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Study of the Intensity of Sound and Light in Faculties of Babol University of Medical Sciences

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ABSTRACT

Background and Objective: Light and brightness are the first environmental factor for any type of activity. The other physical factor that has been considered in recent years is sound. Noise/sound and light can affect the quality of human performance. Therefore, the aim of this study was to evaluate the intensity of light and sound in the Faculties of Babol University of Medical Sciences.

Methods: Among 4 selected faculties, 25 classrooms and 25 offices were randomly chosen. The intensity of light was measured (both natural and artificial). The light level was measured using the S724997 device, whose metering sensor was mounted at a height of 24 in. (60 cm) from the floor. Sound was measured in classrooms during two periods of the presence and absence of students and university staff members. The sound level was measured using a sound level meter (SLM). Data were analyzed using SPSS 22.

Findings: The mean sound intensity of the classrooms at the time of the presence and absence of individuals was 59.10 dB, 59.09 dB, and 48.53 dB, respectively, which was higher than the standard. The mean light intensity was 445.44 and 535.93 lux in the classrooms and office, respectively, which was standard.

Conclusion: The results of this study indicated that the sound level was higher than the standard at all places. The light level was near-minimum standard in most places that should be improved. Therefore, because of the importance of these two issues, the necessary measures should be taken to remove the defects.

Keywords: Faculty, Light, Sound, Intensity

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Introduction

Light and brightness are the first environmental factor for any type of activity (1). Man needs ambient light to use his most important sense of sight. A mature person uses his eyes for about 16 hours during day and night. Therefore, the level of light should be provided according to the nature, type, accuracy, and precision of work so that people can perform their duties (2). According to Nabil and Mardaljevic, high brightness throughout the day can improve human function, increase melatonin secretion, decrease body temperature at night, and ultimately improve sleep quality (3).

Strong or poor light can lead to poor consciousness and work performance, eye fatigue, headache, vision impairment, drowsiness, and physical fatigue, as well as changes in body temperature and sleep patterns, which can have psychological effects and even cause incidents (4–6). In educational settings, due to the high level of visual activities (performed most of the time during the day), attention to light and brightness, especially natural light, is very important (7). Since 83% of all learning is done through vision, if the vision is faced with a problem, a decrease in learning is created (5). Therefore, for light design, it is necessary to consider appropriate conditions for present and future needs (8).

The other physical factor that has been considered in recent years is noise (9). Sound is only an integral part of human life (10). The highest exposure of humans to sound is in urban living environments, especially in office environments, with low-frequency sounds, which often results in numerous problems such as sound discomfort and harassment, stress and anxiety, fatigue, headache, sleep disorder, and decreased mental performance. Sounds with frequencies of 20–250 Hz are known as low-frequency sounds (11).

There is sufficient evidence that the sound can cause hearing problems, blood pressure, heart diseases, harassment, sleep disturbances, and learning problems among students (12). Hearing loss is the most known undesirable noise effect (13). Although noise-induced hearing loss can be easily prevented, it is irreversible after creation and stabilization (14). Adult hearing loss is described as the 15th health problem in the world with profound effects, including the social isolation and elimination of the economic power of individuals (15). Nowadays, noise pollution is less important than other ones because the health risks caused by it are not immediately visible (16). Light and sound are important and effective physical factors in both educational and office environments, if not in accordance with standards, have adverse effects on the health of individuals. Therefore, the aim of this study was to determine the intensity of light and sound in these places.

Methods

This cross-sectional descriptive-analytic study was conducted at the Faculties of Babol University of Medical Sciences in the winter of 2017. A total of 4 faculties, including Rehabilitation, Dentistry, Par medicine, and Medicine, were studied as a sample. These faculties had 50 teaching classrooms and 58 offices, among which 25 classrooms and 25 offices were randomly selected. The number of classrooms and offices in faculties is as follows: The Dental Faculty consisted of 6 classrooms and 1 office, among which 4 classrooms and 1 office were studied. The Faculty of Rehabilitation included 9 classrooms and 7 offices, among which 6 classrooms and 4 offices were randomly selected for the study. The Faculty of Par medicine had 17 classrooms and 25 offices, among which 7 classrooms and 10 offices were randomly selected. The Faculty of Medicine had 18 classrooms and 25 offices, among which 8 classrooms and 10 offices were randomly studied. The sound level metering was carried out 3 days a week. The mean of sound pressure level (SPL) was calculated, and the obtained value was expressed as the SPL for each classroom and office. For classrooms, the sound measurement was conducted in the presence and absence of students. To determine the equivalent sound level (Leq), a 30-minute period was considered as Leq (30) for each classroom and office. The sound level was measured using a sound

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level meter (SLM; AZ8925, made in Taiwan), which was calibrated daily, and by which the measurements were made at a height of 1–1.5 m (averagely 1.2 m) from the ground in the center of the classroom and office.

