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The Impact of Faculty Brain Drain on Clinical Training and Academic Progress Among Sudanese Medical Students During the Sudan War : A Cross-Sectional Study

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Research Article

Keywords: medical education, faculty migration, clinical training, Sudan, conflict

Posted Date: November 11th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11463284/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

The armed conflict in Sudan since April 2023 has disrupted medical education. This study assessed students' perceptions of faculty migration and its impact on clinical training across five public universities.

Methods

A cross-sectional online survey was conducted from 15 July to 20 August 2026 among 362 undergraduate medical students from Khartoum, Gezira, Kordofan, Red Sea, and Dalang universities. Participants were recruited via WhatsApp and Telegram using convenience sampling. Data were analyzed using SPSS version 29.

Results

Of 362 participants, 55.5% were inside Sudan and 44.5% outside. Most students (71.5%) estimated that over 25% of faculty had migrated or were absent, with professors perceived as most affected (40.1%). No significant differences were found in learning adaptations by location or in training adequacy across universities (all $P > 0.05$).

Conclusions

Faculty absence was commonly perceived during the conflict, with consistent patterns across locations and universities. These perceptions require validation with official workforce data.

Background

Medical education in Sudan was established in 1924 with the Kitchener School of Medicine (now University of Khartoum) on a British academic model, followed by a community-oriented shift in 1975 with the University of Gezira introducing community-based and problem-based learning. From the 1990s onwards, rapid expansion resulted in more than 60 public and private medical colleges regulated by the Sudan Medical Council [1–3]. While Sudanese graduates are recognized for clinical competence, the system has faced chronic challenges including brain drain, strain on infrastructure, and disruptions due to conflict [4–6].

The armed conflict that began on 15 April 2023 triggered a major displacement crisis, with 12.9 million forcibly displaced people including 8.9 million internally displaced [7]. Health and education were severely disrupted: more than 10,400 attacks on health care have been documented globally since 2018

[8], 19 million children in Sudan were out of school with 10,400 schools closed [9], and within three months of the war 58.6% of 58 medical schools in conflict-affected states reported attacks, looting, or military use [10]. Surveys of Sudanese students described loss of clinical sites, psychological distress, and reduced access to teachers: among 224 students from Khartoum, 61.1% lost clinical training hospitals, 55.3% reported at least one staff member permanently leaving Sudan, and 45.2% reported lack of experienced teaching staff affecting the curriculum [11]. Migration of health professionals predates the war [10], with 58.4% of students in five medical schools frequently thinking about leaving after graduation in 2023 [12]. In a 2025 survey of 27 institutions, 70.4% had relocated, online teaching increased from < 5% to 46.7%, teachers estimated 30% of colleagues had left, and clinical teaching was suspended in 22% [13].

Loss of teaching staff is a recognised consequence of armed conflict, reported in Liberia [14], Iraq where 56% of students planned to leave [15], and Syria where adaptations included online and diaspora teaching [16, 17]. Clinical training depends on supervised bedside teaching that online delivery cannot fully replace, and students outside Sudan reported lower satisfaction with clinical training [18, 19].

To capture the diversity of conflict exposure, this study purposively included five public universities representing distinct conflict typologies: University of Khartoum as ground-zero where fighting erupted in 2023; University of Gezira in Wad Madani which was captured in 2023 and recaptured in 2025; University of Kordofan in El-Obeid which endured prolonged siege with recurrent drone strikes; University of Dalanj in South Kordofan which experienced an 18-month siege with reported famine conditions; and Red Sea University in Port Sudan which became the interim national capital and safe hub hosting displaced universities. To our knowledge, few studies have examined students' perceptions of faculty migration across multiple Sudanese universities while including students inside and outside the country. This study aimed to describe students' perceptions of the extent of faculty migration or absence, the faculty categories perceived to be most affected, and the perceived implications for clinical training and academic progress.

Study design

Study design and setting

This descriptive, cross-sectional online survey was conducted from 15 July to 20 August 2026 among undergraduate medical students from five public universities purposively selected to represent distinct conflict typologies: University of Khartoum, University of Gezira, University of Kordofan, University of Dalanj, and Red Sea University in Port Sudan. The study was coordinated from the Faculty of Medicine and Health Sciences, University of Kordofan, El-Obeid, Sudan.

Participants and sampling

Eligible participants were undergraduate medical students registered at one of the five universities, whether located inside or outside Sudan. Recruitment used convenience sampling via WhatsApp and Telegram student groups. An up-to-date sampling frame was unavailable; therefore, response rate could not be calculated.

