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Perception of the clinical learning environment among cardiology residents: A PHEEM-based cross-sectional study in a Moroccan university hospital

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Abstract

Background: The hospital learning environment quality is a key determinant of postgraduate medical training outcomes. The PHEEM is a validated 40-item instrument widely used to evaluate residents' perceptions of their clinical training environment. No study has previously assessed the learning environment among cardiology residents in Morocco.

Methods: A cross-sectional survey was conducted in February 2026 at Ibn Sina University Hospital, Rabat, Morocco. All cardiology residents were invited to participate, yielding a response rate of 86.1% (130/151). The French-language validated PHEEM was distributed electronically. Global and subscale scores were computed for perception of role autonomy, teaching, and social support. Internal consistency was assessed using Cronbach's alpha and group comparisons by one-way ANOVA.

Results: The mean global PHEEM score was 82.43 ± 19.42 out of 160, placing the learning environment in the "more positive than negative" category. Subscale scores were 30.20 ± 8.18 out of 56 for autonomy, 32.15 ± 8.09 out of 60 for teaching, and 20.08 ± 5.24 out of 44 for social support. Internal consistency was excellent (Cronbach's $\alpha = 0.928$). No significant differences were found by year of residency ($F = 0.650$, $p = 0.584$) or subspecialty interest ($F = 1.500$, $p = 0.195$). However, role autonomy differed significantly across subspecialty groups ($F = 2.730$, $p = 0.022$), with heart failure residents scoring highest and cardiac imaging residents lowest.

Conclusion: Cardiology residents perceived their learning environment positively overall, though social support was the most deficient domain. Subspecialty-specific disparities in autonomy warrant targeted interventions within imaging-oriented training tracks.

Keywords: Clinical Learning Environment; Postgraduate Medical Education; Cardiology Residency; PHEEM; Morocco

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1. Introduction

The clinical learning environment is a central determinant of postgraduate medical education quality. A stimulating and well-structured training setting promotes clinical competence, professional identity formation, and trainee satisfaction, while a deficient one has been consistently linked to burnout, suboptimal patient care, and reduced training outcomes. Evidence from large national surveys suggests that the quality of the learning environment as perceived by residents is a major determinant of burnout risk, with poorer perceptions independently associated with higher rates of emotional exhaustion and depersonalization. As healthcare systems worldwide seek to produce competent specialists efficiently and sustainably, systematic evaluation of postgraduate training environments has become an institutional and research priority. (1)

In Morocco, medical residency represents the sole pathway to specialty certification, with programs lasting three to five years depending on the discipline. Cardiology residency presents particular educational challenges that distinguish it from other specialties: trainees must simultaneously develop expertise across a broad and rapidly evolving spectrum of subspecialties — including interventional cardiology, electrophysiology, cardiac imaging, and heart failure — rotating through inpatient services, cardiac intensive care, imaging laboratories, and catheterization units while progressively managing increasingly complex cardiovascular cases. This breadth of required competencies, combined with high clinical acuity and demanding workloads, creates a unique training environment. A systematic review of burnout among medical residents identified cardiology as a specialty with notably high levels of emotional exhaustion and depersonalization, underscoring the importance of understanding the educational conditions in which cardiologists-in-training operate. In resource-constrained settings in particular, cardiologists in training must navigate continuous subspecialty demands, research expectations, and professional development pressures, all while striving to maintain personal well-being. Despite the central role of residency in shaping the future specialist workforce, data on how Moroccan cardiology residents perceive their learning environment remain absent from the published literature. (2,3)

The Postgraduate Hospital Educational Environment Measure (PHEEM) is a validated 40-item instrument specifically designed to evaluate the clinical learning environment of postgraduate medical residents across three domains: perception of role autonomy, perception of teaching, and perception of social support. Developed using a combination of grounded theory and Delphi methodology, it demonstrated excellent internal reliability in its original UK validation, with a Cronbach's alpha above 0.91. A systematic review encompassing 30 studies from 14 countries confirmed it as a widely adopted tool, capable of identifying specific strengths and weaknesses across diverse clinical training settings. In Morocco, the French-language version of the PHEEM was validated and applied across multiple specialties in Rabat university hospitals, revealing an overall perception of the educational environment as more positive than negative, but with persistent challenges in supervision quality, protected educational time, and institutional infrastructure, and with significant inter-specialty variation. No study to date has focused specifically on cardiology residents, leaving a gap in understanding how this specialty's unique training demands shape the perceived learning environment. (4–6)

