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The Effects of the Physical Environment on Operating Room Nurses

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ABSTRACT

Objective: This descriptive research has been performed to determine the effects of the physical environment on operating room nurses.
Materials and Methods: The research population consists of 246 operating room nurses working at two hospitals of the Ministry of Health, one university hospital, and five hospitals belonging to a special health group. The sample size was not calculated due to the aim of reaching the entire population. The research has been completed with 233 operating room nurses. The study collected the data using a two-part survey and analyzed the data using descriptive statistics and correlation and regression analyses.
Results: According to the results, the nurses' ages range between 20-52 years (median=30); 91.8% are female, 54.1% are married, 38.6% are licensed, and 88.4% are operating room staff nurses. The time spent working in the operating departments ranges between 1-29 years (median=4), with postgraduate work experience ranging from 1-30 years (median=9) and 60.1% working daytime shifts. The research shows statistically significant differences regarding demographic comparisons, working duration, working position, shift schedule, gender, and the mean values for the subdimensions of the Operating Room Physical Environment Survey.
Conclusion: The study has determined the subdimensions of architectural functionality, environmental safety, suitability for resting, color compatibility, and temperature and humidity control in the operating room to have positive effects on the nurses' effective use of the operating room.
Keywords: Operating room, operating room nurse, physical environment

INTRODUCTION

Operating rooms are a physical and functional environment where surgical procedures are carried out; they provide the highest level of comfort for the patient and the surgical team during surgery (1). Operating rooms' architectural design as well as the functional components of their surgical and technical equipment involve factors such as heating, lighting, ventilation, and sound that enable surgical procedures to be carried out safely and constitute the physical components of operating rooms (2). Progress in the field of surgery and innovations in technology enable positive results based on surgery and help surgical interventions be preferred more. The success of surgery is related to surgical knowledge, techniques, and skills, as well as to the quality of the care provided, with yet another factor affecting the success of surgery being the adequacy of the environment in which surgical interventions are performed (3).

The operating room environment is very important in terms of creating a suitable working area for healthcare workers and patients, as well as the instruments and devices to be used, and in terms of ensuring traffic control throughout the area (4,5). Having operating rooms be in a suitable condition in terms of architectural design, thermal conditions (temperature and humidity), ventilation, lighting, radiation safety, and fire and electrical safety is of great importance for the health professionals who work in these units (6). Operating rooms have critical importance for the treatment of diseases and should have a very different and unique structure compared to normal living environments. Providing a healthy environment

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in operating rooms not only affects surgical success but also contributes to the increased comfort of the surgical team (7). The literature states that environmental conditions such as lighting and ventilation are important factors that affect the productivity of those who work in operating rooms and that an appropriate physical design and arrangement of equipment will also positively affect the performance of the surgical team (8).

The design of operating rooms should be in a way that does not threaten patient safety and protects the staff from the risks of surgery (9). A safe healthy working environment is very important in terms of positively supporting people's work efficiency and the health and safety of employees (10). The ability of nurses to continue their work in an environment with optimum conditions brings with it an increase in work efficiency and the quality of the care provided. Experiencing negativities in this regard can also lead to a decrease in job satisfaction by reducing the quality of the care provided (11, 12). Having nurses work in a healthy environment contributes to an increase in their work efficiency and the provision of optimal care. Any negativities experienced in this process can lead to a decrease in nurses' job satisfaction by reducing the quality of the care they provide (13). For this reason, the current research has been carried out to examine the effects operating rooms have on nurses in terms of the physical environment.