Light metering could be done on sunny, cloudy, or semi-cloudy days, but in the current study, the sunny days were chosen. The light metering (artificial and natural) was carried out from 10 to 12 noon. Measurements were taken only in the center of the offices due to their limited dimensions; however, in the classrooms, they were taken at three points of the rear, middle, and front of the classroom. The mean of values was calculated and expressed as the light intensity of the classroom and office. The light level was measured using the S724997 made in Taiwan. Whose metering sensor was mounted at a height of 24 in. (60 cm) from the floor. In addition, the window-to-floor ratio as an effective parameter on light is determined for each classroom and office. Finally, the intensity of light and sound was compared with the national standard and analyzed using SPSS 22 (SPSS Inc., Chicago, Ill., USA).

Results

Classroom

The results of the sound measurement including the sound values, Max, Min, Leq in the presence and absence showed that, in the absence of students, the highest levels of sound, max, min, and Leq were related to Classroom 4 in the Paramedical Faculty (51.85 dB), Classroom 2 in the Paramedical Faculty (66.7 dB), Classroom 1 in the Paramedical Faculty (42.7 dB), and Classroom 113 in the Faculty of Rehabilitation (48.9 dB), respectively. In the presence of students, the highest levels of sound, max, min, Leq were in Classroom 314 in the Faculty of Rehabilitation (63.8%), Classroom 12 in the Faculty of Medicine (86.4 dB), Classroom 5 in the Faculty of Dentistry (45.1 dB), and Classroom 12 in the Faculty of Medicine (70 dB), respectively.

The results of the t test for sound metering in the presence of students in different faculties showed that the highest mean of sound belonged to the Faculties of Rehabilitation with 59.23 dB. graphs (1-2) show, the highest mean of max, min and Leq in the presence of students was related to the Faculty of Medicine with 79.33 dB, mean of min Dentistry with 42.37 dB and and mean of Leq Par medicine with 61.22 dB. Moreover, in the absence of students in the classroom, the highest means for max and min were 61.85 dB and 39.85 dB in the Faculties of Par medicine and Dentistry, respectively (Figure 1, 2). The results of the statistical test indicated no significant difference ($P > 0.05$). Moreover, the results of this test in the absence of students in different faculties represented that the highest mean sound level was for the Faculty of Par medicine with 49.95 dB.

Mean Leq had a significant difference with the standard ($P < 0.05$). The results of the test represented that the sound and Leq levels in all Faculties were higher than the national standard. The results of the light measurement, including the light values and window-to-floor ratio in the classrooms, are presented in Table 1. As shown, Classroom 1 in the Paramedical Faculty and Classroom 9 in the Faculty of Medicine have the min (257 lux) and max (710 lux) light, respectively. The lowest and highest window-to-floor ratios belonged to Classrooms 2 and 5 in the Faculty of Dentistry (0.04), as well as Classrooms 9 and 11 in the Faculty of Paramedicine (0.34), respectively.

The lowest mean of light was for the Faculty of Dentistry with 334.5 lux, and the lowest window-to-floor ratio was for the Faculty of Dentistry with 0.055. The results of the sound metering, including max, min, and Leq values, are illustrated in Table 2. The results demonstrated that the Presidential Room in the Faculty of Paramedicine had the highest level of sound (64.4 dB).The highest values of max, min, and Leq were related to the Personnel Office in the Faculty of Medicine (81.9 dB), Archive Room in the Faculty of Dentistry (50.1 dB), and Secretariat in the Faculty of Paramedicine (61.4 dB), respectively.

