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Assessing the Influence of Ambient Features on Staff Satisfaction in the Healthcare Environment

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ABSTRACT

The influence of ambient features on staff satisfaction in a healthcare environment is gaining recognition as an essential component of overall well-being. While traditional healthcare design is largely focused on patient care, there is a growing emphasis on creating environments that support staff satisfaction. Although there is extensive research on the relationship between ambient conditions and outcomes in various healthcare settings, it is unclear whether these results are consistent across diverse settings. As a result, this study aims to holistically explore the relationships and interdependencies between ambient features and staff satisfaction in a healthcare setting, prioritizing the factors that most influence satisfaction. The literature review identified a wide range of ambient features that impact healthcare environment staff, including natural light, artificial light, smell, acoustics, temperature, humidity, air quality, and music. A mixed-method design was conducted, incorporating a questionnaire survey and semi-structured interviews administered across seven private hospitals. Quantitative data were gathered through surveys, whereas qualitative insights were obtained through semi-structured interviews. Statistical techniques such as ANOVA, correlation, and regression were used to examine the relationships between demographic factors and satisfaction. The results ranked the satisfaction factors as follows: smell, air quality, temperature, natural light, humidity, artificial lighting, music and acoustics. As a result, the study identifies ambient features that have a significant impact on staff and strongly recommends implementing interventions to increase satisfaction among healthcare professionals. Healthcare administrators and policymakers can utilize these findings to enhance ambient conditions in healthcare facilities, promoting high-quality treatment while improving satisfaction.

1.0 INTRODUCTION

The healthcare environment plays a pivotal role in influencing the health and well-being of patients and provides supportive places for staff to work (Ulrich et al., 2008; Joseph et al., 2016). Many studies have shown that the healthcare environment directly impacts staff outcomes and that healthcare professionals are conscious of the need for a well-designed workplace, as this environment is crucial for fostering a positive and supportive work environment (Massen et al., 2021). A satisfied and motivated workforce is essential for high-quality healthcare delivery, making it crucial for healthcare administrators to regularly understand and improve the factors that affect staff perceptions of satisfaction to ensure optimal working conditions (Andrade et al., 2012). For any healthcare organization, it is vital to prioritize the well-being of the staff to ensure the effective delivery of care to patients (Karaferis et al., 2022).

Satisfaction is a crucial component for staff in healthcare settings, as satisfied staff are more likely to provide better patient care and can positively impact patient satisfaction. A supportive and conducive workplace environment enhances staff well-being and improves patient care quality, safety, and satisfaction (Shetty et al., 2024). Research has emphasized a strong relationship between ambient features in the healthcare environment and satisfaction (Terzi et al., 2019; Wang, 2013; Campos-Andrade et al., 2013; Dianat et al., 2013; Trickey et al., 2012; Quan et al., 2012). Optimal ambient conditions in healthcare settings enhance user comfort, well-being, and satisfaction, improving patient outcomes (Khodakarami & Nasrollahi, 2012; Nimlyat & Kandar, 2015). Ambient features, such as lighting, noise levels, odor, and temperature, are integral components of the physical environment that shape individuals' sensory experiences within a space (Harris et al., 2002; Dijkstra et al., 2006; Waroonkun, 2018). These elements have been found to significantly affect staff mood, concentration, satisfaction, burnout and performance (Al-Bqour et al., 2022; Amleh et al., 2023; Applebaum et al., 2010; Chawla et al., 2017; Freihoefer et al., 2019; Shepley et al., 2011; Terzi et al., 2019). However, poor environmental conditions can lead to increased stress, contribute to burnout, and decrease productivity among healthcare professionals. Therefore, understanding the impact of these ambient features is crucial for healthcare administrators seeking to optimize the working conditions for their staff.

The primary aim of this research is to assess the influence of various ambient features on staff satisfaction in healthcare environments. It seeks to provide actionable insights that can inform the design and management of healthcare facilities to increase staff well-being. The objectives of the study are (i) to identify and analyse the key ambient features that impact staff satisfaction in healthcare environments; (ii) to investigate the extent to which each ambient feature influences staff satisfaction; and (iii) to provide recommendations for healthcare facility design on the basis of the findings to improve staff satisfaction.

2.0 LITERATURE REVIEW

Several studies have explored the impact of specific ambient features, such as noise levels, lighting, temperature, air quality and humidity, on staff satisfaction. Studies by Chang et al. (2022); Davis et al. (2020); Dianat et al. (2013) and Gharaveis et al. (2020) have investigated the effects of temperature on satisfaction. Research on the effects of daylight (Chang et al., 2022; Davis et al., 2020; Fay et al., 2018) and artificial light (Campos-Andrade et al., 2013; Chang et al., 2022; Djukic et al., 2014) on satisfaction has been conducted in healthcare settings. Kim et al. (2015) investigated the effects of humidity levels on satisfaction among staff in hospitals. The studies by (Copeland & Chambers, 2017; Kim et al., 2015;

Terzi et al., 2019) explored the impact of acoustics and noise levels on satisfaction. Table 1 lists the ambient features identified from the literature review.

Table 1. List of ambient features identified from previous studies

Ambient features	Description of the feature	Author/year
Lighting (Daylight and artificial lighting)	Lighting, including both daylight and artificial sources, is a key ambient feature that affects well-being and functionality. Daylight enhances mood, regulates circadian rhythms, and improves comfort, while artificial lighting provides necessary illumination for various tasks.	Al-Bqour et al. (2022); Amleh et al. (2023); Applebaum et al. (2010); Davis et al. (2020); Dianat et al. (2013); Fay et al. (2018); Freihoefer et al. (2019); Gharaveis et al. (2020); Kim et al. (2015); Andrade et al. (2012); Campos Andrade et al. (2013); Chang et al. (2022); Nimlyat and Kandar (2015); Shikder et al. (2012); Buchanan et al. (1991)
Acoustic	Acoustics refers to the characteristics of sound within the space, including factors such as noise levels, sound quality, and sound insulation. Good acoustic design aims to minimize disruptive noises and enhance overall auditory comfort for both patients and staff.	Applebaum et al. (2010); Freihoefer et al. (2019); Kim et al. (2015); Chawla et al. (2017); Andrade et al. (2012); Terzi et al. (2019); Campos Andrade et al. (2013); Nimlyat and Kandar (2015); Dubbs (2004); Bayo et al. (1995); Copeland and Chambers (2017)
Odor	Odor refers to the presence and quality of scents or smells within the facility. Odor can significantly impact the comfort and perception of the environment by both patients and staff.	Applebaum et al. (2010)
Indoor air quality	Indoor Air Quality refers to the condition of the air within a healthcare facility and encompasses various factors such as ventilation.	Freihoefer et al. (2019); Kim et al. (2015); Nimlyat and Kandar (2015); Seppanen et al. (2006)
Thermal comfort	Thermal comfort refers to the state of satisfaction with the thermal conditions in a healthcare environment.	Amleh et al. (2023); Freihoefer et al. (2019); Kim et al. (2015); Khodakarami and Nasrollahi (2012); Nimlyat and Kandar (2015); Fischer et al. (2006); Witterseh et al. (2004); Obeidat et al. (2022); Fay et al. (2018)
Humidity	Humidity refers to the level of moisture in the air, which plays a critical role in maintaining indoor air quality and comfort.	Kim et al. (2015); Andrade et al. (2012)

