RESEARCH



Barriers to undergraduate medical students' search engagement in Pakistan: a qualitative exploration

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Abstract

Background Engaging in research is a critical component of medical education, fostering critical thinking and evidence-based practices. Despite its importance, undergraduate medical students in Pakistan face significant barriers to research engagement. This study explores the challenges hindering their participation in research activities.

Methods A qualitative research design was employed, utilizing semi-structured interviews with 45 undergraduate medical and dental students from a public medical university in Pakistan. Participants were purposefully selected to provide diverse perspectives. Data were analyzed thematically to identify recurring barriers and challenges.

Results Four key themes emerged: (1) Time constraints, as academic workloads and clinical rotations left limited time for research; (2) Lack of extrinsic motivation, knowledge, and research ability, including insufficient training and limited institutional incentives; (3) Inadequate financial assistance and poor maintenance of research facilities, with students highlighting a lack of funding and outdated infrastructure; and (4) Lack of support from research mentors and training, emphasizing the need for effective mentorship and structured research programs. These barriers collectively hinder students' ability to engage meaningfully in research.

Conclusions The study highlights the urgent need for systemic reforms in medical education, including integrating research training into curricula, improving mentorship programs, providing financial and infrastructural support, and incentivizing research participation. Addressing these challenges can foster a culture of inquiry, empowering students to contribute to advancements in medical science.

Keywords Undergraduate medical education, Research barriers, Research Engagement, Research mentorship

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Introduction

Research plays a crucial role in fostering innovation and improving patient care in the rapidly advancing fields of medicine and dentistry. A global trend has emerged across all disciplines, including medicine, emphasizing the creation and use of scholarly communication, specifically focusing on improving healthcare [1]. Research not only supports professional and personal development but also plays an indispensable role in the education and growth of undergraduate and graduate students [2]. It provides students with knowledge on scientific inquiry, critical thinking, and problem-solving, ultimately shaping how they view evidence-based practices in medicine [3].



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Research can be invaluable for medical and dental students, enhancing their ability to think critically and solve problems, thereby enabling learners to approach complex medical and dental conditions logically based on the best available evidence [4]. It fosters lifelong learning, promotes a deeper understanding of scientific concepts, and ensures students stay informed about recent advancements [5]. Research also empowers students to comprehend and critically analyze scientific material, which equips them to make informed medical decisions, as evidenced by a study in the [6], where dental students showed enhanced critical thinking skills while engaged in research.

In addition to promoting continuous education, students actively involved in research are introduced to the latest scientific literature and methodologies, which helps them keep pace with the rapidly evolving body of knowledge [7]. This approach to education ensures that students are equipped with the skills needed to provide high-quality care to their future patients. Furthermore, engaging in research allows students to explore their interests and acquire specialized knowledge, potentially inspiring them to pursue further studies or careers in academic research, dentistry, or specific medical specialties [2]. Academic institutions and residency programs highly value research experience, offering students a competitive edge when applying for postgraduate education or research careers [8].

Specifically, the reputation, respect, and ranking of higher educational institutions (HEIs) are primarily determined by their academic integrity and the quality of their published scientific research. In developed countries such as the United States, the United Kingdom, and other European nations, HEIs continuously strive to enhance the quality of education and research, thereby improving their rankings and prestige [9]. In contrast, HEIs in low- and middle-income countries (LMICs), such as Pakistan, lag in providing quality education and promoting research publications.

In Pakistani medical and dental institutions, research exposure is formally introduced through the undergraduate curriculum, particularly within the "Community Medicine" course offered in the final year of the MBBS program. As part of this course, students are typically required to conduct a small-scale research project and submit a final report. While this provides a basic introduction to research methodology, including literature review, data collection, and report writing, it is often limited in scope and duration. Unlike a comprehensive thesis, this component may not be sufficient to develop strong research skills. Additionally, the requirement to complete a full thesis as a prerequisite for graduation varies across institutions and is not uniformly enforced by regulatory bodies such as the Pakistan Medical and Dental Council (PMDC), now replaced by the Pakistan Medical Commission (PMC). As a result, although research is present in the curriculum, its depth and impact on students' research competency can vary significantly between institutions.

Globally, universities are expected to generate knowledge and find innovative solutions to medical challenges. However, Pakistani universities have contributed very little compared to their international counterparts [10]. The increasing reliance of international agencies on medical student involvement in research has highlighted the urgent need to drive this engagement, especially in light of the United Nations' 2030 Sustainable Development Goals. Achieving these goals, particularly "Good Health and Well-Being," will depend significantly on the role of medical education research. Thus, one of the core missions of Pakistani universities should be to encourage and promote research activities, which requires implementing strategies by university research managers.