Sample-size planning

The planning population was estimated at 6,306 students (Kordofan 1,684; Khartoum 1,701; Gezira 1,700; Red Sea 812; Dalanj 409). A minimum sample of 362 was calculated using a single-proportion formula with 95% confidence level, p = 0.50, 5% margin of error, and finite-population correction.

Questionnaire and variables

The 20-item questionnaire was developed based on the study objectives regarding medical education disruptions in conflict settings. Content validity was established by the research supervisor. Before main deployment, the questionnaire was pilot-tested on a small sample of 15 medical students (not included in the final analysis) to ensure clarity, relevance, and logical flow. This study was conducted and reported in accordance with the STROBE guidelines for cross-sectional studies and the CHERRIES checklist for internet e-surveys. The questionnaire collected participant characteristics, current location (inside/outside Sudan), perceptions of the proportion of faculty who had migrated or were absent, the faculty category perceived to be most affected, perceived effects on curriculum and clinical training, and experiences with alternative learning methods. It was administered in English via Google Forms with an Arabic introductory statement. No identifying information (names, university IDs, emails) was collected.

Statistical analysis

Data were exported to Microsoft Excel for checking and cleaning and analyzed using IBM SPSS Statistics version 29. Categorical variables were summarized as frequencies and percentages.

Ethical considerations

Ethical approval

was obtained from the Ethics Committee of the Faculty of Medicine and Health Sciences, University of Kordofan (Date: 09 July 2026). University of Kordofan is the institution conducting this study. Due to war conditions, it was not possible to obtain separate ethical approvals from University of Khartoum, University of Gezira, and University of Dalanj. Electronic informed consent was obtained from all participants, no identifying data were collected, and all methods were performed in accordance with the Declaration of Helsinki.

Use of AI tools

Grammarly was used for language editing only. No generative AI was used for data analysis or interpretation.

Results

A total of 362 medical students from five Sudanese public universities participated in the study. More than three-fifths of respondents were female (n = 224, 61.9%) and 38.1% were male (n = 138). Participants were distributed across University of Kordofan (n = 96, 26.5%), University of Gezira (n = 95, 26.2%), University of Khartoum (n = 80, 22.1%), Red Sea University (n = 46, 12.7%), and University of Dalanj (n = 45, 12.4%). More than half of the students were located inside Sudan at the time of data collection (n = 201, 55.5%), while 44.5% (n = 161) were outside Sudan. Regarding academic stage, 55.2% (n = 200) were in the basic stage and 44.8% (n = 162) were in the clinical stage (Table 1).

Table 1
Demographic characteristics of the participants (N = 362)

Variable	Category	n (%)
Sex	Male	138 (38.1%)
	Female	224 (61.9%)
University	University of Kordofan	96(26.5%)
	University of Khartoum	80 (22.1%)
	University of Gezira	95 (26.2%)
	University of Red Sea	46 (12.7%)
	University of Dalang	45 (12.4%)
Location	Inside the Sudan	201(55.5%)
	Outside the Sudan	161 (44.5%)
Academic Stage	Basic	200 (55.2%)
	Clinical	162(44.8%)

Regarding the most absent faculty category, 40.1% (n = 145) of students perceived professors as the most absent, followed by specialists (n = 120, 33.1%) and teaching assistants (n = 97, 26.8%). When asked to estimate the proportion of migrated staff, the majority of students (n = 209, 57.7%) reported that 25–50% of faculty had migrated or were absent, while 28.5% (n = 103) estimated less than 25% and 13.8% (n = 50) estimated 50–75% (Table 2).

Table 2
Student's perceptions of Faculty migration and absence (n = 362)

Variable	Category	n (%)
Most absent Faculty category	Professors	145 (40%)
	Specialists	120 (33.1%)
	Teaching assistants	97 (26.8%)
Percentage of migrated staff	less than 25%	103 (28.5%)
	25%_50%	209 (57.7%)
	50%_75%	50 (13.8%)

Chi-square (χ^2) tests of independence were performed to examine associations between perceived most affected faculty category and students' perceptions regarding curriculum disruption and clinical training. No statistically significant associations were observed (all $P > 0.05$) (Table 3).

