Impact of hospital design on the psychological well-being of geriatric patients

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Abstract

Purpose – The study investigates the relationship between hospital environmental factors and the well-being of geriatric in-patients. It aims to identify the impact of architectural design on comfort, safety, privacy and stress levels experienced by elderly patients during their hospital stays.

Design/methodology/approach – Employing a mixed-methods approach, the research assesses the experiences of 100 geriatric in-patients across various hospital types through surveys, observational checklists and state anxiety measurements. The methodology involves examining architectural features, patient perceptions and correlations among environmental variables and patient experiences. Statistical analyses, including correlations and chi-square tests, were employed to discern associations between environmental variables and patient experiences.

Findings – The research identified key architectural features significantly impacting geriatric patients' experiences. Factors such as sturdy beds, furniture quantity, lighting conditions, proximity to facilities and ward occupancy levels were found to influence spatial, sensory and social comfort. Notably, proximity to facilities and control over the immediate environment were crucial for self-control and safety perceptions. Privacy, highly valued by patients, correlated with the presence of curtains and ward occupancy. Moreover, patient stress levels exhibited correlations with autonomy, privacy and ward occupancy.

Originality/value – This research offers significant insights into the criticality of specific architectural elements in enhancing comfort and reducing stress for geriatric in-patients. These findings hold substantial value for healthcare facility design, emphasizing the need to prioritize certain design aspects to promote the well-being of elderly patients during hospitalization.

Keywords Healthcare design, Patient comfort, Patient's stress, Hospital architecture, Geriatric well-being

Paper type Research paper

1. Introduction

The hospital environment can be stressful experience for elderly patients since they are removed from their familiar surroundings and are placed in a new unfamiliar location with new routines. The process of being hospitalized can have an impact on the quality of life and functionality of patients. Prolonged bed rest can lead to changes in their psychological well-being, sensory deprivation and limited mobility, which may ultimately result in a loss of functional abilities.

The physical environment within the healthcare settings holds importance in shaping the experiences and overall well-being of individuals particularly the elderly population. It has an impact on their mental and emotional health. The design of healthcare facilities can either positively or negatively influence the health outcomes of patients. Research has

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demonstrated that the built environment has an effect on people's mood, abilities and general well-being (Hartig and Mang, 1991; Tian, 2023). Moreover, studies have shown that incorporating elements such as plants, light and water features into healthcare facilities can improve patients' recovery time, pain perception and medication use. The design of hospitals can also influence levels of stress and perception regarding the quality of care received (Devlin and Arneill, 2003). The facility design affects patient safety, satisfaction and staff productivity (Shepley *et al.*, 2016).

The study examined six design factors and their impact, on the well-being of patients. These factors encompassed the comfort of the space, sensory experiences, social interactions, personal autonomy, privacy levels and overall feeling of safety (Schreuder *et al.*, 2016).

The study aims to determine the relationship between the stress levels of geriatric in-patients and their perception of the ward's infrastructure elements, ultimately contributing to the improvement of patient care. The findings of this study can help healthcare providers create environments that promote health, healing and well-being by informing the development of evidence-based design guidelines.

1.1 Spatial comfort

Spatial comfort refers to the sense of physical and emotional ease that individuals experience in a specific environment or space (Eijkelenboom and Bluyssen, 2022; Evans *et al.*, 1996; Lawton, 1996). If a room is too small or cluttered, it can generate feelings of confinement and restriction, resulting in heightened levels of stress. Conversely, a spacious room can instill feelings of security and well-being, thereby reducing stress levels (Evans *et al.*, 1996; Lawton, 1996).

The availability of spaces plays an important role in shaping individuals' psychological well-being (Browning *et al.*, 2014). Additionally, elements such as spatial hierarchy, accessibilities and circulation also significantly impact individuals' psychology (Ramadan and Kamel, 2019). For instance, a study conducted on healthcare facilities, it was observed that large and disconnected spaces have adverse effects on communication and mobility, influencing both staff members' satisfaction with their work environment as well as patients (Sheldon *et al.*, 2007).