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The highest mean of max and min was associated with the Faculties of Par medicine (78.46 dB) and Dentistry (47.76 dB), respectively. The results of the t test showed that the highest mean of sound and Leq was for the Faculties of Medicine with 59.5 dB and Dentistry with 57.54 dB, representing that both values were higher than the national standard, which had no statistically significant difference with the standard level (P > 0.05). The results of the light measurement indicated that the lowest and highest levels of light were for the waiting hall in the Faculty of Dentistry (199 lux), and the max light was associated with office in the Faculty of Par medicine (1700 lux). The lowest window-to-floor ratio (zero) belonged to the Secretariat in the Head Department of the Rehabilitation Faculty and the Personnel Office in the Faculty of Dentistry with no windows (Table 3). Both the lowest mean light intensity (323 lux) and the lowest window-to-floor ratio (0.1) were related to the Faculty of Dentistry.

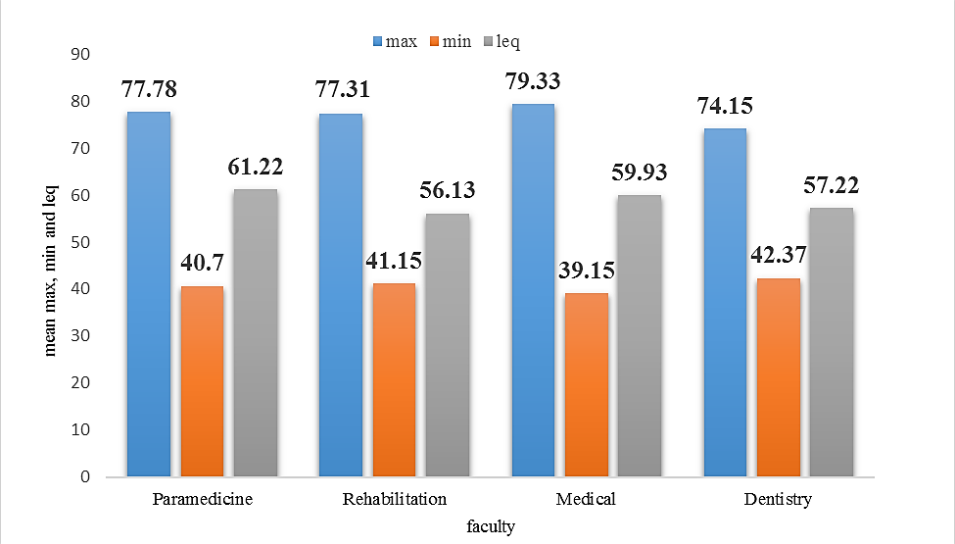

Figure 1. Mean max, min and leq in the presence of students in the classes of different Faculties

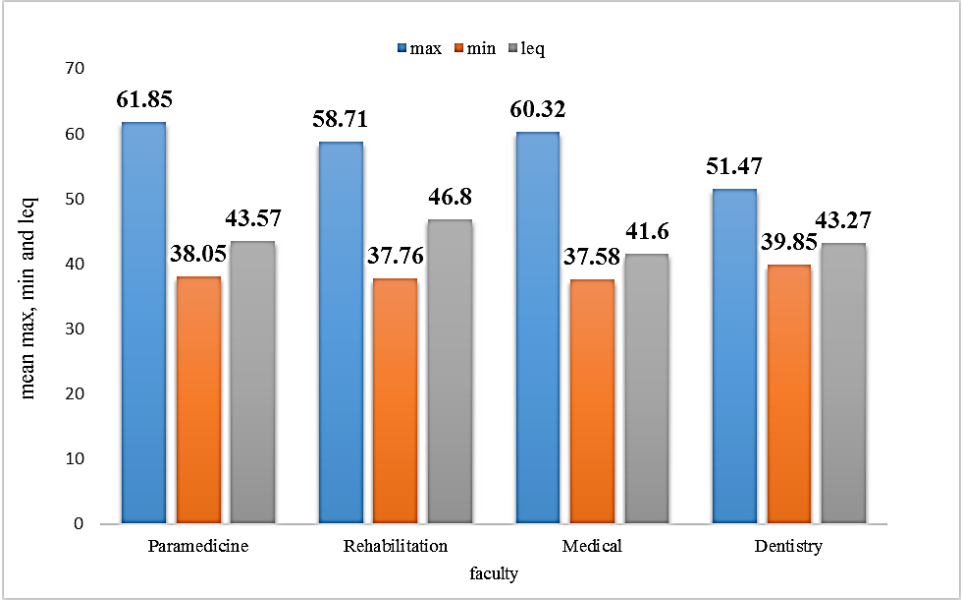

Figure 2. Mean max, min and leq in the absence of students in the classes of different Faculties