According to [11, 12], each Pakistani university must engage in research activities to generate new knowledge, enhance teaching, increase research output, and support developmental projects. Despite these policies, student involvement in research remains low, particularly in medical schools [13].

Previous studies from other low- and middle-income countries (LMICs) have identified barriers to research engagement among medical and dental students that closely mirror those observed in Pakistan. For example, research from India, Malaysia, Nigeria, and Egypt has consistently reported challenges such as inadequate research training, lack of mentorship, insufficient institutional support, and limited access to funding opportunities [14, 15]. Furthermore, the medical curricula in many of these countries tend to prioritize clinical competencies over research, resulting in limited time and motivation for students to pursue research activities [16, 17]. These studies also highlight common issues such as poor exposure to research methodology, lack of statistical training, and minimal incentives to engage in scholarly work [18]. By critically comparing these findings, it becomes evident that the barriers faced by Pakistani students are not unique, but rather reflective of broader systemic challenges in LMICs. This comparative analysis underscores the relevance of our study and situates its findings within a global context, highlighting the need for policy-level reforms to promote undergraduate research engagement in resource-limited educational settings.

Therefore, it is crucial to assess the factors hindering medical students' participation in research to address the challenges and propose recommendations for global universities facing similar issues. This study is guided by the research question: *What factors do medical students perceive as barriers to engaging in research activities?* The justification for this study is that no prior research has specifically examined the engagement of medical students in research within Pakistan.

The context of the study

The Pakistani government invests very little in research and development, and there is often no direct funding or financial incentives to encourage student participation in research activities [19]. Compared to developed nations, most developing countries, including Pakistan, invest less than 1% of their GDP in research (UNESCO, 2015). While Pakistani universities are tasked with promoting education and research in various fields, including medicine, student participation in research has been little improved. Despite the formulation of research policies and strategic development plans, medical students' involvement in research remains insufficient.

Research management is often overlooked in many Pakistani medical colleges, leading to conflicts between research managers and researchers [20]. While the mandate of Pakistan's medical colleges is to promote and conduct research in all areas of medicine for national development and social welfare, low student involvement in research indicates that these institutions are not fulfilling their research role effectively [21]. Research facilities are often inadequate, with many deteriorating due to heavy use. Enhancing student engagement in research is critical to ensuring that students engage in relevant and rigorous research [22].

Pakistan, with a population of over 230 million, is the fifth most populous country globally, following China, India, the United States, and Indonesia [23]. The country has an annual intake of approximately 15,000 medical students. Of the nearly 3,000 medical colleges worldwide, Pakistan hosts over 114 medical colleges, with 38% being public institutions and 62% private. The provinces of Sindh and Punjab, along with the federal territory, house over 50% of the medical colleges, while regions like Khyber Pakhtunkhwa (KPK), Baluchistan, and Azad Jammu & Kashmir (AJK) have fewer institutions [24].

As an LMIC, Pakistan's HEIs face significant challenges in scientific and technical advancement and contribute minimally to global research repositories. Thus, concerns are rising regarding the history and status of publication practices among Pakistani medical students [25]. It is essential to understand where these practices currently stand and what actions are needed to upgrade them. This study aims to be the first to explore the publication practices of medical students in Pakistan, examining potential barriers to research participation and paper submissions.

Theoretical framework

Maslow's theory of the hierarchy of needs has been used in various organizations to increase engagement [26], and it can also be applied to enhance student participation in research activities within universities. The core premise of Maslow's theory is that unmet needs drive behavior, and most individuals are motivated by the desire to fulfil specific needs. A crucial aspect of this theory is that people tend to fulfil their needs in a systematic manner, beginning with their most basic needs and progressing through the hierarchy until the lower-level needs are satisfied. Only then can higher-level needs, such as selfactualization, be pursued.

According to Maslow's hierarchy of needs, medical students also have specific needs that must be addressed to enable effective engagement in research. These include their physical, safety, social, esteem, and self-actualization needs. When students' research needs and desires are considered, it may serve as an incentive to increase their engagement in research activities. Furthermore, if students' basic needs are unmet, they may be forced to focus on other activities, leaving little time or energy for research.

The educational sector must ensure that essential needs such as subsidized university cafeterias, breaks, and sufficient time for research are available to meet students' physiological requirements [27]. Different factors can affect individuals in varying ways, so recognizing the specific level of needs that each student is working to fulfil is crucial for fostering increased involvement in research. An academic environment that nurtures curiosity and the desire to engage in research is essential for motivating students to pursue scientific inquiry.

