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Levels of Physical Environment Factors and Their Impact of Worker Health in Sanliurfa Hospitals

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ABSTRACT

Background: The present research aims to investigate the noise, thermal comfort, illumination and electromagnetic field levels, the state of working environment characteristics and relationship between physical environment factors with some symptoms and stress levels of workers in hospitals in Sanlıurfa.

Materials and methods: This was a cross-sectional study. Cluster sampling was used as the sampling method. Socio-demographic form, symptom questionnaire form, stress scale were used to collect the data. In addition, measurements of physical environment factors were performed for the selected cluster. Descriptive statistical parameters were used. Spearman correlation analyses were performed between stress score and symptoms and measurements.

Results: Equivalent noise level measurementswere high in all units, but was the highest in the pediatric emergency department (85.5 Decibel).Predicted Main Vote was the highest in the dialysis unit with 1.10. Thermal comfort state of the dialysis unit was "slightly hot".Illumination was inadequate in all units except the surgery room. The unit with the highest electromagnetic field level was the Computed Tomography room (6.1 Gauss). **Conclusions:** Working environments in hospitals should be arranged. Measurements of physical environment factors should be made and management studies should be performed if the recommended levels are exceeded.

Key words: Physical environment factors,health workers, stress

INTRODUCTION

Healthcare services is one of the very dangerous areas of work with respect to occupational health and safety.[1]

Appropriate personnel placement by performing baseline job examination and efforts to ensure a "safe" workplace along with a cascade of procedures including periodical examinations are needed to protect and improve the health of healthcare workers.[2]Emphasizing this, the International Labor Organization (ILO) had announced their year 2009 theme as, "Life and health in the workplace: A basic human right".

There are many biological, chemical, physical, biomechanical and psychosocial factors that negatively affect the health of the employees in several domains of healthcare services, especially in hospitals.[3]

Low and high ambient temperature, humidity, noise, vibration, elevation, sunlight, ionizing light are the most important physical factors. Inappropriate physical environment conditions have negative impact on both the physical and mental health of the employees. [4]

National Institute for Occupational Safety and Health (NIOSH) reported that there were 29 types of physical hazard and risk in hospitals. [5]In a guideline they issued for healthcare workers, the institute emphasizes noise, heat (thermal comfort) and radiation among these physical environment factors.[6]

ILO describes 'noise' as sounds that lead to reduced hearing and impaired health or occurrence of other hazards.[4]The unit of loudness of sound is decibel and is abbreviated as "dB". [7]

The best known, most important and common effect of noise is progressive hearing loss. With its overall stress induction, it can also affect the cardiovascular, endocrine, neurological systems as well as other physical systems. Noise also makes it difficult to communicate within the work environment, to recognize impending dangers and concentrate on the work at hand. [6] In addition, low-level noise was found to increase psychological stress.[7]

The parts of hospitals that are most risky in terms of noise are dining rooms, laboratories, technical service rooms, patient admission units and nurse rooms. [7] It has been

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reported that noise in hospitals has increased to disturbing levels for patients and workers over the last 50 years. [8] Given that the noise level in a workplace in general does not remain stable over time, making noise measurements in intervals will allow for a better assessment. [9]

Thermal comfort was described in ISO 7730 as "complete mental satisfaction from the thermal environment".[10]Individual thermal susceptibility depends on environmental thermal parameters (atmospheric temperature, average radiation temperature, air velocity and relative humidity), physical activity and clothing.[3]

An environmental temperature ranging from 17ºC to 23ºC is recommended for a convenient and comfortable workplace. Good level of temperature in the working environment enhances the productivity of the personnel and reduces occupational accidents.[11] The most common complaints due to high environmental temperature are headache and overall feeling of being unwell, but easy fatigue and decreased muscle strength are also seen.[4]

Laundry room, boiler room and kitchen are acknowledged as the hot areas of the hospital, while other areas can also be hot due to inadequate ventilation and cooling systems, particularly during summer.[6]

