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Bridging the Gap Between Research Readiness and Practice: A Mixed-Methods Study of Medical Students

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Abstract

Background:

Undergraduate medical research is essential for developing evidence-based practitioners; however, a gap often exists between students' interest and their actual research practices. This study aimed to assess perceived research readiness, attitudes, research practices and associated factors among undergraduate medical students.

Methods:

A mixed method analytical cross-sectional study was conducted among 252 undergraduate medical students at a private Medical College in Karachi Pakistan. Participants were selected using systematic random sampling. Data were collected through validated self-administered questionnaire assessing exposure to research education, perceived readiness, attitude, practices and barriers. Readiness and attitude were measured using Likert scale instrument and internal consistency was assessed using Cronbach's alpha. Association was analyzed using chi square test. Additionally, 2 focus group discussions were conducted and analyzed using thematic analysis to explore underlying perceptions.

Results:

The mean perceived readiness score was 40.93 ± 10.59, and the mean attitude score was 27.55 ± 6.35, indicating generally positive perceptions toward research. Despite this, only 20.2% of students participated in research projects and 17.5% were involved in IRB-approved studies, with minimal involvement in statistical analysis (1.2%). Research readiness was significantly associated with age ($p = 0.034$), residential status ($p = 0.021$), research participation ($p = 0.035$), publication status ($p = 0.010$), and attitude ($p < 0.001$). Motivation was predominantly extrinsic, driven mainly by mentorship (46%). Major barriers included academic overload (85.3%), lack of structured training (84.5%), lack of statistical support (79%), and inadequate mentorship (74.6%). Qualitative findings highlighted a gap between theoretical knowledge and practical application, with mentorship emerging as a key facilitator and administrative delays as major barriers.

Conclusion:

Although undergraduate medical students demonstrated positive attitudes towards research, perceived readiness remained limited and did not consistently translate into meaningful research participation or publication. Strengthening structure training, mentorship and institutional support is essential to bridge the gap between readiness and research output.

Introduction

Research is a vital part of medical education for undergraduates, serving as the foundation of evidence-based practice (1). In medical education, readiness refers to students' preparedness and willingness to

participate in research activities and is influenced by their knowledge base, attitudes toward research, availability of mentorship, and institutional support (2).

In developing countries like Pakistan, where the burden of communicable and non-communicable diseases is high, fostering a research culture among medical students is essential. Early research exposure enhances critical thinking, improves clinical decision-making, and prepares future physicians for academic and leadership roles (3, 4). Participation in research among medical students varies globally, with South Asian undergraduates' involvement much lower. A study of international health research production showed that scientists from the South Asian region produced just 1.2% of all papers listed in the Institute for Scientific Information database (5, 6).

In Pakistan, although 80% of students demonstrate moderate knowledge of health research, the average knowledge score remains low at 49%. Despite 88% expressing interest, only 51% have participated in research (7, 8). These findings highlight a significant gap between interest and participation, indicating barriers to research engagement. Unclear intrinsic and extrinsic motivators, inadequate undergraduate research training, lack of structured curriculum, and time constraints hinder students from translating knowledge and attitudes into meaningful research practice and publication outcomes (9).

Medical students face barriers such as inadequate training, limited mentorship, and time constraints, which hinder research participation (10). In response, DIMC has introduced mentorship programs, training workshops, and conferences. Student motivation for research is largely career-driven, aimed at improving future academic and professional opportunities(11).

Although some students engage in research independently, most lack adequate support, resulting in low participation and publication rates. Understanding factors affecting readiness and motivation can help institutions develop targeted strategies to promote research culture and evidence-based practice.

This study is grounded in behavioral theories, primarily the Knowledge–Attitude–Practice (KAP) framework and self-efficacy theory. The KAP model suggests that knowledge influences attitudes, which in turn shape behavior or practice. In the context of research engagement, students’ exposure to research education contributes to their attitudes toward research. Additionally, self-efficacy theory highlights that an individual’s confidence in their ability to perform a task influences their likelihood of engaging in that behavior. Therefore, perceived research readiness, reflecting confidence and motivation, acts as a key determinant in translating positive attitudes into actual research practice.