Table 1: Socio-demographic and work-life characteristics of operating room nurses (N=233)

Characteristics	Number (n)	Percentage (%)
Age		
20-25	58	24.9
26-30	60	25.8
31-35	58	24.9
36-40	29	12.4
41-45	20	8.6
>45	8	3.4
Gender		
Female	214	91.8
Male	19	8.2
BMI (kg/m²)		
<18.5	18	7.7
18.5-24.9	161	69.1
25-29.9	43	18.5
30-39.9	11	4.7
>40	0	0.0
Marital status		
Married	126	54.1
Single	107	45.9
Education level		
High school	48	20.6
Associate degree	81	34.8
Undergraduate	90	38.6
Postgraduate	14	6.0
Working Position		
OR staff nurse	206	88.4
OR head nurse	20	8.6
OR training nurse	4	1.7
OR team leader	3	1.3
Working duration (years)		
≤9	118	50.6
>9	115	49.4
Working duration in the operating room (years)		
≤4	133	57.1
>4	100	42.9
Shift schedule		
Day	140	60.1
Night	3	1.3
Day/ Night	90	38.6

OR: Operating Room; BMI: Body Mass Indeks

MATERIALS AND METHODS

The research has been planned as a descriptive study to examine the effects the physical environment of an operating room has on nurses. This study develops a model by considering the variables of effective use of the operating room, architectural functionality in the operating room, lighting efficiency, environmental safety, suitability for resting, noise control, color compatibility, and temperature and humidity control with the aim of examining the effect that the variables of the physical environment have on operating room nurses' effective use of the operating room.

Data Collection Tools

The research was conducted between December 2010-March 2011 with 233 operating room nurses who agreed to participate in the research and who work in eight hospitals in Istanbul, including two training and research hospitals affiliated with the Ministry of Health, a university medical faculty hospital, and five hospitals belonging to a private health group. The data were collected by the researcher via the survey method. The data collection form was prepared by the researcher with the support of the literature and consists of two parts.

Sociodemographic Questionnaire Form

This part of the data collection form consists of 11 questions about nurses' individual characteristics and the characteristics of their professional life.

Table 2: ORPES Sub-dimensions and overall mean scores (N=233)

	Mean	SD
Effective use of the operating room	4.43	0.52
Architectural functionality in the Operating room	4.33	0.62
Lighting efficiency	4.40	0.60
Environmental safety	4.43	0.54
Convenience to rest	4.59	0.57
Noise control	3.81	1.04
Color compatibility	4.21	0.82
Temperature and humidity control	4.42	0.70
Total	**4.33**	**0.48**

SD: Standard Deviation

Table3: Findings related to the physical environment effect of the operating room nurses (N=233)

ORPES																							
Variables	**Effective use of the operating room**			**Architectural functionality in the operating room**			**Lighting efficiency**			**Environmental safety**			**Convenience to rest**			**Noise control**			**Color compatibility**			**Temperature and humidity control**		
	Mean±SD	t	p	Mean±SD	t	p	Mean±SD	t	p	Mean±SD	t	p	Mean±SD	t	p	Mean±SD	t	p	Mean±SD	t	p	Mean±SD	t	p
Gender																							
Female	4.43±0.52	0.126	0.900	4.32±0.63	0.389	0.698	4.39±0.59	0.293	0.770	4.4±0.55	0.641	0.522	4.58±0.58	0.890	0.374	3.77±1.04	2.009	0.046	4.21±0.80	0.410	0.682	4.41±0.71	0.531	0.682
Male	4.45±0.43			4.38±0.55			4.44±0.71			4.50±0.49			4.70±0.46			4.26±0.99			4.13±1.09			4.50±0.58		
Working Position																							
OR nurse	4.41±0.52	2.157	0.032	4.30±0.64	1.622	0.106	4.41±0.58	1.075	0.284	4.40±0.55	2.468	0.014	4.58±0.58	0.505	0.614	3.79±1.05	0.829	0.408	4.16±0.84	2.239	0.026	4.38±0.71	2.129	0.034
OR manager nurse	4.63±0.43			4.51±0.43			4.28±0.77			4.67±0.45			4.64±0.51			3.96±0.92			4.54±0.63			4.69±0.48		
Working duration																							
≤9yıl	4.45±0.46	0.380	0.705	4.36±0.59	0.814	0.417	4.45±0.57	1.273	0.204	4.44±0.51	0.277	0.782	4.58±0.51	0.353	0.724	3.78±1.02	0.341	0.733	4.28±0.78	1.304	0.193	4.52±0.56	2.297	0.022
>9yıl	4.42±0.58			4.29±0.65			4.35±0.63			4.42±0.58			4.60±0.64			3.83±1.07			4.13±0.87			4.31±0.80		
Shift schedule																							
Day	4.52±0.47	3.067	0.002	4.43±0.58	3.273	0.001	4.42±0.64	0.525	0.600	4.53±0.50	3.568	0.001	4.62±0.58	0.866	0.388	3.89±1.06	1.431	0.154	4.34±0.80	3.196	0.002	4.47±0.72	1.086	0.279
Day/ Night	4.31±0.56			4.16±0.65			4.37±0.55			4.27±0.57			4.55±0.57			3.69±1.00			3.99±0.82			4.37±0.64		