The well-being of elderly patients in hospital wards can be greatly influenced by the physical environment surrounding them. By taking into account their comfort and designing healthcare facilities with this in mind, healthcare professionals have the ability to reduce stress levels and improve overall wellness. Various factors including room size, personal space, furniture selection, interior design aesthetics and access to natural elements can all contribute to the overall spatial comfort experienced (Evans *et al.*, 1996; Lawton, 1996).

1.2 Sensory comfort

Sensory comfort refers to the levels of comfort that patients feel regarding their senses, such as touch, sight, sound, smell and taste. The built environment can greatly affect sensory comfort by creating spaces that are calming, soothing and engaging. This is particularly important for geriatric in-patients, who may have reduced sensory perception due to age and be more vulnerable to sensory overload or discomfort.

Incorporating a diverse range of sensory stimuli into the physical environment can lead to the positive outcomes for patients, as stated by (Ulrich *et al.*, 2008). Within hospice care, having a connection with nature is an important factor in improving the quality of life, contributing to enhanced mental state, spirit, comfort and overall satisfaction among patients. Various studies have demonstrated that exposure to natural

elements can evoke positive emotions, alleviate fear and anxiety, promote tranquility of mind and even assist in pain management (Evans *et al.*, 1996; Hartig and Mang, 1991; Rowlands and Noble, 2008; Ulrich, 1991). Additionally, the presence of natural lighting has proven beneficial for instilling a general sense of well-being. Artificial lighting should, therefore, be thoughtfully designed to achieve suitable levels of brightness and contrast (Anderson, 2008; Joseph and Rashid, 2007; Ulrich *et al.*, 2008). Adjustable lighting can allow geriatric in-patients to customize their environment, according to their individual preferences and needs. If proximity to natural sunlight or plants is not feasible, placing photographs or videos of landscapes, animals, flowers and other nature scenes can be beneficial to their psychological well-being (Moser and DarrinYork, 2008; Hathorn and Nanda, 2008).

The choice of colors can have an impact, on the mood and perception of inpatients. Soothing colors like blues and greens can create soothing environment for them while bright colors or patterns can be overwhelming and increase discomfort (Dalke *et al.*, 2006; Dalke and Matheson, 2007). In addition to color sound is another factor in designing healthcare facilities for patients. Excessive noise can cause stress and anxiety, whereas gentle sounds like nature or soft music can promote relaxation. Using materials that absorb sound, such as tiles has the potential to reduce noise levels. Furthermore, spaces can be tailored to minimize sounds and provide a comfortable environment for geriatric patients (Joseph and Ulrich, 2007; Ulrich *et al.*, 2004).

Maintaining a temperature is crucial when caring for older patients as they are more susceptible to the effects of both hot and cold conditions than the younger individuals (van Hoof *et al.*, 2017). Architects can play a role by designing spaces, with the ventilation systems and effective temperature control mechanisms (Chaudhury *et al.*, 2005a).

1.3 Social comfort

The term "social comfort" pertains to the feeling of support, connection and a sense of belonging that individuals experience when they interact with others. In stressful situations having support can be beneficial, in reducing stress levels (Bolger and Amarel, 2007). Patients who receive support from others often report lower levels of fear and anxiety, which can help mitigate the negative effects of stress and have better self-esteem (Ulrich *et al.*, 2004). Studies have also shown that the well-being of a family can positively impact a patient's health as well (Åstedt-Kurki *et al.*, 2001).

Conversely feelings of isolation and loneliness can contribute to depression, anxiety and increased stress levels ultimately exacerbating existing health conditions (World Health Organization, 2021). Geriatric in-patients who experience social isolation and loneliness are more likely to have poor health outcomes.

According to Ulrich, hospital designs that encourage interaction and allow for visits from family and friends play a role, in promoting social comfort among patients. This goal can be accomplished by including elements, like telephones chairs for visitors and areas for overnight stays (Ulrich, 2001).

1.4 Control

When patients are admitted to a hospital, they often experience a sense of powerlessness and lack of control, over their surroundings. This can have consequences for their health, including extended hospital stays, increased stress and anxiety levels and reduced satisfaction with the overall hospital experience (Devlin and Arneill, 2003; Ulrich, 1991). Studies have indicated that the loss of control can even contribute to conditions like depression and hypertension (Ulrich *et al.*, 2004; Ulrich, 1991).