From the literature review, the critical factors influencing outcomes for hospital staff were identified as follows: daylighting, artificial lighting, acoustics, odor, indoor air quality, thermal comfort, humidity, and music. The independent factors that impact staff satisfaction, which is a dependent variable, are extracted from the review articles with maximum occurrence. Sociodemographic data, such as age, gender, and work hours, were used to analyse and compare different groups of staff, revealing patterns in their responses. This approach ensures pertinent inquiries, mitigates biases, and provides insights for specific groups. For example, a younger population is adaptable to a wide range of temperatures, whereas an older population can be sensitive to extreme temperatures. The study settings pertain to the distinct departments where the research was conducted. Each department requires specific conditions, such as optimal ventilation and daylighting, for thermal comfort and satisfaction.

2.1. Theoretical framework

The theoretical framework is shown in Figure 1. It outlines a structured approach to understanding the complex relationship between ambient features in a healthcare environment and their impact on staff satisfaction. This framework is grounded in a theory that explains how environmental features influence the satisfaction of healthcare staff, both clinical and nonclinical. One of the underlying theories is person–environment fit theory, which suggests that an individual is more satisfied and performs better when his or her environment aligns with his or her needs and preferences. In the healthcare context, the alignment between staff preferences for ambient features and actual environmental conditions can significantly influence staff satisfaction.

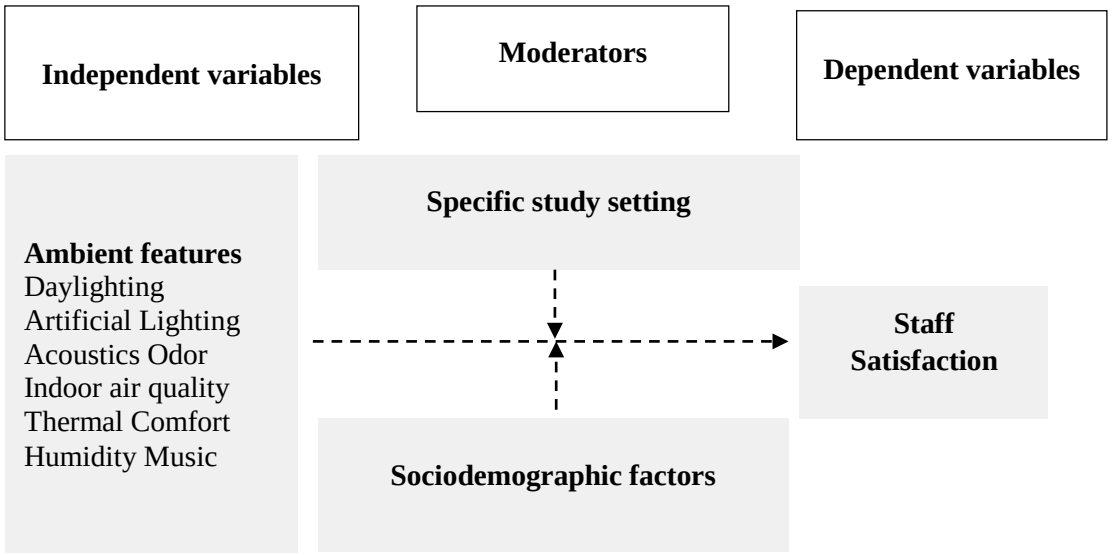

Figure 1. Conceptual model (Author)

The independent variables identified are ambient features within the healthcare setting, which include daylight, artificial lighting, acoustics, odour, indoor air quality, thermal comfort, humidity and music. Each of these factors is crucial, as they directly influence the physical and psychological comfort levels of staff members. Daylighting, for example, is linked to improved mood and reduced fatigue, essential for the demanding environments in which healthcare workers operate. Similarly, appropriate thermal comfort can enhance concentration and efficiency, thereby potentially increasing satisfaction levels. The primary dependent variable in this study is staff satisfaction; this variable is crucial because

it reflects the overall well-being of the staff, which is impacted by ambient features. The study framework also integrates moderators that influence the relationship between ambient features and staff satisfaction. The moderator includes sociodemographic factors. The study setting refers to the particular environment within the healthcare facility where the study is conducted, recognizing that different settings may present varying challenges and benefits. Sociodemographic factors help in understanding diverse responses to the same environmental conditions, thus providing a nuanced analysis of how different groups perceive their work environment.

Overall, this theoretical framework serves as a model for exploring how modifications in the environment can lead to improvements in staff satisfaction. It allows for the systematic study of environmental impacts in a healthcare context, facilitating targeted improvements that could significantly enhance staff morale and retention, ultimately leading to better patient care.

3.0 METHODOLOGY

A mixed-methods design was used to combine the quantitative and qualitative data. The quantitative study used questionnaire items with closed-ended questions, where the participants were asked to rate items on a scale from strongly agree to strongly disagree. The qualitative study used open-ended questions, where the participants shared their views.

On the basis of the review of relevant articles, a list of items related to ambient features in the healthcare environment was compiled. Following the recommendation of Boateng et al. (2018), face validation of the compiled items was conducted with reviews and inputs from two academicians. As per Elangovan and Sundaravel (2021), for content validity, the recommended minimum number of experts is three, and the maximum number of experts is ten. A heterogeneous panel comprising six experts from industry and academia assessed and validated the items to mitigate the risk of bias in the validation process. For content validation, the content validity index (CVI) was adopted, as it is the most widely used tool for quantifying the opinions of experts (Polit et al., 2008). The items were assessed for relevance on a four-point Likert scale, with "1=not relevant, 2=somewhat relevant, 3=quite relevant, and 4=very relevant". For each item, an additional comment column was provided for feedback and remarks by the experts. The CVI calculates the degree of agreement among the experts at the individual level and overall scale (Polit et al., 2007). Accordingly, the I-CVI is the validity index for each item of the constructs of the study, and the S-CVI is the overall scale, which is calculated as the average of the I_CVI. The I-CVI is the number of experts in agreement divided by the number of experts.

A pilot study was conducted before the large-scale data collection to test the feasibility of the study and to revise the items if needed. The final questionnaire was distributed to facilitate the analysis of data variability and central tendency by comparing demographics with other ambient factors, whereas qualitative data, enabled the identification of unique requirements and necessary modifications in a given environment. Figure 2 explains the detailed methodology followed in this paper.

