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Perceived Barriers to Participating in Dental Research Among Undergraduate Students

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ABSTRACT

Background: *Research engagement during undergraduate dental training strengthens evidence-based practice and academic development, yet participation remains limited in many low- and middle-income settings due to structural and educational constraints.* ***Objective:*** *To assess perceived barriers to participating in dental research among undergraduate dental students in Pakistan and examine associations between prior research participation and self-reported research confidence.* ***Methods:*** *A cross-sectional online survey (17-item, two-section questionnaire) was administered to BDS students across Pakistani dental institutions from 1 July to 31 August. Data included demographics, research exposure, perceived barriers (training, opportunities, academic pressure), process-related experiences (questionnaire design, IRB, publication), and confidence to conduct research. Analyses were performed using SPSS v25, with categorical associations tested using chi-square-based methods.* ***Results:*** *Among 190 respondents, 68.4% were female and 73.2% were from public/government institutions; third- and fourth-year students comprised 25.8% and 25.3%, respectively. Prior research participation that enhanced learning was reported by 49.5%. Only 43.1% agreed that research opportunities are available, while 85.8% agreed that lack of research training discourages participation. Academic pressure affected research participation in 95.3% of students. Prior research participation was significantly associated with higher research confidence (χ^2=41.217, df=12, p<0.001).* ***Conclusion:*** *Pakistani dental undergraduates report high academic pressure, insufficient training, and limited opportunities as major barriers; early structured training and mentorship may improve confidence and engagement.*

Keywords: *Dental students; undergraduates; research barriers; mentorship; training; academic pressure*

INTRODUCTION

Scientific research underpins evidence-based dentistry by informing prevention strategies, diagnostic pathways, and treatment decision-making, and it also strengthens students' academic development through skills in critical appraisal, study design, and scientific communication. Across health professions, early exposure to research is linked with improved analytical thinking, stronger scholarly productivity, and greater likelihood of sustained engagement in academic or postgraduate pathways.

However, translating these benefits into routine undergraduate participation remains challenging, particularly where students perceive research as complex, time-intensive, and insufficiently supported within demanding clinical curricula. Surveys among dentists and dental students consistently identify constrained time, limited mentorship, and inadequate institutional support as recurrent barriers, even in relatively well-resourced settings, suggesting that structural determinants often outweigh individual motivation in shaping research involvement (1). Broader syntheses of undergraduate research involvement

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similarly emphasize that skill deficits and opportunity constraints—rather than lack of interest—commonly explain low participation and low confidence among students (2).

Within South Asian and comparable low- and middle-income contexts, barriers frequently cluster around four domains: (i) training and methodological preparedness, (ii) availability and quality of supervision, (iii) access to research infrastructure (databases, software, laboratories, funding), and (iv) competing academic and clinical workload. Studies focusing on healthcare professionals in the region describe inadequate training, limited protected time, and scarce mentorship as core impediments to initiating and completing research projects, and these impediments are often amplified by competitive assessment cultures and heavy curricular demands (3).

Among undergraduate health sciences cohorts, perceived barriers frequently include weak familiarity with research methods, uncertainty regarding ethics processes, and limited hands-on guidance, which collectively reduce self-efficacy and increase avoidance of research tasks, particularly questionnaire development, protocol writing, and analysis (4). In mixed samples of medical and dental students, these constraints persist even when attitudes toward research are positive, indicating a gap between interest and actionable capability that can undermine participation unless curricula integrate structured training and mentorship (5).

Evidence from Pakistan and similar settings suggests that the local training ecosystem further intensifies this interest–participation gap. Although professional organizations and institutional initiatives have historically promoted scholarly activity, many undergraduate students still experience limited access to supportive research environments, including consistent supervision and stepwise skill-building opportunities (6).

Internationally, students report that early research exposure improves competence, confidence, and longer-term engagement; in classic student-perspective work, undergraduates often value research but identify barriers such as time scarcity, limited supervision, and limited methodological expertise as decisive deterrents (7). Where institutional scaffolding is weak, the “leaky pipeline” phenomenon becomes more pronounced: students—particularly those from under-resourced programs—may perceive research careers as inaccessible due to practical constraints and the absence of mentoring networks (8). The cumulative effect is that students may endorse research in principle yet remain unable to initiate, sustain, and disseminate projects, especially when publication pathways are perceived as opaque or unattainable (9).