To address this feeling of helplessness and promote autonomy, it is important to empower patients by giving them control over aspects of their environment. This includes allowing them to adjust their bed position regulate the amount of light in their room manage the temperature, according to their preference personalize their space and create an acoustical environment (Chaudhury *et al.*, 2005a). Additionally allowing patients to choose artwork for their surroundings has been found to enhance feelings of control (Suter and Baylin, 2007). By empowering patients with autonomy, over their environment during hospital stays healthcare providers can contribute significantly to improving outcomes and overall satisfaction with the hospital experience.

1.5 Privacy

Maintaining a sense of privacy is crucial for the well-being of patients in hospitals. The provision of privacy within the hospital wards has an influence on patient outcomes, including stress levels, recovery times and overall satisfaction with their hospital experience. Research studies have shown that patients who perceive a level of privacy experience lower stress levels and greater satisfaction with the care they receive (Scott *et al.*, 2003; Ulrich *et al.*, 2004). Additionally, the architectural design of the ward or unit also plays a role, in ensuring patients' privacy and preserving their sense of dignity (van de Glind *et al.*, 2007).

Privacy has three components: visual, auditory and physical. Visual privacy can be provided by curtains, screens and doors, while auditory privacy can be provided by placing noisy areas away from patient's zone and by also installing sound-absorbing materials (Barlas *et al.*, 2001; Chaudhury *et al.*, 2005b; Hagerman *et al.*, 2005). Physical privacy can be provided by ensuring staff provides dignity to patient while treatment (Adib-Hajbaghery and Aghajani, 2015). Hospital administrators and architects must consider the importance of privacy in hospital ward design. The provision of privacy is essential for creating a conducive environment for healing, and it is the responsibility of healthcare providers to ensure that patients feel safe and respected during their hospital stays.

1.6 Safety

The built environment can either help or hinder the patient's physical performance. It is important to maximize the perception of safety and security of patients, staff and families in a hospital facility (Ulrich *et al.*, 2004). Designing for the elderly presents a challenge as body functionality declines with age. Mobility also presents a challenge as it becomes more difficult for older adults to kneel, transition from a sitting or standing position and stand upright (Rosenberg *et al.*, 2011). Falls are among the most critical concerns for geriatric patients in a hospital. The presence of hazards in a space is positively associated with the likelihood of falls and injuries (Joseph *et al.*, 2018; Valipoor *et al.*, 2020).

The design of a hospital plays a critical role in ensuring patient safety. This can be achieved by incorporating various features such as furniture placement, bed bars and locks, appropriate lighting, accessibility to personal belongings, anti-skid flooring and rounded furniture corners with contrasting floor and wall colors. Additionally, hospital design should consider the proximity of toilets to the beds, lower bed heights, strategically placed grab bars and railings to reduce the risk of falls and contrasting finishes on handrails or furniture to differentiate them from the wall and aid older adults in visualizing them from a distance (Joseph *et al.*, 2018; Joseph and Rashid, 2007; Vaccari *et al.*, 2014).

2. Conceptual framework

See (Table 1).

Objective	Key indicators	Data collection	Analysis
To identify the environmental factors influencing the experience of geriatric patients in a hospital	Environmental factors – Space – Furniture – Natural and artificial lighting – Sound – Windows – Color and paint – Temperature	Secondary – Desk research	Qualitative – Literature review
To investigate and analyze different hospital wards in the Delhi capital region with respect to geriatric patients	– Architecture setting of the inpatient ward – Patients perception towards setting of the ward	Primary – Architecture observation checklist – Structured interview with geriatric patients	Quantitative – Frequency – Cross tabulation – Chi-square test
To understand and analyze the geriatric patients' perceived stress, comfort and interaction with the indoor built environment	– Patients' perceived stress – Patients perceived sense of control and safety with immediate built environment – Perceived sense of social support, sensory comfort, spatial comfort and privacy	Primary – Structured interview with geriatric patients	Quantitative – Frequency – Cross tabulation – Chi-square test – Regression and co-relation analysis

Source(s): Table by authors

Table 1.
Conceptual framework

3. Method of research

3.1 Sample size estimation

Delhi emerges as the optimal study state due to its demographic significance revealed in the 2011 census. With a total population of 16.78 m, the elderly cohort (60+), constituting 6.8% of the populace, is a substantial and diverse demographic. The prevalence of health issues among the elderly in urban areas positions Delhi as a robust and pertinent choice for this research study. The sample size (n) was computed based on the following formula:

$$n = \frac{Z^2 * p * (1 - p)}{C^2}$$

Where,

n = sample size.

z = z value at 95% confidence interval (standard value of 1.96)

p = the proportion in the target population having specific characteristic (taken as 6.8%)

c = margin of error at 5% (standard value of 0.05)

NRR = Nonresponse rate considered at 4%.