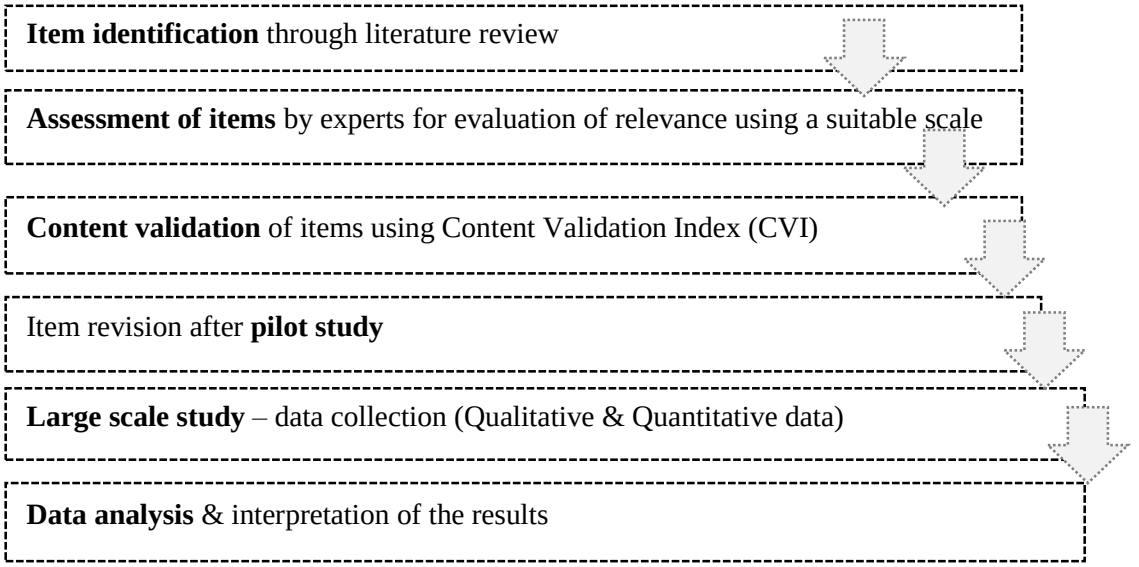

Figure 2. Research methodology adopted for the study (Author)

3.1. Item identification and face validation

An initial list of items related to ambient features was compiled from the literature. This was later subjected to face validation by two academicians. The suggested inputs were incorporated, which included revision, elimination, and rephrasing of few items. After the face validation, the items were compiled for content validation in the next stage.

3.2. Content validation

For the content validation, the stages followed were (i) preparation of the content validation form; (ii) selecting a review panel of experts; (iii) conducting content validation; (iv) revising the domain and items and providing scores for each item; and (v) calculating the CVI. After a thorough review and assignment of scores to each question, the CVI was calculated. The CVI for the satisfaction-related questions yielded a score of 0.95, as shown in Table 2. These CVIs surpass the minimum acceptable CVI, which is typically set at a standard value of 0.83 when assessed by a panel of six experts (Yusoff, 2019). This finding indicates that the questionnaire has strong content validity, suggesting that the questions on satisfaction effectively measure the intended constructs. The expert panel's comments were extremely beneficial in refining the questionnaire. Their suggestions included clarifying words to ensure that the respondents had clear and consistent knowledge of the ideas being addressed. Second, the experts stressed the need to realize that various departments within the healthcare center may have distinct needs. For example, they noted that the ENT department may prefer dark illumination to accommodate their specialist operations, but the orthopedic department may want brighter lighting for their unique inspections and procedures.

Table 2. Calculation of the CVI for Satisfaction

Items/Experts	1	2	3	4	5	6	Experts in Agreement	I-CVI	UA
Q1	1	1	1	1	1	1	6	1	1
Q2	1	1	1	1	1	1	6	1	1
Q3	1	1	1	1	1	1	6	1	1
Q4	1	1	1	1	1	1	6	1	1
Q5	1	1	1	1	1	1	6	1	1
Q6	1	1	1	1	1	1	6	1	1
Q7	1	1	1	1	1	1	6	1	1
Q8	1	1	1	1	1	1	6	1	1
Q9	1	1	1	1	1	1	6	1	1
Q10	1	1	1	1	1	1	6	1	1
Q11	1	1	1	1	1	1	6	1	1
Q12	1	1	1	1	1	1	6	1	1
Q13	1	1	1	1	1	1	6	1	1
Q14	1	1	1	1	1	1	6	1	1
Q15	1	1	1	1	1	1	6	1	1
Q16	1	1	1	1	1	1	6	1	1
Q17	1	1	1	1	1	1	6	1	1
Q18	1	1	1	1	1	1	6	1	1
Q19	1	1	1	1	1	1	6	1	1
Q20	0	1	1	1	1	1	5	0.8	0
Proportion relevance	0.95	1	1	1	1	1	S- CVI/Ave	0.99	
Average proportion of items judged as relevance across the ten experts						0.99	S- CVI/UA		**0.95**

3.3. Data collection

A pilot study was conducted before the large-scale study to test the feasibility of the study. Participants from three hospitals with diverse job descriptions participated in the study. The primary aim was to assess the completeness of the questionnaire. With a sample size of 27, valuable discussions and comments were gathered from participants, with a particular focus on the section related to observational studies. This feedback served as a foundation for the revision of the survey instrument. On the basis of the input received, necessary corrections were subsequently made, leading to the development of an improved questionnaire.

For the large-scale study, the data were collected from seven special hospitals. A total of 74 participants from outpatient departments (OPDs) responded fully to the questionnaire; 40 females and 34 males were included. These participants were categorized into clinical and nonclinical staff, with 58 in the clinical group and 16 in the nonclinical group.

The questionnaire contained three sections. The first section included the introduction of the study, consent for voluntary participation, and collection of basic workplace and department details from the participants. The second section focused on demographic information. The third section included the assessment of satisfaction and comprised 21 items. Eight of these items pertained to specific ambient features, with participants rating their satisfaction on a 5-point Likert-type scale. The remaining 13 items involved items about their workplace environment and were presented in a checkbox format, allowing for multiple selections on the basis of ambient features. Additionally, an open-ended option was included for participants to provide suggestions regarding ambient features.

4.0 DATA ANALYSIS AND RESULTS

In this analysis stage, questionnaire items were identified on the basis of the literature, and face validation and item assessment were conducted by subject experts and later evaluated by content validation indices. The data were collected through in-person and online questionnaire survey forms.

