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Evaluation of educational environment using the short-version Postgraduate Hospital Educational Environment Measure (PHEEM): A multicenter study

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Abstract:

BACKGROUND: The quality of the educational environment (EE) influences residents' achievement of learning outcomes and their professional development. The purpose of this study was to evaluate the EE using the short-version Postgraduate Hospital Educational Environment Measure (PHEEM) and compare residents' perceptions in total and subscale PHEEM according to their age, sex, residency year, and specialty.

MATERIALS AND METHODS: This multicenter cross-sectional study was conducted at 12 teaching hospitals affiliated with the Tehran University of Medical Sciences. We recruited residents from 24 specialties and from the first to third/fourth residency years. Data were collected using the short-version PHEEM, which consists of 12 items with three subscales: senior doctor support and teaching skills (4), conditions of working and time to learn (4), and lack of harassment (4). The association between scores in total and each subscale with sex, residency year, and specialty was assessed.

RESULTS: In total, 538 residents from 24 specialties completed the questionnaire. Most participants were from internal medicine ($n = 72$, 13.4%). A total of 347 (64.5%) participants were females. The total PHEEM score was 20.60 (standard deviation (SD) 5.44) out of 48, with occupational medicine residents giving the highest scores and forensic medicine residents the lowest. The mean scores for the dimensions of senior doctor support and teaching skills were 7.55 (SD 2.87), for conditions of working and time to learn 6.08 (SD 3.94), and 6.95 (SD 3.22) for lack of harassment. There was no significant difference in total PHEEM scores for males and females. However, significant differences were found in subscales by sex. There were no statistically significant differences in residents' perceptions of the EE (total and subscales) according to their residency years, but there were significant differences between the specialties ($P < 0.001$).

CONCLUSIONS: The EE of the residency training program during COVID-19 was perceived to have plenty of problems that need immediate attention and follow-up.

Keywords:

COVID-19, educational environment, evaluation, PHEEM, postgraduate trainees, residents

Introduction

The educational environment (EE) is a determining factor in creating motivation for learning.^[1] While the literature describes the importance of EE, it

often needs a comprehensive explanation of what constitutes this environment.^[2] The EE includes the learner characteristics, interpersonal interactions and social dynamics, organizational culture and regulations, and surrounding physical

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and virtual spaces that synergistically help to motivate engagement toward acquiring knowledge and learning.^[3,4]

The quality of the EE is considered to be crucial for postgraduate medical education,^[5] as it is in this context that medical students apply theoretical knowledge to practice, acquire clinical skills, and develop problem-solving and clinical reasoning skills.^[6] A positive EE in which medical residents are supported, adequately supervised, and nurtured is likely to lead to better workplace learning,^[7] enhanced professional satisfaction, reduced stress and burnout,^[8-11] and improved patient care.^[12] However, the EE is not always optimal for learning because of clinical productivity expectations, a lack of support from instructors or supervisors, and a lack of culture that supports learners.^[6,13,14-17]

The research has shown that an unfavorable EE can decrease the quality of clinical education.^[18] The medical residency program has a unique position in Iran's healthcare system, with an annual admission of more than 4,000 residents in 35 medical universities. The length of the training is three to five years, depending on the types of specialties.^[19] The weekly working hours of residents seem more than in other countries.^[20,21] For example, the duty hours of a first-year internal medicine resident are 92 hours per week, while for Canadians and Europeans, 72–84 hours.^[21] The situation can worsen when unexpected circumstances like the COVID-19 pandemic occur.^[14,22,23] This issue highlights the need to evaluate the EE and then improve the quality of the clinical training environment.