The calculation above generates 97 samples. Considering a 4% NRR to account for nonavailability, nonresponse or dropouts at the interview, the study included 100 geriatric in-patients admitted to general wards of government, private and NGO-based healthcare facilities in Delhi.

3.2 Data collection

Geriatric acute care inpatients were surveyed in Delhi based hospitals. About 100% response rate was achieved during the data collection phase from the designated target respondents, underscoring the robustness of our research methodology.

The necessary permissions were acquired at each of the hospitals. The institution issued the certificate with IHEC No. BT/IHEC-IITR/2020/7004 to collect the data from intended respondents. Directors/chief medical officers and other concerned authorities of sampled hospitals were informed of the study's purpose and methodology. Before conducting interviews, the researcher obtained informed consent from respondents.

3.3 Demographic characteristics/profile of the respondents

The survey conducted covers a total of 100 geriatric in-patients from the three distinct types of healthcare institution. These include super specialty private hospital, public hospital and nonprofit medical college hospital. Table 2 illustrates the demographic characteristics of geriatric in-patients across the three different types of healthcare institutions.

3.4 Research instrument

In order to document the ward's architectural setting, an observation checklist was used (Table 3). The Likert scale instrument was used to record the perception of geriatric in-patients in the hospital ward (Table 4). The level of anxiety among geriatric in-patients was measured using the state anxiety checklist, which was an adapted version of the Spielberger State-Trait Anxiety Inventory (Spielberger *et al.*, 1983).

3.5 Hospital and ward architectural description

Various hospitals had general wards, each with its own unique design and size. In Delhi NCR, there was a private super specialty hospital boasting 300 beds. This facility housed 10 general medicine wards, each accommodating a maximum of six patients and there were four shared toilets available to both genders. Additionally, there was a 200-bed public hospital in Delhi, equipped with a 17-bed general medicine section that provided two gender-neutral public toilets. The third alternative was a 300-bed nonprofit medical college hospital, also located in Delhi, NCR. It included two general medicine wards, with each having a capacity for

Hospital type	Gender distribution	Women (%)	Men (%)	Mean age (years)	Standard deviation (years)
Super specialty private hospital (52)	Women: 19 and Men: 33	36.54	63.46	66.8	4.0
Public hospital (25)	Women: 11 and Men: 14	44.00	56.00	67.0	4.5
Nonprofit medical college hospital (23)	Women: 6 and Men: 17	26.09	73.91	66.8	3.8
Total (100)	Women: 36 and Men: 64	36.00	64.00	N/A	N/A