Table 3
Association between perceived most affected faculty category and reported impact on training (n = 362)

Variable	Professors (n = 145)	Specialists (n = 120)	Teaching assistants (n = 97)	χ^2	P-value
Affected of curriculum					
Partially affected	65 (44.8%)	50 (41.7%)	38 (39.2%)	2.45	0.654
Severely affected	55 (37.9%)	48 (40.0%)	35 (36.1%)		
Not affected	25 (17.2%)	22 (18.3%)	24 (24.7%)		
Academic stage largely affected					
Clinical	90 (62.1%)	70 (58.3%)	55 (56.7%)	0.82	0.664
Basic	55 (37.9%)	50 (41.7%)	42 (43.3%)		
How practical training was affected					
Completely affected	60 (41.4%)	45 (37.5%)	30 (30.9%)	1.78	0.776
Insufficient	55 (37.9%)	50 (41.7%)	40 (41.2%)		
Not affected	30 (20.7%)	25 (20.8%)	27		

Comparing students inside versus outside Sudan revealed no significant differences in preferred learning resources, methods to cover academic gaps, dependence on self-learning, or challenges facing

alternative methods (all P > 0.05), indicating that coping strategies and obstacles remain universally similar regardless of geographical location (Table 4).

Table 4
Association between current geographical location and learning adaptations (n = 362)

Variable	Inside Sudan (n = 201)	Outside Sudan (n = 161)	χ^2	P-value
Learning resources			0.95	0.813
Medical textbook	95 (47.3%)	68 (42.2%)		
Online medical courses	65 (32.3%)	55 (34.2%)		
Peer to peer	25 (12.4%)	22 (13.7%)		
Ai assistant	16 (8.0%)	16 (9.9%)		
Affected new methods in academic gap				
Cover the academic gap	75 (37.3%)	55 (34.2%)	0.62	0.712
Neutral	80 (39.8%)	60 (37.3%)		
Uncover	46 (22.9%)	46 (28.6%)		
Dependence on self learning				
Much higher	85 (42.3%)	60 (37.3%)	1.25	0.535
Slightly high	75 (37.3%)	65 (40.4%)		
Unchanged	41 (20.4%)	36 (22.4%)		
Challenge facing alternative methods				
Poor internet	70 (34.8%)	50 (31.1%)	0.54	0.909
Lack of supervision	65 (32.3%)	52 (32.3%)		
Difficult understand	45 (22.4%)	38 (23.6%)		
Financial problems	21 (10.4%)	21 (13.0%)		

Similarly, comparing students across the five universities revealed no significant differences in perceptions of adequate training or shortening of clinical rotations, indicating that perceptions of training disruption remain universally consistent regardless of university affiliation (Table 5).

Table 5
Association between university affiliation and perceptions of training adequacy (n = 362)

Variable	Kordofan (n = 96) n(%)	Khartoum (n = 80) n(%)	Gezira (n = 95) n(%)	Red sea (n = 46) n(%)	Dalanj (n = 45) n(%)	X^2	P-value
Adequate training							
Agree	35 (36.5%)	28 (35.0%)	30 (31.6%)	15 (32.6%)	14 (31.1%)	0.85	0.991
Neutral	38 (39.6%)	32 (40.0%)	40 (42.1%)	19 (41.3%)	18 (40.0%)		
Disagree	23 (24.0%)	20 (25.0%)	25 (26.3%)	12 (26.1%)	13 (28.9%)		
Shortening of clinical rotations							
Agree	45 (46.9%)	35 (43.8%)	42 (44.2%)	20 (43.5%)	19 (42.2%)	0.32	0.999
Neutral	30 (31.3%)	28 (35.0%)	32 (33.7%)	16 (34.8%)	15 (33.3%)		
Disagree	21 (21.9%)	17 (21.3%)	21 (22.1%)	10 (21.7%)	11 (24.4%)		

Discussion

Principal findings: In this five-university sample of 362 medical students (Table 1), 41.2% perceived professors and senior academic staff as the most affected category (Table 2), and 58.1% estimated that more than one-quarter of faculty had migrated or were absent since the start of the armed conflict (Table 2). Substantial perceived impacts on clinical training were reported, including reduced clinical teaching and supervision (Table 3). More than two-fifths of respondents (44.5%) were located outside Sudan when they completed the survey (Table 1).

Our analysis revealed no significant geographical or institutional variation in coping strategies. Students inside versus outside Sudan showed similar learning adaptations ($P > 0.05$ for all comparisons, Table 4), and perceptions of training adequacy did not differ across the five universities (Table 5). This indicates that disruption and adaptation patterns are universal rather than location-specific. It is important to note that the five universities included represent distinct conflict typologies and war-affected areas: University of Khartoum (active conflict and displacement), University of Gezira (recent conflict escalation), University of Kordofan and University of Dalanj (areas of protracted insecurity and resource constraints), and Red Sea University in Port Sudan (relatively stable hosting area for displaced institutions). Despite these different war contexts, perceptions remained consistent.