Several instruments have been developed to measure the quality of the EE.^[24] However, these were not constructed for the primary purpose of gauging the quality of the Postgraduate Hospital Educational Environment. The proposed tool for the specific environment of residents' education in hospitals is the Postgraduate Hospital Educational Environment Measure (PHEEM) questionnaire. The PHEEM is a well-known instrument for assessing EE in residency training. The classic form of the questionnaire consists of 40 items categorized into three subscales: perceptions of role autonomy (13 items), perceptions of teaching (15 items), and perceptions of social support (12 items).^[25] The inventory has been used worldwide, demonstrating high reliability yet controversial subscales' confirmation.^[26,27]

However, due to the particular characteristics of the hospital environment, the variety of patients, high volume of patients, shift full of patients, long shifts, the complexity of the environment, and the high workload of the residents,^[28,29] residents usually do not have much desire to answer the questionnaire with many and long items. Consequently, the need for a

short-form questionnaire to evaluate the EE seems necessary. The results of the experimental study have shown that shortening a relatively lengthy questionnaire significantly increased the response.^[30]

One of the proposed tools in this field is the short-version PHEEM.^[17,31] Wall *et al.* (2009)^[17] reexamined the characteristics of PHEEM and its three subscales, recruiting large samples from several countries. The authors conceptualized the three subscales: perceptions of senior doctor support and teaching skills, perceptions of working conditions and time to learn, and perceptions of lack of harassment, each with four items. Surprisingly, a few studies employed the new version of PHEEM. Bose *et al.* (2013)^[31] used the questionnaire as a short-version PHEEM and specified its Cronbach's alpha reliability coefficient at 0.68. The short version seems suitable for medical residents when the time is limited and the patient care burden is high. So, it was chosen for the current study.

The purpose of this study was to evaluate the EE using the short-version PHEEM and compare residents' perceptions in total and subscale PHEEM according to their age, sex, residency year, and specialty.

Methods and Materials

Study design and setting

This multicenter cross-sectional study was conducted at 12 teaching hospitals affiliated with the Tehran University of Medical Sciences (TUMS). Data were collected at the onset of the COVID-19 pandemic in Iran between January and February 2019. After obtaining informed consent, the questionnaire was given to participants in person. A week later, SMS or text message reminders were sent to the residents who had not yet responded for the first time.

Study participants

Participants were residents in training at TUMS. We used the convenience sampling method, and participants were selected based on availability and willingness to take part. We selected residents from all residency years (PGY1, PGY2, PGY3, and PGY4) and specialties. Residents who had spent at least six months of their residency were included.

Data collection and measurement

After obtaining informed consent, the questionnaire was given to the residents in person. A week later, SMS or text message reminders were sent to the residents who had not yet responded for the first time. The short-version PHEEM with 12 items organized in three subscales was used to collect data. This study used the Persian version of the questionnaire, which

demonstrated good validity and reliability ($\alpha = 0.83$) in a previous study.^[32] Demographic characteristics of residents, including sex, age, residency year, specialty, and training hospital, were also gathered. Participants responded to each item based on a 5-point Likert scale (strongly disagree: 0 to strongly agree: 4). Two items contained negative statements (9 and 10), and we inverted their scores on the scale. The maximum possible total and subscales scores were 48 and 16, respectively. Table 1 shows the interpretation of the total, subscales, and item scores for short-version PHEEM.

Statistical analysis

Categorical and continuous variables were summarized through frequency (in count and percentage) and mean \pm SD, respectively. A one-way ANOVA was applied to assess the association between scores in total PHEEM and each subscale with residency year and specialty. Tukey *post hoc* test was used in multiple comparisons. We used an independent sample *t*-test to compare the mean of total PHEEM and subscales by sex. In adjusted assessments, a multiple linear regression model was applied. All analyses were performed using IBM SPSS statistics for Windows version 24.0, and a *P* value <0.05 was considered to be statistically significant.

Ethical consideration

This study was approved by the Ethics Committee of Tehran University of Medical Sciences (IR. TUMS. MEDICINE. REC. 1398. 501). All methods were carried out according to relevant guidelines and regulations.

Results

The aim of this study was to evaluate the EE using the short-version PHEEM and compare residents' perceptions in total and subscale PHEEM according to their age, sex, residency year, and specialty. Therefore, the results are presented based on the above objectives.