Research design and methodology

A case study research design was employed for this study, utilizing a qualitative approach. A qualitative design is most suitable for this study because it allows the researcher to understand a phenomenon from the perspective of those directly involved [28]. The qualitative case study research design is particularly appropriate as it provides new insights into medical students' engagement in research activities. Moreover, it enables the researcher to comprehensively analyse and clarify the issue [28, 29].

This study was conducted in Pakistan, where English and Urdu are the official languages. The research was conducted in Multan, Punjab, selecting Nishtar Medical University as the study site. This institution was deliberately chosen as it is the only public medical university in Southern Punjab, established in 1951–52. The study population comprised final-year medical and dental students at Nishtar Medical University. A purposive sampling technique was employed to select final-year medical students as final-year students had completed their coursework and were involved in their research work. The sample included 45 medical students who voluntarily agreed to participate in the study. Participants were from two campuses of Nishtar Medical University: the main campus offering the MBBS program and the Dental College offering the BDS program (see Table 1).

To collect data, a semi-structured interview guide was used, which allowed for one-on-one interviews. This format was most suitable for the study as it provided the interviewer with the flexibility to ask follow-up questions, probe for additional information, monitor changes in tone, and observe body language, offering deeper insights. Additionally, the interview guide allowed the interviewer to gather detailed information about participants' personal feelings and reflections. According to Creswell [28], researchers need to choose an interview format that will enable them to obtain the necessary information from participants. All one-to-one interviews were conducted via face to face on campus, and scheduled according to participants' availability and convenience. With participants' consent, each interview was audio-recorded to ensure accuracy, facilitate verbatim transcription, and support subsequent coding and thematic analysis.

The questions for the interviews were derived from a review of the existing literature on student engagement in research activities [30–33]. An interview guide was developed specifically for this study, allowing for flexibility in questioning. While the core questions remained consistent, follow-up and probing questions were asked based on participants' responses to gain deeper insights. The full interview guide is provided as Supplementary File 1. Some of the interview questions included: What factors hinder your active participation in research activities, such as writing and publishing research papers? What factors hinder your participation in research conferences, workshops, and seminars? The interview guide included core questions derived from the literature, supplemented by spontaneous follow-up questions based

Table 1 Gender distribution of participants by medical anddental programs

| Gender | MBBS | BDS | Total |
|--------|------|-----|-------|
| Female | 21 | 4 | 25 |
| Male | 12 | 8 | 20 |
| Total | 33 | 12 | 45 |

(This table presents the gender distribution of the final-year medical (MBBS) and dental (BDS) students who participated in the study at Nishtar Medical University. The total number of participants was 45, with 33 medical students (MBBS) and 12 dental students (BDS). The distribution shows the number of male and female participants in each program.)

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on participants' responses. Examples of these follow-up questions include prompts such as 'Could you elaborate further?', 'Can you provide a specific example?', and 'What would help you overcome this barrier?' This approach facilitated rich, detailed responses, allowing deeper exploration and greater clarity of themes. The same researchers independently analyzed the data. Any discrepancies during the coding process were resolved through mutual discussion and consensus.

The data collection period spanned five months, with interviews conducted at the convenience of the participants. Each interview lasted between 30 to 40 min. All interviews were conducted in English. With participants' informed consent, interviews were audio-recorded and subsequently transcribed verbatim by the researchers. Transcripts were reviewed thoroughly to ensure accuracy and completeness.

The researcher who conducted the interviews also took on the responsibility of coding the data. The coding process involved systematically categorizing responses and identifying recurring themes, ensuring a comprehensive understanding of the data and maintaining the rigor of the thematic analysis. The coding process involved the development of a coding tree, which was used to organize and categorize the data into themes and sub-themes. The researchers started by reading through the interview transcriptions multiple times to gain a thorough understanding of the data. Initial codes were then generated based on significant phrases or concepts mentioned by the participants. These codes were systematically grouped into broader themes related to the study's objectives. The coding tree was iteratively refined, with codes being merged or split as necessary to ensure that they accurately represented the data. This process allowed the researcher to identify key patterns and relationships within the data, which were crucial for the subsequent thematic analysis. Data analysis was conducted using thematic analysis derived from the data, in which transcripts were coded systematically, allowing for the identification, interpretation, and reporting of key themes emerging from the data.

Data collection continued until data saturation was reached, defined as the point when no new themes or additional insights emerged from successive interviews. Data saturation was determined through iterative discussions among the research team, who continuously reviewed interview transcripts during data collection. After approximately 35 interviews, themes started repeating consistently. However, an additional 10 interviews were conducted (totalling 45 interviews) to confirm saturation and ensure the comprehensiveness and robustness of the data. Ethical guidelines were strictly adhered to, ensuring participant confidentiality. Ethical conduct is particularly vital in scientific research. The researchers briefly introduced themselves to establish rapport with participants, after which the study's purpose was explained. Participants were informed about the duration of the interview, how the collected data would be used, and the availability of the study findings upon completion. The researcher also explained how the study would benefit society, rather than just the researcher. Participants were reassured that their responses would remain confidential. Written informed consent was obtained from each participant prior to conducting the interview.

