

Senior-Friendly Furniture Design for Urban Public Spaces: A Solution for Physical, Social and Psychological Limitation and Well-Being

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Abstract: With the rapidly increasing senior population globally, the need for the design and development of urban public spaces for senior citizens is also rising. Most senior citizens are reluctant to go outdoors often and prefer to spend most of the time indoors due to various physical, social and psychological limitations which also include the minimal consideration towards developing suitable furniture for them in the outdoor environment. This necessitates the development of furniture design in line with their preferences and requirements with special consideration towards their comfort level. A suitable and appropriate furniture design meeting all the requirements of design and human comfort enhances its usability by senior citizens and contributes to the concept of active ageing. This paper identifies the role of human dimensions in designing furniture for seniors in urban areas along with the impact of ergonomics of furniture design on them, through a literature review. Personal interactions and the questionnaire identified the factors that influence the usability of furniture in public spaces by senior citizens. The identified factors shall be statistically analyzed, for their association, acceptance and overall satisfaction of the senior citizens, through a chi-square test on SPSS. Pearson correlation, identified the most significant factor that influences the usability of furniture in public spaces by the senior citizens and the conclusions have been drafted based on the findings.

Keywords: Ergonomics, furniture design, public spaces, Senior-friendly, Urban environment

1. Introduction

We are in the middle of a monumental shift in the count of the urban senior population of the world. - Demographics, globally, are changing rapidly with the increasing world's senior population in every nation. United Nations (2011), indicates a substantial rise in the senior population which is expected to double by the year 2050. The significant increase in the count of senior citizens, worldwide, channelled everyone's attention, especially the Architects, Designers, Planners, etc., towards the development of several commodities for the senior population. Consequently, the thought process of most designers has been directed towards the design and development of senior-friendly spaces and furniture for convenient usability by senior citizens. Tornstam (2011), defines ageing as a process that includes various sequences of events of biological, psychological, social as well as functional ageing. Vaupel (2010) states that with the increased life expectancy, people reach their old age with better health conditions, relatively; to which the physical environment contributes substantially, including furniture. With improved healthcare facilities and better-quality living, the proportion of the senior population is rapidly increasing globally (Hilderbrand, 2022). Malone and Dellinger (2011) support the fact that furniture plays a significant role in the overall well-being of the users, especially, the senior citizens. Such contribution is often overlooked, and as a result, the whole designing and developing of the furniture pieces and the entire focus is laid upon the commercial side of it. Hence, one of the major global concerns is to create an environment that meets the requirements, desires and needs of senior citizens. The requirement profiles of the furniture for seniors vary with that of other age groups and environments, which drags our attention towards designing the furniture by incorporating the ergonomics appropriately.

1.1 Significance of study

The urban senior population is rising dramatically which resulted in the need for high-quality spaces and furniture to ensure a comfortable experience for senior citizens which would also contribute to active ageing. Our seniors are different from other age groups in terms of their needs and preferences. The psychology and perception of senior citizens are different from other age groups which needs to be respected and sincerely taken care of. Furniture design components and their dimensions significantly influence the usability of a public space by the seniors which makes this study inevitable.

1.2 Problem statement

Most of these spaces are designed and developed with minimal emphasis on the requirements of all age groups which impacts senior citizens negatively. It is significant to incorporate the preferences of senior citizens - physical, social as well and psychological - during the design and development of senior-friendly spaces. However, such aspects often get overlooked while planning public spaces which affects the usability of such spaces by the senior citizens.

1.3 Aim and objectives

The study aims to understand the impact of ergonomics on senior citizens

Objectives:

- To identify the needs and preferences of senior citizens for furniture design
- To identify the challenges and constraints of senior citizens
- To statistically analyse the association between various components of furniture design and senior citizens