OR: Operating room

Table 4: The effect of the ORPES sub-dimensions on the effective use of the operating room sub-dimension

		Dependent variable: Effective use of the operating room		
Independent variables		β	t	Significance (p)
			3.490	0.001
Architectural functionality in the operating room		0.231	3.899	**<0.001***
Lighting efficiency		0.042	0.915	0.361
Environmental safety		0.201	3.483	**<0.001***
Convenience to rest		0.188	3.941	**<0.001***
Noise control		-0.015	-0.328	0.744
Color compatibility		0.294	5.736	**<0.001***
Temperature and humidity control		0.102	2.010	**0.046****
	Model F	58.901		
	R^2	0.648		
	(p)	<0.001		

Operating Room Physical Environment Survey

The researcher-created Operating Room Physical Environment Survey (ORPES) consists of 43 statements about the physical design, environmental conditions, technical equipment, and layout of the operating rooms to determine the factors of the physical environment in operating rooms. The survey was created by the researchers with the support of the literature (2-6) to determine the physical environmental factors that should be in an ideal operating room. Factor analysis was performed for reliability and Cronbach's alpha value was determined as 0.963. The answers to the statements on the survey are ranked according to a 5-point Likert-type scale, with the highest possible score given to each statement being a 5 and the lowest being a 1. As a result of the factor analysis, the most appropriate factor structure that was reached has eight factors (i.e., effective use of the operating room, architectural functionality in the operating room, lighting efficiency, environmental safety, suitability for resting, noise control, color compatibility, and temperature and humidity control) that explain 74% of the total variance.

Data Analysis

Factor analysis was used to determine whether the statements on the survey are loaded onto the relevant factors, with descriptive statistics being used for the frequency, percentages means, and standard deviations of the variables, and correlation analysis is used to determine the relationships between dependent and independent variables. Multiple regression analysis was used to test the developed model. The results have been evaluated at a 95% confidence interval and a significance level of $p < 0.05$.

Limitations of the Study

The research is limited to the population of the study, as it was carried out with the data obtained from the individuals in the study population.

Ethical Considerations

To carry out the research, an ethical compliance decision was received from on September 15, 2010, by providing information about the relevant procedures (Decision No. B.30.2. ACÜ.0.00.00.9000/679). Institutional work permits were obtained from the Healthcare Group Nursing Services Directorate, the Provincial Health Directorate, and a medical faculty of a university.

RESULTS

The distribution of sociodemographic and work-life characteristics of operating room nurses are given in Table 1. The operating room nurses' median age was determined to be 30, with most of them being female and married. Most of the nurses included in the sample were determined to have an undergraduate degree and to work in the operating room as a staff nurse on the day shift.

Mean scores for ORPES and its sub-dimensions are given in Table 2. When examining the means from the subdimensions of ORPES, the operating room nurses were observed to have scored highest on the suitability for the resting subdimension and lowest on the noise control subdimension.

Findings related to the physical environment effect of the operating room nurses are given in Table 3. It was determined that the mean score of the female nurses from the noise control sub-dimension was statistically significantly lower than the mean score of the male nurses ($p<0.05$). When the ORPES sub-dimension means are examined according to the working position; it was found that the mean score of the OR nurses in the sub-dimensions of effective use of the operating room, environmental safety, color compatibility, and temperature and humidity control was statistically significantly lower than the mean score of the nurses working in managerial positions ($p<0.05$). It was found that the mean score of the nurses with a total working duration of over 9 years in the temperature and humidity control sub-dimension was statistically significantly lower than the mean score of the nurses with a working duration of 9 years or less ($p<0.05$). And it was found that the mean score of the nurses working in the day/night shift in the sub-dimensions of the effective use of the operating room, architectural functionality in the operating room, environmental safety, and color compatibility was found to be statistically significantly lower than the mean score of the nurses who work constantly during the daytime ($p<0.05$).