Data analysis was based on [34] six stages of qualitative data analysis. Thematic analysis was employed. After recording and transcribing all 45 interviews, the data was carefully coded. Relevant codes were grouped into categories, facilitating the development of themes. The researcher read through the themes multiple times to ensure they appropriately addressed the research questions.

Findings

This section presents the systematic analysis of interview data collected to explore the factors preventing medical students from engaging in research activities. The study results indicate that very few medical students were actively involved in research. Some students perceived research as irrelevant and expressed a lack of interest. However, while the majority of students recognized the positive impact of undergraduate research and showed a strong interest in conducting research, several barriers, such as a lack of awareness of research methodologies, insufficient guidance, and time constraints, impeded their engagement. Many students reported that their heavy academic workload and demanding schedules left them with limited time for research activities. They believed that research could enhance their understanding of subjects by making them more interesting and engaging. [35] highlighted the importance of undergraduate research, stating that it promotes critical thinking and reasoning skills and cultivates a positive attitude towards scientific inquiry from the outset of a medical career. The following themes and quotes were derived from the interviews:

Time constraint: a key challenge in research involvement

Most participants reported that time is a key factor in undergraduate medical research due to students' limited availability, primarily due to clinical rotations, extensive coursework, frequent assignments, homework, and other academic responsibilities. Allocating sufficient time for tasks such as literature reviews, data collection, analysis, and writing can be challenging for students, even if they are willing to engage in research. The following quotes illustrate these points:

"Balancing research with the rigorous demands of undergraduate medical education is very challenging. As medical students, we manage extensive coursework, frequent assignments, and homework while dedicating significant time to hospital wards and patient care. These responsibilities often leave limited time for research activities. However, I believe that research is an integral part of medical education, as it fosters critical thinking and enhances clinical knowledge." (MBBS Final Year Female Student)

"As a BDS student, the majority of our time outside classes is dedicated to clinical practice, where we work closely with patients under the supervision of senior doctors to develop and refine our skills. This hands-on training is essential for gaining practical expertise and building confidence in patient care. However, the demanding nature of our schedule often leaves little time to focus on research." (BDS Final Year Male Student)

"I don't see the point of spending time writing papers, how will that help me? Focusing on research means less time for coursework, which could affect my grades. Here, grades matter more than research" (MBBS Final Year Male Student)

Lack of extrinsic motivation, knowledge and ability to engage in research

Engaging in research during undergraduate medical education is often hindered by several significant challenges, with a lack of extrinsic motivation, knowledge, and research abilities being prominent barriers. Conducting research requires a foundational understanding of research methodologies, critical thinking, and technical expertise, which many students feel inadequately prepared for. The rapidly advancing nature of research further adds to the complexity, making it essential for students to have prior knowledge and training before embarking on research projects. Additionally, a majority of students report limited external incentives, such as recognition, rewards, or institutional support, to encourage active participation in research. This lack of motivation, coupled with insufficient training, significantly reduces students' engagement in research, despite its recognized importance in medical education and practice. Examples of medical students' lack of motivation to engage in research activities are presented below:

"There's no reward or recognition for students involved in research. If the university doesn't value it, why should I put in the effort? There's nothing encouraging students to take part." (MBBS Final Year Male Student)

"I don't see the point in spending my time writing research papers. How is that going to benefit me? After graduation, if I become a faculty member, I can focus on research since I'll at least get a research allowance. But for now, there's nothing really motivating me to do it." (BDS Final Year Male Student)

"In medical school, we're constantly bombarded with a mountain of complex terminologies and concepts. Our focus is mostly on memorizing and scoring well in exams, because that's what helps us secure our place in a good specialty. Research is just not something we prioritize. Professors are more focused on grades, and the few who are interested in research are usually those planning to go abroad for further studies. It feels like there's little room or support for anything outside of passing exams."(MBBS Final Year Female Student)

"Honestly, most of us don't feel equipped to engage in research. We're taught so much theory and facts, but the practical skills needed for research are barely touched upon. Only a handful of students those who are naturally self-motivated or have a clear goal of going abroad take the leap into research projects. For the rest of us, it's just not something we feel we can do, especially when the emphasis is on getting good grades and memorizing medical jargon."(BDS Final Year Female Student)

Inadequate financial assistance and poor maintenance of research facilities

A significant number of participants identified insufficient financial support as a key barrier to their engagement in research activities. Many respondents highlighted that conducting research requires substantial funding, which they lacked, and noted that universities typically offer minimal or no financial assistance to support students' research endeavors. In the medical field, research can be particularly expensive, requiring access to high-end technologies and well-equipped laboratories, which are often unavailable in resource-limited settings.