Recent multi-country undergraduate surveys reiterate that insufficient training and limited protected time are among the most powerful predictors of reduced research involvement (10). Importantly, emerging work from Pakistan highlights the need to distinguish between general “attitudes toward research” and concrete, dentistry-specific participation barriers, because dental curricula combine intensive didactic requirements with escalating clinical responsibilities that can displace extracurricular scholarly work. Local evidence indicates that undergraduate medical and dental research participation is uneven and often dependent on informal networks, with students reporting constraints in mentorship, time, and methodological competence (11).

In Islamabad, dental undergraduates similarly report persistent barriers spanning knowledge, attitudes, practices, and resource limitations, supporting the concern that dentistry-specific constraints may require targeted interventions beyond generic research-awareness sessions (12). Despite these signals, the evidence base remains fragmented: many studies pool medical and dental students, focus on attitudes rather than the research process

(e.g., ethics approval, questionnaire development, manuscript preparation), or lack analytic links between prior participation and measurable confidence—an omission that limits actionable curriculum reform.

Accordingly, the present study addresses a clearly defined problem: undergraduate dental students in Pakistan may have substantial latent interest in research but face modifiable barriers—particularly academic pressure, limited opportunities, and insufficient training—that reduce participation and research self-efficacy. The knowledge gap is the lack of Pakistan-focused, dentistry-specific quantification of perceived barriers across the research lifecycle and the extent to which prior participation is associated with higher research confidence and fewer perceived difficulties.

The justification is practical and policy-relevant: identifying the dominant perceived barriers and their association with confidence can inform curriculum design (early structured methodology training), mentorship models, and protected time strategies to strengthen the pipeline for evidence-based dental practice. In PICO terms, the population is Pakistani undergraduate dental students; the exposure is perceived barriers (training deficits, mentorship constraints, limited opportunities/resources, and academic pressure); the comparator is students with lower versus higher research exposure (e.g., prior participation versus none); and the outcomes are research participation, perceived difficulty across key steps, and self-reported confidence.

Therefore, the study objective is to assess perceived barriers to participating in dental research among undergraduate dental students in Pakistan and to examine whether prior research participation is associated with higher self-reported research confidence and fewer perceived difficulties during key research tasks (13). We hypothesize that students with prior research participation will report significantly higher research confidence and fewer perceived procedural difficulties than those without prior participation (14).

MATERIAL AND METHODS

This cross-sectional observational study was designed to evaluate perceived barriers to participation in dental research and their association with prior research exposure and self-reported confidence among undergraduate dental students in Pakistan, in alignment with international reporting standards for observational research (15). The study was conducted nationwide using an online survey platform, targeting students enrolled in Bachelor of Dental Surgery (BDS) programs across public, private, semi-government, and internationally affiliated dental institutions. Data collection was carried out over a two-month period from 1 July to 31 August, allowing participation across different academic schedules and institutional settings. The study population comprised undergraduate dental students currently enrolled in any year of the BDS program. Eligibility criteria included active enrollment in a recognized dental college within Pakistan and willingness to participate voluntarily. Students who had completed their undergraduate training, interns, postgraduate trainees, or non-dental students were excluded to maintain population homogeneity.

Participants were selected using a non-probability convenience sampling approach, which is commonly employed in multi-institutional student surveys where comprehensive sampling frames are unavailable (16). Recruitment was conducted through academic coordinators and peer networks, who disseminated the survey link via institutional communication channels and student social media groups. At the start of the online questionnaire, participants were provided with an information sheet outlining the study purpose, procedures, confidentiality assurances, and voluntary nature of participation, and informed consent was obtained electronically prior to survey initiation.

Data were collected using a structured, self-administered questionnaire developed based on previously published instruments assessing research attitudes, barriers, and practices among undergraduate health sciences students, with contextual adaptation for dental education (17,18). The questionnaire consisted of 17 closed-ended items organized into two conceptual domains. The first domain captured demographic and academic characteristics, including age, gender, year of study, and type of institution. The second domain assessed research-related variables, including prior participation in research activities, perceived educational benefit of research, perceived difficulties across key stages of the research process (questionnaire design, ethics approval, and publication),

perceived availability of research opportunities, perceived adequacy of research training, academic pressure related to grades and competition, and self-reported confidence in selecting a research topic and conducting a project. Most perceptual items were measured using five-point Likert-type response scales ranging from strong agreement to strong disagreement or from very confident to not at all confident, enabling categorical analysis consistent with the study objectives.

