provide for internet and email access, at least one power outlet and a telephone jack or cable connection will be required in the bedroom. An intercom system, telephone or an alarm is required in case of an emergency.

- None of the elder people had such communication system within an arm's reach. The telephone was located in the living room and eh phone charging points away from the bed.

Furniture


Poor Circulation around bed

All furniture should be easy to get in and out of. For that reason, chairs and sofas should be chosen according to the size of the person using them. While taller people require generally deeper seating, a smaller person needs shallower seats. Narrower or shallow seats are also better for someone with bad knees or for people who have difficulty rising out of a seated position. Recliners can be useful for seniors. They are often used for sleeping at night because of medical conditions that cause breathing difficulties, or when legs need to be elevated for better circulation. Easy to clean Choose upholstery that can be cleaned easily.


Furniture with sharp edges

Round tables or tables with rounded edges should be used to prevent or minimize injuries that can happen from bumping into sharp corners. Glass-tops must be avoided so also tables and furniture with wheels.

Arrange furniture so that it is easy to move around the space. That is especially important if a wheelchair is being used. It should be easy to maneuver. Avoid overcrowding, and never place furniture near entry/exits.

It was observed that in many residences:

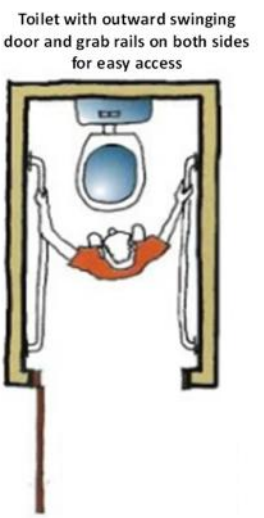
- Centre tables have castor wheels which is considered as a hazard, mainly because they are very unstable when used as a support while standing from a seated position.
- 78 (86.7%) had a near miss or a fall due to furniture or furniture arrangement (Fig 6.33) The height of the bed was inappropriate for 17 (18.9%) respondents and 73 (81.1%) faced problems while getting in and out of the bed.
- Sometimes, the older adult used a low stool to climb up the bed. The stool did not have a rubber bushes for a good grip.
- Some bed had sharp edges too.
- Only 7 (7.8%) beds had guard rails. It was also observed that some beds were shaky when the older adult would sit on it.

Bath and Toilet Area

Bathroom designs, whether traditional or modern, are suited for the young and the healthy. It is challenging, to design a bathroom with careful consideration to accommodate the needs of the elderly. Bathrooms was the observed as being the most hazardous place in homes of the elderly. The functional value of the house gets reduced if the occupants cannot use the bathroom comfortably.

Home Safety Audit (Bath and Toilet)							
Details		Female (n = 47)		Male (n = 43)		Total (n = 90)	
		Yes	No	Yes	No	Yes	No
1.	Tub/shower have rubber, non-skid mats or strips	17 (36.2%)	30 (63.8%)	12 (27.9%)	31 (72.1%)	29 (32.2%)	61 (67.8%)
2.	Grab bars near the shower, tub and toilet.	7 (14.9%)	40(85.1%)	5 (11.6%)	38 (88.4%)	12 (13.3%)	78 (86.7%)
3.	Safe non-skid flooring	25 (53.1%)	22 (46.9%)	26 (60.5%)	17 (39.5%)	51 (56.7%)	39 (43.3%)
4.	Hot water regulation/mixer prevents burns	13 (27.7%)	34 (72.3%)	12 (27.9%)	31 (72.1%)	25	65
5.	Hand held shower/jet spray easy to handle/use	6 (12.7%)	41 (87.2%%)	6 (14%)	37 (88%)	12 (13.3%)	78 (86.7%)
6.	Phone/emergency bell installed in the bath/Toilet	5 (10.6%)	42 (89.4%)	2 (4.7%)	41 (95.3%)	7 (7.8%)	83 (92.2%)
7.	Mirror length is extended to basin and is easy to view/use	22 (46.9%)	25 (53.1%)	13 (30.2%)	30 (67.8%)	35 (38.9%)	38 (42.1%)
8.	Clothing hooks and towel rail are easily accessed	5 (10.6%)	42 (89.4%)	5 (11.6%)	38 (88.3%)	10 (11.1%)	80 (88.9%)
9.	Doors can be locked from inside but can be opened from outside if need be	5 (10.6%)	42 (89.4%)	6 (14%)	37 (88%)	11 (12.2%)	79 (87.8%)
10.	Toilet flush button is easy to recognize, access and operate	4 (8.5%)	43 (91.5%)	4 (9.3%)	39 (90.7%)	8 (8.9%)	82 (91.1%)

Size is an important factor in the usability of a bathroom. The bigger the bathroom the better it is. The bathroom needs to be accessible from other parts of the house. It is most convenient is to have access to the bathroom from within the bedroom.