Based on this framework, the study conceptualizes that exposure to research education enhances students perceived readiness and attitudes toward research. These, in turn, influence their actual research practices, including participation and publication. However, this relationship may be modified by perceived barriers such as lack of time, mentorship, and resources, which can hinder the translation of readiness and positive attitudes into practice.

Given these considerations, this study aims to assess the perceived research readiness of undergraduate medical students, along with their attitudes, research practices, and perceived barriers, using a mixed-methods approach.

Objectives

Primary Objective:

To assess the perceived research readiness and attitudes of undergraduate medical students at DIMC in relation to participation in research.

Secondary Objective:

To assess intrinsic and extrinsic factors, as well as perceived barriers, influencing research participation and publication among undergraduate medical students.

Methods

Study design and setting:

An analytical cross-sectional study with a mixed-methods approach was conducted at Dow International Medical College (DIMC), a constituent institute of Dow University of Health Sciences (DUHS), Karachi, Pakistan. The study was carried out over a period of three months following approval from the institutional ethical review board.

Study population and sampling:

The study population comprised undergraduate MBBS students enrolled in academic years 1 to 5 (2021–2025). A minimum sample size of 233 participants was calculated using standard sample size estimation techniques(population size (N) 750, hypothesis % frequency of outcome factor in population(p) 32.5%+/- 5, confidence limits as % of 100 (absolute +/-%(d) 5%, Design effect 1); however, a total of 252 students were included to ensure adequate representation. Participants were selected using systematic random sampling, with proportional representation from each academic year. Students who provided informed consent were included in the study, while those who declined participation or submitted incomplete questionnaires were excluded.

Data collection tool:

Data were collected using a pre-tested, semi-structured, self-administered questionnaire developed from previously validated instruments. The questionnaire consisted of six sections: (1) demographic

information, (2) exposure to research education and training, (3) perceived research readiness, (4) attitudes toward research, (5) research practices, and (6) perceived barriers to research involvement.

Perceived research readiness was assessed using a set of Likert-scale items evaluating students' self-reported confidence, motivation, and willingness to engage in research activities. Each item was scored on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). A composite readiness score was calculated by summing individual item responses, with higher scores indicating greater perceived readiness. For analytical purposes, scores were categorized using the median split method; scores above the 50th percentile were classified as "satisfactory perceived readiness," while those at or below the median were categorized as "unsatisfactory perceived readiness." The internal consistency of the readiness scale was assessed using Cronbach's alpha.

Attitude toward research was measured using a 7-item Likert-scale instrument, with total scores ranging from 7 to 35, where higher scores indicated a more positive attitude.

Exposure to research education was assessed based on students' self-reported attendance in undergraduate research-related teaching sessions (UGME), including topics such as study design, research methodology, and data analysis.

Research practice was assessed using objective indicators, including participation in research projects, involvement in Institutional Review Board (IRB)-approved studies, authorship status, and engagement in specific research tasks such as data collection, manuscript writing, and statistical analysis.

Perceived barriers and motivational factors were assessed using multiple-response items, including academic workload, lack of mentorship, insufficient training, limited access to resources, and financial constraints.

Qualitative component (Focus Group Discussions):

To complement the quantitative findings, two focus group discussions (FGDs) were conducted using purposive sampling. One group included clinical-year students (4th and 5th year), while the other comprised non-clinical students (1st to 3rd year). Each FGD included 6–7 participants and lasted approximately 60 minutes. A semi-structured interview guide was used to explore perceptions of research readiness, attitudes, practices, and barriers. Discussions were audio-recorded with participant consent, transcribed verbatim, and anonymized. Thematic analysis was performed to identify recurring patterns and key themes.

Data analysis:

Quantitative data were analysed using IBM SPSS Statistics version 27. Continuous variables were reported as mean ± standard deviation, while categorical variables were presented as frequencies and

percentages. Associations between categorical variables were assessed using Chi-square test or Fisher's exact test, as appropriate. A p-value of ≤ 0.05 was considered statistically significant.