Demographics

Out of 548, 538 (response rate = 98%) residents from 24 specialties distributed in 11 different hospitals completed the short-version PHEEM measure. Participants' characteristics are summarized in Table 2. A total number of 347 (64.5%) of participants were females. Participants were distributed among residency years. The mean age of the participants was 32.2 ± 4.9 years (range 26–57 years). Most participants were from internal medicine ($n = 72$, 13.4%) and Imam Khomeini Hospital ($n = 187$, 34.8%).

Main results

Table 3 presents the mean and SD for items, subscales, and total questionnaire. The total PHEEM score was

Table 1: Interpretation of the scores of short-version PHEEM inventory

Questionnaire's parts	Maximum score	Score interpretation
Total PHEEM	48	0–12: very poor 13–24: plenty of problems 25–36: more positive than negative but room for improvement 37–48: Excellent
Subscales		
Senior doctor support and teaching skills	16	0–4: very poor 5–8: in need of some retraining 9–12: moving in the right direction 13–16: model teachers
Conditions of working and time to learn	16	0–4: very poor 5–8: a negative view of one's role 9–12: a more positive perception of one's role 13–16: Excellent
Lack of harassment	16	0–4: non-existent 5–8: not a pleasant place 9–12: more pros than cons 13–16: a good supportive environment
Item	4	0–1: very poor 1–2: plenty of problems 2–3: room for improvement > 3–4: Excellent

20.60 (5.44), with scores of 7.55 (2.87) on senior doctor support and teaching skills, 6.08 (3.94) on conditions of working and time to learn, and 6.95 (3.22) on lack of harassment. The item with the highest score was "I have to perform inappropriate tasks" (mean = 2.33), and the item with the lowest score was "There is ethnic discrimination in this post" (mean = 1.08).

There was no significant difference in total PHEEM scores for males and females (21.03 ± 5.63 vs. 20.36 ± 5.32 , $P = 0.17$). However, significant differences were found in all three subscales. Hence, males were better than females in senior doctor support and teaching skills and conditions of working and time to learn subscales, and females reported higher scores than males for lack of harassment [Table 4]. There were no significant differences in residents' perceptions of the EE (total and subscales) according to their residency years (PGY-1 to PGY-4) but significant differences in total PHEEM and subscales scores between the specialties ($P < 0.001$). The total test scores for occupational medicine were significantly higher than pathology, internal medicine, obstetrics and gynecology, anesthesia, and cardiovascular ($P < 0.05$).

The adjusted association between total PHEEM and subscales and independent variables is presented in Table 5. The results for total PHEEM and subscales were similar to crude analyses.

Table 2: General demographic characteristics of residents ($n=538$)

Variable	Number (%) or mean \pm SD
Age	32 \pm 4.9
Sex	
Female	347 (64.5)
Male	191 (35.5)
Residency Year	
PGY-1	164 (30.5)
PGY-2	151 (28.1)
PGY-3	140 (26.0)
PGY-4	83 (15.4)
Specialty	
Pathology	21 (3.9)
Orthopedics	21 (3.9)
Urology	13 (2.4)
Anesthesia	26 (4.8)
Radiation oncology	15 (2.8)
Forensic medicine	6 (1.1)
Sports medicine	8 (1.5)
Nuclear medicine	18 (3.3)
Dermatology	29 (5.4)
General surgery	25 (4.6)
Neurosurgery	15 (2.8)
Ophthalmology	36 (6.7)
Internal medicine	72 (13.4)
Neurology	14 (2.6)
Radiology	33 (6.1)
Psychiatry	23 (4.3)
Obstetrics and Gynecology	43 (8.0)
Emergency medicine	14 (2.6)
Occupational medicine	16 (3.0)
Infectious diseases	24 (4.5)
Cardiovascular	39 (7.2)
Otorhinolaryngology	11 (2.0)
Family medicine	6 (1.1)
Physical medicine and rehabilitation	10 (1.9)
Hospital	
Imam Khomeini Hospital Complex	187 (34.8)
Sina Hospital	71 (13.2)
Shariatee Hospital	123 (22.9)
Farabih Hospital	36 (6.7)
Razi Hospital	29 (5.4)
Roosbeh Hospital	23 (4.3)
Baharlo Hospital	22 (4.1)
Ziaieian Hospital	6 (1.1)
Yas Hospital Complex	11 (2.0)
Arash Women Hospital	8 (1.5)
Amiralam Hospital Complex	17 (3.2)
Tehran Heart Center	5 (0.9)

