

## Assessment of Furniture in Old Age Homes of Uttarakhand, North India

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**ABSTRACT** The study was conducted in two regions of Uttarakhand State of North India with an objective of evaluating the dimensions of furniture provided in old age homes and to determine whether this type of furniture is well- designed and promotes good posture by taking into account the dimensions of elderly people and Indian Standard codes. Anthropometric data were collected on twenty percent of total elderly people (N=60) randomly selected from the old age home at Geeta Kutir in Haridwar district of the state. The dimensions were measured for different types of furniture prevalent in old age homes. Finally, the anthropometric measurements of the elderly and the furniture dimensions were compared in order to identify any incompatibility between them. The results indicate a mismatch between the elderly body dimensions and the furniture available to them. The chairs and beds were too high and too deep and tables were also high for the elderly. This situation has negative effect on the sitting posture of the elderly especially when reading or writing. These findings call for the attention of all architects, engineers, residential designers, builders, developers and agencies which are engaged in planning and building housing intended to be occupied by the elderly.

### INTRODUCTION

Old Age Home is defined as “a residential complex comprising dwelling for one or more types established to provide accommodation for retired person or the aged and may include provisions for community facilities such a recreational or medical facilities for person comprising such community, but does not include an institutional home or a hospital” (Thorne 1986). Residential Care Facilities (RCFs) and Intermediate Care Facilities (ICFs) (hereafter called ‘old age homes’) provide care to the less handi-capped. As per recent statistics, there are 1018 old age homes in India today, of which 427 homes are free of cost while 153 old age homes are on pay and stay basis. A total of 371 old age homes all over the country are available for the sick and 118 homes are exclusively for women. A majority of the old age homes are concentrated in the developed states including Gujarat. Information on the capacity of the selected old age homes for accommodating the elderly indicates that old age

homes may be considered small as their intake capacity does not exceed 25. Regarding the criterion for admitting an elderly person in the old age home, one of the four old age homes studied admit persons who are at least 70 years old whereas 55 years is the minimum age criterion in the remaining three old age homes. Especially in old age homes (as compared with nursing homes which provide more specialized care), other factors like formal or informal help, living alone or not, age and gender have repeatedly been found to be associated with an increased chance of admission (Anderson et al. 1998; Boaz et al. 1994; Davis et al. 1997; George et al. 1989; Green et al. 1990; Johnson et al. 1996).

Among the population aged 55 and above in Asia, there are about 90 men for every 100 women; for those aged 75 and above, there are only about 70 men for every 100 women (Lee and Mason 2000). Projected increases in both the absolute and relative size of the elderly population in many third world countries is a subject of growing concern for public policy (Kinsella and Velkoff 2001; World Bank 2001; United Nations 2002; Bordia and Bhardwaj 2003; Liebig and Irudaya Rajan 2003). In India, the population of the elderly is growing rapidly and is emerging as a serious area of concern for the government and the policy planners. Seven percent of India’s population is elderly today. These demographic changes have

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been accompanied with a fast changing family structure due to forces like urbanization and migration which are not quite conducive to the welfare of the elderly NISD (2005). The definition of elderly as defined by WHO and other agencies is above the age of sixty years. But interestingly, now the agencies divide the elderly population into three age groups:

Young-old-aged (60 to 70 years)

Middle-old-aged (70 to 80 years)

Old-old-aged (above 80 years)

Research has shown that one of the serious problems in elderly care is the unsuitable residential environment for the elderly who are physically and psychosocially fragile (Choi 2000; Kim et al. 1999; Lee 1998). The role of the environment in the health improving process is a growing concern among architects, designers, environmental psychologists, and health care providers (Devlin 2003). Elderly people remain seated in old age homes for a considerable amount of time. Static posture and prolonged sitting in a forward bending position, as elderly often acquire, puts an extreme physiological strain on the muscles, the ligaments and in particular on the discs (Bendix 1987; Brunswic 1984). Correct standing and sitting posture is an important factor for the prevention of musculoskeletal symptoms. Furniture has an important role in the maintenance of good sitting posture.

Anthropometric measurements are important factors that should be taken into account in old age home furniture design. Specific measurements, such as popliteal height, knee height, buttock-popliteal length and elbow height are necessary in order to determine furniture dimensions that enable the correct sitting posture (Knight and Noyes 1999; Parcells et al. 1999). During the past decade ergonomic research has focused especially on the design of work furniture based on the biomechanics of the human body. Many researchers dealt with the principles for the design of chairs and tables in the workplace, particularly for computer system users (Nagvi 1994; Cook and Kothiyal 1998; Kumar 1994; Villanueva et al. 1999). However, little effort has been made in India in the design of furniture. Therefore, this study is a modest attempt to bridge the gap in the study of furniture which is used by elderly for prolonged periods of time at old age homes. The aim of this study is to compare furniture dimensions with anthropometric measurements and Indian

Standard Code to determine whether the furniture promotes good posture at old age homes.