2. Furniture for senior citizens

There is a wide range of spaces that are visited by senior citizens such as libraries, museums, restaurants, healthcare facilities etc. All such spaces are associated with activities that demand sitting for a long duration and would require furniture that offers long-term comfort, accessibility and convenient usability. Senior citizens prefer furniture that offers safe and convenient ingress and egress. Special consideration to all such design components and their incorporation appropriately is necessary while designing furniture for the senior population to ensure effective usability. Senior citizens prefer furniture that is accessible, comfortable and safe to use (Farage *et al.*, 2012). (Franz *et al.* (2012), emphasize incorporating the headrest as well as the backrest to create a perfect piece of furniture for a better comfort level and ease of the users. According to one of the studies from the past (PirkI, 1994), it is significant to emphasize the physical limitations of some of the seniors such as joint mobility, reduced grip, and stiffness of joints etc. Hence, the furniture needs to be strong, sturdy, stable and must offer high-quality grip supports to avoid overturning and preventing the users from falling as some of the seniors might experience dizziness and reduced ability to balance themselves (Farage, Miller, Ajayi and Hutchins, 2012; Malone and Dellinger, 2012). Uniform load distribution is another significant aspect that contributes to the stability of the furniture and consequently, contributes to the safety of the user. The ability of senior citizens to regulate their body temperature varies with that of other age groups, increasing the need for cool and warm surfaces of the furniture which also varies with the age and the environment. This necessitates the requirement of a suitable material to match their body temperature requirement.

2.1 Ergonomics and well-being of senior citizens

The level of convenient usability of furniture depends majorly on its components and dimensions, which include the armrest, the backrest, the footrest and their positioning (Holden, Fernie and Lunau, 1988). The appropriate placement and dimension of various parts of the furniture in line with the requirements makes the furniture more accessible, and comfortable and allows them to sit and do their activities for a longer duration with a higher level of convenience. In an attempt to design more attractive furniture with higher aesthetic levels, such aspects often get neglected which needs to be taken care of. Designing furniture with higher seating height makes it inconvenient to use, especially for seniors with shorter height. Such designs also result in excessive stress on the rear thighs of the users as they prevent the feet from reaching the floor. Not only the dimensions, but the angle at which the furniture design components rest is equally important and it can affect the health of the seniors, such as inappropriate backrest angles can influence the breathing which becomes critical in the case of senior citizens. Material and finishes, if incorporated appropriately, can contribute greatly to the safe and frequent usability of furniture by senior citizens. Higher contrast levels of the materials are desirable as they allow the seniors to conveniently distinguish between various components of the furniture, especially in the case of seniors with vision-related problems. Complex patterns must be avoided as they increase the stimulation level in the case of senior citizens, which ultimately leads to increased stress levels. Some studies show interesting results in link with the design of cabinets, cupboards etc. for senior citizens. Fabisiak *et al.* (2014), pointed out that senior citizens prefer the cabinets with lesser depths which prevents the spine from straining due to over-bending or over-stretching, in an attempt to reach the items inside the cabinet. The height of the cabinets is another essential aspect that requires sincere consideration. Cabinets with lower heights are preferred as it would be convenient to reach the items on the top shelf of the cabinet and would also prevent the use of ladders etc. Lower seating height of the

chair is another highlighted aspect by the senior citizens which requires special consideration while designing senior-friendly furniture. Some of the seniors suffer from joint mobility issues and face a lot of difficulty while getting up from chairs with low seating height even with the help of armrests. It is also pointed out that some of the furniture designs of the modern world do not provide sufficient seating width which makes it inconvenient to use the furniture. Human dimensions change with age and must be taken into consideration while designing furniture for senior users. Another study by Fabisiak *et al* (2014), points out that seniors would prefer the kitchen cabinets to be at a convenient height with easy-to-reach depths which would contribute greatly to the overall convenience level in the usability of the kitchen. The survey highlights that some of the seniors prefer to write as a hobby or regular mental exercise to keep themselves mentally active. These activities keep them involved and enhance their mental health. The furniture dimensions for such activities such as reading, writing etc. need to be incorporated appropriately to ensure convenient usability and higher comfort level for a longer duration. Some of the seniors pointed out that inappropriate seating height and the work desk height require prolonged bending causing backaches and hindering them from continuing these activities for too long. Interaction with the senior citizens further channelled the attention towards the incorporation of rounded corners for the furniture items. Some seniors have a reduced ability to balance themselves and are required to grab the furniture components such as armrests etc. while taking a seat. Sharp and hard edges in such cases can hurt and are not suited for senior citizens. Most of the senior citizens develop a sense of isolation among themselves due to limited interaction, which ultimately affects their mental health. The design of a space and the furniture if incorporated appropriately, plays a vital role in encouraging social inclusion. Furniture design and the way it is arranged has a direct impact on the social health of senior citizens (Sommer, 1969). Sociopetal arrangement of furniture can significantly positively impact social interaction. Movable furniture, placed at a convenient distance, allowing a convenient sitting experience during the conversation encourages social inclusion. However, inflexible arrangements at inappropriate distances or positions will discourage social inclusion.