Toilet with outward swinging door and grab rails on both sides for easy access

The standard measurement for a toilet is 900 mm X 900 mm which is way too small to provide access to the elderly with functional limitations. The elderly who can walk may be able to use a standard toilet with grab rails easily. Hinging the door to open outwards gives more space for easy access.

It is essential that taps are easy to use. Many elders have weak grip and hence find it difficult to use standard taps. Four-pronged capstan head/wheel-type

tap is easy to use but many elderly participants of this study preferred lever handle mixer taps.

The elderly members cannot stand under the shower for too long. Some sitting arrangements or fixture can be very helpful for self-help.

Capstan head and Lever type mixer taps are easy to operate

Observations made in this area include rubber, non-skid mats or strips in the tubs/shower in the bathrooms were not used commonly in the homes. 61 (67.8%) reported that they did not have non-skid mats or strips in the bathrooms

Poor illumination, floor level difference and absence/inappropriate placement of grab bars in bathrooms of the elderly

- According to the study conducted it was found that 12 (13.3%) of the elderly had grab bars in their bathroom and toilet areas, whereas 78 (86.7%) did not have grab bars. In one of the homes, the grab bar was used to dry cleaning cloths by the maid servant.
- Some elders grabbed the taps and other such fixtures to sit and stand up due to the absence of strong grab bars in the toilet areas.
- The grab rails in 2 homes (Fig 6.37) were not placed at appropriate height, hence was seldom used by the elder residents.
- A few homes did not have towel rails/racks, hence the towel was placed near or on the instant water geyser, which is a potential electric shock hazard.
- The bathroom door was unsafe for the elderly because of the lack of a bidirectional door, inadequate door width (less than 750 mm) and presence of threshold.

- The bathroom space was also used for laundry, making the already small bathroom size shrink further. Washing machine was installed inside the common bathroom area which was used by most elders living with families.
- Uneven flooring and change in floor levels (Fig 6.41 and Fig 6.42) posed a high risk.

- Many elderly couples living alone used zero watt bulbs (Fig 6.38) for the bathroom area to save on electricity.
- According to the results, 39 (43.3%) experienced minor burns/scalds in the bathroom due to accidently testing hot water.
  - Some 20 (22.2%) elder respondents did not have hot water regulator/mixer at their residences so they use to boil/heat the water in the kitchen in a container and then take it to the bathroom. This is a high risk habit. There have been incidences of the heavy utensil slipping from their hands leading to burns/scalds.
  - In one of the homes, the instant geyser had a loose wire hanging which was again a potential hazard.
- 82 (91.1%) elders found it difficult to operate the flush buttons. 28 (31.1%) said the flush rope was too high and still others claimed the flush button was hard to push. A few (6.7%) said the colour of the flush button same as that of the cistern and therefore, it was difficult for them to locate.

Poor illumination, floor level difference and absence/inappropriate placement of grab bars in bathrooms of the elderly

Suggestions for modifications in the homes

Problems observed in the homes of the elderly	Suggestions for improvement
Lighting	– Brighter staircase lighting – Large rocker light switches that turn on/off with a push – General lighting from a steady source – Placement of task lighting in appropriate work areas
Clear walkways	– Accessible path of travel to the home – Walkways must be in good repair for safe walking – Doorbell in accessible location – Surface to place packages on when opening door
Stairs	– Should be well lit at all times. – Should have a landing at the top as the bottom for the user to steady themselves before changing directions – Handrails on both sides of staircases and outside steps. – Increased visibility by adding contrast strip on top and bottom stairs, colour contrast between treads and risers on stairs and use of lighting – Should no doors that obstruct the top or bottom landings
Grab bars	– Bracing in walls around tub, shower, shower seat, and toilet for installation of grab bars to support 90 – 100 kgs – Grab bars should have graspable size and must be slip resistant
Doorways	– House number should be clearly visible from far Doorbell in accessible location

