

# Factors and Challenges Affecting the Research Output of Medical Students: A Mixed-Methods Study

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**Background:** Despite the curricular integration of research training in undergraduate medical education, student research publications remain limited. This study aimed to identify the factors associated with the publication of student research and explore the challenges faced by students, supervisors, and research personnel at the Faculty of Medicine–Jeddah (COM-J), King Saud bin Abdulaziz University for Health Sciences (KSAU-HS), Saudi Arabia.

**Methods:** A concurrent triangulation mixed-methods design was used. Quantitative data were collected from 187 student research proposals, 778 student curriculum vitae (CVs), and 87 supervisor CVs over four academic years (2017–2021). Variables including student gender, research experience, supervisor background, and project design were analyzed using JMP (SAS Institute Inc. Cary, NC, USA). Semi-structured interviews were conducted with 15 students, 10 supervisors, and 5 Research Unit (RU) personnel to explore perceived barriers to publication.

**Results:** Only 40 (21.4%) of 187 student research projects achieved peer-reviewed publications, with an annual average publication rate of approximately 5.4%. No statistically significant associations were found between publication status and student gender ( $p = 0.72$ ) or prior research experience ( $p = 0.58$ ). Students with prior research experience had slightly higher, though non-significant, publication rates (25% vs. 20.6%). Male students published marginally faster than female students (e.g. at the R1 level, 2.8 years vs. 3.3 years). Interns had the highest publication rate (11.2%), followed by sixth-year students (10.1%). Supervisors with strong publication profiles were associated with higher student publication rates (up to 57.5% among prolific supervisors). Qualitative findings from 30 interviews revealed barriers including time constraints (students: 80%; supervisors: 60%), lack of motivation (students: 55%; supervisors: 90%), and insufficient research skills (students: 50%; supervisors: 85%). Key themes included inadequate mentorship quality, limited early research exposure, skill-building gaps, and insufficient post-project support.

**Conclusion:** The 21.4% publication rate among medical student research projects at COM-J reflects systemic challenges related to time constraints, mentorship availability, and institutional support. Addressing these barriers through specific interventions—including mandatory protected research time for faculty, credit-based incentive systems for research mentorship, and structured post-block publication support—may enhance student research productivity. Future multi-institutional and longitudinal studies are needed to validate these findings and evaluate the effectiveness of targeted mentorship models.

**Keywords:** medical education, medical student research, publication barriers, research mentorship, mixed-methods

## Introduction

The integration of research training into undergraduate medical curricula has become a cornerstone of modern medical education worldwide.<sup>1,2</sup> This emphasis arises from the recognition that medical research competencies—including literature appraisal, research design, data analysis, and scientific writing—are fundamental to evidence-based clinical practice, professional development, and the cultivation of future physician-scientists.<sup>3,4</sup> While many programs assess research training as producing work that is “publishable” or of sufficient quality for peer review, the translation of these competencies into actual

peer-reviewed publications remains a critical and under-examined gap. In Saudi Arabia, medical colleges such as King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) have formalized research components within their programs to foster academic inquiry and improve the global competitiveness of graduates.<sup>5–7</sup>

Despite these curricular efforts, the actual research output, particularly measured by peer-reviewed publications in indexed journals (excluding abstracts and conference proceedings), remains modest in many contexts. The publication rate among medical students at the College of Medicine–Jeddah (COM-J), as revealed in the current study, is 21.4%, with annual rates of approximately 5.4%—figures that are comparable to, yet in some cases trail, reported averages from the Gulf region.<sup>8</sup> Globally, publication rates fluctuate widely, from 10% to 32%, depending on whether the research is mandatory, elective, or supported by institutional resources.<sup>9</sup> What constitutes “adequate” research output is debated, but rates below 20% are generally considered suboptimal relative to institutional investments in research training.<sup>8,10</sup> The observed low output raises questions about the effectiveness of curricular integration and the broader research ecosystem.<sup>11–13</sup>

Research productivity among medical students can be understood through a multi-level framework encompassing student-, supervisor-, project-, and institutional-level determinants.<sup>14</sup> At the student level, factors such as prior research experience, previous academic attainment, and gender dynamics have been commonly evaluated.<sup>7,15,16</sup> At the supervisor level, the experience, academic profiles, and institutional affiliations of mentors are increasingly recognized as critical influences guiding students through the demanding publication process.<sup>17,18</sup> Project-level variables, such as research design and study population, further contribute to the feasibility and eventual dissemination of student research.<sup>5,19–21</sup> At the institutional level, policy frameworks, curricular design, support infrastructure (including dedicated Research Units), and resource allocation shape the environment within which student research occurs.