4.1. Demographic characteristics of the respondents

Among the respondents from the clinical staff, 15.5% were nurses, 3.4% were therapists, 24.1% were surgeons, 21% were residents, and 25.8% were physicians, for a total of 77%. A total of 51.7% of the participants were aged 21--35 years, and 53.4% were female. Fifty percent had a duration of service of less than 10 years, 94.8% had a day shift, and 86.2% had worked for more than 5 days. Among the nonclinical staff, 56.2% were administrators, 37.5% were receptionists, 56.2% were in the 21–35 years' age group, and approximately 43.7% were female. A total of 56.2% had a duration of service of less than 10 years, 100% had a day shift, and 87.5% had worked for more than 5 days. The division of patients into clinical staff and nonclinical staff was based primarily on similarities in their working environments and job characteristics, as shown in Table 3.

Table 3. General characteristics of the respondents

		Clinical Staff			**Nonclinical staff**		**Total**	
		Frequency (n=58)	%		Frequency (n=16)	%	Frequency (n)	%
Age	21-35 35-50 50+	30 17 11	51.7 29.3 18.9		9 4 3	56.2 25 18.7	38 21 14	52.7 28.3 18.9
Gender	Male Female	27 31	46.5 53.4		7 9	43.7 56.2	34 40	45.9 54.1
Job title	Physician Surgeon Nurse Therapist Intern Residents Technicians	15 14 9 2 2 12 4	25.8 24.1 15.5 3.4 3.4 21 12	Administrators Receptionists Porter	9 6 1	56.2 37.5 6.2	Clinical=58 Nonclinical=16	78.3 21.6
Length of service	<10 years 10-20 years >20 years	29 11 19	50 18.9 34.4		9 6 1	56.2 37.5 6.2	39 17 18	51.3 31.4 27
Work shift	Dayshift Afternoon shift Night shift	55 6 7	94.8 10.3 12		16 1 0	100 6.2 0	69 8 7	95.9 18.9 9.4
Number of working days	< 5 days a week > 5 days a week	8 50	24.1 86.2		2 14	12.5 87.5	10 63	13.5 86.5

4.2. Quantitative Data Analysis

The statistical analysis of the quantitative data was performed with SPSS 29.0 software, which included descriptive statistics, one-way analysis of variance (ANOVA), correlation and regression. A comparison between clinical and nonclinical staff satisfaction was carried out as previously stated, and eight criteria were applied to assess different elements of perceived satisfaction. For each of the eight areas evaluating perceived satisfaction, descriptive data such as the mean and standard deviation are provided. It provides an overview of the central tendency of data and variability. ANOVA was used to compare the mean ratings of perceived satisfaction for clinical and nonclinical staff. The method assisted in establishing whether there were significant differences in satisfaction ratings between the two groups. Pearson's correlation analysis was used to study the relationships between variables, specifically how different factors affect satisfaction. The strength and direction of the associations are quantified via this method. A simple linear regression analysis was carried out by averaging the independent categories, yielding a composite variable known as "overall satisfaction". This technique is a standard method for reducing data to a single measure of satisfaction perception. A simple linear regression was used to identify the specific contribution of each independent variable to overall satisfaction. This allows us to assess the extent to which each element influences the dependent variable. The analytical hierarchy process was used to investigate the weight of each demographic variable with respect to satisfaction. This strategy aids in the prioritization and comprehension of the relative importance of distinct demographic variables in the investigation.

4.3. Qualitative Data Analysis

The interview data analysis began after all the open-ended sections of the questionnaire were entered into the Excel sheet. The content/theme analysis involved predefined categories related to the independent variables. Graphs were created to help identify the proportion of users, as well as their current challenges and future demands, to improve the ambient features. Finally, the outcomes of thematic analysis were described, including the themes found, the proportion of users connected with each topic, and any research implications.

4.4. Satisfaction Ratings of the Respondents

It was found that natural light had the greatest impact on staff satisfaction, with 63.4% of respondents expressing satisfaction. This was followed by odour (58.1%), indoor air quality (54%), artificial lighting (44.6%), thermal comfort (41.9%), humidity (37.9%), and music (35.7%). The lowest satisfaction was reported for acoustics, at 28.4% (Figure 3). According to this rating, participants valued natural light, odour control, and indoor air quality the most in their surroundings, whereas acoustics and humidity levels were less important to them.

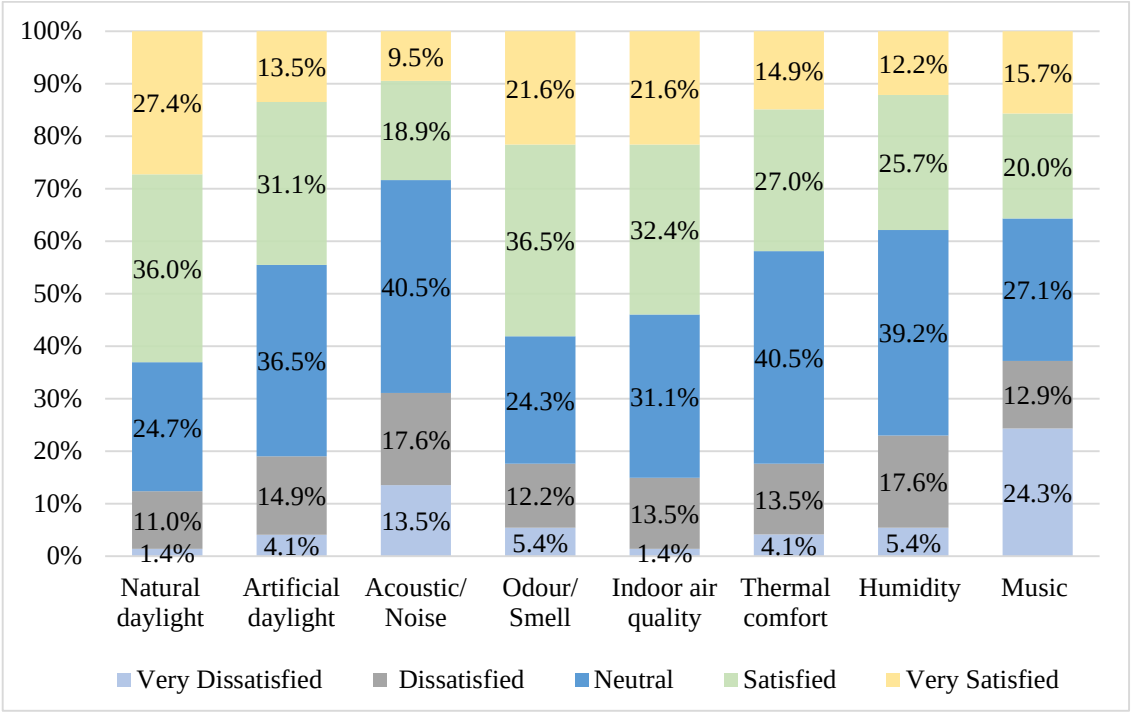

Figure 3. Percentage of participants with their perceived satisfaction.