The present study therefore aims to evaluate the hospital learning environment as perceived by cardiology residents at Ibn Sina University Hospital, Rabat, using the PHEEM questionnaire, and to explore whether perceptions vary according to the year of residency and the resident's area of subspecialty interest within cardiology. By focusing on a single specialty with near-complete population coverage (130 out of 151 residents, 85.8%), this study provides a granular and methodologically rigorous assessment that complements existing multi-specialty surveys and establishes a baseline for targeted quality improvement in cardiology postgraduate training in Morocco.

2. Methods

2.1. Study Design and Setting

This was a cross-sectional survey study conducted in February 2026 at Ibn Sina University Hospital, Rabat, Morocco, one of the main university hospital centers providing postgraduate cardiology training in the country.

2.2. Participants

The target population consisted of all cardiology residents enrolled at Ibn Sina University Hospital at the time of data collection. Of 151 eligible residents, 130 completed the questionnaire, yielding a response rate of 86.1%. Residents at all years of training were eligible to participate. Participation was voluntary and anonymous.

2.3. Instrument

The learning environment was assessed using the French-language validated version of the Postgraduate Hospital Educational Environment Measure (PHEEM). (5) The PHEEM is a 40-item self-administered questionnaire rated on a five-point Likert scale ranging from 0 (strongly disagree) to 4 (strongly agree). Four items (items 7, 8, 11, and 13) are negatively worded and are reverse-scored. The instrument yields a global score ranging from 0 to 160 and three subscale scores: perception of role autonomy (14 items, maximum score 56), perception of teaching (15 items, maximum score 60), and perception of social support (11 items, maximum score 44). Global scores are interpreted as follows: 0–40, very poor educational environment; 41–80, numerous problems; 81–120, more positive than negative with room for improvement; 121–160, excellent. The French version of the PHEEM has been previously validated in the Moroccan context and demonstrated strong psychometric properties. (4)

2.4. Data Collection

The questionnaire was distributed electronically via a Google Form link shared with all eligible residents during February 2026. Completion of the questionnaire implied consent to participate. No personally identifying information was collected.

2.5. Ethics

Ethical approval was obtained from the Ethics Committee of the Military Hospital, Mohammed V University, Rabat, Morocco, one of the constituent hospitals of Ibn Sina University Hospital. In accordance with the committee's procedures, no reference number was issued.

2.6. Statistical Analysis

Data were analyzed using Microsoft Excel and Jamovi (version 2.3.28). Categorical variables were described as frequencies and percentages. Continuous variables were expressed as mean ± standard deviation. The internal consistency of the overall PHEEM questionnaire and its three subscales was assessed using Cronbach's alpha coefficient, with values above 0.70 considered acceptable. Prior to inferential testing, normality of the global PHEEM score distribution within each subgroup was assessed using the Shapiro-Wilk test. As all subgroups conformed to normality (Shapiro-Wilk, all $p > 0.05$), one-way analysis of variance (ANOVA) was used to compare global and subscale PHEEM scores across year of residency and subspecialty interest groups. A p-value of less than 0.05 was considered statistically significant for all analyses.

3. Results

3.1. Sample Characteristics

A total of 130 cardiology residents participated in this study, representing an overall response rate of 86.1%. Participation rates by year of training were 95.1% for fourth-year residents, 83.3% for first-year residents, 82.5% for third-year residents, and 82.3% for second-year residents. The median age of participants was 28 ± 3 years. The sample was predominantly female, with 84 women (64.6%) and 46 men (35.4%). In terms of training level, 39 residents (30.0%) were in their fourth year, 33 (25.4%) in their third year, 30 (23.1%) in their first year, and 28 (21.5%) in their second year. Regarding subspecialty interest, the most frequently reported area was cardiac catheterization (n=43, 33.1%), followed by cardiac imaging and non-invasive explorations (n=32, 24.6%), undecided residents (n=31, 23.8%), electrophysiology (n=11, 8.5%), congenital cardiology (n=7, 5.4%), and heart failure and cardiac rehabilitation (n=6, 4.6%). (Table 1)

3.2. Internal Consistency

The PHEEM questionnaire demonstrated excellent internal consistency in this sample, with an overall Cronbach's alpha of 0.928 for all 40 items. Subscale reliability was good across all three domains: 0.836 for the perception of role autonomy subscale, 0.876 for the perception of teaching subscale, and 0.738 for the perception of social support subscale, all exceeding the accepted threshold of 0.70.