The scope of this study was limited to measuring those body dimensions that were considered important and useful for the designing of a chair, bed and table. Till today it has not been practice in India to make furniture for elderly people specifically, therefore, the Indian Standard Code which has been utilized in the study has been extracted from the available literature (IS: 5974-1986 Reaffirmed 1996, IS: 7259 (Part 1)-1988). The fixed-height task-surfaces (table) used to assess may not be a suitable method of evaluation when using elderly subjects, due to their physical limitations.

## MATERIALS AND METHODS

The present study was conducted in two regions of Uttarakhand State in North India, that is, Kumaon in Haldwani block of Nainital district and Garhwal in Haridwar and Dehradun districts during 2007. Four old age homes, Vridh Sewa, Geeta Kutir (Haridwar), Nirmala (Nainital) and Prem Dham (Dehradun) were selected randomly for the study. For collecting anthropometric data, twenty per cent out of total elderly people (N=60) were randomly selected from the old age home Geeta Kutir of Haridwar district.. The elderly people were of normal physical health and were active in life at the time of anthropometry for the study. These selected elderly people, residing in the old age homes were the reliable representations of the total population of India as per their physical build up, functional status, health status, longevity, income, educational status and gender. A placid and non-chalet atmosphere was created, so as to ensure the maintenance of the quality of the research protocol and to enable interviewees to confide their feelings freely. Voluntary revealing was essential, and they were assured that this study was conducted purely to better understand their needs and assist with better moral and psychological support and other comforts.

The stature and the rest of the anthropometric measurements were taken with a standard professional anthropometric kit. Anthropometric measurements of twenty per cent of total elderly people (N=60) for the study were randomly selected from the old age home Geeta Kutir of Haridwar, a District located in the Garhwal region of Uttarakhand State, which does not

charge anything from its occupants. Barring stature, measurements were taken in sitting posture. Percentile of 5th, 50th, and 95th for the various body dimensions were estimated.

Furniture measurement: chair, table, and bed dimensions were measured with a metal tape and the seat and table slope with an angle finder. The dimensions of the furniture that were measured are the following:

1. *Seat Height*: It was measured as the distance from the highest point on the front of the seat to the floor.
2. *Seat Depth*: It was measured from the back of the sitting surface of the seat to its front
3. *Seat Slope*: Seat slope is the direction and angle of the slope of the seat's sitting surface.
4. *Table Height*: It was measured from the floor to the top of the front edge of the desk.
5. *Table Clearance*: It was measured from the floor to under the writing surface.
6. *Table Slope*: It is the angle at which the writing surface of the table slopes.

To test the significance of difference between two means from two independent samples, Fisher's *t* test was used (Snedecor and Cochran 1967). Anthropometric measurements of each individual were compared to the relative furniture measures and Indian Standard Codes in order to identify a match or mismatch between the specific elderly and the furniture he/she uses. Based on existing research (Parcells et al. 1999; Chaffin and Anderson 1991) a mismatch is defined as incompatibility between the dimensions of the furniture and the dimensions of the body as follows:

1. *Popliteal and Seat Height Mismatch*: A mismatch was defined when the seat height was either >95% or < 88% of the popliteal height.
2. *Buttock-Popliteal Length and Seat Depth Mismatch*: A mismatch was defined when the seat depth was either > 95% or < 80% of the buttock-popliteal length.
3. *Knee Height and Desk Clearance Mismatch*: A mismatch was defined as occurring when a desk was < 2 cm higher than the knee height.
4. *Elbow-Shoulder Height and Desk Height*: Elbow-shoulder height and desk height was defined when the desk was either shorter than the minimum desk height.