4.5. A Comparison of Satisfaction Between Clinical and Nonclinical Staff

As indicated in Table 3, the means and standard deviations for each group of clinical and nonclinical staff members were calculated and compared via mean difference tests. The means for clinical staff were all more than 2 and less than 4, whereas the majority of nonclinical staff means were equal to or less than 4. Natural light is ranked the highest, music is rated the lowest, and noise is rated the lowest in both groups. To determine whether there was a statistically significant difference between the responses of the two respondent groups, mean difference tests and F tests were performed. Two of the p values for each of the eight categories, odor and air quality, were less than 0.001, indicating that the answers differed considerably more for all of the tested independent factors. The rest of the variables were either equal to or greater than 0.001, indicating that the responses were collectively comparable. Table 4 shows the order and extent of the differences in satisfaction levels between the clinical staff and nonclinical staff with respect to the ambient features. The factors were ranked on the basis of F values from an ANOVA test, which measures how much the satisfaction level differs between the two groups. A higher F value indicates a greater difference in opinion. The greatest difference between the two groups was with respect to smell, with an F value of 12.97, suggesting a significant difference between the two groups in terms of satisfaction. The second largest difference was in air quality (F=7.63), followed by temperature (F=6.37), natural light (F=5.94), and humidity (F=4.02). The differences in artificial lighting (F=1.92) and music (F=1.56) were smaller, indicating that the satisfaction levels of the two groups were relatively similar. The lowest difference was reported with acoustics, with an F value of 0.66, indicating very little difference between the two groups in terms of satisfaction with acoustics.

Table 4. Mean values and p values for satisfaction between clinical and nonclinical staff.

Independent variables		Clinical Staff (n=58)	Non-Clinical Staff (n=16)	F	P value
Natural light	Mean	3.70	4.00	5.940	0.001
	Std. deviation	1.068	0.816		
Artificial lighting system	Mean	3.28	3.63	1.924	0.134
	Std. deviation	0.988	1.147		
Acoustics/noise	Mean	2.86	3.19	0.665	0.576
	Std. deviation	1.067	1.377		
Smell	Mean	3.53	3.69	12.794	0.000
	Std. deviation	3.53	1.302		
Air quality	Mean	3.50	3.94	7.634	0.000
	Std. deviation	1.013	0.998		
Humidity	Mean	3.22	3.19	4.027	0.011
	Std. deviation	1.044	1.109		
Temperature	Mean	3.33	3.44	6.370	0.001
	Std. deviation	1.066	0.892		
Music	Mean	2.76	3.40	1.561	0.207
	Std. deviation	2.76	1.352		

Note: 1 = Very dissatisfied to 5 = Very satisfied, 95% confidence interval

4.6. Responses to Existing Conditions

Approximately 32 respondents expressed a preference for increasing natural light via courtyards and atria. Courtyards and atria are architectural features that allow ample natural light to penetrate indoor spaces. In cases where space restrictions prevent the addition of more windows or the enlargement of existing windows, respondents recommended the use of clerestory windows and skylights. These solutions can be effective when traditional windows are not feasible. Only 2 respondents reported being satisfied with the location of their workstations, which already had facilities such as windows or skylights in place, as shown in Table 5.

Table 5. Participant responses to existing conditions of natural and artificial lighting

Variables	Count
Recommendation for Natural light availability	
Increased number of windows	32
Increased size of windows	23
Courtyard/Atrium	32
Skylight/Clerestory	19
Adequate	2
Existing artificial lighting conditions	
Glare	10
Dim	27
Distractive	9
Flickering	6

Unwanted shadows created	16
Inappropriate positioning	13
Need of additional lights	27
Lighting color is inappropriate	13
Blocked by furniture	8
No issues observed	3
Use of devices like headlights	2
The duration of the day strongly confirms the use of artificial lighting.	
Morning	17
Afternoon	11
Evening	36
Whole day	28

Approximately 27 respondents expressed, as shown in Table 5, that they had dim lighting and that the need for additional lighting was mostly due to congestion of space and negligence of need. A lack of optimum light causes delays in patient care and visibility, which can reduce performance. The use of artificial lighting in professional settings tends to be high because of limited natural light during that time. Professionals often prefer it for its consistent quality, superior color rendering, and glare control. The ability to adjust light levels based on individual needs is a preferred choice for a productive workspace.

Approximately 38 individuals often experienced humid air conditions. This discomfort was due to high temperatures and elevated moisture content, which resulted in an overall sense of mugginess. On the other hand, 18 staff members encountered dry air conditions, particularly in spaces such as doctor rooms and technician laboratories, when the air conditioning temperature was set to lower for extended periods. Specifically, 18 reported feeling stuffy air. This sensation is largely a consequence of inadequate ventilation within indoor spaces and is more pronounced in crowded areas, such as waiting rooms and corridors, as shown in Table 6.

Table 6. Responses to existing air quality conditions

Variables	**Count**
Stuffy air	10
Humid air	38
Dry air	18
Still air	18
Dusty air	2

Human activity, especially within the pediatric department, is identified as the primary source of noise, necessitating preventive measures to reduce noise levels, as shown in Table 7. Outdoor factors, particularly vehicular traffic, cleaning and maintenance and ongoing construction, contribute to noise pollution in the vicinity of healthcare facilities. Air conditioning systems are identified as another significant source of noise, often resulting from inadequate maintenance. Noise levels are observed to be highest in the morning, coinciding with increased activities and likely emphasizing the need for noise mitigation strategies during this time.

Table 7. Responses to existing conditions of noise

Variables	Count
Existing factors of noise	
Human activity	54
Equipment	11
Air conditioning	15
Surface finishes	4
Outdoor factors	25
No noise	2
Duration of day that confirms to high noise	
Morning	42
Afternoon	16
Evening	7
Whole day	16
No noise	3

Hospitals prioritize cleanliness and hygiene to prevent the spread of pathogens and healthcare-associated infections. This distinctive odor arises from the frequent use of cleaning agents, disinfectants, and antiseptics throughout the facility, as shown by the 44 respondents in Table 8. On the other hand, 30 respondents experienced unhealthy smells, such as urine, excreta, garbage building material and surfaces, due to a lack of maintenance and no buffer spaces with the workstation.

Table 8. Responses to the existing conditions of Smell.

Variables	Count
Interiors such as paint and furniture	8
Building materials	4
Cleansers and disinfectants	44
Medical supplies	30
Urine and excrement	9
Garbage Odor	9
Humid packed	1
No Odor	2

As shown in Table 9, the temperature is controlled through a combination of natural settings such as ventilation, courtyards and landscaping, with air conditioning mainly used during the afternoon to maintain the temperature for comfort and high performance, as reported by 25 respondents. Some respondents experienced temperatures < 24°C, possibly due to prolonged and aggressive use of AC. Above 28°C, which could be attributed to the absence of AC or natural settings to mitigate heat.