Thermal comfort level of a working environment can be estimated through combined assessment of temperature, radiation temperature, humidity and air current. Thermal comfort measurements utilize Wet Bulb Globe Temperature (WBGT) or Predicted Mean Vote (PMV) index analytic devices.[12]

Illumination describes the amount of light falling on a given surface. More frequent occupational accidents and psychological disorders are reported in workplaces with non-optimal illumination conditions. Visual disturbances, eye fatigue, headache, ocular pain may be seen with inadequate illumination.[7]

The unit of measurement of illumination is lux (lx). Measurements can be performed on a single spot on a given point of time or the average value over a given period may be taken.[7]

Electric fields generated by stationary loads and magnetic fields generated by live loads comprise, when combined, the electromagnetic field (EMF).[13] EMF is reported to negatively affect blood pressure, ECG, heart rate, blood biochemistry and body temperature, though to a limited extent.[14] According to the World Health Organization (WHO), common symptoms that may be associated with EMF include headache, weakness, fatigue, restlessness, sleep disorders and nausea.[15] EMF unit is Tesla (T) or Gauss (G).[14]

It should be noted that electrically powered diagnostic, therapeutic and surgical devices have a very widespread use in institutions that offer healthcare, particularly in hospitals.[14]

Upper and/or lower limits for physical environment factors in hospitals have been defined by different institutions and organizations to protect worker health. However, these limits may still be exceeded to an extent that may harm worker health.

The present research aims to investigate the relationship between noise, thermal comfort, illumination and electromagnetic field levels, the state of working environment characteristics and physical environment factors with some symptoms and stress levels of workers in hospitals in Sanliurfa.

MATERIALS AND METHODS

This was a cross-sectional study and was performed between August 2014 and April 2015.

Characteristics of the Research Location: Sanliurfa was the ninth biggest city in Turkey, with a population of 1.801.980. About 40% of the population were children aged 0 to 14 years, and 3.5% were elderly people above 65 years of age.[16] According to 2013 Turkish Statistical Institute data, it was the city with the highest crude birth rate with 33 in 1.000.[17]It was taked the 73rd place among the 81 cities in terms of level of development based on education, health and economic criteria.[18]

In year 2013 report of Health Indicators in Turkish Cities, the number of hospitals per 100.000 persons was 122 in Sanliurfa, with 250 hospital beds for every 100.000. The number of specialized physicians per 100.000 persons was 48 in Sanliurfa compared to 86 in Turkey in general. The number of nurses per 100.000 persons was 98 in Sanliurfa compared to 156 in Turkey.[19]

Study population: Four public hospitals (one pediatric hospital, one gynecology and obstetrics hospital and two second-tier hospitals) and a university hospital (Harran University Research and Practice Hospital) in the city center were chosen as study sites. Individuals who provide direct healthcare (physicians, nurses, midwives, medical assistants, physiotherapists, dieticians, healthcare technicians, caregivers) and those that are involved in healthcare management (only medical secretaries)[20] were included in the study. A total of 2532 healthcare workers formed the universe of the study.

Sample Size and Sampling Method: Cluster sampling was used. Public hospitals in the city center and Harran University Research and Practice Hospital (HURPH) have a total of 67 branched outpatient clinics (OC), 52 inpatient units (IU), 22 radiology units, 18 laboratories, 17 intensive care units (ICUs), 8 electroencephalography (EEG)-electromyography (EMG) rooms, 6 emergency services, 5 sterilizations units, 5 blood centers, 4 dialysis units, 4 surgery rooms 3 physiotherapy units, 3 chemotherapy units, 3 delivery rooms, 2 endoscopy rooms, 2 nuclear medicine units, 2 extracorporeal shock wave lithotripsy (ESWL) rooms and 1 burn unit. Each unit was considered a cluster. There were 223 clusters in total.

Healthcare staff employed in each unit was taken as cluster unit. A pilot study was performed in HURPH because cluster diameters (number of persons working in each unit) changed constantly and up-to-date data was not available.