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Table 1. Light intensity and window-to-floor ratio in the classrooms of different faculties

Faculty	Classroom name	Light intensity (Lux)	Window-to-floor ratio
Paramedicine	Hall 1	460	0.19
	Classroom 2	501	0.21
	Classroom 4	330	0.21
	Classroom 6	398	0.29
	Classroom 1	257	0.09
	Classroom 11	383	0.34
	Classroom 9	409	0.34
Rehabilitation	Classroom 314	473	0.19
	Classroom 315	553	0.22
	Classroom 210	570	0.22
	Classroom 112	677	0.19
	Classroom 113	355	0.22
	Classroom 114	650	0.2
Medicine	Classroom 9	710	0.12
	Classroom 8	943	0.12
	Classroom 14	295	0.22
	Classroom 12	260	0.2
	Classroom 1	375	0.06
	Classroom 2	457	0.08
	Classroom 3	432	0.08
	Classroom 11	310	0.31
Dentistry	Classroom 2	297	0.04
	Classroom 3	376	0.07
	Classroom 4	345	0.07
	Classroom 5	320	0.04

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Table 2. Sound intensity in dB and light intensity in lux in the offices of different faculties

Faculty	Office name	Sound (dB)	Max	Min	Leq
Paramedicine	Secretariat	59.7	78.2	41.2	61.4
	Computer affairs	56.1	75.3	36.9	49.3
	Educational affairs	57.5	78.9	36.1	54.8
	Services	59.65	81.8	37.5	55.5
	Financial manager	60.2	80	40.4	53.6
	Presidency	64.4	79.4	49.4	55.8
	Educational expert	63.75	78.2	49.3	55
	Educational head	57.4	77.9	36.9	59.6
	Administrative affairs	58.7	78.4	39	59.1
	Supplier	57.6	76.5	38.7	58.3
Rehabilitation	Administrative affairs	57.55	74.2	40/9	52.5
	Supplier	61.55	79.9	43.2	57
	Educational expert	58.45	75.4	41.5	50.8
	Presidency	62.15	80.5	43.8	56.9
	Secretariat	55.4	71.3	39.5	51.9
Medicine	Supplier	58.2	81.9	34.5	55.7
	Typing	59.6	74.2	45	51.6
	Education	56.9	80.3	33.5	60.1
	Secretariat	59.95	79.9	40	60.3
	Accounting head	61	80.5	41.5	58.2
	General medical research	57.6	75.4	39.8	56.9
	Educational research	59.8	76.1	43.5	50.8
	Supplier	60	78.3	41.7	57
	Research Deputy	56.75	77.2	36.3	51.9
	Administrative affairs	56.20	75.21	37.2	52.5
Dentistry	Administrative affairs	60.5	72.5	48.5	58.6
	Waiting hall	61.85	78.2	45.5	59.8
	Archive	60.95	71.8	50.1	55.3
	Accounting	59.2	70.5	47.9	56.3
	Personnel	54.45	62.1	46.8	57.7

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Table 3. Light intensity and window-to-floor ratio in the in the offices of different faculties

Faculty	Office name	Light intensity (Lux)	Window-to-floor ratio
par medicine	Secretariat	447	0.14
	Computer affairs	225	0.35
	Educational affairs	500	0.35
	Services	380	0.17
	Financial manager	266	0.35
	Presidency	950	0.54
	Educational expert	460	0.35
	Educational head	1650	0.35
	Administrative affairs	1700	0.35
	Supplier	470	0.35
Rehabilitation	Administrative affairs	550	0.36
	Supplier	665	0.26
	Educational expert	990	0.26
	Presidency	561	0
	Secretariat	573	0.36
Medicine	Supplier	497	0.3
	Typing	432	0.23
	Education	220	0.12
	Secretariat	415	0.23
	Accounting head	480	0.28
	General medical research	285	0.14
	Educational research	245	0.17
	Supplier	637	0.15
	Research Deputy	475	0.23
	Administrative affairs	490	0.23
Dentistry	Administrative affairs	457	0.21
	Waiting hall	199	0
	Archive	380	0.18
	Accounting	358	0.11
	Personnel	221	0