The primary outcomes of interest were perceived barriers to research participation and self-reported research confidence. Key exposure variables included prior research participation and academic year of study. Operationally, prior research participation was defined as self-reported involvement in any research-related activity during undergraduate training, regardless of publication outcome.

Research confidence was defined as the participant's self-assessed ability to independently select a research title and conduct a research project, categorized across five ordinal levels. Perceived barriers were defined as self-reported endorsement of factors such as inadequate training, limited opportunities, and academic pressure as discouraging influences on research participation. To minimize information bias, the questionnaire employed standardized response options and neutral wording, and participation was anonymous to reduce social desirability bias. Potential confounding by academic seniority was addressed analytically by examining associations stratified by year of study.

The sample size was determined pragmatically to ensure adequate representation across academic years and institution types while maintaining sufficient power for categorical association testing. A target sample exceeding 180 participants was considered adequate to detect moderate associations between key categorical variables using chi-square-based analyses at a 5% significance level (19). Data integrity was maintained by restricting the survey to single responses per device and by screening submissions for completeness prior to analysis.

All responses were exported from the survey platform into Microsoft Excel for initial cleaning and coding and subsequently analyzed using SPSS version 25. Descriptive statistics were computed for all variables, with categorical data summarized as frequencies and percentages. Associations between categorical variables, including prior research participation and research confidence, year of study and perceived difficulties, and perceptions of training and interest in mandatory research, were examined using chi-square tests or likelihood ratio tests as appropriate. Linear-by-linear association tests were applied for ordinal variables to assess trends across ordered categories. Where necessary, exact significance testing was considered to account for sparse data distributions (20). Statistical significance was set at $p < 0.05$, and all tests were two-sided. Missing data were minimal due to mandatory response settings in the online questionnaire and were handled using complete-case analysis.

The study protocol was reviewed and approved by the Ethics Committee of the Pakistan Research Institute of Dental Education, and all procedures were conducted in accordance with the Declaration of Helsinki and established ethical standards for human-subject research (21). Participant confidentiality was ensured through anonymous data collection and secure storage of datasets accessible only to the research team. To enhance reproducibility, the study design, questionnaire structure, variable definitions, and analytical approach were documented in detail, allowing replication of the methodology in comparable educational settings.

RESULTS

A total of 190 undergraduate dental students were included in the analysis. As shown in Table 1, most respondents were aged 21–22 years (n=89, 46.8%), followed by 23–25 years (n=58, 30.5%), while smaller proportions were under 20 years (n=33, 17.4%) or above 25 years (n=10, 5.3%). Female students constituted more than two-thirds of the sample (n=130, 68.4%), whereas males represented 31.6% (n=60).

The sample was predominantly drawn from public/government institutions (n=139, 73.2%), with fewer students from private colleges (n=35, 18.4%), semi-government institutions (n=14, 7.4%), and international dental schools (n=2, 1.1%). By academic year, participation was highest among third-year (n=49, 25.8%) and fourth-year students (n=48, 25.3%), followed by second-year (n=37, 19.5%), fifth-year (n=29, 15.3%), and first-year students (n=27, 14.2%).

Regarding research exposure and procedural experience (Table 2), nearly half of the respondents reported prior participation in research activities that they perceived as significantly enhancing learning (n=94, 49.5%). An additional 8.9% had participated but did not perceive substantial learning benefit (n=17), while 40.5% had not participated but believed research could enhance learning (n=77). Only 1.1% neither participated nor believed research would be beneficial (n=2).

When asked about questionnaire design, 36.3% reported having faced difficulty (n=69), whereas 21.6% indicated no difficulty (n=41); notably, 42.1% reported that this item was not applicable because they had never attempted to design a questionnaire (n=80). Experience with ethics review processes was limited: only 18.9% reported having applied for IRB approval (n=36), 17.4% had not applied (n=33), and 63.7% indicated this was not applicable (n=121). Similarly, publication experience was uncommon: 28.9% reported encountering obstacles related to publication (n=55), 10.0% reported no obstacles (n=19), and the majority (61.1%) indicated this was not applicable because they had never published (n=116).