Eight clusters were included in the pilot study. Stress level was the point of interest in the universe of the study. Required cluster size was calculated as 36 from the average cluster diameter of 3.88 obtained from the pilot study, average stress of 10.95, estimated variance of 355.77 and error estimation margin of 1.5.

In addition, one cluster from each of the delivery rooms, endoscopy rooms, nuclear medicine units, burn units, ESWL rooms and chemotherapy rooms with not enough numbers to be included in the sample were also chosen. A total of 42 clusters were chosen. Clusters were selected following stratification based on the unit type and cluster number in hospitals.

The personnel in the selected cluster present in the workplaces on the day the measurements were performed were included in the study. A total of 175 healthcare workers were included in the study. After they have provided informed consents, the personnel who agreed to take part in the study were asked to complete the prepared forms under supervision. Three individuals refused to take part in the study. Rate of participation is 98.3%.

Data Collection Tools and Methods of Measurement: Socio-demographic information form, symptom questionnaire and the stress subscale of Lovibond&Lovibond Depression, Anxiety, Stress Scale (DAS) were used to collect the data. Socio-demographic information form was covered socio-demographical characteristics (age, gender, marital status, education level, number of children, chronic conditions, occupation, working time, worked unit) and characteristics of the working environment (number of persons using the worked room, availability of a room for rest, availability of a hand-washing sink, availability and number of a restroom). Symptoms included in the symptoms questionnaire were selected, with the guidance of literature information, based on their relationship with the physical environment factors which were to be measured. The sum of the items in the stress subscale of DAS gives the stress score. The validity and reliability of the scale in Turkish were established by Ahmet Akın and Bayram Çetin. Total score of stress-associated items give stress score. Scores ≤ 14 indicate normal stress level whereas ≥ 15 points indicate high level of stress. [21]

Of the physical environment factors, levels of noise, thermal comfort, illumination and EMF were measured in the selected clusters. Measurements were performed in areas where the healthcare workers in each cluster spent their time on any day of the week between 8.00 a.m and 16.00 p.m. Noise, thermal comfort and illumination devices were chosen in accordance with the ISO standards.

Noise measurement device was Extech model type 2. The device was placed fixed at the defined points of measurement at least 1 meter away from the wall and 1.5 meter away from the floor, with measurements performed for 8 hours with windows closed. The measurements were performed A-weighed in speed mode based on the Leq level.[22] The key parameters measured were Leq, L min and L max. Based on environmental noise assessment and management guideline, noise levels should not be more than 45 dB in hospitals. Assessment of measurement results was performed according to this guideline. [23,24]

Thermal comfort was measured by Delta OHM WBGT Index Analyzer. Measurements were performed according to PMV standards, with measurements performed for 20 minutes in each occasion. The key parameters measured were Temperature (T), relative humidity (RH), PMV. PMV is a thermal sensation measure that may be used to describe the level of comfort in an environment where heat transfer between the bodies of the residents and environment is assumed to be stable.[12]During calculation of PMV by the device, metabolism coefficient was taken as 1.20 and cloth coefficient as 1. The results of the measurements were evaluated according to the TS EN 7730 standards. In TS EN-ISO 7730, a PMV value between -1 and +1 is considered as normal.[10]

Illumination was measured by Extech SDL 400 model, which was performed 76 cm away from the floor[7] with the device at the mid-room, and for 2 seconds for each measurement with lx as the measuring unit. The results of the measurements were evaluated according to TS EN 12464 standards, according to which overall illumination is 1000 lx in examination and treatment rooms in clinics, surgery rooms and ICUs at bed levels, 500 lx for laboratories and dialysis unit, and illumination 300 lx for endoscopy and sterilization units.[25]

EMF measurement device was FW BELL 5170 Gaussmeter. It was ensured that each measurement lasted for 15 minutes. Gaussmeter measurements were performed at midpoint of the rooms, 90 cm above the floor. Measurements were carried out at AC mode by inserting the Hall probe to the device, with calibrations performed prior to each measurement. The key parameter for the measurements read as Gauss units was maximum magnetic flow (Hmax). The results of the measurements were evaluated according to the International Commission on Non-Ionizing Radiation Protection (ICNIRP).[26]The magnetic field value of 5 G described by the ICNIRP was taken as the limit. There are no standards regarding EMF exposure in healthcare workers in Turkey.