The findings regarding the effect of the ORPES subdimensions on the effective use of the operating room subdimension are given in Table 4. The operating room physical environment survey model, which investigates the effects of the subdimensions of architectural functionality in the operating room, lighting efficiency, environmental safety, suitability for resting, noise control, color compatibility, and temperature and humidity control in the operating room, was found to be statistically significant ($F = 58.901$; $p < 0.01$), with the explanatory power of the model also turning out to be significant ($R^2 = 0.648$).

DISCUSSION

Operating rooms are areas upon which the patient is highly dependent and where intense stress is experienced, fast, and correct decision-making is vital, teamwork is carried out, and advanced surgical techniques are used in light of high technology and new information. The success of a surgery is directly proportional to surgical knowledge, techniques, skills, and quality of care. Another important factor in the success of a surgery is the adequacy of the environment in which the surgery is performed. Using this information, the findings obtained from this research that has been carried out to examine the effect the physical environment has on operating room nurses' effective use of the operating room will now be discussed in line with the literature.

The professional work experience of the nurses participating in the study being 9 years with the work experience of nurses in the operating room only being 4 years can be explained by how newly graduated nurses are assigned to other units before the operating room due to the specialized nature of an operating room. In addition, given that the median age of the nurses is 30 years old, they are expected to have a median work experience of 9 years. Most of the nurses being married suggest that they generally prefer to work during the day. The predominance of female nurses in this study can be explained by the labor turnover rate in specialized units such as operating rooms being lower than in other units and males not being approved to work as nurses until 2009. The findings from Sayın and Eğri also parallel the ones in this study (14).

The design and layout of the work environment have a very significant effect on increasing productivity and preventing physical injuries and the work environment should be designed according to how individuals intend to use it (13). Blegen et al.'s (15) study reported a lack of physical resources to be effective in the occurrence of undesirable events in the work environment, while Incesesli's (16) study found 57.5% of nurses to have been exposed to trauma due to negative occurrences in the physical environment, with this percentage being 34.5% in Karayemişoğlu's (17) study. The high mean for the subdimension of effective use of the operating room in the current study supports the literature and suggests that nurses' efficiency will be supported by providing operating rooms with an appropriate layout, comfortable movement, and sufficient space. Operating rooms should be built separately from other departments on hospital buildings' top or bottom floors. The reason for this is to avoid the possibility of interdepartmental contamination by separating these rooms from general hospital traffic and ensuring that they are close to surgical wards and intensive care units (18,19). Güner and Kıreker (20) observed 76.2% of the operating rooms in their study to be located on the same floor as surgical services and 57.1% on the same floor as intensive care units. This study found a high mean score for the architectural functionality subdimension regarding operating rooms and determined the location of the operating room in the hospital and its distance to other medical units to positively affect nurses' effectiveness. This result suggests easy access to other units to be beneficial for ensuring time management and preventing physical fatigue. Regarding operating room lighting, general and local lighting should be adequate and complement one another in terms of color characteristics (21). Karayemişoğlu's (17) study found 16.7% of nurses to have been negatively affected by inappropriate lighting. In parallel with Karayemişoğlu's findings, the current study has found a high mean score for the lighting effectiveness subdimension, which suggests that inappropriate lighting in operating rooms can affect nurses' effectiveness because of negative occurrences such as pain, itchiness, and increased risk of visual errors.