Pakistan, as a lower- and middle-income country (LMIC), faces particular challenges in this regard. Most students enrolled in public universities come from low-income or middle-class families, and they simply do not have the financial resources to conduct or publish research. Medical and dental research is inherently an expensive domain, and the lack of funding severely

hampers students' ability to engage meaningfully in research and publish their findings.

Furthermore, participants indicated that the absence of university-supported research grants or incentives further exacerbates this issue. One respondent shared that a renowned journal indexed in Scopus requested a publishing fee of 1300 USD for their paper, a sum that is often required by some (non-open access) journals in the fields of medical sciences. For students from economically disadvantaged backgrounds, such fees are prohibitively expensive and deter them from pursuing publication.

In addition to financial barriers, the lack of well-maintained research facilities was also highlighted. Many respondents noted that their institutions struggled to maintain essential research infrastructure, such as laboratories, equipment, and access to academic databases. This lack of proper facilities and resources further limits their ability to conduct high-quality research and contributes to the overall stagnation in academic research productivity. Below are some of the quotes that illustrate these challenges:

"Honestly, the lab isn't equipped with the latest technology. If we had access to modern tools, we could diagnose more accurately and carry out more advanced research. It's hard to make any real breakthroughs when we're working with outdated equipment."(MBBS Final Year Female Student) "It's really frustrating. We do have resources, but they're mostly outdated or not well-maintained. Without proper, up-to-date equipment, it's difficult to produce research that can stand out. To get published in good journals, we need to show something novel, and that's impossible if we're not working with the latest tech." (MBBS Final Year Female Student) "Well, without proper funding, it's nearly impossible to dive deep into research. We don't have the money to access databases or even purchase papers. So, I often have to ask my friend in abroad to download the research papers for me. It's frustrating, but it's the only option."(MBBS Final Year Male Student)

Lack of support from a research mentor and training

Inadequate mentorship and training in research activities emerged as significant barriers to medical students' engagement in research. The absence of proper guidance and support from faculty members, particularly in the undergraduate phase, severely hinders students' ability to develop essential research skills. A strong research mentor not only guides students in their academic journey but also fosters their personal and professional growth, helping them navigate through complex research processes. However, in the context of this study, many students felt that they lacked the necessary encouragement and mentorship, ultimately affecting their interest and involvement in research.

"Honestly, our teachers are the future builders of the nation, but they barely have time for research. Most of them are so focused on teaching, they don't have time to guide us in research. The experienced ones have their own private clinics, and the few who are great also teach at private colleges. It's hard to ask them for extra help on top of everything they're doing."(MBBS Final Year Female Student)

"Some of our teachers have incredible experience, but they're often too busy with their private practices to help us with research. They're focused on teaching, which is important, but we need mentors who can help us grow in research too. It feels like we're missing out on a big opportunity."(MBBS Final Year Female Student)

"Teachers are so busy with their own work that they don't have the time or energy to guide us in research. Many have their own clinics or teach at other colleges. It's tough because we really need their mentorship, but it's like research is just an afterthought." (BDS Final Year Female Student)

"We don't just need guidance; we need proper training on how to do research. It's not something we can figure out on our own. Our teachers are great at teaching theory, but when it comes to practical research skills, there's no structured training or workshops to help us. Without training, it feels impossible to start or even think about publishing."

Discussion of findings

The findings of this study highlight several key barriers to medical students' engagement in research activities in Pakistan. These include time constraints, lack of external motivation, insufficient research skills, inadequate financial support, poor maintenance of research facilities, and limited guidance or training opportunities from mentors. Insights gained from this research can help inform strategies to enhance medical students' involvement in research and address these challenges effectively.

Time constraint: a key challenge in research involvement

A key challenge identified by participants was the limitation of time available for research activities. In Pakistan, medical curricula are traditionally structured with extensive clinical rotations, frequent examinations, and intensive theoretical coursework, leaving minimal protected time for research. Such rigid schedules prioritize clinical training and examination performance over research engagement, reflecting broader systemic and institutional barriers. A study by [36] noted that approximately 40% of Pakistani medical students identify time restrictions as a significant impediment, aligning with findings from other LMICs, such as India, Egypt, and Nigeria, where medical students similarly report difficulty balancing rigorous academic schedules with research activities. These parallels indicate that the barrier of time constraints is not unique to Pakistan but represents common challenges due to traditional medical curriculum structures prevalent in many LMICs. Furthermore, the traditional curriculum structure in Pakistan focused predominantly on rote memorization, theoretical lectures, and extensive clinical rotations, often fails to incorporate protected or designated research time. This institutional culture places minimal emphasis on research skills, critical inquiry, and independent scholarly activities [37]. Consequently, medical students experience burnout, fatigue, and decreased motivation for research pursuits, as indicated by previous literature linking heavy workloads to increased stress levels among medical students [38].