Discussion

Classroom

The results of the comparison of sound and Leq with the standard level in the absence of students in each faculty suggested that in all faculties, the sound level and mean Leq were higher than the national standard (40 dB for sound and 35 dB for Leq), and the results of the statistical test indicated no significant difference with the standard ($P > 0.05$). In the presence of students, the sound intensity was

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higher than the standard. A study (2009) was conducted by Alizadeh et al. in elementary schools of Sari City (Iran) to investigate noise pollution. The results exhibited that the SPL mean was 62.28 ± 5.86 and 74.31 ± 5.36 dB in the classroom with the presence and absence of students in all schools, respectively, which was higher than the national standard, indicating similar results to ours (17). The difference of sound level during the presence and absence of students in the classroom was about 10 ± 0.55 dB, representing a natural difference, which could be due to the conversation of students, the sound of professors during teaching, and the number of people in the classroom. Golmohamadi (2005) studied the noise pollution of schools and ways to remove it and concluded that the background Leq mean was 39.41 dB during teaching hours in elementary, guidance, and high schools; also, the Leq mean was 71.98 dB in the mentioned schools, which were higher than the standard level; thus, his results are accordance with those of the current study (18).

The results of the statistical test illustrated that 28% and 72% of the classrooms had inappropriate and appropriate light, respectively. In addition, 48% and 52% of the classrooms had an appropriate and inappropriate window-to-floor ratio, respectively. Moreover, Ghotbi Ravandi et al. evaluated the intensity of light and ultraviolet radiation in the libraries of Kerman University of Medical Sciences in 2011 and found that like the present study, the overall light intensity in 28.57% of reading rooms was less than the national standard (6). Besides, another study was also conducted by Golmohammadi et al. to assess the indoor light intensity in the girls' schools of Hamadan in 2014; they expressed that less than 25% of the total study sites had favorable lighting conditions, which are inconsistent with the results of the current study (19).

Office

The results of the present study indicated that the mean level of sound and Leq was higher than the max permissible national standard (sound: 45 dB and Leq: 40dB), which according to the statistical test, had no significant difference with the standard level. Comparison of the measured values of the light and window-to-floor ratio represented that the light values did not have a significant difference with the standard level (200–500 lux), but for the window-to-floor ratio, the results of this comparison suggested a significant difference with the standard level ($P < 0.05$). Gholami et al. evaluated the appropriateness of light in the workplace and its effect on performance improvement and the reduction of human error in 2013. Their results showed that the light intensity mean was 190 and 251 lux for sections I and II, respectively, while the standard light intensity was about 200–500 lux; therefore, these results are similar to the measurement results in some sites of the current research (20). The indoor and environmental artificial light of hospitals in Hamadan was evaluated in 2013 by Golmohammadi et al.; they stated that the average light intensity of the indoor space was 90.44 ± 46.97 lux, which was lower than the national recommended level (8).

Conclusion

Considering the high level of sound in all studied places, it can be concluded that the rate of noise pollution in the classrooms and offices of Babol University of Medical Sciences is considered a serious problem, which should be solved through planning and necessary measures. The light level in most sites was close to the min permissible national standard, which was not optimal and could be improved. The window-to-floor ratio in most places was below the standard level, which is considered as a problem in providing the natural light and requires more attention and redesigning the classrooms and offices. The results of this study demonstrated that the most important factors in creating noise in the studied places are the noise of the heating and cooling systems and other equipment in the building, the establishment of offices and classrooms in one building, and the voice of people, such as maintenance staff members and students. In the case of light, our results indicated that the most important factors of the lack of

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appropriate light in some places were related to the lack of natural light (window-to-floor ratio), lack of proper layout, and insufficient number of light sources, which should be improved.

Authors' Contributions

All authors contributed equally and participated in the data collection, analysis, and interpretation. All authors critically reviewed, refined, and approved the manuscript.

Compliance with Ethics Guidelines

The authors certify that this manuscript is the original work of the authors, all data collected during the study are presented in this manuscript, and no data from the study has been or will be published separately.

Competing Interests

The authors declare that they have no conflict of interests.

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