Students' confidence levels and research-related perceptions (Table 3) showed that 15.8% were very confident in selecting a research title and conducting a project (n=30), and 38.4% were somewhat confident (n=73), yielding 54.2% with at least some confidence. In contrast, 21.6% were neutral (n=41), 20.0% were not very confident (n=38), and 4.2% were not at all confident (n=8), indicating that 24.2% expressed low confidence.

Perceived availability of research opportunities was mixed: 14.7% strongly agreed (n=28) and 28.4% agreed (n=54), totaling 43.1% who endorsed opportunity availability, whereas 24.2% were neutral (n=46) and 32.6% disagreed or strongly disagreed (n=49 and n=13, respectively). Perceived inadequacy of training was highly prevalent: 37.9% strongly agreed (n=72) and 47.9% agreed (n=91) that lack of research training discourages participation, totaling 85.8%, while only 2.7% disagreed/strongly disagreed (n=3 and n=2). Academic pressure was nearly universal as a deterrent: 54.2% reported it affected participation very significantly (n=103),

41.1% somewhat (n=78), 4.2% slightly (n=8), and only 0.5% not at all (n=1), meaning 95.3% reported at least some impact (n=181).

Table 1. Demographic and Academic Characteristics of Respondents (n = 190)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Under 20	33	17.4
	21–22	89	46.8
	23–25	58	30.5
	Above 25	10	5.3
Gender	Male	60	31.6
	Female	130	68.4
Type of Institution	Public/Government	139	73.2
	Private	35	18.4
	Semi-government	14	7.4
	International	2	1.1
Year of BDS Program	1st Year	27	14.2
	2nd Year	37	19.5
	3rd Year	49	25.8
	4th Year	48	25.3
	5th Year	29	15.3

Table 2. Research Participation and Process-Related Experience (n = 190)

Variable	Category	n (%)
Research participation	Participated; enhanced learning	94 (49.5)
	Participated; no significant benefit	17 (8.9)
	Not participated; believe beneficial	77 (40.5)
	Not participated; not beneficial	2 (1.1)
Difficulty designing questionnaire	Yes	69 (36.3)
	No	41 (21.6)
	Not applicable (never attempted)	80 (42.1)
Applied for IRB approval	Yes	36 (18.9)
	No	33 (17.4)
	Not applicable	121 (63.7)
Encountered publication obstacles	Yes	55 (28.9)
	No	19 (10.0)
	Not applicable	116 (61.1)

Table 3. Confidence and Perceptions Toward Research (n = 190)

Variable	Category	n (%)
Confidence in conducting research	Very confident	30 (15.8)
	Somewhat confident	73 (38.4)
	Neutral	41 (21.6)
	Not very confident	38 (20.0)
	Not at all confident	8 (4.2)
Research opportunities available	Strongly agree	28 (14.7)
	Agree	54 (28.4)
	Neutral	46 (24.2)
	Disagree	49 (25.8)
	Strongly disagree	13 (6.8)
Lack of training discourages research	Strongly agree	72 (37.9)
	Agree	91 (47.9)
	Neutral	22 (11.6)
	Disagree	3 (1.6)
	Strongly disagree	2 (1.1)
Academic pressure affects participation	Very significantly	103 (54.2)
	Somewhat	78 (41.1)
	Slightly	8 (4.2)
	Not at all	1 (0.5)

Table 4. Association Between Research Participation and Research Confidence (n = 190)

Test Statistic	Value	df	p-value	Effect Size
Pearson Chi-square	41.217	12	<0.001	Cramér's V = 0.33
Likelihood Ratio	44.039	12	<0.001	—
Linear-by-linear association	29.948	1	<0.001	—

Table 5. Association Between Year of Study and Difficulty in Questionnaire Design (n = 190)

Test Statistic	Value	df	p-value	Effect Size
Pearson Chi-square	15.189	8	0.056	Cramér's V = 0.20
Likelihood Ratio	15.585	8	0.049	—
Linear-by-linear association	5.032	1	0.025	—

Inferential analyses (Tables 4–6) demonstrated statistically significant associations between key variables. The relationship between prior research participation and research confidence was significant (Pearson χ^2=41.217, df=12, p<0.001), with a moderate effect size (Cramér's V=0.33), indicating that confidence levels differed meaningfully by participation status.