## RESULT AND DISCUSSION

The furniture under study consisted of two types and the dimensions of both types of chairs, tables and beds are given in (Tables 1-3). Nearly identical chairs were found in old age homes, Vidh Seva and Geeta Kutir. Similar studies (Raschko 1982) showed that there are two basic anthropometric measurements that lead chair seat design, length of lower leg (popliteal area to floor) which leads the "chair height" at the front edge, generally from 14 to 18 inches (35.6 to 45.7 cm); and length of the upper leg (often measured from the plane of the back to the popliteal area or back of the knee), that leads the "depth of the seat," from 15 to 18 inches (38.1 to 45.7 cm). Vertical back does not permit the person to relax and it does not take up the weight of the person's upper body. The recommended (IS: 5974-1986 Reaffirmed 1996) dimensions of easy chairs are as follows:

Seat height: 38 -40 cm

Seat depth: 52-60 cm

Height of armrest above seat: 15 -23 cm

The recommended (IS: 7259 (Part 1)-1988) overall dimensions of the single bed are as follows:

Height from floor to the top of the mattress  
Maximum 45 cm

Clear in-bed length between head boards 190-200 cm and the foot boards

Width: 91 cm

The average length, width and height from floor of bed were 190.37, 90.87 and 46.11 cm, respectively. These findings are consistent with Pirkl (1994) that for the elderly people, bed heights should be the same as their sitting heights, about 16 or 17 inches (40.6 or 43.2 cm), since they sometimes sit on the side of the bed. Too low bed is not recommended in order to make possible bed making and an overly high bed makes getting into it too difficult and increases anxiety about falls and possible injury. The computed Fisher's *t* value showed significant relationship for height and depth of chair, whereas for width of bed no such relationship was found. The dimensions of the beds found in old age homes were not according to the IS code. Having to spend more time in bed due to illness or disability can actually be quite uncomfortable. Adjustable beds can be adjusted to desired position thus providing with the ability to maximize comfort.

In case of table height, it should correspond to seated elbow height or 95th percentile of

**Table 1: Dimensions of chair (cm)**

<i>Old age home</i>	<i>Total height</i>	<i>Seat (from floor)</i>			<i>Back rest</i>		<i>Angle of back rest</i>	<i>Material used</i>
		<i>Height*</i>	<i>Width</i>	<i>Depth*</i>	<i>Height</i>	<i>Width</i>		
Vridh Sewa	84	43	42.5	42.5	46	47	105°	Plastic
Geeta Kutir	85	47.2	47.2	35	43	46	100°	Plastic
Nirmala								
Chair I	64	46	47.5	50	53	45	90°	Wooden
Chair II	85	45	50	39	46	43	114°	Wooden
Prem Dham	84	44	45.5	42	45	45.5	110°	Plastic
Mean	80.4	45.04	46.54	41.7	46.6	45.3	103.8	
S.D.	9.18	1.64	2.77	5.51	3.78	1.48	9.33	
Fisher's <i>t</i> value	-	12.283*	-	5.794*	-	-	-	-

\*Statistically significant

**Table 2: Dimensions of table (cm)**

<i>Description</i>	<i>Length</i>	<i>Depth</i>	<i>Height of knee zone</i>	<i>Material used</i>
Vridh Sewa				
Table small	42.5	80	55	Wooden
Geeta				
Kutir				
Table I	180	60	70	Wooden
Table II	180	35	25	Wooden
Nirmala				
Table I	157	40	71	Wooden
Table II	122	74	76	Wooden
Prem Dham	122	61	71	Wooden
Mean	133.91	58.33	61.33	
S.D.	51.80	17.91	19.16	

elbow rest height. Data regarding elbow height of selected elderly people (Table 4, Figure 1 a, b) showed that the 95th percentile of elbow rest height from seat was 23.75 cm. and adding ideal seat height to it gives 66.6 cm of table height, while existing table heights in all four old age homes were more than this value. The results indicate a mismatch between the elderly body dimensions and the furniture available to them (Tables 1-3). A higher than usual seat would impact on the clearance between the thigh and the underside of the table required for the free movement of legs. Therefore, table height for the elderly people would need to be accordingly adjusted. The height of the work table depends

on the nature of the activity. For example, observations on the general working population suggest that writing is better done at a table height a little higher than elbow height. Adjustable desks can be used to support an operator's work. Work involving a moderate amount of force requires the working height to be 50 to 100 mm below the elbow (Grandjean 1988). The adaptable table gives a stable surface for reading, writing, or working while seated (Pirkl 1994). There is lack of data on preferred working heights for the elderly population, and therefore observations on the young population can be considered as a guide. A work station which induces a sitting position with a too-forward inclination of

**Table 3: Dimensions of bed (cm)**

<i>Old age home</i>	<i>Length *</i>	<i>Width</i>	<i>Height from floor</i>	<i>Material used</i>
Vridh Sewa	190	94	46.0	Wooden
Geeta Kutir	177.5	87.5	46.25	Wooden
Nirmala	201	92	46	Iron
Prem Dham	193	90	46.2	Iron
Mean	190.37	90.87	46.11	
S.D.	9.75	2.78	0.13	
Fisher's <i>t</i> value	5.200*	0.899	-	