Source(s): Table by authors

Table 2. Demographic characteristics of geriatric patients

No.	Observation	Possible choices
1	Area of the ward	Area in Sq. ft
2	Circulation area of the ward	Area in Sq. ft
3	Distance from bed to toilet of the ward	A) 1–50 ft B) 51–100 ft C) 101–150 ft
4	Flooring material of ward	A) Tile B) Stone (C) Other
5	Is floor anti-skid?	A) Yes B) No
6	Number of furniture allocated to each patient	
7	Provision of personal storage space	A) Yes B) No
8	Provision of chair for visitor	A) Yes B) No
9	Provision of sleeping space for A family member	A) Yes B) No
10	Color of furniture contrast with the surrounding environment	A) Yes B) No
11	Is there a source of daylight in the ward area?	A) Yes B) No
12	Distance of the switchboard to control lights from the bed	A) 1–10 ft B) 11–20 ft C) 21–30 ft D) 31–40 ft
13	Distance of the switchboard to control fans from the bed	A) 1–10 ft B) 11–20 ft C) 21–30 ft D) 31–40 ft
14	Is there a provision of bedside window?	A) Yes B) No
15	Color of the wall?	
16	Wall and floor color contrasting?	A) Yes B) No
17	Provision of A television in the ward	A) Yes B) No
18	Type of air conditioning in the ward	A) AC B) HVAC
19	Average temperature maintained in the ward	A) < 18 °C B) 18–22 °C C) 22–26 °C D) > 26 °C
20	Distance of nurse station from the bed	A) 1–50 ft B) 51–100 ft C) 101–150 ft
21	Number of patients in a ward	
22	Handrails in the corridor?	A) Yes B) No
23	Adjustment features among patient's bed	A) Adjustable Height B) Tilt C) None
24	Provision of overhead light	A) Yes B) No
25	Provision of fan	A) Yes B) No
26	The curtain on each bed?	A) Yes B) No
27	Furniture in the patient area has rounded corners?	A) Yes B) No
28	Orientation of the windows of the ward	A) North B) South C) East D) West
29	Type of lights in the ward	A) LED B) Fluorescent C) Incandescent D) Other
30	Curtains over windows	A) Yes B) No

Source(s): Table by authors

Table 3. Architectural observation checklist

11 patients and two shared toilets that were equally accessible to both men and women. All of the above-mentioned wards within these hospitals were evaluated for architectural observation and patient data collection through the use of research instruments.

3.6 Data analysis

For the statistical analysis, SPSS/Windows 26.0 was used. The data were analyzed using descriptive statistics, independent *t*-tests and stepwise linear regression.

4. Results

4.1 Descriptive analysis

The researcher evaluated the environmental variables offered by each hospital's wards. The result shows that the geriatric inpatients in super specialty private hospitals perceived more autonomy permitted by staff than those at public hospital and nonprofit medical college hospital. The evaluated variables are listed in Table 5.

Environmental parameters		Indicators	Likert scale instrument
Spatial comfort	1	The area of the ward	Very Uncomfortable (1) to Very Comfortable (5)
	2	Circulation area of the ward	
	3	Adequacy of the furniture allotted on each bed	
	4	Patient bed	
	5	Quality of the furniture	
	6	Ward's storage	
Sensory comfort	1	Exposure to sunlight	Very Uncomfortable (1) to Very Comfortable (5)
	2	Placement of artificial lights	
	3	Type artificial lights	
	4	Sleeping conditions	
	5	Color theme	
	6	Lighting conditions	
	7	Noise	
	8	Exterior view from windows	
	9	Temperature maintained (thermal comfort)	
	10	Freshness of aAir	
	11	Tidiness and cleanliness	
Social comfort	1	Space for family and visitors	Very Uncomfortable (1) to Very Comfortable (5)
	2	Length of time taken by the nursing staff to Reach	
	3	Furniture for family and visitors	
Self-autonomy	1	Accessing the toilets	Very Difficult (1) to Very Easy (5)
	2	Access to control the fan	
	3	Bed's adjustment features	
	4	Access to control the lights	
Safety and security	1	Accessing the toilets	Very unsafe (1) to Very safe (5)
	2	Getting over bed	
	3	Utilizing patient bed	
	4	Utilizing food table	
Privacy	1	Patients in the ward and personal activities	Not at All(1) to Very Much (5)

Source(s): Table by authors

Table 4. Environmental parameters and perception of geriatric in-patients

Additionally, it was discovered that geriatric in-patients in super specialty private hospital reported that the conditions in their wards were better for maintaining control of the immediate environment as opposed to those in public hospital and nonprofit medical college hospital. The analysis extended to comfort dimensions, revealing that super specialty private hospitals scored higher in spatial, social and sensory comfort. These higher scores suggest a more conducive environment for recovery in super specialty private hospitals. The analysis also showed that geriatric inpatients treated in super specialty private hospitals perceived safer while using the physical items available to them than geriatric inpatients treated at nonprofit medical college or public hospital.

The results of the study on the levels of stress experienced by geriatric inpatients at the sampled hospitals showed that even though super specialty private hospitals offered better conditions for comfort dimensions, permitted autonomy, self-control, safety and privacy patients still experienced higher levels of stress than those from non-profit medical college hospital and public hospital. It can be deduced that other factors, beyond the physical environment, such as the nature of illness and socioeconomic status of the patients, significantly contribute to stress levels.