Qualitative data were analyzed using thematic analysis. Transcripts were coded, and emerging codes were grouped into broader themes and subthemes, including perceived readiness, attitudes, research practices, and barriers.

Ethical considerations:

Ethical approval

was obtained from the institutional review board of DUHS prior to data collection. Participation was voluntary, and written informed consent was obtained from all participants. Confidentiality and anonymity of respondents were maintained throughout the study.

Results

Quantitative Results:

The current study included 252 students, of which 64.3% were female and 35.7% were male. Mean age of students was 21.62 ± 1.86 years whereas 85.3% of the students were aged under 23 years and 14.7% were over 23 years. Most students (53.6%) had a GPA between 2.70 and 3.69 on their prior exam, while about 79% were non-hostellers. Students had most subspecialties of interest for health research in Medicine and allied (29.8%), and surgery. Demographic profiles of study participants along with readiness score and attitude score mean and validity are presented in Table-1.

Exposure to research education varied considerably. The most attended subjects of research were, Introduction to study Design (65.5%), Introduction to Research methodology and topic selection (63.9%), Objective Writing, Research Question, and Hypothesis (58.3%) and Study design (50%). Least attended were Measures of Association (OR RR) (revisit) (17.9%), Bias, chance, confounding (19.4%), Health System Research (21.4%), data analysis (21.4%), Regression Analysis: linear and logistic regression (24.6%), Descriptive Study Designs (24.2%), indicating limited exposure to advanced research skills.

The average score for "perceived readiness score" or preparedness was 40.93 ± 10.59 (11–55) with Cronbach alpha = 0.959. Of the 252 students, 44.5% agree that they enjoy reading research papers and academic articles, Most students expressed interest in research, with 71.4% willing to conduct research and 69.8% interested in participation during studies. A majority recognized its importance, including its role in advancing knowledge (71.7%), supporting academic and career goals (68.3%), improving critical thinking (64.7%), and encouraging further learning of research methodologies (67.1%). Despite high interest, fewer students reported confidence in conducting research independently (41.3%) or enthusiasm for writing research papers (48%).

Motivation for research was predominantly extrinsic, with mentorship (46%) being the most common factor, followed by parents (10.7%), friends (8.7%), and siblings (3.6%). Career-related motives were less frequent. Intrinsic motivation was low, with only 3.2% reporting self-motivation, while 25% reported no clear motivation.

The mean attitude score was 27.55 ± 6.35 (range: 7–35) with high internal consistency (Cronbach's α = 0.948), indicating an overall positive attitude toward research among students.Among 252 students, 68.7% of students agreed that research improves clinical decision-making, 72.6% agreed that research is a crucial component of medical education, and 74.2% agreed that research improves patient care, 74.6% agree that research influences health policy, 73% agree that research offers worthwhile future career opportunities, 67.8% agree that research supports the promotion and acquisition of scholarships, and 59.1% agree with interest in pursuing research in a medical career.

Despite Positive attitudes and satisfactory readiness, actual engagement in research was limited **(**Fig. 1**).** Only 20.2% of students participated in at least one research project and 17.5% were involved in IRB approved research. Participation most commonly involves assisting with writing manuscripts 44.8% and data collection 38.9% whereas very few students 1.2% reportedly involved in statistical analysis. Although 34.9% of the participants reported having published research work only 15.9% were first authors. The most cited motivations for participation were career advancement of 90.1% and academic rewards 51.2%.

Students reported multiple barriers to engaging in research. The most frequently cited were Academic overload(85.3%), lack of structured research training(84.5%), lack of statistical support(79%), lack of mentorship and teamwork(74.6%), Lack of awareness of basic research skills(72.2%), lack of financial support/funding(64.3%), lack of opportunities to publish research(64.7%), lack of acknowledgment of contributions(64.7%), lack of opportunities to present research(54.8%), technical and logistic support like computer and internet(43.3%).