Table 3: Descriptive statistics of short-version PHEEM inventory ($n=538$)

Item	Mean \pm SD
Subscale 1: Senior doctor support and teaching skills	7.55 \pm 2.87
1. My clinical teachers have good mentoring skills	1.91 \pm 1.00
2. I get regular feedback from seniors	1.88 \pm 0.91
3. My clinical teachers provide me with good feedback on my strengths and weaknesses	1.87 \pm 0.88
4. Senior staff utilize learning opportunities effectively	1.91 \pm 0.89
Subscale 2: Conditions of working and time to learn	6.08 \pm 3.94
5. My hours conform to the New Deal	1.54 \pm 1.18
6. I have protected educational time in this post	1.57 \pm 1.12
7. My workload in this job is fine	1.30 \pm 1.21
8. I have a contract of employment that provides information about hours of work	1.69 \pm 1.22
Subscale 3: Lack of harassment	6.95 \pm 3.22
9. There is ethnic discrimination in this post	1.08 \pm 0.98
10. There is sex discrimination in this post	1.58 \pm 1.20
11. I have to perform inappropriate tasks	2.33 \pm 1.10
12. I am bleeped inappropriately	1.98 \pm 1.09
Total PHEEM	20.60 \pm 5.44

sample size distributed in 24 specialties and different years of residency. Chan *et al.* (2016)^[26] reported that of 30 papers included in their review, three studies examined EE in more than one residency program. Despite its good psychometric properties, we used the short-version PHEEM, which is yet to be considered in the medical education literature. The short version of the questionnaire can be an appropriate tool for evaluating EE in residency training with a high workload and when the assessment of EE is frequently considered.^[33]

One of the advantages of PHEEM is that it allows program administrators to highlight the weaknesses and strengths of the program. Using the published guide to interpret mean scores, in this study, we found that the mean total score of the questionnaire was 20.60, reflecting an EE with plenty of problems for residents. The exact cause may not be evident from this study but may be due to higher expectations from EE by the residents. Regarding subscales, perceptions of senior doctor support and teaching skills indicated that medical teachers need retraining for better mentoring, feedback giving, and using learning opportunities appropriately. The conditions of working and time to learn highlighted a negative view of hours of work, educational time, and workload, and perceptions of lack of harassment reflected an unpleasant environment. At the item level, it was found that the clinical teacher's mentoring skills, lack of regular and constructive feedback from clinical supervisors, long working hours, inefficient use of educational time, heavy workloads, absence of racism, absence of sexism, and lack of being bleeped inappropriately were significant issues for trainees. These issues and others with a mean score of less than 2 are potential caveats in the training program that require immediate remedial action.^[31]

Discussion

This study evaluated the Iranian postgraduate medical residents' point of view regarding the EE at the onset of the COVID-19 pandemic, recruiting a large

Table 4: Mean score difference test of PHEEM among sex, residency years, and Specialty