		Non profit medical college hospital	Public hospital	Super specialty private hospital
Stress	Mean	2.62	2.69	2.82
	SD	0.33	0.32	0.26
Spatial comfort	Mean	2.71	2.96	3.53
	SD	0.66	0.53	0.50
Social comfort	Mean	2.96	3.04	3.40
	SD	0.95	0.88	0.76
Sensory comfort	Mean	2.97	3.00	3.43
	SD	0.39	0.62	0.5
Permitted autonomy	Mean	3.02	3.04	3.69
	SD	0.78	0.67	0.52
Control	Mean	2.49	3.14	3.49
	SD	0.76	0.82	0.61
Safety and security	Mean	3.03	3.19	3.34
	SD	0.92	0.98	0.67

Source(s): Table by authors

Table 5. Cumulative descriptive statistics of environmental variables in the wards

4.2 Physical features of the ward and perceived level of spatial comfort

The research findings unveil several aspects of spatial comfort for geriatric in-patients in general hospital wards. In terms of the degree of comfort in the beds provided, patients who used sturdy or stable beds and beds with adjustment features were more likely to report positive experiences of comfort (56.9 and 54.7%, respectively) than those without these features. However, these relationships were not statistically significant, with p-values of 0.062 and 0.159. The comfort with the quality of furniture displayed no significant relationship with its sturdiness, but potential relationships regarding bed adjustment features and rounded corners were noted, with p-values close to the threshold (0.062), necessitating further investigation. The quantity of furniture significantly affected comfort, with 49.0% comfortable with the provided quantity and a chi-square value of 10.92 ($p = 0.027$) indicating statistical significance. Provisions for visitor sleeping space were found to enhance comfort significantly, with 59.6% of respondents reporting positive feelings ($p = 0.036$). Regarding the degree of comfort with the circulation area of the ward, wards with 201–300 sq.ft displayed the highest comfort level (62.1% positive comfort), while the responses in other size categories were more polarized or evenly distributed. Overall, the findings shed light on specific architectural features of wards influencing the comfort of geriatric patients, some requiring additional exploration due to the proximity to statistical significance thresholds.

4.3 Physical features of the ward and perceived level of sensory comfort

The study examined sensory comfort in the context of sleeping conditions, color themes, noise, cleanliness, lighting and thermal comfort. Sleeping comfort appeared to improve with increased distance from the nurse station and fewer patients, while not significantly. Color contrasts in furniture and surroundings were noted, but only white wall color showed a trend towards positive comfort. Noise comfort seemed to improve with distance from the nurse station and fewer patients, but only the latter was close to being significant. Cleanliness comfort did not vary significantly with the type of hospital or patient numbers, while private hospitals and wards with fewer patients tend to yield more positive responses. Lighting comfort was significantly enhanced with the presence of a bedside window while other factors like wall color, overhead artificial lights, window orientation and type of lights

used showed trends but were not statistically significant. Thermal comfort varied significantly with the type of AC, ward temperature and fan provision, indicating preferences for HVAC systems, 26 °C temperature and individual fans. Freshness of air trends was observed but did not reach statistical significance. Overall, the findings illustrate subtle preferences and significant insights into the architectural features influencing geriatric patients' comfort in hospital wards, while many of the observed trends lacked statistical validation.

4.4 Physical features of the ward and perceived level of social comfort

The study examined the social comfort experienced by geriatric in-patients during their hospital stays. A clear relationship was identified between the type of hospital ward and patients' comfort level regarding space for family visits: patients in private wards felt the most comfort (75.0% positive), compared to those in medical college wards (26.1% positive) and public hospital wards (36.0% positive) ($\chi^2 = 24.5$, $p = 0.002$). Additionally, the presence of visitor chairs was crucial: 75.0% of patients in wards with visitor chairs reported positive comfort, in contrast to the 31.3% in wards lacking them ($\chi^2 = 23.9$, $p = 0.001$). The distance between a patient's bed and the nurse station was another determinant of comfort, especially in relation to nurse response time. Patients situated 1–50 feet from the nurse station felt most comfortable with response times (60.9% positive), while a distance of 101–150 feet resulted in 100% negative perceptions ($\chi^2 = 30.32$, $p = 0.001$). Lastly, the provision of chairs or sleeping couches significantly elevated patients' satisfaction regarding furniture for their visitors: 73.1% of those in wards with these facilities reported positive satisfaction, compared to the 41.7% in wards without them ($\chi^2 = 13.49$, $p = 0.009$).