Statistical Analysis: All statistical analyses of the study were performed on the SPSS 20.0 software package. Descriptive statistics of percentage, median, minimum and maximum were used. Univariate analyses were performed on a confidence interval level of 95%.

Dependent variables of the study were stress and some symptoms. Environmental factors measured (noise, thermal comfort, illumination and EMF) were handled as independent variables.

Other independent variables (gender, age, marital status, education level, occupation, having children, chronic conditions, total working time in healthcare institutions, average daily working time, average weekly working time, number of staff using the worked or rested rooms, presence of a hand washing sink in the worked room, presence of a staff restroom in the worked unit) were only used to describe the universe and working environment.

- Spearman correlation analysis was performed between symptoms and noise, thermal comfort, illumination and EMF values.
- Spearman correlation analysis was performed between stress score and noise, thermal comfort, illumination and EMF values

RESULTS

Some of the socio-demographic characteristics of the healthcare workers were provided in Table 1. Of the healthcare workers, 52.6% were females, 66.9% were married, 34.8% had university degree and 40.6% were midwives/nurses. Of them, 55.4% had children and 15.4% had a chronic condition

Table 1:Some socio-demographic characteristics of the healthcare workers

	Number (N)	Percentage (%)
Education level		
Primary	3	1.7
Secondary	5	2.9
High school	21	12.0
Two-year associate's degree	59	33.7
Four-year bachelor's degree	61	34.8
Post-graduate master's degree	8	4.6
Specialty /Doctorate	18	10.3
Occupation		
Specialist physician	10	5.7
Research assistant physician	9	5.1
Midwife/nurse	71	40.6
Medical assistant	4	2.3
Healthcare technician	23	13.1
Healthcare operative	31	17.8
Medical secretary	20	11.4
Emergency medicine technician	4	2.3
Caregiver	3	1.7
Total	**175**	**100.0**

Median age of healthcare workers was 30 years (min:19, max:60), median total working time in healthcare institutions was 6 years (min:0.5, max:30), median average daily working time was 8 hours (min:5, max:24), median average weekly working time was 40 hours (min:25, max:120).

The majority of the healthcare workers were employed in inpatient units, radiology units, laboratories and outpatient clinics. Of the healthcare workers, 9.8% work in more than one unit.

The median number of staff working in the room the healthcare workers were employed were 5 (min:1, max:20). Of the workers, 53.7% had a room for rest and the median number of staff using the room the healthcare workers rested were 10 (min:1, max:20). Of the healthcare workers, 82.3% had hand washing sinks in the room they worked and 48.0% had staff restrooms. Of these staff restrooms, 21.4% were shared by men and women.

Noise values and noise levels in all units were provided in Table 2. The measured noise values varied between a minimum of 38.2 dBA and a maximum of 129.3 dBA, and Leq was the highest in pediatric emergency unit with 85.5 dBA. The levels of noise in all units were higher than the level that meets the standard.