Table 9. Responses to existing levels of temperature (in degrees Celsius)

Variables	Count
<24	14
24-28	25
>28	12

More than half of the participants reported experiencing extreme discomfort from humidity, particularly in the afternoon. Ventilation is commonly used to mitigate humidity-related discomfort, but

there is a risk of over mitigation or poor ventilation design that can lead to moisture being trapped indoors. Heating, ventilation, and air conditioning (HVAC) systems are widely incorporated in facilities and are considered key solutions for optimizing environmental conditions, as shown in Table 10.

Table 10. Responses to existing conditions of humidity

Responses to existing conditions	Count
Existing humidity levels	
High, >50%	17
Average, 40-50% (Optimal condition)	41
Low, <50%	17
Duration of the day at high humidity	
Morning	34
Afternoon	35
Evening	11
Whole day	10
Various ways of mitigating humidity	
HVAC	30
Ventilation	47
Indoor plants	10

As shown in Table 11, 66 respondents expressed that music was not played because doctors preferred a silent environment to focus and diagnose patients. Nonclinical staff preferred soothing, pleasant, and relaxing tunes to be played during break hours and in common areas. They believe that such music would not affect their daily work and could help patients calm down. Approximately 11 staff members highly preferred not to use any kind of music because they found it distracting.

Table 11. Responses to preferences for Music

Responses to existing conditions	Count
Background music preferences	
Yes	4
No	66
Sometimes	3
Background music reports	
Soothing	31
Pleasing	20
Relaxing	5
Stressful	1
No music preferred	11

4.7. Relationships between demographic variables and independent variables

Table 12. Pearson correlation (r) coefficients between demographics and satisfaction

	Natural light	Artificial lighting	Acoustics/noise	Smell	Air quality	Humidity	Temperature	Music
Age	0.086	0.073	0.159	0.227	.310**	0.187	.455**	0.038
Gender	-0.144	0.001	0.055	0.139	0.075	0.121	.241*	0.025
Job title	-0.052	-.315**	-0.144	-0.017	-0.104	-0.010	-0.018	-0.170
Length of service	0.045	-0.120	0.097	.400**	0.201	.303**	.393**	-0.208
Work Shift	0.041	-0.164	-.264*	-.252*	-0.065	-0.218	-0.123	-0.106
Number of working days	0.105	-0.058	-0.128	0.059	0.037	-0.032	0.136	0.003

**Correlations are significant at the 0.01 level (2-tailed)
*Correlations are significant at the 0.05 level (2-tailed)

Given the significant differences in staff perceptions of satisfaction between the two groups, it is critical to establish which satisfaction categories were heavily influenced and what variables steered these responses. The calculated p values were calculated for both clinical and nonclinical personnel. Table 12 shows that age has a substantial effect on the air quality and temperature response, with p values of 0.01, 0.310 and 0.455, respectively. Gender had a strong influence on temperature (r=0.241), and job title had a strong influence on artificial illumination (r=-0.315). Similarly, there are substantial associations between length of service and fragrance, humidity, and temperature. A work shift has a significant effect on noise and odor. However, the number of working days and music have weak significance, which means that there is less to no relationship.

4.8. Simple linear regression between overall satisfaction and the independent variables

Table 13. Simple linear regression between the dependent variable and the independent variables.

Independent variables	Coefficient	t test	p value
Natural light	0.234	3.856	0.000
Artificial lighting system	0.007	0.122	0.904
Acoustics/noise	0.058	0.986	0.328
Smell	0.209	3.094	0.003
Air quality	0.259	3.557	0.001
Humidity	0.183	2.576	0.013
Temperature	0.276	3.837	0.000
Music	0.026	0.513	0.610

Note: Dependent variable = Overall satisfaction

Table 13 shows the results of a simple linear regression to determine whether there was a linear relationship between each variable and overall satisfaction. Since the sample size for nonclinical staff was small, both groups were pooled to validate the explanatory factors that impacted staff satisfaction. The linear regression findings confirmed that natural light, air quality, odor, humidity, and temperature all had significant influences on overall satisfaction. The other independent variables had weak effects

on overall satisfaction in both groups, as shown in Figure 4. Given that natural light, air quality, odor, and temperature are identified as significant contributors to overall satisfaction, the remaining factors, artificial light, acoustics, smell, humidity and music, should receive increased attention and intervention in efforts to improve satisfaction in the research context.

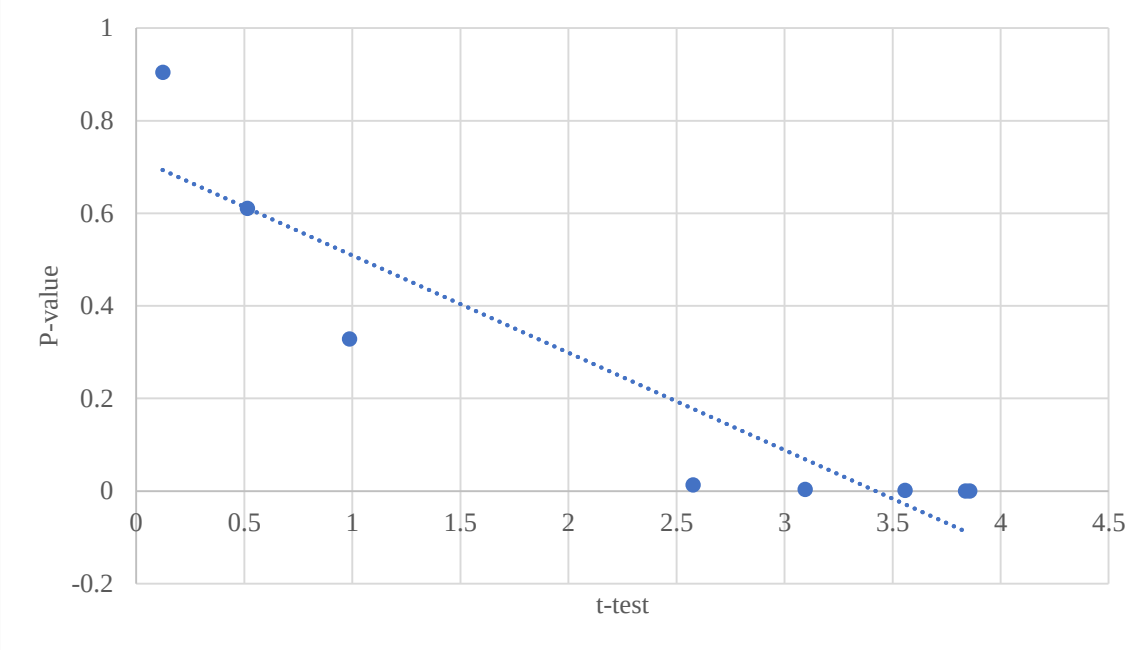

Figure 4. Regression showing a linear relationship

5.0 DISCUSSION

Using a mixed-methods approach, this study analysed and presented a thorough summary of outpatient staff-reported satisfaction. While several studies have examined the impact of ambient features on staff satisfaction in healthcare facilities, this study provides a broader and more integrated analysis, considering a range of factors and utilizing a mixed-method approach to gain deeper insights.