Table 6. Association Between Perceived Training Deficit and Interest in Mandatory Research (n = 190)

Test Statistic	Value	df	p-value	Effect Size
Pearson Chi-square	14.155	8	0.078	Cramér's V = 0.19
Likelihood Ratio	16.003	8	0.042	—
Linear-by-linear association	3.594	1	0.058	—

The association between year of study and difficulty in questionnaire design showed borderline-to-significant results depending on the test statistic (Pearson χ^2=15.189, df=8, p=0.056; Likelihood Ratio=15.585, df=8, p=0.049), with a small-to-moderate effect size (Cramér's V=0.20) and a significant ordinal trend (Linear-by-Linear Association=5.032, df=1, p=0.025), suggesting difficulty patterns varied across academic years. Finally, the association between perceiving inadequate training as discouraging and interest in research if made mandatory was significant on the likelihood ratio test (Likelihood Ratio=16.003, df=8, p=0.042), with a small-to-moderate effect size (Cramér's V=0.19), indicating that students' support for mandatory research differed according to their perception of training-related barriers.

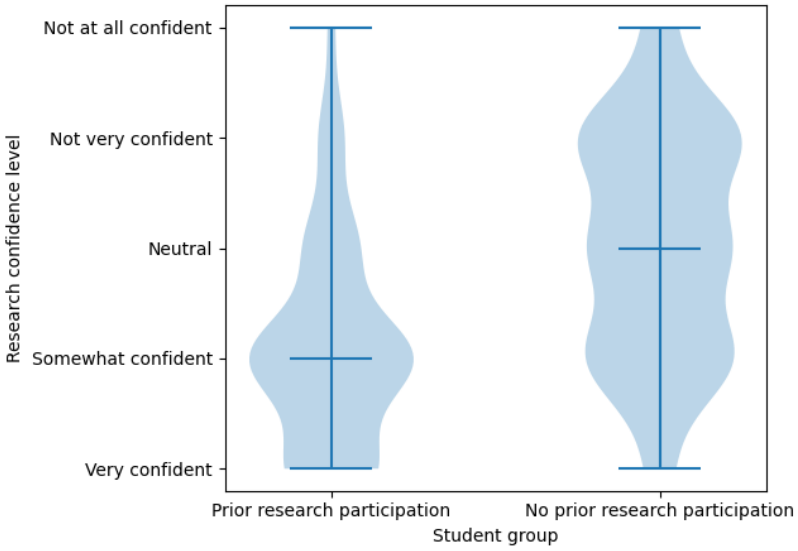

Figure 1 Distribution of Research Confidence by Prior Research Participation

The figure illustrates a clear shift in the distribution of self-reported research confidence according to prior research participation status. Students with prior research experience show a left-shifted, more concentrated distribution toward higher confidence categories, with the median positioned between "somewhat confident" and "very confident," reflecting that more than half of this group (54.2%) reported at least moderate confidence. In contrast, students without prior research participation demonstrate a broader and right-skewed distribution extending into lower confidence categories, with the median centered around the "neutral" to "not very confident" range, consistent with the finding that approximately one-quarter reported low confidence. The reduced density of low-confidence responses among previously exposed students, alongside the wider dispersion and lower central tendency in non-participants, visually reinforces the statistically significant association observed in inferential analysis (χ^2=41.217, p<0.001; Cramér's V=0.33), highlighting prior research exposure as a clinically and educationally meaningful gradient in shaping undergraduate research self-efficacy.

DISCUSSION

The present study provides a comprehensive assessment of perceived barriers to dental research participation among undergraduate dental students in Pakistan and demonstrates that, despite generally positive attitudes toward research, substantial structural and educational obstacles persist. Nearly half of the respondents reported prior research participation that they perceived as educationally beneficial, while a comparable proportion had not participated but believed research could enhance their learning. This finding underscores a critical interest–participation gap, suggesting that lack of engagement is not driven by disinterest but rather by modifiable barriers within the academic environment. Similar patterns have been reported among undergraduate health sciences students in other low- and middle-income countries, where favorable perceptions coexist with low participation due to systemic constraints rather than attitudinal resistance (22).