3. Methodology

The research has been carried out with the data collected from primary as well as secondary sources. The preferences, needs and requirements of senior citizens in terms of furniture design have been identified through a concentrated literature study, along with the identification of various components of furniture design through online articles, journals, books etc. The research is further intensified through personal interactions with the users which revealed various constraints and limitations faced by the senior citizens while utilizing the modern day furniture items. The collected data includes both qualitative as well as quantitative responses which were quantified for a systematic analysis. The identified components of furniture design were tested for association with the comfort levels of senior citizens and the most critical aspect of furniture design that influences seniors has been identified statistically by applying Pearson's correlation on SPSS.

4. Results and discussion

A survey of users aged 60 years and above was conducted to understand their requirements, preferences, needs and experience in terms of furniture design along with its impact on their overall well-being. Interactions with the senior respondents highlighted their preferences for furniture that offers ease-of-movement and ensures convenient usability. The sample size of 84 respondents includes 44 females and 40 males. The majority of the respondents lie within the age range of 60 to 65 years, followed by the age range of 66 to 70 years; with the least count of respondents from the age group of 80 years and above. The first and foremost aspect that was examined was their preference for the type of public space, indoor or outdoor; to which most of the seniors showed an inclination towards outdoor public spaces. Around 59 percent of the respondents are daily park visitors which includes activities like walking, interacting with other visitors, reading newspapers, relaxing, watching the landscape etc. Such activities involve reasonably long hours of sitting and require suitable furniture. Apart from public parks, other preferred outdoor spaces include local markets. These respondents reported that they prefer to visit local markets at least four times a week, mostly in the mornings to take a stroll or to get daily household stuff, considering this as an exercise for themselves. Less than one-third of the total respondents reported the incorporation of senior-friendly furniture in public spaces. Out of 84 respondents, 67 highlighted the need for appropriate furniture for taking breaks while walking or just to relax. Some of the seniors also showcased their desire to visit the libraries or cafes that have reading areas. Personal interactions with seniors indicated that reading areas with moderately high book stacks, usually between 750 mm to 1500 mm, were the most preferable and conveniently reachable as they prevented too much bending down or stretching upwards. Another fact that was highlighted was the lack of appropriate furniture for the seniors to just sit, interact with each other, and play some group games, which enhances their social well-being. However, the absence of suitable furniture to enable them to sit comfortably for long hours discourages them and creates a sense of reluctance towards visiting such spaces

frequently. Bench, and chairs, without the backrest, provide a sense of discomfort while sitting for a longer duration. Insufficient or more than the required depth of the benches has been identified as another hindrance causing discomfort, especially for the respondents with spinal pain or injury. Around 16 per cent of the respondents reported having undergone some sort of surgery. Eight, out of 84 respondents have undergone the knee replacement procedure which deters them from sitting on the floor (at religious places) or on the furniture with low seating height. Six of the respondents faced spine-related and joint mobility issues and underwent treatment for the same, which resulted in difficulty while getting up conveniently from the chair, sofa etc. They further emphasized the need for furniture with higher armrests and higher backrests that offer better support and enable them to get up off the seat with relatively less effort. Although the armrests assist while getting up, the presence of corners and edges in some of the furniture designs hinder convenient and barrier-free movement. Nearly one-third of the respondents are working or willing to work, either self-employed as Doctors, Architects etc. advisors in some organizations or Senior Professors in Universities. Such a scenario necessitates the incorporation of ergonomics appropriately for work spaces, to enhance the comfort levels for better productivity, performance and healthy working. The responses showcased the need for incorporation of various design components such as arm-rests, back-rests, foot-rest for chairs, desks etc., comfortable seating height, stability, mobility, longevity, padded surfaces, soft corners, insertion of levers instead of knobs etc., to prevent the rotatory movement due to joint pains. Another set of respondents raised their concerns regarding the difficulty in stretching and reaching the furniture, mainly due to reduced grip strength and stiff joints; highlighting their preference for a light-weight but sturdy and stable furniture. The need for higher seating height was a common concern among all the respondents, especially with knee-joint-related issues and reduced mobility with age.