While environmental factors constitute 20% of occupational accidents, factors such as non-ergonomic conditions and wet/slippery floors are considered among the reasons for occupational accidents caused by the environment and pose significant risks (11). This study found a high mean score for the environmental safety subdimension. In line with this result, creating a safe and positive working environment can be said to be able to reduce occupational accidents and allow health workers to provide higher-quality care. A lack of restrooms and eating areas in operating rooms is one significant factor that affects the health of working individuals. Göktepe's (22) study found 56.3% of nurses to be concerned about being provided with a suitable environment for resting and dressing. They stated that this would positively affect their productivity. This current study also found a high mean score for the subdimension of suitability for resting, and the nurses to agree that they can work more effectively with conditions that are suitable for resting; this result also parallels Göktepe's study.

When comparing the ORPES subdimension means by gender, male nurses were found to be more affected by noise in the operating room than female nurses. Özkoç's (23) study determined female nurses to score the variable "noise in the work environment negatively affects my health and productivity" at a higher level than male nurses, which is found to be incompatible with the current findings. The results from the current study suggest that male nurses are more sensitive about noise and feel a greater negative effect from noise on their work stress. When comparing the ORPES subdimension mean scores with respect to work position, the nurses who work in managerial positions were determined to and to exhibit a more positive attitude and have statistically significantly higher means for the subdimensions of the effective use of the

operating room, environmental safety, color compatibility, and temperature and humidity control than the mean scores from the operating room nurses. This significance can be associated with the fact that nurses working in managerial positions have a wider range of duties, authorities, and responsibilities; are more knowledgeable about the operating room layout and operation procedures than those working as operating room nurses, and to be competent regarding the requirements. When comparing the ORPES subdimension mean scores according to the nurses' overall work experience, a statistically significant difference has been found between the mean score for the temperature and humidity control subdimension mean of nurses with more than 9 years of work experience and the same mean score of nurses with 9 years or less of work experience. In addition, nurses with less work experience were more often found in the operating room and to be more affected by negative occurrences regarding the temperature and humidity control applications. This significance can be explained by nurses with more than 9 years of work experience having had time to adapt to the special temperature and humidity of operating rooms and to be less affected by imbalances due to their experience in the profession. Studies indicate working in shifts or on a shift system negatively affects the physiological and psychological health of individuals; this in turn negatively affects the safety of both employees and patients. In addition, a significant relationship exists between nighttime insomnia, decreased attention span, and decreased performance regarding cognitive functions (24-26). When comparing the subdimension mean scores for the physical environment of the operating room in terms of work style, the mean scores for the subdimensions of the effective use of the operating room, architectural functionality in the operating room, environmental safety, and color suitability of nurses who work in shifts are found to be statistically significantly lower than the means of nurses who consistently work during the daytime. These findings agree with the literature. This result can also be associated with the fact that nurses working in the shift system are less affected by the problems experienced in the operating room environment due to the negative effects of shift work.

CONCLUSION

This study has examined the effects of the physical environment of the operating room on nurses and shown the physical environment of the operating room to have quite an effect on nurses' effectiveness at work. Male nurses were determined to be more affected by noise in the operating room and operating room nurses who work in managerial positions to pay more attention to processes such as the effective use of the operating room, ensuring environmental safety, color, and temperature and humidity control in the operating room. Nurses who work constantly on the day shift were determined to mostly care about the effective use of the operating room, providing architectural functionality in the operating room, environmental safety, and color compatibility. As a result, the study has determined the subdimensions of architectural functionality, environmental safety, suitability for resting, color compatibility, and temperature and humidity control in the operating room to have positive effects on the nurses' effective use of the operating room. Establishing safe working environments in operating rooms, providing appropriate physical conditions, realizing effective patient and employee traffic, regular placement of devices and instruments, and providing the necessary space and conditions for health workers to work efficiently are akin to links on a chain: If one link in this system is disrupted, negative events can be experienced in the work environment and the safety of those under the care of healthcare workers can be placed at risk. For this reason, continuously evaluating the working environment in operating rooms and identifying the conditions that adversely affect the safety of patients and employees will increase the work effectiveness and satisfaction of health workers and positively impact the quality of patient care.

Ethics Committee Approval: This study was approved by the ethics committee of Non-invasive Clinic Ethical Committee of Istanbul University Cerrahpaşa (date: 15.10.2010; no:679).

Informed Consent: Written consent was obtained from the participants.

Peer Review: Externally peer-reviewed.

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