and Doors	– Surface to place packages on when opening door – All exterior doors must have secure, easy-to-use locks, bolts and knobs. – Door should open into the house (inward opening) to avoid accidents. – A fish-eye lens viewer/peephole should be installed at an appropriate height. – Door closers can be convenient if installed in an appropriate location. – The 'D – pull' handle is the most appropriate. Door knobs are difficult to grip and turn.
Handles (cupboard and cabinets)	– Should be easy to open and close. – The 'D – pull' handle is the most appropriate. – The closing mechanism should be soft roller catches, magnetic catches or self-closing hinges.
Floor and Flooring	– Arrange furniture so that there – Arrange furniture so that there is a clear pathway between rooms (is plenty of space to move around). – Remove items (boxes, old articles, old furniture etc.) from stairs, hallways, and pathways. – Keep low-rise side tables, magazine racks, footstools, plants etc. out of the path of traffic. – No steps between rooms/areas on the same level – No changes in surface levels as far as possible – Non-slip flooring in foyer, entrance – Smooth, non-glare, slip-resistant flooring in bathroom and shower – Colour/texture contrast to indicate change in areas – Do not store boxes near doorways or in passage. – Remove newspapers and all clutter from pathways.
Windows	– Plenty of windows for natural light – Low windows or taller windows with low sill height – Window curtains/blinds/shades/cords are easy to reach and open/close
Electrical, Safety and Security	– Security light at main entrance door – Rocker or touch light switches – Light switches must be located near entrance to every room/area. – Keep electric, appliance and telephone cords out of walkways, but do not put cords under a rug. – Do not use extension cords across pathways; rearrange furniture, if needed. – Electrical cords/wires should be out of the flow of traffic – Security alarm, emergency alert system and/or video-monitoring system.
Access to private areas (bedroom, bath, toilet)	– Place a lamp, telephone, or flashlight/torch near the bed. – Replace satiny sheets with cotton sheets. – Arrange clothes in the closet so that they are easy to reach. – Provide a nightlight along the route between the bedroom and the bathroom. – Keep clutter off the bedroom floor.

Conclusion: For an elderly person, falling can result in devastating consequences, and falls are too common. Most falls among the elderly occur in known spaces rather than in unknown areas. The results of this study prove strongly that falls among the elderly can be prevented. A fall often results from multiple factors, one of the main factors being hazards in the home.

Homes can be modified for the elderly taking into consideration their physical and cognitive strengths, capabilities and limitations and their body dimensions (anthropometric measurements).

Aging increases postural instability, thus a simple economic solution is to consider installation of support bars or grab rails. Ensuring that circulation routes/paths are free of clutter and furniture is another simple modification that can be made immediately. Another contribution is to place the most used objects in areas where old people can see and reach easily.

After identifying the potential risks, an ergonomic approach was used to suggest simple changes in the existing layout/arrangement in the homes so that the elderly people could better adapt to their environment. Many a times, the older adults themselves had practical solutions to the problem being discussed. Involving them in making the modifications helps understand their capabilities and limitations. Guidelines for age-friendly home design and construction are recommended. Improving awareness of older adults, caregivers and family members is also important to their safety.

Designers and Architects working in the housing industry must deliver creative and innovative solutions to meet the everyday needs on the ageing population. Smart homes are homes equipped with technology that promotes independence, ensures safety, security and increases the quality of life. Smart homes are equipped with automated systems for different tasks such as lighting, kitchen safety, door switches, movement sensors, individual tracking badges, reminder systems etc. Installation of smart home technology might be a stigma to some elderly leading them to think themselves as older and frailer than other adults, but if accepted well, it can be a enormous boon to their comfort and safety.

One limitation of the study was the convenient sampling method adopted. Participants were urban elderly predominantly from the modern Indian population and culture. The study findings cannot be generalized to rural elderly with a common facilities shared among several houses, or other regions and cultures of India. Although the HSSAT Checklist has potential for clinical application, further research is needed to establish and improve its psychometric properties for clinical use. The effectiveness of the assessment and modifications in reducing injury in older adults also needs to be investigated.

Way Forward: The results of the present study reflect the circumstances and consequences of falls among the home living elderly. The morbidity due to falls include bruises, sprains, cuts as well as serious injuries and fractures, restricted

mobility and loss of independence leading to functional decline, psychological fear of falling (post fall syndrome) and permanent disability in a few cases. To avoid such incidence, more emphasis needs to be given to the circumstances like the falls observed in houses with inadequate lighting, level changes in the house, uneven floor of the house and slippery floor of the house.

Designers, architects, town planners and builders must aim at creating accessible built environments. The built environment should take into consideration the physical and mental capabilities of the people using them. The 'design for all' concept is the design for human diversity, social inclusion and equality.