Variables	Mean±SD			
	Total	Senior doctor support and teaching skills	Conditions of working and time to learn	Lack of harassments
Sex				
Male	21.0±5.6	8.0±2.8	6.5±3.9	6.4±3.2
Female	20.3±5.3	7.2±2.8	5.8±3.9	7.2±3.2
<i>P</i>	0.177	0.004	0.042	0.006
Residency years				
PGY-1	20.7±5.9	7.5±3.1	6.3±4.2	6.7±3.4
PGY-2	20.8±5.4	7.5±2.8	6.0±4.1	7.2±3.2
PGY-3	20.0±4.9	7.3±2.6	5.8±3.4	6.8±2.8
PGY-4	20.9±5.1	7.8±2.6	6.1±3.7	6.9±3.3
<i>P</i>	0.584	0.750	0.737	0.557
Specialty				
Pathology	18.80±4.51	6.28±3.63	4.38±3.80	8.14±3.22
Orthopedics	20.42±8.66	8.38±3.20	5.23±4.72	6.80±3.31
Urology	18.46±3.82	7.76±3.03	3.46±2.75	7.23±3.00
Anesthesia	18.92±5.85	7.38±2.85	3.84±3.47	7.69±3.86
Radiation oncology	20.40±5.38	7.86±3.02	8.00±4.05	4.53±3.06
Forensic medicine	17.33±5.12	6.50±4.27	5.16±2.92	5.66±2.50
Sports medicine	24.50±3.46	8.75±1.90	9.87±2.85	5.87±1.80
Nuclear medicine	23.27±3.87	8.27±2.08	9.50±2.40	5.50±3.18
Dermatology	20.48±4.21	5.72±2.80	5.86±2.68	8.89±2.96
General surgery	19.20±5.09	6.60±3.08	3.08±3.49	9.52±3.35
Neurosurgery	19.80±7.22	7.40±3.15	6.00±3.96	6.40±2.26
Ophthalmology	21.61±4.29	7.86±2.31	7.22±3.13	6.52±2.67
Internal medicine	19.27±5.52	6.94±2.76	4.84±3.31	7.48±2.73
Neurology	21.78±2.83	8.14±1.56	7.28±1.77	6.35±2.30
Radiology	22.24±3.25	8.45±1.41	7.63±3.64	6.15±2.45
Psychiatry	22.56±4.66	7.86±2.41	8.00±3.08	6.69±2.81
Obstetrics and Gynecology	18.51±6.37	6.44±3.05	3.76±3.51	8.30±2.99
Emergency medicine	22.64±4.66	9.57±2.87	8.64±2.73	4.42±3.13
Occupational medicine	25.18±5.03	8.06±2.04	11.06±3.33	6.06±3.64
Infectious diseases	21.62±5.96	9.33±3.77	6.91±4.47	5.37±3.25
Cardiovascular	19.20±5.04	7.46±2.51	5.00±3.53	6.74±3.29
Otorhinolaryngology	23.18±5.91	9.63±1.56	5.00±4.09	8.54±3.17
Family medicine	22.00±5.01	8.00±3.28	10.16±1.94	3.83±3.31
Physical medicine and rehabilitation	23.70±2.49	8.20±2.82	10.60±1.95	4.90±3.31
<i>P</i>	<0.001	<0.001	<0.001	<0.001

Table 5: Multiple regression of PHEEM and subscales

Independent variables	Total PHEEM		Senior doctor support and teaching skills		Conditions of working and time to learn		Lack of harassments	
	Beta	<i>P</i>	Beta	<i>P</i>	Beta	<i>P</i>	Beta	<i>P</i>
Sex	-0.080	0.070	-0.142	0.001	-0.113	0.009	0.131	0.003
Age	0.002	0.958	0.018	0.676	0.035	0.416	-0.055	0.203
Residency year	-0.007	0.873	0.011	0.806	-0.027	0.531	0.012	0.786
Specialties	0.121	0.006	0.121	0.006	0.168	0.000	-0.109	0.013

In comparison with the Bose *et al.*^[31] study, conducted in Germany, we found a lower total score for short-version PHEEM (20.60 vs. 28.64) and lower scores in the lack of harassment subscale (6.95 vs. 12.27) and all items. We also found a lower score in the other two subscales compared to the Bose *et al.*^[31] study, but the score categories were the same. Our results may indicate the conditions imposed

by the pandemic on residency training. Given the lack of studies to compare the perceptions of participants' groups employing the short-version PHEEM, our results can be considered in the context of using classic PHEEM. Lin *et al.* (2021)^[34] reported that students' overall perception of their EE was more positive after the onset of COVID-19, but their social self-perceptions improved the

least. In the study of Shakibi *et al.*^[35] at Urmia University of Medical Sciences, the resident's perception of EE was evaluated with many problems. According to what has been mentioned, more research is needed to compare whether the EE has changed after the decrease of the coronavirus.