3.3. Global and Subscale PHEEM Scores

The mean global PHEEM score was 82.43 ± 19.42 out of 160, placing the overall perception of the learning environment in the "more positive than negative, with room for improvement" category. Mean subscale scores were 30.20 ± 8.18 out of 56 for perception of role autonomy, 32.15 ± 8.09 out of 60 for perception of teaching, and 20.08 ± 5.24 out of 44 for perception of social support. Expressed as a percentage of the maximum achievable score, the social support subscale

yielded the lowest relative score at 45.6%, compared to 53.9% for autonomy and 53.6% for teaching, indicating that social support was the most negatively perceived domain. (Table 2)

3.4. Comparison by Year of Residency

One-way ANOVA revealed no statistically significant difference in global PHEEM scores across the four years of residency ($F = 0.650$, $p = 0.584$). Mean global scores were 84.23 ± 23.03 for first-year residents, 83.00 ± 23.25 for second-year residents, 78.39 ± 15.22 for third-year residents, and 84.05 ± 16.91 for fourth-year residents. Similarly, no significant differences were found across training years for any of the three subscales: perception of role autonomy ($F = 1.110$, $p = 0.348$), perception of teaching ($F = 0.148$, $p = 0.931$), or perception of social support ($F = 2.143$, $p = 0.098$).

3.5. Comparison by Subspecialty Interest

One-way ANOVA showed no statistically significant difference in global PHEEM scores according to subspecialty interest ($F = 1.500$, $p = 0.195$). Mean global scores ranged from 77.25 ± 20.26 among residents interested in cardiac imaging to 99.33 ± 14.08 among those interested in heart failure and cardiac rehabilitation. At the subscale level, no significant differences were found for perception of teaching ($F = 1.173$, $p = 0.326$) or perception of social support ($F = 0.409$, $p = 0.842$). However, a statistically significant difference was observed for the perception of role autonomy subscale ($F = 2.730$, $p = 0.022$).

Table 1 Characteristics of the study population (n = 130)

Variable	**n**	**%**
Sex		
Female	84	64.6
Male	46	35.4
Age		
Median ± SD (years)	28 ± 3	—
Year of residency		
1st Year	30	23.1
2nd Year	28	21.5
3rd Year	33	25.4
4th Year	39	30.0
Subspecialty interest		
Cardiac catheterization	43	33.1
Cardiac imaging	32	24.6
Undecided	31	23.8
Electrophysiology	11	8.5
Congenital cardiology	7	5.4
Heart failure and cardiac rehabilitation	6	4.6

Table 2 Global and subscale PHEEM scores with internal consistency

Scale	No. of items	Maximum score	Mean ± sd	% of maximum	Cronbach's α	Interpretation
Global PHEEM	40	160	82.43 ± 19.42	51.5	0.928	More positive than negative, with room for improvement
Perception of role autonomy	14	56	30.20 ± 8.18	53.9	0.836	More positive than negative, with room for improvement
Perception of teaching	15	60	32.15 ± 8.09	53.6	0.876	More positive than negative, with room for improvement
Perception of social support	11	44	20.08 ± 5.24	45.6	0.738	Numerous problems

Residents interested in heart failure and cardiac rehabilitation reported the highest autonomy scores (40.50 ± 6.24 out of 56), followed by those interested in congenital cardiology (32.00 ± 9.05), cardiac catheterization (31.00 ± 7.57), undecided residents (29.00 ± 7.37), electrophysiology (28.00 ± 9.35), and cardiac imaging and non-invasive explorations (26.50 ± 8.52). (Table 3)

Table 3 Comparison of global and subscale PHEEM scores by year of residency and subspecialty interest (one-way ANOVA)