Faculty absence in the context of conflict: The findings are consistent with published accounts of disruption to medical education in Sudan, including reported loss of clinical training sites and reduced access to experienced teachers [11–13]. Previous studies from Khartoum State reported that 61.1% of students lost clinics or hospitals used for clinical training, 55.3% reported that at least one academic staff member had permanently left, and 45.2% identified lack of experienced staff as affecting the curriculum.[11]

Implications for clinical training: Students' concern about faculty absence is educationally important because clinical learning depends on supervision, feedback, role modelling, and repeated exposure to patients. Nevertheless, this survey cannot isolate faculty absence from other concurrent disruptions, including damaged facilities, insecurity, displacement, and loss of clinical placements.

Learning continuity and support: Prior work describes the use of online teaching, peer learning, and support from diaspora clinicians to maintain continuity [13, 17–20]. These strategies may be useful complements, but feasibility depends on connectivity, devices, and supervised clinical placements. Our finding that challenges such as poor internet (33.1%) and lack of supervision (32.3%) were equally reported inside and outside Sudan (P = 0.909, Table 4) highlights the need for coordinated solutions.

Our study demonstrated no statistically significant differences in challenges between students staying inside Sudan and those who moved abroad (P > 0.05 for all metrics). This key finding emphasizes that disruption of clinical supervision and academic progress is an institutional and systemic crisis rather than a location-based one. Students face severe infrastructure barriers - namely unstable internet connectivity and the widespread absence of senior clinical mentors - highlighting the vital need for decentralized, cross-border digital learning platforms supported by the Sudanese medical diaspora.

Strengths and limitations: Strengths include inclusion of five public universities and respondents inside and outside Sudan during active conflict. Limitations include non-probability convenience sampling via WhatsApp/Telegram, self-selection and coverage bias, absence of response rate, self-reported perceptions, absence of institutional staffing records or objective educational outcomes, and potential over-representation of students with internet access. Due to ongoing conflict, selection bias may exist. The cross-sectional design cannot establish causation.

Conclusions: Students from five Sudanese public universities commonly perceived substantial faculty migration or absence during the armed conflict, with professors and senior academic staff most affected (Table 2). Perceptions were consistent across geography and university affiliation (Table 4 and Table 5). These are perceptions rather than verified staffing estimates and do not establish causal effects on clinical competence or academic progress. Future studies should triangulate student reports with institutional workforce data and objective measures of educational continuity.

Abbreviations

CHERRIES

Checklist for Reporting Results of Internet E-Surveys
SPSS
Statistical Package for the Social Sciences
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology

Declarations

Ethics approval and consent to participate

The study protocol was reviewed by the Department of Community Medicine, University of Kordofan, on 9 July 2026, and written administrative permission was granted by the Faculty of Medicine and Health Sciences on the same date. Electronic informed consent was obtained. All methods were performed in accordance with the Declaration of Helsinki.

Consent for publication: Not applicable.

Availability of data and materials: The dataset is available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

Funding: No funding was received.

Authors' contributions: All authors contributed to data collection, analysis, and approval of the final version.

Authors' contributions

Randa Fadlallah Khaleel Hamoudah: Led the research idea, designed the study, created the questionnaire, led data collection from the five universities, performed data cleaning and SPSS analysis, wrote the first draft of Introduction, Methods, Results and Discussion, and is the corresponding author.

Nancy Aseel Mohammed Ahmed, Salahaldeen Ali Aldoma, Abubakar Alsiddig Habiballa, Ahmed Widaa Ahmed Elteyb, Malaz Mulla Abu Al-Noor, Raghda Fadlallah Khaleel Hamoudah: Participated in distributing the online questionnaire via WhatsApp and Telegram groups, collected responses from their respective universities, assisted in data entry and literature review.

Abdelrahim Mohamed Abdelrahim Ali, Ayman Alaeldein Omer Ali: Assisted in statistical analysis, cross-checked the tables, verified chi-square tests, and revised the Results section.

Abdelrahman Mohamed Abdelrahman Abu: Research supervisor. Supervised the study design, reviewed the methodology, validated the analysis, critically revised the Discussion and Conclusion, and gave final approval for submission.

All authors have read and approved the final manuscript.

Acknowledgements

We thank all medical students from the five public universities who participated in this study despite the difficult war conditions, and we thank the administration of the Faculty of Medicine and Health Sciences, University of Kordofan for administrative support.

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Clinical trial number

Not applicable.

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