4.5 Physical features of the wards and perceived level of self-control

The findings of the study indicate that the proximity of the toilet and the switchboard to the patient's bed affects the ease of use. A total of 3 out of 10 geriatric inpatients in wards larger than 300 square feet and 5 out of 10 in wards with 100–200 square feet of circulation area experienced difficulties accessing the toilets from their beds. On the other hand, 48% of geriatric inpatients found it easier to use the toilet when it was located closer to their bed, between 1–50 square feet. A chi-square test of independence was performed to determine the relationship between the distance of the toilet from the bed and the ability to use it, revealing a statistically significant association ($p = 0.05$).

Additionally, the study found that a greater distance between the bed and the switchboard made it harder for geriatric inpatients to regulate the fans and lights in the ward. Around 7 out of 10 interviewed geriatric in-patients reported difficulty in controlling the lights and fans when the distance was 31–40 feet. The results of the chi-square test of independence showed a significant link between the distance from the bed to the switchboard and the ease of regulating the lights and fans ($p = 0.003$). Furthermore, 3 out of 10 geriatric inpatients had trouble using the bed adjusting mechanisms. The results of the chi-square test of independence indicated that the ward circulation area, distance from the bed to the switchboard and distance from the bed to the toilet all affected perceived control (refer to Table 6).

In conclusion, the study found that geriatric in-patients had limited control over the switchboard and the ability to operate the lights and fans when the distance from the bed to the switchboard was significantly increased. On the other hand, when the beds were located closer to the toilet on the ward, geriatric in-patients reported having a greater sense of control over their immediate surroundings.

Features of the ward	Chi-square value vs total perceived control by patient
Circulation area of the ward	0.002*
Distance from bed to the toilet of the ward	0.001*
Distance of switches to control the fans	0.001*
Adjustment features of patient's bed	0.41
Distance of switches to control the fans	0.001*

Features of the ward	Chi-square value vs total perceived safety by patient
Circulation area of the ward	0.382
Distance from bed to the toilet of the ward	0.369
Flooring material	0.218
Anti-skit flooring	0.218
Furniture in patient area sturdy	0.983
Wall and floor color contrasting	0.218
Handrails in corridor	0.033*
Furniture in patient area have rounded corners	0.16

Features of the ward	Chi-square value vs total perceived privacy by patient
Curtains on each bed	0.002*
Number of patients in each ward	0.004*

Source(s): Table by authors

Table 6. Chi-square test of independence

4.6 Physical features of the wards and perceived degree of safety

According to the findings, 52% of geriatric inpatients felt less secure when accessing the toilets in a ward with a circulation area of 100–200 square feet, the smallest size. On the other hand, 56% of geriatric inpatients felt more secure when the circulation area was larger than 300 square feet. Additionally, 43% of geriatric inpatients indicated that shorter distances between the bed and the toilet, ranging from 1 to 50 feet, made them feel safer compared to distances of 101–150 feet. The flooring material was also found to have an impact on perceived safety, with 44% of geriatric in-patients feeling less secure in the ward with stone flooring as opposed to 56% in the unit with tiles. Other factors contributing to a lack of perceived safety included the absence of handrails and wall and floor color contrast, as reported by 52% of patients, which was a concern for 56% of patients. The chi-square test of independence showed that handrails in the corridor and the level of safety while using the toilet were crucial factors (Refer Table 6). Furniture without rounded edges in the patient area was also found to negatively affect perceived safety.

In evaluating the safety of geriatric patients' beds, food tables and foot over stools, 65% were rated as nonfunctional or partially functional. This resulted in 3 out of 10 geriatric inpatients feeling unsafe and uncomfortable when using these devices. The chi-square test of independence showed a significant relationship ($p = 0.001$) between the perceived overall safety and the feeling of safety when using the food table, suggesting that the food table is the most significant architectural element for geriatric in-patients to perceive the hospital environment as safe.