A. By year of residency

	1st year (n=30)	2nd year (n=28)	3rd year (n=33)	4th year (n=39)	F	p
Global PHEEM	84.23 ± 23.03	83.00 ± 23.25	78.39 ± 15.22	84.05 ± 16.91	0.650	0.584
Autonomy	31.47 ± 8.97	31.54 ± 9.74	28.27 ± 7.29	29.90 ± 7.06	1.110	0.348
Teaching	31.90 ± 9.96	32.04 ± 9.73	31.64 ± 6.11	32.85 ± 6.99	0.148	0.931
Social support	20.87 ± 5.79	19.43 ± 5.75	18.48 ± 4.01	21.31 ± 5.17	2.143	0.098

B. By subspecialty interest

	Catheterization (n=43)	Imaging (n=32)	Undecided (n=31)	Electro physiology (n=11)	Congenital (n=7)	Heart failure (n=6)	F	p
Global PHEEM	84.05 ± 17.28	77.25 ± 20.26	81.26 ± 17.60	84.82 ± 27.59	83.14 ± 22.56	99.33 ± 14.08	1.500	0.195
Autonomy	31.00 ± 7.57	26.50 ± 8.52	29.00 ± 7.37	28.00 ± 9.35	32.00 ± 9.05	40.50 ± 6.24	2.730	0.022
Teaching	32.49 ± 7.84	30.16 ± 8.59	31.87 ± 7.74	33.27 ± 10.19	30.86 ± 9.37	37.17 ± 6.40	1.173	0.326
Social support	20.56 ± 4.96	20.59 ± 5.82	20.39 ± 5.35	23.55 ± 6.54	20.29 ± 5.82	22.17 ± 4.71	0.409	0.842

4. Discussion

4.1. Overall Perception of the Learning Environment

The global mean PHEEM score obtained in this study was 82.43 ± 19.42 out of 160, placing the learning environment as perceived by cardiology residents at Ibn Sina University Hospital in the "more positive than negative, with room for

improvement" category. This result is consistent with the only prior study assessing Moroccan residents using the PHEEM, in which a global mean score of 81.4 was reported across multiple specialties at university hospitals in Rabat, reflecting a similarly moderate perception of the educational environment. Our finding also aligns with the broader international literature, where most PHEEM-based studies across diverse healthcare settings report scores in the same interpretive band. A study conducted in Pakistan reported a global mean score of 88.16 ± 14.18, likewise categorized as more positive than negative. Higher scores have been reported in better-resourced settings — a Singaporean internal medicine residency program achieved a mean total PHEEM score of 112.23 ± 16.7, exceeding most international benchmarks — suggesting that resource availability and institutional infrastructure significantly influence residents' perceptions, a context particularly relevant to university hospitals in low- and middle-income countries such as Morocco. (4,7,8)

4.2. Internal Consistency

The overall Cronbach's alpha of 0.928 obtained in this study confirms excellent internal consistency of the PHEEM questionnaire in the cardiology residency setting, consistent with an international multi-country analysis using data from the UK, Brazil, Chile, and the Netherlands, which reported an overall Cronbach's alpha of 0.928 across 1563 datasets. Subscale reliability was good for all three domains, with values of 0.836 for autonomy, 0.876 for teaching, and 0.738 for social support, all exceeding the accepted threshold of 0.70. These results reinforce the suitability of the French-language PHEEM for evaluating the learning environment in the Moroccan cardiology training context. (9)

4.3. Social Support as the Most Negatively Perceived Domain

The perception of social support subscale yielded the lowest relative score of the three domains at 45.6% of its maximum, compared to 53.9% for autonomy and 53.6% for teaching. This pattern — social support being the most negatively perceived domain — is consistently observed across international PHEEM studies. Berrani et al. similarly identified social support as the most negatively perceived subscale among Moroccan residents, highlighting specific concerns related to catering facilities, physical safety, and absence of a no-blame culture. (4) A Pakistani study also found no significant difference in perception across years of residency, with social support representing a persistent area of concern across training levels. In the cardiology context specifically, the relatively low social support scores likely reflect systemic challenges common to resource-constrained university hospital environments, including inadequate on-call infrastructure, limited counseling services, and insufficient career guidance — areas that require targeted institutional intervention regardless of training year or subspecialty orientation. (7)