Interactions with field experts such as Furniture designers, Interior Designers, Architects etc. recommended the incorporation of some substantial facets such as cushions, padded upholstery for seats, and armrests, for comfortable seating and relaxation. Padded surfaces have been highly recommended, especially in cases of joint-pain-related issues, as they prevent direct contact between the body and furniture surfaces. Furthermore, the presence of corners and edges was highly discouraged as they hamper the ability to grip appropriately, cause pain in joints and increase the risk of senior citizens being hurt, especially seniors suffering from arthritis. This necessitates the incorporation of soft and rounded edges and corners, especially for users with reduced bone strength and weak joints

Table 1: Pearson Correlation to test the association between identified factors and overall comfort

	Overall_ Comfort	Duration	Age	Head_rest	Arm_rest
Overall Comfort Pearson Correlation	1	.429**	-.139	.224*	.606**
Sig.(2-tailed)		0	0.208	0.041	0
N	84	84	84	84	84
Duration Pearson Correlation	.429**	1	-.019	.481**	0.082
Sig. (2-tailed)	0		0.865	0	0.461
N	84	84	84	84	84
Age Pearson Correlation	-.139	-.019	1	0.076	-.088
Sig. (2-tailed)	0.208	0.865		0.492	0.426

N		84	84	84	84	84
Head_rest Correlation	Pearson	.224*	.481**	0.076	1	0.006
Sig. (2-tailed)		0.041	0	0.492		0.958
N		84	84	84	84	84
Arm_rest Correlation	Pearson	.606**	0.082	-.088	0.006	1
Sig. (2-tailed)		0	0.461	0.426	0.958	
N		84	84	84	84	84
Back_rest Correlation	Pearson	.580**	0.082	-.055	-.025	.977**
Sig. (2-tailed)		0	0.46	0.619	0.82	0
N		84	84	84	84	84
Seating_height Correlation	Pearson	.559**	.706**	-.101	.230*	.249*
Sig. (2-tailed)		0	0	0.362	0.035	0.022
N		84	84	84	84	84
Seating_depth Correlation	Pearson	.459**	.491**	0.107	0.108	.357**
Sig. (2-tailed)		0	0	0.332	0.328	0.001
N		84	84	84	84	84
Stability_strength Pearson Correlation		.293**	.450**	-.284**	.231*	0.206
Sig. (2-tailed)		0.007	0	0.009	0.035	0.061
N		84	84	84	84	84
Foot_rest Correlation	Pearson	.291**	.232*	-.219*	0.135	.248*

Sig. (2-tailed)	0.007	0.034	0.046	0.221	0.023
N	84	84	84	84	84
Padded_surface Pearson Correlation	0.135	.241*	-.187	0.181	0.105
Sig. (2-tailed)	0.22	0.027	0.089	0.1	0.341
N	84	84	84	84	84
Rounded_corners_edges Pearson Correlation	.324**	.551**	0.078	0.196	0.181
Sig. (2-tailed)	0.003	0	0.481	0.074	0.1
N	84	84	84	84	84

	Back_rest	Seating_height	Seating_depth	Stability_strength
Overall_Comfort Pearson Correlation	.580**	.559**	.459**	.293**
Sig. (2-tailed)	0	0	0	0.007
N	84	84	84	84
Duration Pearson Correlation	0.082	.706**	.491**	.450**
Sig. (2-tailed)	0.46	0	0	0
N	84	84	84	84
Age Pearson Correlation	-.055	-.101	0.107	-.284**
Sig. (2-tailed)	0.619	0.362	0.332	0.009
N	84	84	84	84
Head_rest Pearson Correlation	-.025	.230*	0.108	.231*