\* Statistically significant

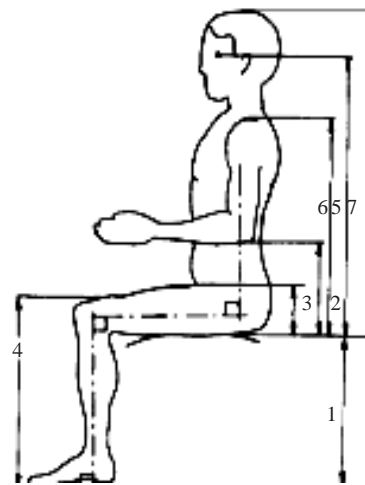
**Table 4: Sex-wise percentile distribution of different anthropometric dimensions of elderly people**

Anthropometric variable (cm)	Men			Women		
	5th	50th	95th	5th	50th	95th
Stature	154.16			141.60		
Body height above seat	73.82	75.65	76.97	2.52	73.35	73.87
Shoulder height above seat	54.12	61.7	65.75	49.42	50.8	51.92
Elbow height above seat	21.25	22.75	23.75	17.025	18.05	19.17
Knee height above ground	51.25	53.1	53.87	44.12	46.9	48.72
Popliteal height above ground	40.35	43.2	43.95	35.75	37.75	39.25
Buttock popliteal length	48.52	50.75	51.37	46.07	48	49.65
Buttock knee length	55.52	56	56.37	49.22	52.5	53.62
Hip breadth	33.75	38.65	40.4	34.27	39.2	40.57

the head or elevated shoulder contributes to neck and shoulder pain (Szeto et al. 2002). From the computed Fisher’s *t* value, it is inferred that the furniture was not made according to the dimensions of human body and Indian Standard Codes. Elderly people have not been considered important in India he past with the result that designers have not given any significant attention to design furniture for them. Some items of “Assistive & Enabling Technologies (AET)” are accepted readily by most users as they serve both able and disabled users ( for example, reclining chairs, adjustable beds) (Goyal and Dixit 2008b).

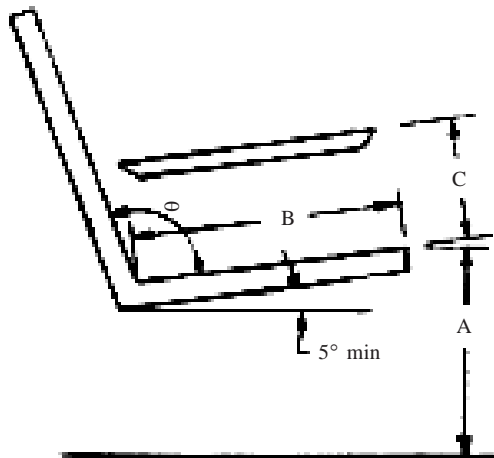
**CONCLUSION**

The current study suggests that there is a substantial discrepancy between the dimensions



1. Popliteal height above ground  
 2. Elbow height 3. Thigh height 4. Patellar (knee) height 5. Eye height 6. Shoulder height 7. Body height above seat.

**Fig. 1 (b). Anthropometric measurements in sitting posture**



A = seat depth  
 B = seat depth  
 C = armrest height  
 $\theta$  = included angle which should be 110° to 115°

**Fig. 1 (a). Chair dimensions**

of the elderly and the dimensions of the furniture at old age homes off Uttarakhand, North India. Chair with cushioning and backward slop of 115° help in decreasing postural discomfort, and increase efficiency. A foot rest must be attached to the chair so that the elderly person can place feet flat to keep knee joint angle at approximately 90°. The armrests should be adjustable up and down, as well as in and out. This allows for more customization and better control of comfort. Chairs should also be of an appropriate height to allow the individual’s feet to rest flat on the floor with no pressure behind the knees. If the bed is too high, the elderly people will have to slide to the edge and try to jump down, with increased risk of falling and subsequent injury, or care staffs will have to assist with transfer. Beds should be set up so that when seated at the side of the bed,

a person's feet will rest firmly on the floor with their legs at right angles. Use an attachable hand-rail on beds is suggested when needed. The hand-rail should attach securely to the frame, bed height-adjustable, and swivel and lock in place. All furniture must be adjusted to suit the individual to allow them to maintain their mobility by being able to move from sitting to standing posture by them. Thus, product design has an ongoing effect on the quality of the elderly people's lives in order to provide independence. Moreover, there are many elderly people that confront with their environments, so product design can provide environmental accommodations that can be used with dignity.

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