Table 2: Values of the noise (dBA) and noise levels measured

	Leq	Lmin	Lmax	Noise Level
Ear-throat-nose (ENT) OC	62.8	41.2	87.1	High
Infectious disease OC	61.5	40.4	86.8	High
Orthopedics and traumatology OC	56.7	40.0	71.1	High
Thoracic diseases OC	65.8	42.1	87.7	High
General surgery OC	59.6	40.9	73.3	High
Pediatric diseases OC	68.9	45.3	99.5	High
Gynecological diseases OC	68.0	46.0	93.6	High
Internal diseases OC	65.7	42.2	87.2	High
Physiotherapy and rehabilitation OC	62.5	40.0	86.5	High
Cardiology IU	63.8	43.3	86.9	High
Ophthalmology IU	66.1	46.0	91.5	High
Internal sciences shared IU	64.8	48.1	93.4	High
Infant 1 IU	67.7	46.9	93.6	High
Infant 2 IU	65.0	43.2	87.5	High
Gynecological diseases IU	68.7	47.1	96.9	High
Internal diseases IU	63.5	43.9	87.4	High
Thoracic diseases IU	64.2	48.5	94.1	High
Pediatric surgery-ENT shared IU	64.7	47.3	99.3	High
Pediatric emergency unit	85.5	45.1	129.3	High
Sterilization unit	72.6	61.5	96.6	High
General ICU	65.4	50.1	92.1	High
Surgical ICU	63.6	49.6	88.2	High
Neonatal ICU	66.7	49.9	89.2	High
Biochemistry 1	66.4	44.4	94.7	High
Biochemistry 2	68.0	46.4	95.6	High
Biochemistry 3	68.6	47.2	116.4	High
Blood center	65.0	43.9	91.8	High
Radiology 1	67.8	41.2	96.5	High
Radiology 2	70.6	44.0	98.2	High
MR	63.6	42.3	89.1	High
CT	61.7	51.0	87.2	High
Nuclear medicine unit	55.2	40.1	71.8	High
Endoscopy unit	62.7	48.7	82.1	High
EMG	58.2	38.2	74.5	High
EEG	60.9	51.0	79.8	High
Dialysis unit	61.9	39.9	88.7	High
Physiotherapy unit	70.2	44.6	109.4	High
Burn unit	63.8	44.3	84.1	High
Chemotherapy unit	62.8	44.6	82.6	High
ESWL	69.4	58.9	85.1	High
Surgery room	67.8	42.1	96.6	High
Delivery room	71.6	38.7	112.3	High

T, RH, PMV values and thermal comfort levels in all units were provided in Table 3. The measured PMV values ranged between -0.81 and 1.10 with the highest PMV in the dialysis unit with 1.10. Thermal comfort was within normal ranges in all units except the dialysis unit.

Table 3: T (°C), RH (%), PMV values and thermal comfort measured

	T	RH	PMV	Thermal Comfort
ENT OC	25.0	35.3	0.51	Normal
Infectious disease OC	24.7	34.9	0.39	Normal
Orthopedics and traumatology OC	23.9	35.7	0.40	Normal
Thoracic diseases OC	22.2	37.0	0.21	Normal
General surgery OC	22.9	35.9	0.28	Normal
Pediatric diseases OC	23.0	26.7	0.27	Normal
Gynecological diseases OC	24.6	45.5	0.66	Normal
Internal diseases OC	24.9	38.9	0.41	Normal
Physiotherapy and rehabilitation OC	25.6	40.4	0.79	Normal
Cardiology IU	23.1	30.3	0.31	Normal
Ophthalmology IU	22.9	29.6	0.22	Normal
Internal sciences shared IU	20.9	47.2	-0.14	Normal
Infant 1IU	21.3	31.1	-0.10	Normal
Infant 2 IU	21.8	30.6	-0.18	Normal
Gynecological diseases IU	23.5	35.0	0.35	Normal
Internal diseases IU	22.3	37.7	0.09	Normal
Thoracic diseases IU	22.6	37.1	0.17	Normal
Pediatric surgery-ENT shared IU	22.3	37.8	0.21	Normal
Pediatric emergency unit	23.9	28.9	0.49	Normal
Sterilization unit	20.8	42.2	-0.28	Normal
General ICU	24.2	34.3	0.55	Normal
Surgical ICU	22.6	40.3	0.18	Normal
Neonatal ICU	24.3	37.1	0.57	Normal
Biochemistry 1	23.7	21.5	0.21	Normal
Biochemistry 2	21.9	30.5	-0.03	Normal
Biochemistry 3	23.6	27.5	0.24	Normal
Blood center	25.8	26.6	0.79	Normal
Radiology 1	18.3	34.5	-0.81	Normal
Radiology 2	20.8	36.8	-0.19	Normal
MR	19.5	41.3	-0.49	Normal
CT	23.6	33.1	0.38	Normal
Nuclear medicine unit	18.5	28.8	-0.71	Normal
Endoscopy unit	24.3	22.7	0.47	Normal
EMG	22.7	37.5	0.20	Normal
EEG	22.5	36.5	0.24	Normal
Dialysis unit	27.5	26.1	1.10	Slightly hot
Physiotherapy unit	22.4	47.9	0.20	Normal
Burn unit	26.0	28.0	0.61	Normal
Chemotherapy unit	23.5	35.0	0.28	Normal
ESWL	23.9	37.8	0.29	Normal
Surgery room	19.6	55.5	-0.23	Normal
Delivery room	25.8	34.8	0.86	Normal