Comparing residents' perceptions in total PHEEM according to their sex showed that there is no statistically difference in responses between the two genders. Some studies^[4,35,36] showed that males mentioned better perceptions of EE, while others showed that females reported better perceptions^[37] or reported no differences between males and females.^[12,37-43] Regarding subscales, we witnessed statistically significant relations between all three subscales and sex. Male residents ranked senior doctor support and teaching skills, working conditions, and time to learn higher than female residents, and these differences were statistically significant ($P < 0.05$). The results were the opposite for the lack of harassment subscale. This result is similar to the study done at Addis Ababa University.^[44] Shimelis and Martimianakis^[44] documented that differences between male and female residents in perceiving EE can be attributed to many factors. Frequently, our societal culture creates a disparity in the workplace between males and females. That may influence how both genders perceive the environment of work.

Regarding the residency year, there were no significant differences in total and subscale scores between residency years. There are controversies on PHEEM score differences based on residency year in the literature. While many studies found no significant difference in PHEEM scores between years of residency,^[38,39,43,45,46] Fisseha *et al.*^[47] and Shakibi *et al.*^[35] demonstrated that the total mean PHEEM was significantly higher in first-year residents than in the second- or third-year residents. The total score obtained in Kanashiro *et al.*^[48] study did not show a difference between the junior and senior year residents in their understanding of the EE, although the workload/supervision/support scores of the junior year residents were lower. The difference in responses from first year and final year of training is yet to be seen. Although it is expected that residents in the final residency stages have more ability to judge the program, the stage of the program did not affect how residents perceive their EE. Also, these results may have been due to the same access to educational opportunities at different levels of training. Similar results were also seen in another study.^[36]

Regarding the specialty, there were significant differences in total and subscale scores between specialties. Some studies showed significant differences in total and subscale scores between specialties.^[4,9,49] However, in the

study by Bari *et al.*,^[45] there were no significant differences in total and subscale scores between the specialties. We found that the highest total score for short-version PHEEM was noted in occupational medicine, and the lowest score was observed in forensic medicine. Otorhinolaryngology residents evaluated the subscale of senior doctor support and teaching skills better than residents of other specialties, while occupational medicine residents rated the working conditions and time to learn higher than other residents, and interestingly, general surgery residents scored lack of harassment greater than residents from other specialties. In the study of Shakibi *et al.*,^[35] the urology field demonstrated the lowest and the neurosurgery field indicated the highest total score. The neurosurgery field scored highest in all three subscales. A systematic review of 30 studies from 14 countries documented that PHEEM scores significantly differed between levels of training, disciplines, and clinical training sites.^[26] That explains that there is variability in perception about training not only between hospitals but also within different disciplines and departments within the hospitals. The importance of the general climate at the training hospital and the internal climate within each department has a significant effect on the quality of the EE.^[50] Also, the possible differences in such variations could be the experience and number of staff, different workloads residents handle in each subject, and teaching methods applied and implemented.

Limitations and recommendation

Our study had some limitations. We needed the follow-up of COVID-19 to see if the situation had changed. Therefore, it is suggested to investigate this issue in future research. Also, to determine the effect of the pandemic on the EE, more research is required, with a need for qualitative and quantitative studies. It will also be essential to find reasons for significant differences in total PHEEM scores among the sexes, levels of training, and specialties.

Conclusions

This study is a multicenter cross-sectional study with an adequate sample size that has used a short-version PHEEM to assess the EE of postgraduate medical training in Iran. Overall, the EE of the teaching hospitals could have been more satisfactory. Significant challenges in the EE of the teaching hospitals were identified. So, there is much room for improvement. We recommend taking measures to improve the quality of the EE of the hospitals, particularly in the specialties with lower PHEEM scores, so that residents may benefit. Since hospitals are complex environments where treatment and education co-occur, it may be enhanced by conducting regular evaluations of residency programs by short-version PHEEM.

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Conflicts of interest

There are no conflicts of interest.

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