Sig. (2-tailed)		0.82	0.035	0.328	0.035
N		84	84	84	84
Arm_rest Correlation	Pearson	.977**	.249*	.357**	0.206
Sig. (2-tailed)		0	0.022	0.001	0.061
N		84	84	84	84
Back_rest Correlation	Pearson	1	.226*	.339**	0.205
Sig. (2-tailed)			0.039	0.002	0.062
N		84	84	84	84
Seating_depth Correlation	Pearson	.226*	1	.470**	.308**
Sig. (2-tailed)		0.039		0	0.004
N		84	84	84	84
Seating_height Correlation	Pearson	.339**	.470**	1	.258*
Sig. (2-tailed)		0.002	0		0.018
N		84	84	84	84
Stability_strength Pearson Correlation		0.205	.308**	.258*	1
Sig. (2-tailed)		0.062	0.004	0.018	
N		84	84	84	84
Foot_rest Correlation	Pearson	.227*	.230*	0.139	.305**
Sig. (2-tailed)		0.038	0.036	0.208	0.005
N		84	84	84	84

Padded_surface Pearson Correlation	0.088	0.199	.235*	.466**
Sig. (2-tailed)	0.424	0.07	0.032	0
N	84	84	84	84
Rounded_corners_edges Pearson Correlation	0.201	.502**	.491**	.390**
Sig. (2-tailed)	0.066	0	0	0
N	84	84	84	84

	Foot_rest	Padded_surface	Rounded_corners_edges
Overall_Comfort Pearson Correlation	.291**	0.135	.324**
Sig. (2-tailed)	0.007	0.22	0.003
N	84	84	84
Duration Pearson Correlation	.232*	.241*	.551**
Sig. (2-tailed)	0.034	0.027	0
N	84	84	84
Age Pearson Correlation	-.219*	-.187	0.078
Sig. (2-tailed)	0.046	0.089	0.481
N	84	84	84
Head_rest Pearson Correlation	0.135	0.181	0.196
Sig. (2-tailed)	0.221	0.1	0.074

N		84	84	84
Arm_rest Correlation	Pearson	.248*	0.105	0.181
Sig. (2-tailed)		0.023	0.341	0.1
N		84	84	84
Back_rest Correlation	Pearson	.227*	0.088	0.201
Sig. (2-tailed)		0.038	0.424	0.066
N		84	84	84
Seating_depth Correlation	Pearson	.230*	0.199	.502**
Sig. (2-tailed)		0.036	0.07	0
N		84	84	84
Seating_height Correlation	Pearson	0.139	.235*	.491**
Sig. (2-tailed)		0.208	0.032	0
N		84	84	84
Stability_strength Correlation	Pearson	.305**	.466**	.390**
Sig. (2-tailed)		0.005	0	0
N		84	84	84
Foot_rest Correlation	Pearson	1	.294**	0.191
Sig. (2-tailed)			0.007	0.082
N		84	84	84
Padded_surface Correlation	Pearson	.294**	1	.556**

Sig. (2-tailed)	0.007		0
N	84	84	84
Rounded_corners_edges Pearson Correlation	0.191	.556**	1
Sig. (2-tailed) N	0.082	0	
	84	84	84

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

5. Conclusions

Senior-friendly furniture must offer comfortable ingress and egress for senior citizens. This study proposes the fundamental characteristics that must be considered while designing furniture for senior citizens. Furniture design components and dimensions need to be sincerely incorporated in line with the requirement of senior citizens, for comfortable usability, which includes, armrest, backrest, headrest, and higher seating height than usual; along with stable design and durable material. Seniors would prefer a natural material over a synthetic one, which channelizes our thoughts towards circular economy and sustainability. The parts that come in direct contact with the body, may be fabricated with the natural material. Considering a suitable and sustainable material, wood-panel-based furniture could be one of the solutions for future senior-friendly furniture which has minimal to no adverse impact on environment and health. Furthermore, the use of a self-healing and self-cleansing fabric would further add to the ease of use in public spaces with low maintenance. Most senior citizens have an emotional connection with their existing furniture, which may be upgraded by incorporating the essential components for a smooth and comfortable experience. Increased design flexibility can be provided by developing adjustable fittings such as provision to conveniently adjust the height and angle of the footrest, arms rests etc. The study would encourage furniture designers and fabricators to develop such components as individual, detachable and adjustable modules which can be attached to any furniture type for its transformation to a senior-friendly furniture.

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