Outpatient staff often perform a variety of tasks around the facility. The investigation revealed distinctions between clinical and nonclinical workers. The studies provided answers to the first research question, which involved identifying the independent variables that needed to be considered: natural light, artificial light, acoustics, odour, air quality, humidity, temperature, and music. Nonclinical staff members rated all aspects higher or felt more satisfied than did clinical staff. Although actual ambient features such as temperature, humidity, and indoor air quality were not assessed, occupant assessments of satisfaction strongly support the observed built environment conditions. Importantly, clinical and nonclinical staff members have distinct needs, demands, and working conditions within the healthcare setting. These inherent differences likely contributed significantly to the variation in their responses regarding their level of satisfaction with the environment.

As analysed via simple linear regression between the dependent variable and the independent variables, natural light, air quality, odor, and temperature are acknowledged as essential factors impacting overall satisfaction. This study indicates that artificial light, acoustics, odor, humidity, and music should be given more attention and intervention to promote satisfaction. Therefore, the most

significant order of differences in satisfaction was smell, followed by air quality, temperature and natural light. Small differences were observed for humidity, artificial lighting and music, and the smallest differences were observed for acoustics.

Odour emerged as the most important factor affecting staff satisfaction, which aligns with the findings of Zuo and MaloneBeach (2017), whose study also identified odor as a significant aspect of indoor environmental quality in healthcare setting. Smell is a sensory factor that can cause discomfort in hospitals. The importance of smell in the findings suggests that healthcare environments should prioritize odor control to enhance staff well-being. Studies by Liu et al. (2018) have also shown concerns regarding the impact of odors on occupants in healthcare facilities.

The second most important factor was the air quality, which aligns with the previous studies by Khan et al. (2020) emphasising the importance of air circulation in maintaining a healthy workplace environment. Poor air quality is linked to ineffective ventilation leading to discomfort among healthcare staff, and directly impacting satisfaction. Similarly, to temperature, another critical factor was thermal comfort closely linked to well-being (Dascalaki et al., 2009). The results align with previous studies by Nimlyat (2018), highlighting to maintain an optimal thermal environment in healthcare settings, as fluctuations in temperature can cause discomfort for staff.

Natural light was also a crucial factor, though less important than air quality and temperature. Studies by Zuo et al. (2017), have indicated that exposure to natural light positively contributes to overall staff satisfaction. However, in this study, artificial lighting and humidity played a less prominent role. This finding might be attributed to the sampled hospital's well-regulated lighting systems reducing their impact on staff satisfaction. Artificial lighting and humidity were secondary concerns as in studies by Liu et al. (2018), where users showed less sensitivity to these factors when primary elements, such as air quality and temperature, were adequately managed.

Music and acoustics showed the smallest differences in satisfaction in the study as these factors are not directly related to physical discomfort. Previous studies by Budaiwi et al. (2022) have shown acoustics as a less significant factor in healthcare settings. However, in operating rooms, sound control may be more critical (Dascalaki et al., 2009). The minimal impact of music and acoustics in this study suggests that these factors may not be as crucial for staff satisfaction.

Correlation analysis helped in identifying the significance of demographics as a major component that might alter respondents' perceptions. Age, gender, and duration of employment all have significant impacts on temperature. Smell is affected by work shift and duration of service, whereas noise, humidity, and air quality are affected by gender, age, and work shift. Job title appeared to affect artificial lighting, whereas music had little significance.

The introduction of more natural light received positive feedback from the staff, as it was perceived to enhance visual comfort, improve performance, and reduce glare. Interestingly, approximately 17 individuals rated this aspect with a score less than 3, suggesting some variation in preferences. Both the clinical staff and the nonclinical staff expressed a desire for specific changes related to the lighting environment. Their primary requirements included an increased number of windows, the creation of courtyards or atria, larger windows, and the implementation of skylights or clerestory windows. Approximately 36.5% of the respondents rated artificial lighting systems with a score of 3. The variability in ratings can be attributed to the diverse working needs of different professionals. For example, an ENT physician might require a dim environment for diagnosis. Additionally, approximately 37.5% of the staff either found the lighting to be dim or felt that it needed more lighting fixtures, suggesting that there is room for improvement in this aspect. Noise received a relatively lower

average score of approximately 2.86. Higher noise levels were associated with increased stress and reduced performance. The observations indicated that the majority of noise originated from human activities and external factors, with peak noise occurring in the morning, affecting approximately 56.8% of the respondents. The perception of smell received scores of approximately 3.5 and 3.6, with a p value of 0, indicating some variation in opinions. A significant majority (approximately 60.3%) of the staff noted the presence of cleansers and disinfectants, which did not seem to hinder their performance. In terms of music, ratings differed between clinical staff and nonclinical staff. The clinical staff generally did not prefer music, as they found it distracting and potentially detrimental, with a rating of 2.76. In contrast, nonclinical staff members seemed to already play music, which they found relaxing and soothing, resulting in a higher rating of 3.40 for this category.

The rate of satisfaction of staff in healthcare settings is analysed and ranked with the variables that most strongly influence the dependent variables via the AHP methodology. The AHP is an integrated methodology that enables decision-makers to make correct decisions by using empirical data. It is also a systematic approach developed to derive solutions in a priority order to solve a particular problem (Saaty, 2002). The steps involved in calculating the analytical hierarchy were as follows: as criteria, 8 independent variables were assigned, and demographic data were used as sub criteria.