The rigorous schedule of medical students often results in burnout, negatively impacting their academic performance and overall well-being. [39] reported that the workload of medical students, including outpatient consultations and hospital ward duties, is associated with burnout, decreasing satisfaction and hampering participation in research activities. Moreover, the lack of structured time management training exacerbates these challenges [40]. A cross-sectional study highlighted that medical students often struggle with managing their time effectively, leading to difficulties in balancing academic responsibilities and research pursuits [41]. Addressing these systemic and institutional barriers requires targeted curricular reforms. Medical institutions should restructure curricula to explicitly include protected time dedicated to research training, mentorship, and scholarly activities. Additionally, providing flexible learning platforms such as virtual research workshops, peer-assisted learning models, or integrating research-focused electives within existing curricula could facilitate students' ability to engage in research without compromising clinical training. Countries such as India have successfully piloted integrated research modules within undergraduate medical education, resulting in enhanced student participation and research output [36]. Additionally, implementing low-cost, peer-taught virtual research workshops can provide flexible learning opportunities, allowing students to acquire research competencies without compromising their academic obligations [42]. Such approaches could be adapted in the Pakistani context, fostering a culture of balanced education that equally values clinical competence and research excellence.

Lack of extrinsic motivation, knowledge, and ability to engage in research

A lack of extrinsic motivation, inadequate knowledge, and limited research skills emerged as significant barriers to research engagement among undergraduate medical students. Conducting research requires a solid foundation in research methodologies, critical thinking, and technical expertise, skills that many students reported feeling unequipped to develop independently. Without proper training and institutional support, students often perceive research as an insurmountable task, which dampens their willingness to participate.

Extrinsic motivation, such as recognition, rewards, or institutional incentives, fosters students' interest in research [43]. However, many participants expressed frustration over the limited incentives provided by their institutions. Students emphasized that Pakistani universities rarely offer tangible rewards or public recognition for research efforts, discouraging them from undertaking additional workloads beyond their rigorous academic responsibilities. Professors and institutional leaders often reinforce these barriers by prioritizing grades, examinations, and clinical proficiency over research involvement [37]. This reflects a broader institutional culture prevalent in Pakistan, where research is considered secondary rather than integral to medical education. Similar institutional challenges were noted in other LMIC contexts such as Bangladesh and Nigeria, where limited extrinsic motivation also negatively impacts student research participation, suggesting a systemic issue rather than one unique to Pakistan [40].

Another critical issue is the absence of structured, hands-on research training within the medical curriculum. The Pakistani medical education system predominantly emphasizes theoretical knowledge acquisition, memorization, and clinical practice, neglecting essential training in practical research methodologies. Participants frequently reported this knowledge gap as a major reason for their low engagement in research activities. A recent study by [44] highlighted the need for integrating research training into undergraduate medical education, emphasizing that students with prior exposure to research methods were more confident and active in conducting research projects. Yet, despite these insights, curricular reforms remain limited in many Pakistani medical institutions.

Additionally, the demanding nature of medical education in Pakistan further compounds the problem. Students consistently face substantial academic pressures, with heavy emphasis on high-stakes examinations and clinical skills development, leaving little space for independent inquiry or research exploration. A study by [45], confirmed that academic stress and institutional neglect substantially reduce medical students' ability to prioritize research, a pattern similarly documented in Egypt and India. Cultural perceptions further reinforce these issues; many students view research as a secondary or even irrelevant component during undergraduate education, believing research becomes pertinent only in postgraduate training or academia [46], Such perspectives highlight the need for institutional efforts aimed at shifting cultural attitudes toward viewing research as an integral part of medical training from the outset.

To address these challenges effectively, systemic reforms are necessary. Medical institutions in Pakistan must explicitly integrate structured, practical research training into their undergraduate curricula. Institutions should also implement motivational frameworks, including financial incentives, recognition programs, publication opportunities, and dedicated mentorship. Mentorship programs have already demonstrated significant success in enhancing student research productivity and confidence, as seen in other LMIC contexts [47]. Changing institutional culture to prioritize research alongside clinical excellence can cultivate an environment conducive to scholarly activities, empowering students to see research not as an additional burden but as fundamental to their academic and professional development.