Nearly half of the students rated the emphasis on health research within the undergraduate curriculum as low emphasis (poor and fair) 58.7%, while only 9.1% perceived it as high emphasis (very good and excellent)

Perceived research readiness was significantly associated with age ($p = 0.034$), residential status ($p = 0.021$), research participation ($p = 0.035$), publication status ($p = 0.010$), and attitude toward research ($p < 0.001$). Students with positive attitudes and active research involvement were more likely to demonstrate satisfactory readiness. No significant associations were found with gender, study year, GPA, subspecialty interest, motivation, or number of research projects **Table- 2.** The significant decline in positive attitude towards research was observed across advancing undergraduate years (0.05).

Focus group Discussion Results:

Thematic analysis identified four key domains influencing research engagement: perceived readiness, attitudes, research practices, and barriers, each comprising related subthemes, as categorised in Figure-2.

Theme 1: Research Readiness

1.1 Perceived Preparedness

Students generally perceived themselves as inadequately prepared to independently conduct research. Teaching was described as largely theoretical, with limited practical application and insufficient guidance on how to initiate research. As one participant stated:

"Whatever we were taught in our classes did not help me at all…everything I learned was through other resources or mentor I reached out to personally." (Focused Group 1; Student 4; (FGD1; S4))

1.2 Curriculum Emphasis

Participants reported that research teaching was predominantly lecture-based with limited interactive or hands-on learning. Poor timing of sessions, particularly near examinations, further reduced engagement.

"It's kind of, like, lecture-based stuff and we cannot apply those in real life. You have to do the statistical analysis and it's not possible in a 40-minute or one hour lecture." (FGD2; S3)

1.3 Factors for Motivation:

Extrinsic motivation, particularly related to career advancement and curriculum vitae building, was more prominent. However, intrinsic motivation increased when students engaged in clinically relevant or personally interesting topics. Mentorship and peer support were important in sustaining motivation.

"Initially, it was basically for the CV, but when I actually started doing research, it changes my perspective, and I developed interest." (FGD1; S2)

"My professors and seniors have always motivated me and if I'm not doing research, I feel like I'm lacking something." (FGD2; S5)

Theme 2: Attitude Towards Research

2.1 Positive Attitude

Students recognized research as valuable for clinical understanding, evidence-based practice, and professional development, and viewed it as an important component of medical training:

"Research is what we read in textbooks but actually applied in real-life." (FGD2; S6)

2.2 Negative Attitude

Despite overall positive perceptions, research was often described as time-consuming and difficult to sustain alongside academic demands. Delays in processes such as ethical approvals contributed to frustration:

“Ethical approvals take so long that you just lose motivation” (FGD1; S5)

“It got very exhausting because there were so many steps and every little thing was problematic.” (FGD2; S6)

Theme 3: Research Practices

3.1 Participation versus Publication

Although students frequently initiated research projects, many were unable to complete them:

“We do start projects but somewhere in the process everything just stops.” (FGD1; S5)

3.2 Mentor Guidance

Effective mentorship emerged as the single important enabler of sustained research practice across both groups. Students with supportive mentors reported smoother progression and publication success:

“Once you get a good mentor, one gate opens and then many opportunities follow.” (FGD1; S1)

“If you don’t have someone guiding you, you don’t even know where to start.” (FGD2; S2)

Theme 4: Barriers to Research

4.1 Academic Demands

Academic workload limited time available for research:

“Exams and syllabus come before research” (FGD2; S6)

4.2 Administrative Constraints

Students reported delays in ethical approval processes:

“We have to wait two to three months just to get an IRB reply.” (FGD1; S6)

4.3 Access Limitations

Limited access to research resources and training was a recurring concern:

“We don't have access to paid articles. It slows down everything” (FDG2; S3)

4.4 Inadequate Mentorship

Lack of consistent mentorship further hindered research progress:

“Mentors just take attendance and tell us, ‘Do research,’ but they don’t show us how..” (FGD2; S2)

4.5 Research Publication

Students reported difficulties in manuscript writing, journal selection, and publication processes, often leading to incomplete projects:

“I started research but did not know how to end it or publish it.” (FGD2; S5)

4.6 Infrastructure-Related Barriers

Participants highlighted the lack of dedicated space and institutional support for research activities:

“They should give us a proper space where we can actually work on our research.” (FGD2; S1)

Discussion

Despite generally favorable perceptions of research, perceived readiness among undergraduate medical students remained limited, indicating that readiness is often aspirational rather than operational. Only 32.5% students express readiness to participate in health research, indicating that for many students readiness is more aspirational than operational. Although a large proportion reported interest in conducting research in the future and acknowledged research as important for academic and career goals, confidence and preparedness to conduct research independently were comparatively lower. This opening is further explained by uneven exposure to research training, where students reported higher attendance in introductory topics but limited exposure to applied competencies such as regression analysis and SPSS-based data analysis.