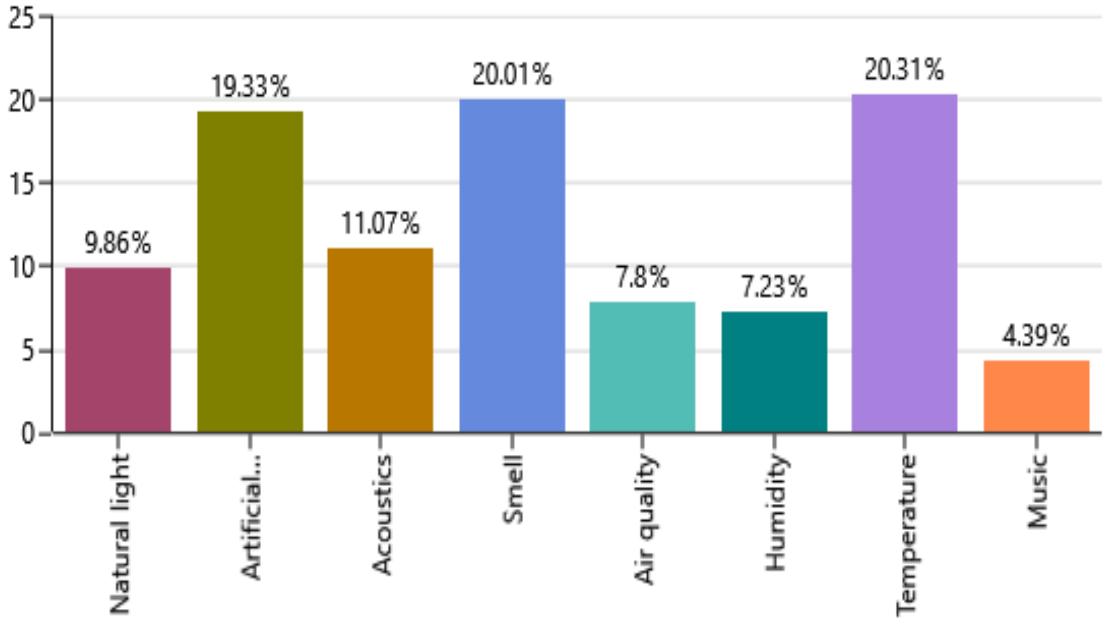

Figure 5. Relative priorities.

Table 14. Weights of the independent variables.

Independent variables	Priorities	Weight
Natural light	0.099	9.86
Artificial lighting	0.193	19.33
Acoustics/noise	0.111	11.07
Smell	0.2	20.01
Air quality	0.078	7.8
Humidity	0.072	7.23
Temperature	0.203	20.31
Music	0.044	4.39

Note: Consistency ratio= 0.0726

Figure 5 presents the priority scores of various ambient features impacting satisfaction levels, with temperature (20.31%) reporting as the most significant determinant, closely followed by smell (20.01%). Artificial lighting (19.33%) is also a crucial factor, reflecting the importance of temperature regulation and visual comfort. Acoustic noise (11.07%) ranks moderately, indicating the relevance of noise control in the healthcare environment. Natural lighting (9.86%) is prioritized over artificial lighting but remains an important factor. Air quality (7.8%) and humidity (7.23%) were considered less critical, although they still contributed to overall satisfaction. Music (4.39%) has the least influence, suggesting that while it might enhance ambiance, it is not a major concern for respondents. The chart emphasizes that comfort-related factors such as temperature, smell, and lighting are central to environment satisfaction, whereas elements such as music hold minimal importance. The priorities and weights are shown in Table 14. The findings suggest important variables that need to be prioritized for existing hospital settings. Addressing these aspects can lead to a more comfortable and pleasant environment, benefiting both patients and staff.

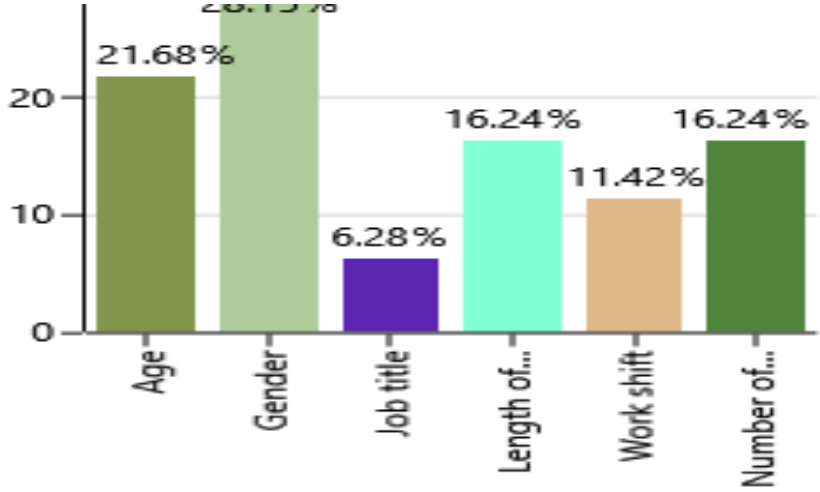

Figure 6. Relative priorities

Table 15. Weights of the independent variables.

Demographics	Priorities	Weight
Age	0.217	21.68
Gender	0.282	28.15
Job title	0.063	6.28
Length of service	0.162	16.24
Work shift	0.114	11.42
Number of working days	0.162	16.24

Note: Consistency ratio= 0.0864

Figure 6 presents the priority score for demographic factors, with gender being rated highest at 0.282, followed by age at 0.217, length of service and number of working days at 0.162, which suggests that these four factors are important variables that need to be considered when designing and implementing ambient systems to cater to the needs and preferences of the workforce.

6.0 CONCLUSION

There is a need to maintain a motivated and satisfied health workforce in resource-constrained environments. The existing research lacks comprehensive strategies, often focusing on single variables. To address this gap, a conceptual model was developed, leading to the use of a questionnaire and assessment technique for hospitals. The survey results indicated varying levels of satisfaction among clinical and nonclinical staff. Both groups were concerned about noise, humidity, and thermal comfort while highly satisfied with natural lighting, odor, and indoor air quality. In-depth analysis, including Pearson's coefficient, correlation, and regression analyses, revealed the importance of satisfaction with ambient features.

Demographics, such as age, gender, and workdays, emerged as significant factors in job satisfaction. In the future, studies should include department-specific layouts that cater to the unique requirements of an organization. The approach aims to increase efficiency, workflow and overall satisfaction by aligning the ambient features of the physical environment.

Implications for Practice

Several key issues have emerged that are critical to healthcare environments. First, examining the structured approach from the perspective of healthcare professionals and their jobs enables incorporating design aspects that complement their work environments, hence increasing their satisfaction. Second, healthcare administrators and policymakers can utilize these findings to enhance ambient conditions in healthcare facilities, promoting high-quality treatment while improving satisfaction. Additionally, the findings can help healthcare staff understand the importance of ambient conditions and their influence on health outcomes. The long-term goal should also be to examine how sustainability standards and rating systems are generalized and how they affect the satisfaction of buildings.

7.0 LIMITATIONS AND FUTURE RESEARCH DIRECTION

The key challenge in this study was the disparity of sample sizes between the two groups due to challenges faced by nonclinical workers with questionnaire comprehension, limited technical knowledge, and extended response times. Importantly, the findings of this study can be most directly applied only to private hospitals, as the built environments in other types of healthcare settings may differ significantly in factors such as infrastructure and facility design, which can vary widely, impacting how ambient features influence staff satisfaction. To enhance the depth of the analysis, correlating workstation areas with user needs and various variables will provide a comprehensive understanding of how workspace design impacts staff satisfaction and serve as a basis for further studies on design elements. The research has limitations related to generalizability, as ambient features can vary among staff across regions. Additionally, the cross-sectional study could limit the ability to capture long-term impacts of ambient features. Further research may explore physical design factors, room layout, and orientation to improve ambient conditions.

Declarations

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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