The measured illumination values ranged between 52 lx and 1265 lx, with the highest value in the surgery room with 1265. Illumination was lower in all rooms except in the surgery room compared to the standards. The measured EMF values ranged between 0.1 G and 6.1 G, with the highest EMF in the Computed Tomography (CT) unit with 6.1 G. EMF was within normal ranges in all units except in the CT unit (Table 4).

Table 4: Illumination (lx) and EMF (G) values and status

	Illumination	Status	EMF	Status
ENT OC	331	Insufficient	0.2	Normal
Infectious disease OC	388	Insufficient	0.5	Normal
Orthopedics and traumatology OC	198	Insufficient	0.4	Normal
Thoracic diseases OC	181	Insufficient	0.3	Normal
General surgery OC	166	Insufficient	0.3	Normal
Pediatric diseases OC	127	Insufficient	0.3	Normal
Gynecological diseases OC	148	Insufficient	0.2	Normal
Internal diseases OC	182	Insufficient	0.2	Normal
Physiotherapy and rehabilitation OC	203	Insufficient	0.2	Normal
Cardiology IU	166	Insufficient	0.7	Normal
Ophthalmology IU	129	Insufficient	0.3	Normal
Internal sciences shared IU	153	Insufficient	0.7	Normal
Infant 1 IU	119	Insufficient	0.6	Normal
Infant 2 IU	122	Insufficient	0.3	Normal
Gynecological diseases IU	203	Insufficient	0.1	Normal
Internal diseases IU	228	Insufficient	0.3	Normal
Thoracic diseases IU	236	Insufficient	0.1	Normal
Pediatric surgery-ENT shared IU	242	Insufficient	0.3	Normal
Pediatric emergency unit	223	Insufficient	0.3	Normal
Sterilization unit	82	Insufficient	0.8	Normal
General ICU	465	Insufficient	0.2	Normal
Surgical ICU	288	Insufficient	0.2	Normal
Neonatal ICU	246	Insufficient	0.8	Normal
Biochemistry 1	161	Insufficient	0.7	Normal
Biochemistry 2	247	Insufficient	0.3	Normal
Biochemistry 3	141	Insufficient	0.6	Normal
Blood center	89	Insufficient	1.0	Normal
Radiology 1	82	*	0.2	Normal
Radiology 2	74	*	0.3	Normal
MR	144	*	0.5	Normal
CT	52	*	6.1	High
Nuclear medicine unit	456	*	0.4	Normal
Endoscopy unit	80	Insufficient	0.4	Normal
EMG	214	*	0.5	Normal
EEG	57	*	2.1	Normal
Dialysis unit	113	Insufficient	0.4	Normal
Physiotherapy unit	179	Insufficient	2.2	Normal
Burn unit	277	Insufficient	0.2	Normal
Chemotherapy unit	269	Insufficient	0.3	Normal
ESWL	93	*	0.7	Normal
Surgery room	1265	Sufficient	1.7	Normal
Delivery room	385	Insufficient	0.1	Normal

* Comparison standard not found

The correlation between noise, thermal comfort, illumination and EMF and some symptoms were provided in Table 5. There was a positive weak correlation between noise and headache (rho=0.172 p=0.023), a positive weak correlation between illumination and eye fatigue (rho=0.170 p=0.025), negative weak correlations between EMF stinging sensation in eyes, burning sensation in eyes, watery eyes (rho=-0.184 p=0.015) and a negative correlation with nausea (rho=-0.150 p=0.047).