4.7 Physical features of the wards and perceived degree of privacy

The study aimed to assess the level of privacy and favorable atmosphere provided to geriatric inpatients in the hospital. The results showed that patients in wards with smaller floor areas, ranging from 500 to 1,000 square feet, reported lower levels of privacy compared to those in wards with larger floor areas, ranging from 1,001 to 1,500 square feet.

According to the research by Ittelson *et al.* (1970), there was correlation found between the feeling of privacy and the number of occupants in the ward and the percentage of isolated passive behavior increased with the number of occupants. Additionally, the study found that most geriatric in-patients reported feeling more private when there were only six patients in the ward and that 66% of geriatric inpatients believed that the presence of curtains in each ward contributed to privacy.

The results of the chi-square test of independence showed a significant relationship between the perception of privacy and the availability of curtains on each bed ($p = 0.002$) and the number of patients in the ward ($p = 0.004$). This suggests that the availability of curtains and the number of patients in the ward are the two most critical elements for geriatric inpatients to feel a higher degree of privacy in the hospital.

4.8 Impact of hospital's environmental variables and geriatric patients' stress levels

The geriatric patients in the hospital settings have a moderate level of satisfaction with spatial, sensory and social comfort, with a mean score close to 3.2 and low variation. Among all the variables, privacy was valued the most (mean = 3.45), though it showed considerable variation. Permitted autonomy was slightly higher (mean = 3.37) than other comfort variables, highlighting a feeling of empowerment. Patients indicated a higher level of autonomy with a positive correlation to spatial comfort (r = 0.523), sensory comfort (r = 0.489), control (r = 0.270) and safety (r = 0.399). There was a negative correlation with the number of patients in the ward (r = −0.422), implying preference for less crowded wards. The perception of control and safety were rated lower (mean = 3.17 and 3.23, respectively) with more variation in responses. Positive correlations were noted with comfort aspects, whereas the control was also positively correlated with stress (r = 0.205). Privacy showed the highest mean value (3.45), though with a substantial variation (SD = 1.27). Privacy positively correlated with the hospital, sensory and social comfort and stress and negatively with the number of patients in the ward (r = −0.188). Stress levels were the lowest among all variables (mean = 2.75), with low variation and showed both positive and negative correlations with other factors like control, privacy and the number of patients in the ward. Patients generally preferred a low occupancy rate in the ward (mean close to 2), but there was a large variation in responses (SD = 0.84). This variable negatively correlated with several others, including hospital, comfort aspects, autonomy, control, privacy and stress.

5. Conclusion

The study was conducted in Delhi, and the findings may not be universally applicable to other regions with different cultural, economic and healthcare infrastructures. However, the study on the perception of geriatric inpatients during their hospital stay in the general ward, several key architectural and environmental factors emerged as pivotal in shaping the comfort, safety, privacy and overall satisfaction levels of geriatric patients. Spatial comfort is significantly influenced by the sturdiness of beds, adjustment features, quantity of furniture and the provision of visitor sleeping spaces. Sensory comfort, on the other hand, hinges upon sleeping conditions, lightings, especially the presence of a bedside window and HVAC system preferences. Notably, geriatric inpatients in private wards showcased a pronounced comfort in terms of family visit space, with the presence of visitor

chairs and the proximity of the nurse station playing determining roles in social comfort. Proximity to toilets and control switchboards is critical for self-control, with a shorter distance enhancing the sense of control and safety. Safety perceptions also vary with circulation area sizes and the flooring material, emphasizing the importance of functional design aspects like handrails and furniture edges. Privacy, one of the highest-valued variables, correlates directly with the presence of curtains and inversely with the number of ward occupants. Lastly, the study reveals that while geriatric patients generally reported moderate satisfaction levels across spatial, sensory and social comfort, their stress levels were notably associated with environmental variables. Higher levels of autonomy were linked to enhanced spatial and sensory comfort and reduced ward occupancy was a predominant preference, correlating negatively with stress levels. This research underscores the criticality of specific architectural features in enhancing comfort and reducing stress for geriatric in-patients during their hospital stays.

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