The Government should take more interest in ensuring quality constructions and safe environments are created. According to the WHO global report on falls prevention in older age, public health policies and strong legislation can effectively decrease falls in older adults (WHO global report on falls prevention in older age http://www.who.int/ageing/publications/Falls_prevention7March.pdf accessed on 5.03.17). Nonetheless, the actual translation of these policies is a problem, especially in health promotion sector in India. Fall prevention must be emphasized in public health policies and health programs for elderly people. Falls are an emerging public health problem and a barrier to active ageing in India. There is an urgent need for coordinated and collaborative efforts of health professionals, researchers, policy makers, and health care delivery systems to prevent falls and promote active ageing.

References:

1. Abhay, B., Mane, T., Prabhakar, S. R. and Sriniwas, T. H. (2014). Prevalence and correlates of fear of falling among elderly population in urban area of Karnataka. Midlife Health; 5(3); 150–55. Available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4195189/ accessed on 10.10.18.
2. Aggarwal, S. R. and Kumar, D. (2007). Lower extremity muscle strength and balance performance in Indian community dwelling elderly men aged 50 years and above. Indian J Physiother Occup Ther Vol.1:13-24.
3. Assistive Technology (2003). Administration on Aging – A Factsheet. U. S. Department of Health and Human Services. Available at http://gero.usc.edu/nrcshhm/resources/fs_assitive_tech.pdf accessed on 28.10.18.
6. Central Statistics Office, Ministry of Statistics & Program Implementation. (2011) Situational analysis of the elderly in India. Available at: http://mospi.nic.in/Mospi_New/upload/elderly_ in_india.pdf accessed on 22.0916.National Sample Survey Organisation, Ministry of Statistics and

Programme Implementation, Government of India. Morbidity, healthcare and condition of the aged: NSS 60th round (January to June 2004). Available at: http://mospi.nic.in/rept%20_%20 pubn/507_final.pdf accessed 10.10.2018.

12. D'Souza, S. A. and et al (2014). Falls in Indian Older Adults: A Barrier to Active Ageing. Asian Journal of Gerontology & Geriatrics. Vol 9: 33-40. Available at http://ajgg.org/AJGG/V9N1/2013-164-RA.pdf
13. Doval, N. (2015). 20% of Population to be Elderly by 2050. Live Mint – 21, Feb 2015. Available at http://www.livemint.com/Politics/z6BacVOwf5SvmpD9P1BcaK/20-of-population-to-be-elderly-by-2050-HelpAge-India-repor.html accessed on 04.10.16
14. Hwang, E., Cummings, L., Sixsmith, A. and Sixsmith, J. (2011). Impacts of Home Modifications on Aging-in-Place, Journal of Housing For the Elderly, 25:3, 246-257. Available at http://dx.doi.org/10.1080/02763893.2011.595611 accessed on 27.09.16.
15. Jesmin, S. S., Amin, I. and Ingman, S. R. (2011). Ageing and Caregiving Crisis in the Low and Middle Income Societies. Indian Journal of Gerontology Vol. 25:309-28.
16. Jha, R.M., Mithal, A., Malhotra, N., Brown, E. M. (2010). Pilot case-control investigation of risk factors for hip fractures in the urban Indian population. BMC Musculoskelet Disord Vol. 11:49.
17. Joshi, R. M. and D'Souza, S. A. (2015) Bathroom Hazards among older adults in Western India: A cross-sectional study. Asian J Gerontol Geriatri. Vol 10: 83-91 available at http://ajgg.org/AJGG/v10n2/2015-198-OA.pdf
18. Murphy S, Tickle-Degnen L. (2001). Participation in daily living tasks among older adults with fear of falling. American Journal of Occupational Therapy Vol.55:538-44
19. Nagananda MS, Sengupta A, Santhosh J, et al. Design and pragmatic studies of bathroom for elderly people in India. Available at http://www.wseas.us/e-library/transactions/ biology/2010/52-464.pdf accessed on 24.12.186.
20. Rajan, S. I. Population ageing and health in India. Available at: http:// www.cehat.org/humanrights/rajan.pdf accessed 18.07.18.
24. Rao, R. (2018). Ergonomic Evaluation of Residences (Bedroom and Bath areas) of the Elderly. Intl. J. of Research Culture Society. Vol-2, Issue-4, Apr. pp 320 – 330.
25. Residential Home Design (2015). Available at http://ddadesign.com.au/accessible-design/residential-design/ accessed on 16.08.18