Our findings are consistent with prior observations reported in Chennai and Uganda, where greater curricular emphasis and structured opportunities were linked with higher research readiness. (9, 12) The Competency-based Medical Education (CBME) framework which includes defined elective posting and competency-oriented learning, may offer students clear pathways to engage with research activities compared to traditional lecture-heavy approaches. (13) This suggests that structured, competency-based approaches may better support the transition from knowledge to practice.

Attitudes toward research were often dual, with students recognizing its importance while simultaneously perceiving it as time-consuming and difficult to sustain. Quantitatively more students endorse research as valuable for improving patient care, clinical decision making, and health policy, reflecting a broadly positive orientation. However the qualitative finding revealed that even students who valued research often simultaneously experience it as intimidating, time consuming and difficult to sustain. This internal tension was particularly evident among clinical year students who described research teaching as largely theoretical and poorly-time relative to examination and rotations,

contributing to reduced motivation and engagement. Similar findings have been reported elsewhere, where increasing academic workload and assessment pressure was shown to compete directly with research engagement, particularly during later years of medical training. (14) The observed decline in positive attitude across advancing undergraduate years further supports the notion that increasing academic and clinical demands can erode students' enthusiasm, even when their baseline beliefs about research remain favourable. Embedding research within clinical learning, rather than positioning it as an additional responsibility, may reduce cognitive overload and enable students to engage more meaningfully with scholarly activities.

Research practice was present but did not consistently translate into end-state outcomes, highlighting a clear practice-publication breach. While students reported participating in research tasks such as data collection and assisting in manuscript writing, involvement in more technical and key stages such as data analysis and manuscript submission, particularly statistical analysis, was minimal. This imbalance suggests that many students participate in supportive stages of research but lack the training and guidance to lead projects through analysis writing, submission and publication. The FGDs reinforced this pattern, with students describing how projects are often initiated but “stop somewhere in the process” and several reported that they did not know how to “end it” or successfully publish even after substantial effort. This helps explain why research engagement may be visible at the participation level while publication and meaningful authorship outcomes remain limited.

In our study, motivation was driven largely by extrinsic factors such as academic rewards and career advancement, skill acquisition and perceived benefits for patient care, which aligns with prior studies among medical students and health professionals. (12, 15) Importantly qualitative insights indicated that extrinsic motivation (e.g., CV building) could evolve into intrinsic interest once students gain authentic exposure and mentor support.

Across both quantitative and qualitative components of the study mentorship emerged as the most decisive factor determining whether research readiness translated into sustained engagement and completion. Students lacking consistent mentor support frequently reported stalled projects, uncertainty regarding procedural steps and eventual disengagement, a pattern mirrored in recent research highlighting lack of mentoring as a key barrier to undergraduate research engagement in medical education contexts.(16) In contrast students who had access to active and supportive mentors described clear research trajectories, enhanced confidence and a greater likelihood of completing projects and achieving publication. This suggests that institutions can strengthen research engagement by pairing early exposure with consistent mentoring structures, recognition systems and visible pathways that rewards sustained effort and completion. The central role of mentorship observed in this study aligns with prior family medicine education research highlighting faculty guidance as a critical determinant of trainee confidence, continuity and scholarly activity.(17) This highlights mentorship as a critical bridge between perceived readiness and successful research outcomes.