4.4. No Significant Difference by Year of Residency

One-way ANOVA revealed no statistically significant difference in global or subscale PHEEM scores across the four years of cardiology residency ($F = 0.650$, $p = 0.584$). This finding suggests that the learning environment is perceived similarly throughout the training trajectory, with challenges and strengths being uniformly distributed across all training levels. This result is consistent with several published PHEEM studies. A study among obstetrics and gynecology residents found no significant correlation between PHEEM scores and year of residency, and a multicenter Iranian study similarly found no statistically significant differences in residents' perceptions of the educational environment according to residency year. The uniformity of perceptions across training years in our study may indicate that the structural determinants of the learning environment — supervision quality, protected educational time, and institutional support — remain constant throughout training and are not substantially modulated by increasing seniority or clinical experience. (10,11)

4.5. Autonomy Perception Differs Significantly by Subspecialty Interest

While no significant difference was found in global PHEEM scores by subspecialty interest ($F = 1.500$, $p = 0.195$), a statistically significant difference emerged specifically for the perception of role autonomy subscale ($F = 2.730$, $p = 0.022$). Residents interested in heart failure and cardiac rehabilitation reported the highest autonomy scores (40.50 ± 6.24 out of 56), while those interested in cardiac imaging and non-invasive explorations reported the lowest (26.50 ± 8.52). This finding is noteworthy and likely reflects intrinsic differences in the training experience across cardiology subspecialties. Heart failure training is characterized by longitudinal patient care that integrates acute management, long-term follow-up, and end-of-life planning, offering trainees a uniquely continuous and autonomous relationship with their patients. This continuity of care may naturally foster a stronger sense of role clarity and professional autonomy. In contrast, cardiac imaging is a highly technical and supervisor-dependent subspecialty, where trainees rely heavily on senior validation of their interpretations and procedural skills, potentially limiting their perceived autonomy. A Brazilian PHEEM study similarly found that autonomy scores varied significantly across specialties, with internal medicine residents rating autonomy most highly, suggesting that the nature of clinical work and the degree of independent decision-making inherent to each subspecialty are key determinants of autonomy perception. This

subspecialty-specific autonomy gap warrants targeted attention from program directors, particularly in imaging-oriented training tracks where structured progression toward independent practice may need to be more explicitly defined. (12,13)

4.6. Limitations

This study has several limitations. First, although the participation rate was high at 86.1%, the study was conducted at a single institution over a single month, which may limit the generalizability of findings to other cardiology training centers in Morocco or the broader region. Second, the PHEEM captures perceptions at a single point in time and does not account for longitudinal changes in the learning environment. Third, the small sample sizes in some subspecialty interest groups — particularly heart failure (n=6) and congenital cardiology (n=7) — should be interpreted with caution, as these groups may not adequately represent the broader population of residents with those interests. Finally, the cross-sectional design precludes any causal inference between training characteristics and perceived educational environment quality.

5. Conclusion

This study provides the first specialty-specific assessment of the hospital learning environment among cardiology residents in Morocco, using the PHEEM questionnaire at Ibn Sina University Hospital, Rabat. The overall learning environment was perceived as more positive than negative, with a global mean score of 82.43 out of 160, consistent with findings from comparable settings internationally and within Morocco. Social support was identified as the most negatively perceived domain across all training levels, representing a priority area for institutional improvement. While perceptions did not differ significantly according to year of residency, a significant difference in role autonomy perception was observed across subspecialty interest groups, with residents oriented toward heart failure reporting the greatest sense of autonomy and those interested in cardiac imaging reporting the lowest. These findings highlight the need for targeted interventions to strengthen social support structures and to address subspecialty-specific disparities in autonomy, particularly within imaging-oriented training tracks. Future multicenter studies encompassing other cardiology training programs across Morocco are warranted to confirm and extend these findings at a national level.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no competing interest.

Statement of ethical approval

Ethical approval for this study was obtained from the Ethics Committee of Mohamed V Military Teaching Hospital, Faculty of Medicine and Pharmacy, Mohammed V University, Rabat, Morocco. The committee does not issue reference numbers.

Statement of informed consent

Informed consent was implied by voluntary completion of the anonymous online questionnaire by all participants included in the study.

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