Table 5: Correlation between noise, thermal comfort, illumination, EMFand some symptoms

	Thermal Comfort							
	Noise				Illumination		EMF	
	Rho	P	Rho	P	Rho	P	Rho	P
Headache	0.172	**0.023**	-0.096	0.20	0.078	0.31	-0.134	0.08
Weakness/fatigue	0.038	0.61	0.079	0.30			-0.074	0.33
Irritability/nervousness	0.046	0.55	-0.108	0.16				
Tinnitus	0.041	0.59						
Poor concentration	0.102	0.18						
Shortness of breath			-0.028	0.72			-0.080	0.29
Eye fatigue					0.170	**0.025**		
Blurred vision					0.057	0.45		
Stinging, burning sensation in eyes, watery eyes					0.100	0.17	-0.184	**0.015**
Skin allergy							-0.012	0.88
Dizziness							-0.127	0.09
Metallic taste in mouth							-0.121	0.11
Nausea							-0.150	**0.047**

Median stress score of the healthcare workers was 13 (min:0,max:39). Stress level was found to be high in 38.3% of the workers. Correlations between stress score and physical environment factors were shown in Table 6.

Table 6: Correlations between stress scores and physical environment factors

	N	Rho	P
Noise	175	0.073	0.34
Thermal Comfort	175	0.025	0.71
Illumination	175	-0.028	0.28
EMF	175	-0.083	0.74

DISCUSSION

Women were an important part of healthcare workers. Consistent with the findings of the present research, women represent 55% of the healthcare workers in a study by Urhan et al.[27] The mean age of the healthcare workers was 30 years. Likewise, in a study by İlhan,[15] healthcare workers had a mean age of 32.4±6.5 years. There are no child workers in the healthcare industry, whereas there are employees at very advanced ages in healthcare.[28] Healthcare workers had quite high levels of education. In a study by Kırcı,[29]67.6% of the healthcare worker had 2-year, 4-year and master degrees, consistent with the results of this study. Compared to many industries, workers of the healthcare industry seem to had a very high level of education. Midwives and nurses had an important place among healthcare workers. Consistent with the findings of this study, the number of midwives/nurses correspond to 37.5% of all healthcare workers according to the year 2013 Health Statistics Almanacin Turkey.[30]The median total working time of healthcare workers was 6 years.Consistent with the findings of this study, the median working time was 7.1 years in the study by İlhan.[15]

Healthcare workers shared the room they work in with many others. Surgery room, laboratory and ICUs were units with high worker load. Only half of the healthcare workers had a room for rest. Physician and nurse rooms in the clinics are used as both working and resting rooms, with no dedicated rooms for rest. In outpatient clinics, healthcare workers have no room for rest or the rooms are used by many workers. There were still working rooms where hand hygiene means were not available in the hospitals the study was carried out. Busari et al. similarly reported that 78.6% of the hand washing sinks in hospitals were accessible. [31]The persisting lack of means to meet the basic needs of workers in hospitals is thought-provoking.