The barriers identified in the study were consistent and strongly explanatory of the readiness practice and practice-publication gaps. Students most frequently cited academic overload, lack of structured research training, inefficient statistical support, inadequate mentorship, limited funding, limited access to databases/softwares, and administrative constraints such as delayed ethical approvals. These barriers are widely reported in other settings as well. (12, 18, 19) In this context, programs such as the ICMR Short-Term Studentship (STS) are particularly relevant, as they address funding constraints and may improve participation by providing incentive and certification. (20) Evidence also suggests that financial support combined with sustained mentorship improves research completion and publication outcomes, emphasizing the need for integral institutional support rather than isolated training sessions. (21) These findings highlight a critical disconnect between research exposure, perceived readiness, and meaningful scholarly output among undergraduate medical students.

Limitations

This study has limitations. Its cross-sectional design precludes causal inference between curriculum type, academic performance and readiness or participation. Conducted at a single institution, its findings may have limited generalizability. Self-reported data may also be subjected to recall and social desirability bias. Nevertheless, the mixed-methods approach is a key strength, as the qualitative findings clarify why positive attitudes and certain practices do not consistently lead to publications, highlighting barriers such as mentorship gaps, IRB delays, lack of statistical support and uncertainty about the publication process. Additionally, self-reported measures may overestimate perceived readiness and attitudes.

Conclusion

In conclusion, while undergraduate medical students demonstrate positive attitudes toward research, their readiness remains limited and does not consistently translate into meaningful research output. Bridging this gap requires strengthening undergraduate research capacity, which is essential for developing a workforce capable of evidence-based practice, quality improvement and community-oriented care.Embedding applied research training within clinical learning environments, rather than positioning it as an additional academic burden, may therefore improve long-term engagement and scholarly output.

Declarations

Authors' contributions:

Aayesha Butt (AB): Conceptualized and designed the study, developed the theoretical framework (KAP model and self-efficacy theory), oversaw all phases of the study, led quantitative and qualitative data analysis, and supervised manuscript writing, review, and submission.

Muhammad Mustafa (MM): Participated in study design and methodology, coordinated and conducted data collection, contributed to writing the original draft (Introduction, Methods, and Results sections), and supported data management.

Rahmah Ashar Sakrani (RAS): Participated in data collection, contributed to drafting the manuscript (Discussion and Conclusion sections), and assisted in literature review and reference management.

Ariba Hashmi (AH): Participated in data collection and field coordination, and contributed to critical review and editing of the manuscript draft.

Fatima Kanwal (FK): Participated in data collection and contributed to review, editing, and preparation of the final manuscript.

Waseem Suleman (WS): Co-designed the study methodology and sampling strategy, contributed to quantitative data analysis and interpretation, and participated in critical revision of the manuscript for intellectual content.

All authors have reviewed and approved the final submitted version of this manuscript, including all data, figures, tables, and supplementary materials. All authors have also approved any substantially modified versions of the manuscript that may arise during the revision process, to the extent that they involve contributions from each respective author.

All authors agree to be personally accountable for their own contributions to this manuscript. In addition, all authors have agreed to ensure that any questions related to the accuracy or integrity of any part of the work; including parts in which they were not personally involved are appropriately investigated, resolved, and that the resolution is documented in the published literature, in accordance with BMC's editorial policies and the ICMJE Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals.

Muhammad Mustafa is the designated corresponding author and takes primary responsibility for ensuring that all listed authors have approved the manuscript before submission; that all data, figures, materials, and code comply with the transparency and reproducibility standards of the field and journal; and that all substantive correspondence with the editors is shared with all co-authors. Muhammad Mustafa confirms that no authors have been added, removed, or reordered without the knowledge and approval of all authors.

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Ethics approval and consent to participate

This study was approved by the Institutional Review Board of Dow University of Health Sciences, Karachi, Pakistan (Approval No. IRB-4088/DUHS/Approval/2025/330, dated 27th August 2025). Written informed consent was obtained from all participants prior to their inclusion in the study.