In conclusion, the barriers of extrinsic motivation, knowledge gaps, and insufficient research skills among Pakistani medical students are rooted deeply in the institutional and curricular structures. To overcome these challenges, comprehensive curricular reforms, structured mentorship, institutional recognition systems, and cultural shifts that value research activities must be prioritized. Such systemic approaches can foster stronger student engagement, equipping future medical professionals with critical skills to contribute meaningfully to evidence-based healthcare practices.

Inadequate financial assistance and poor maintenance of research facilities

Financial constraints and poorly maintained research infrastructure emerged as significant barriers limiting Pakistani medical students' engagement in research. Participants frequently cited insufficient institutional funding for essential resources, such as advanced laboratory equipment, reliable internet access, and subscriptions to up-to-date academic databases. Consequently, students often bear research-related costs themselves, making meaningful participation difficult, particularly for those from economically disadvantaged backgrounds [48]. These issues reflect broader systemic limitations within Pakistani medical institutions, often underfunded and lacking clearly defined budget allocations for research infrastructure. Similar financial and infrastructural

barriers are documented in other LMICs, including Nigeria and Bangladesh, indicating a global trend rather than an isolated local issue [49]. Moreover, students emphasized that inadequate financial support also impacts publication opportunities. High publishing fees of reputable international journals are prohibitive for Pakistani students, further marginalizing their contributions to global academic discourse [42]. Poor laboratory maintenance, outdated equipment, and restricted database access further exacerbate these challenges, significantly compromising research quality and discouraging student participation [24, 50, 51]. The impact of these financial and infrastructural barriers is far-reaching. Without adequate resources, students are unable to undertake innovative research projects, limiting their academic growth and the potential for significant contributions to the medical field [52]. Addressing these barriers demands systemic institutional reforms. Medical universities must prioritize research funding and infrastructure improvements, such as establishing institutional research grants, providing subsidized publication opportunities, and maintaining subscriptions to essential academic resources [36]. Additionally, forming strategic partnerships with international academic and funding organizations could bridge resource gaps, thereby enhancing students' ability to produce impactful, internationally recognized research [53]. Improving the maintenance of laboratories and ensuring access to academic databases are equally critical. By creating an environment conducive to research, institutions can empower students to engage in meaningful scientific inquiry and contribute to advancements in medical science [54]. Addressing these issues requires systemic reforms, including increased funding, improved infrastructure, and accessible publication opportunities. Such measures will not only enhance students' academic experience but also elevate the research output of medical institutions in Pakistan.

Lack of support from a research mentor and training

The absence of proper mentorship and structured training in research emerged as a critical barrier to medical students' engagement in research activities. Effective mentorship and training are fundamental in fostering research skills, yet many students reported that their institutions do not prioritize these aspects [24, 55]. In the context of undergraduate medical education, this lack of support from faculty members hinders students' ability to navigate the complexities of research and develop essential skills for academic and professional growth [39].

Participants emphasized that although highly experienced and capable, their teachers are often preoccupied with teaching responsibilities, private clinics, and commitments to multiple institutions. This leaves little room for faculty to mentor students in research actively. As one participant noted, "Our teachers are the future builders of the nation, but they barely have time for research [42]. They are too focused on teaching to guide us." This imbalance between teaching and research mentorship reflects broader systemic issues within medical institutions, where research is often considered secondary to traditional academic responsibilities [56].

This issue is compounded by a lack of structured research training programs in most Pakistani medical schools, leading students to feel inadequately prepared for scholarly activities. Students consistently reported difficulty initiating research projects due to insufficient practical knowledge of research methodologies, including data collection, analysis, and manuscript writing. Similar issues have been noted in LMIC contexts such as Bangladesh and India, where a lack of institutional emphasis on practical research training creates significant obstacles to student research involvement.

The role of a mentor extends beyond providing technical guidance; it involves fostering a culture of inquiry and motivating students to pursue academic excellence [57]. A strong mentor-mentee relationship can enhance students' confidence, critical thinking, and problem-solving abilities [58]. However, participants noted that mentorship is often treated as an optional responsibility rather than a fundamental part of medical education. A participant commented, "Teachers are so busy with their own work that they don't have the time or energy to guide us in research. It's tough because we really need their mentorship, but it's like research is just an afterthought." This sentiment underscores the lack of prioritization of research mentorship within the current educational framework.

Moreover, mentorship opportunities are often limited to self-motivated students or have prior research exposure [59]. For the majority, the absence of institutional support and accessible mentorship programs creates a significant barrier to entry. Without dedicated faculty or structured workshops, students struggle to acquire the foundational skills necessary for initiating and completing research projects [60].