One of the most salient findings was the strong association between prior research participation and higher self-reported research confidence. Students with previous exposure demonstrated significantly greater confidence in selecting research topics and conducting projects, with a moderate effect size, reinforcing the role of experiential learning in building research self-efficacy. This aligns with earlier evidence indicating that hands-on research involvement enhances students' perceived competence, autonomy, and willingness to engage in future scholarly activity (23). From an educational perspective, this association suggests a reinforcing cycle in which early exposure increases confidence, which in turn may facilitate further participation and productivity. Conversely, students without prior exposure exhibited broader dispersion toward lower confidence levels, highlighting the risk of persistent disengagement if early opportunities are not provided.

Academic seniority was also meaningfully associated with perceived difficulty in key research tasks, particularly questionnaire design. Senior students reported fewer difficulties compared to those in earlier years, with a significant ordinal trend across academic levels. This likely reflects cumulative exposure to research methodology, biostatistics, and academic writing skills as students' progress through the curriculum. Comparable findings have been observed in longitudinal and cross-sectional studies showing that advanced undergraduate students demonstrate greater research competence and productivity, largely attributable to increased academic maturity and curricular exposure (24). However, the persistence of difficulty among a substantial proportion of senior students suggests that passive exposure alone may be insufficient and that structured, competency-based research training may be required earlier in dental education.

The predominance of academic pressure as a perceived barrier represents another critical insight. More than 95% of respondents reported that grade competition and academic workload affected their ability to participate in research to some degree, with over half describing the impact as very significant. Dental curricula are widely recognized as intensive, combining dense didactic content with escalating clinical responsibilities, which can crowd out non-mandatory scholarly activities. Similar observations have been reported among dental and medical undergraduates internationally, where lack of protected time consistently emerges as one of the strongest deterrents to research engagement (25). These findings suggest that encouraging research participation without addressing curricular load may have limited effectiveness and could inadvertently exacerbate student stress.

Perceived inadequacy of research training emerged as a near-universal barrier, with more than four-fifths of students agreeing that insufficient training discourages participation. Importantly, this perception was significantly associated with greater interest in research if

it were made a mandatory component of the curriculum. This indicates that students do not necessarily resist compulsory research; rather, they appear receptive to structured integration when accompanied by appropriate training and support. Prior studies have similarly shown that formal incorporation of research methodology courses, supervised projects, or capstone requirements can improve both participation rates and attitudes toward research, particularly when mentorship is readily available (26). These findings support the argument that optional, extracurricular research opportunities may be insufficient in contexts where students lack foundational skills and institutional guidance.

Limited exposure to the ethics approval process and publication further highlights gaps across the research lifecycle. Fewer than one-fifth of students had applied for institutional review board approval, and the majority had never published, reflecting constrained opportunities to engage in advanced stages of research. This is consistent with reports from resource-limited settings, where undergraduates often struggle to navigate ethical review and dissemination due to procedural complexity, limited mentorship, and lack of institutional incentives (27). Without deliberate exposure to these stages, students may graduate with theoretical appreciation of research but limited practical readiness to contribute to evidence-based dentistry.

Taken together, these findings point to an interrelated set of barriers encompassing training deficits, academic workload, limited opportunities, and uneven mentorship. Addressing any single factor in isolation is unlikely to yield sustained improvement. Instead, a coordinated approach is needed, involving early and longitudinal integration of research training, allocation of protected time within the curriculum, development of structured mentorship frameworks, and institutional recognition of undergraduate research efforts. Such strategies have been shown to improve research engagement and confidence in diverse educational contexts and may be particularly impactful in dentistry, where clinical demands are substantial (28). By systematically addressing these barriers, dental institutions in Pakistan can strengthen the research capacity of future practitioners and promote a more robust culture of evidence-based practice.

CONCLUSION

In conclusion, this study demonstrates that although undergraduate dental students in Pakistan largely recognize the value of research and express interest in participation, their engagement is substantially constrained by modifiable barriers, most notably academic pressure, insufficient research training, limited opportunities, and lack of structured mentorship. Prior research participation was strongly associated with higher self-reported confidence, underscoring the importance of early and experiential exposure to research activities. The findings highlight a clear interest–participation gap driven by systemic and curricular factors rather than negative attitudes toward research. Integrating structured research training, protected time, and supervised research experiences into undergraduate dental curricula may enhance students' confidence, reduce perceived barriers, and foster a sustainable culture of evidence-based practice among future dental professionals in Pakistan.

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DECLARATIONS

Ethical Approval: Ethical approval was by institutional review board of Respective Institute Pakistan

Informed Consent: Informed Consent was taken from participants.

Authors' Contributions:

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