Noise levels in hospitals were above the expected in all units. The average noise values measured were above the recommended noise levels.[23,24] The highest Leq (85.5 dBA) and Lmax values (129.3 dBA) were measured at the pediatric emergency unit. In a similar study, 24-hour Leq value was 68.7 dBA, with 309 readings above 80 dBA.[32] The high level of noise in the pediatric emergency unit may be due to high patient input-output and also because most of the interventions lead to the children to weeping, and due to the noises made by the aspirators and vaporizers used for treatment. The regulation on safeguarding the workers against the risks associated with noise lists the highest exposure action limit as 85 dBA. The regulation requires that ear protection is used above this noise level.[33]

The Leq value of the noise measured in outpatient clinics ranged between 56.7 dBA and 68.9 dBA, with Lmax value reaching as high as 99.5 dBA. This value was lower than the Leq values (67.1 dBA-74.4 dBA), and higher than the Lmax value (87.0 dBA) compared to the values reported in a similar study.[34] Leq values ranged between 63.5 dBA and 68.7 dBA in inpatient units. This value was higher than the Leq values (45.0 dBA-61.0 dBA, 46.0 dBA- 59.0 dBA) compared to the values reported in a similar study.[35] These high values are probably due to high load of patients and relatives in the unit. In the current state, it appears that controlling noise levels would be more difficult than controlling other factors in hospitals.

It appears that thermal comfort levels that are according to the standards have been established in hospitals. Consistent with these findings, PMV values ranged between 0.81 and 1.06 in a study by Pourshaghaghy and Omidvari.[36]Only the dialysis unit had a PMV value of 1.10. High PMV value was due to the high T value. Patients treated in the dialysis unit feel cold due to anemia and increasing the temperature in this setting increases patient satisfaction. This makes the staff in the unit feel "slightly hot" as the perceived thermal comfort of the dialysis unit. Providing thermal comfort in all units in the hospitals seems to be easier in general.

Illumination in hospitals appears to be poor in general except in surgery rooms. Overall illumination in surgery rooms were 1265 lx and above TSİ standards. [25]Because surgical procedures in surgery rooms require fine skills, high level of illumination is needed. Illumination in the units where the research was performed ranged between 52 lx and 1265 lx compared to 70 lx to 9946 lx reported by similar studies. [37,38]This difference may be due to the fact that the units measured were different and they did not meet the same standards. Improving illumination in hospitals is technically easy. However, administrative effort is necessary for having measurements taken and taking necessary actions to meet the standards.

EMF levels in hospitals appear to within normal ranges in general. EMF value was above the recommended standards, i.e. 6.1 G, only in the CT room. [27]In a similar study, EMF level varied slightly between 0.0011 G and 0.0014 G in the hospital building.[15]EMF levels were higher in the physiotherapy unit, EEG unit and surgery room although the upper limit is not exceeded. The ongoing activity of multiple devices in this unit probably contributes to this result.

Noise is known to cause some symptoms. In this study, 30.3% of the healthcare workers suffered frequently or almost always from headache, and there was a correlation between increased noise levels and increased headache severity. It is known from previous studies that noise results in headache.[39,40]

In this study, 33.7% of the healthcare workers suffered frequently or almost always from eye fatigue, and eye fatigue worsened with increased illumination level. Consistent with the results of this study, poor illumination has been described to cause eye fatigue and headache. [37,41]Similarly, another study on illumination determined a correlation between illumination level and eye fatigue.[38]

In this research, 17.2% of the healthcare workers suffered frequently or almost always from stinging, burning sensation in eyes and watery eyes. It is known that increased EMF leads to burning and watery eyes.[15] This phenomenon however has not been observed in this research. This conclusion needs to be verified by other studies.

In this research, 38.3% of the healthcare workers had high stress levels. Previous studies have reported high incidence of stress, dissatisfaction, fatigue and burn-out among healthcare workers.[42,43] Healthcare workers may occasionally be exposed to sources of stress associated with the work or working environment which may be due the lack of information and skill, high workload in a short span of time, and limited social support, depending also on the field they are functioning.

CONCLUSION

Healthcare workers work in crowded environments. There are units which lack rooms for rest, hand washing sinks and restrooms. Working environments should be designed and prepared according to the work done and the number of assigned workers.

Technical or administrative measures, as necessary, should be taken to reduce noise levels and improve illumination levels. Studies should be performed to address units that lack standards for physical environment factors.

Healthcare workers were found to have high stress levels. Practices for stress control should be performed.

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