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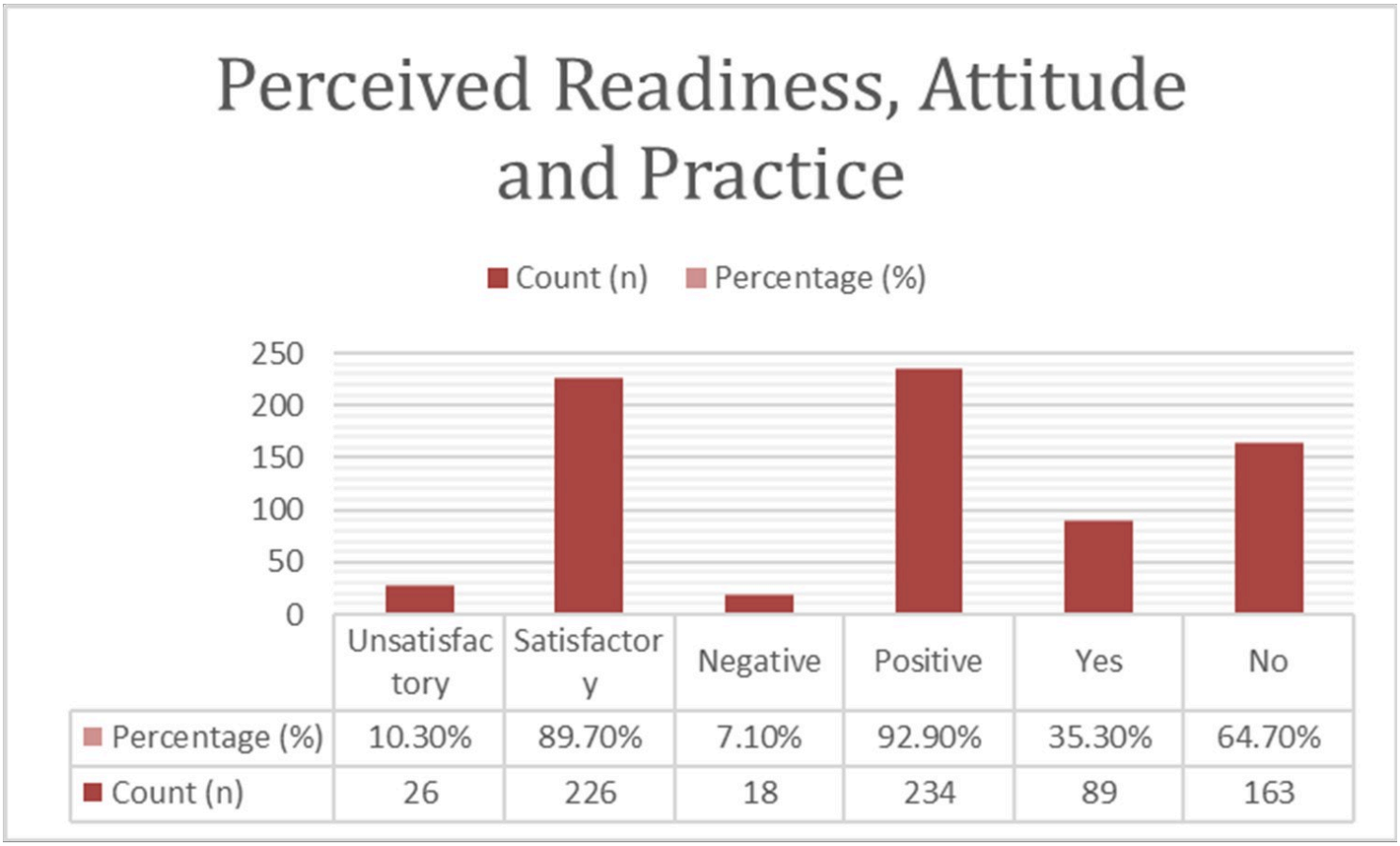
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Tables

Tables are available in the Supplementary Files section.

Figures



	Unsatisfactory	Satisfactory	Negative	Positive	Yes	No
Percentage (%)	10.30%	89.70%	7.10%	92.90%	35.30%	64.70%
Count (n)	26	226	18	234	89	163

Figure 1

Perceived Readiness, Attitude and Practice



Figure 2

Thematic diagram

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryMaterial.docx

- Tables.docx