Addressing these challenges requires systemic changes in medical education. Institutions must recognize the importance of research mentorship and integrate it as a core component of the curriculum [61]. This could involve assigning dedicated research mentors to students, offering training workshops, and incentivizing faculty to actively engage in mentorship. Collaborative programs, where experienced researchers guide students through the research process, could also bridge the gap between theory and practice [62].

Studies have shown that mentorship programs significantly enhance students' research productivity, confidence, and academic success.

To address this, medical colleges must prioritize integrating structured research mentorship and training within undergraduate curricula. Establishing formal mentorship programs, assigning dedicated research mentors, and embedding structured research methodology workshops within the undergraduate timetable could significantly increase student engagement. Evidence from LMICs such as Egypt and India demonstrate that structured mentorship programs markedly improve student confidence, skill development, and research productivity. Institutional incentives encouraging faculty engagement in mentorship could also shift the prevailing culture towards recognizing research as equally integral to medical education as clinical practice.

Conclusion

This study identified four major barriers limiting undergraduate medical and dental students' engagement in research in Pakistan: time constraints, lack of extrinsic motivation, inadequate research knowledge and skills, financial limitations, and lack of structured mentorship. These findings highlight systemic challenges within medical education that hinder the development of a strong research culture. To overcome these barriers, medical institutions must take proactive steps to integrate research training into the curriculum, provide structured mentorship programs, and enhance financial and infrastructural support for students. Research should be incorporated into undergraduate education through mandatory research components, elective modules, and protected research time within academic schedules. Time constraints can be addressed by balancing coursework and research obligations through better curricular structuring. Additionally, faculty involvement in research mentorship must be strengthened by introducing structured programs that incentivize faculty participation through institutional recognition, financial rewards, or career advancement opportunities. Universities should also provide research training workshops, grant-writing seminars, and accessible research funding to support students. By implementing these reforms, medical institutions in Pakistan can foster a more research-oriented academic culture, equipping future medical professionals with essential research competencies that contribute to evidence-based clinical practice and scientific advancement.

Implications

The barriers identified in this study underscore critical systemic gaps within the current medical education framework in Pakistan, highlighting the need for meaningful curricular and institutional reforms. Future medical curricula should explicitly integrate research training and experiences, emphasizing a shift from passive knowledge transfer toward active inquiry-based learning and critical thinking development. Additionally, structured and institutionalized research mentorship programs must be established and prioritized within medical institutions. Such programs should involve formally assigning faculty mentors, providing mentorship training, and offering tangible incentives to mentors. Collectively, these curricular and mentorship reforms can foster a stronger institutional research culture, better preparing future medical professionals to engage in impactful research and evidence-based clinical practice.

Limitations of the study

This study was limited to undergraduate medical and dental students from a single medical university in Pakistan. As a result, the findings may not fully represent the experiences or perspectives of students from other medical universities or regions within the country. The unique institutional culture, resources, and policies of the selected university may have influenced the participants' responses, making the results context-specific.

Additionally, the study did not include students from private medical institutions, whose experiences may differ due to resource variations, mentorship opportunities, and research infrastructure. Future research could expand the scope to include students from multiple public and private institutions across different provinces to provide a more comprehensive understanding of the barriers to research engagement in undergraduate medical education.

Abbreviations

HFIs Higher educational institutions I MICs Low- and middle-income countries MBBS Bachelor of Medicine, Bachelor of Surgery BDS Bachelor of Dental Surgery

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

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Clinical trial number

Not applicable.

Authors' contributions

NR: made significant contributions to the conception and design of the study, writing, data collection, analysis, and interpretation. XH: provided valuable insights into the theoretical framework conceptualization, resources, supervision, validation, and proofreading. AM: Data collection and analysis, writing original draft, review, and editing. IR: Data collection, review, and editing. All authors read and approved of the final manuscript.

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Data availability

The datasets generated and/or analyzed during the current study consist of qualitative interview data containing sensitive and personal information. As such, the data cannot be publicly shared to protect participant confidentiality. However, upon reasonable request, additional information about the study can be made available from the corresponding author.

Declarations

Ethics approval and consent to participate

This study received ethics approval (Approval No: ZSRT20251) from the Human Experiment Ethics Committee at Zhejiang Normal University. The study was conducted under the principles of the Declaration of Helsinki. All participants were informed about the purpose of the study and the confidentiality of their personal information. Written informed consent was obtained from each participant before their involvement in the research. Participants were assured that their participation was voluntary and that they had the right to withdraw from the study without any consequences. All data collected for this study were anonymized and securely stored to protect participants' privacy. The research team adhered to the ethical guidelines and principles set forth by Zhejiang Normal University throughout the study to ensure the responsible and respectful treatment of all participants involved.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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