Barriers to publication are multifaceted.<sup>22</sup> Quantitative and qualitative data indicate that time constraints, lack of motivation, insufficient skills, and limited mentorship are widespread obstacles. Institutional shortcomings, including inadequate research infrastructure, limited protected research time for faculty, and a lack of practical research opportunities, exacerbate these issues.<sup>5,8,23,24</sup>

This study uniquely combines retrospective quantitative analysis of institutional records across multiple student cohorts with qualitative stakeholder perspectives, providing a nuanced understanding that previous purely quantitative studies in the region have not achieved. By employing a concurrent triangulation mixed-methods approach, this research seeks to identify actionable strategies to strengthen undergraduate research output—a necessity for training future clinicians equipped for the demands of evolving healthcare systems.

## Methodology

### Study Area and Setting

The study was conducted at the College of Medicine–Jeddah (COM-J), KSAU-HS, Saudi Arabia. COM-J has graduated eight batches of medical students and currently has an average annual intake of approximately 200 students. Approximately 100 medical sciences and clinical faculty members serve as full-time or adjunct faculty, affiliated with the neighboring hospital, King Abdulaziz Medical City (KAMC).

Students completed two longitudinal research blocks during the third and fourth years of the medical program. The first block included didactic components covering research principles (literature review, research ethics, study design, biostatistics, proposal writing, and scientific communication), while the second focused on executing the research project, including data collection, analysis, and manuscript preparation. Most students published their research in their 5th or 6th year or during their internships. There were no substantive differences in the research curriculum between the 5th and 6th years or the internship; however, students at more advanced levels typically had greater clinical exposure and had more time elapsed since project completion, which may have influenced publication timelines.

Each batch was divided into groups of 4–6 students. Groups were formed as single-gender cohorts (either all male or all female), each led by a designated group leader. Each group selected a preferred research discipline from a curated list of topics prepared by the faculty and the Research Unit and was subsequently assigned a supervisor and co-supervisor.

The Research Unit (RU) is an established department within the college responsible for coordinating all student research activities, including assigning research topics and supervisors, delivering didactic components, managing assignments,

monitoring progress, and providing administrative and technical research support. The RU operates in coordination with the Research Office, which oversees ethical approvals and institutional research governance. The RU is available to all students and faculty across the college. The RU maintained detailed records of student research activities, which provided a comprehensive data source for this study.

## Quantitative and Qualitative Data Collection

The study employed two components. The quantitative component involved a retrospective analysis of student research activity records retrieved from the Research Office at COM-J, covering the academic years 2017–2021. Data included submitted proposals, completed projects, and publication status. The dependent variable was publication status (published vs. not published in a peer-reviewed indexed journal). Independent variables were organized at four levels: (1) student-level (gender, prior research experience [defined as any research activity prior to the research block, including publications, conference presentations, or formal research training], previous degree attainment, academic level); (2) supervisor-level (gender, institutional affiliation, professional experience category, publication profile); (3) project-level (research design, study population, field of study); and (4) institutional-level (RU support, curriculum structure, resource allocation).

Supervisor experience was categorized as: beginner (<5 years of research involvement and <5 publications), intermediate (5–10 years of research involvement and 5–15 publications), and expert (>10 years of research involvement and >15 publications). Supervisor publication profiles were classified as: beginner (<10 publications), moderate (10–30 publications), and prolific (>30 publications).

The qualitative component involved semi-structured interviews conducted in person at the college campus. A total of 30 interviews were conducted: 15 students (selected purposively to represent different academic levels, genders, and publication outcomes), 10 supervisors (representing varying levels of experience and affiliations), and 5 RU personnel. Interview participants were selected using purposive sampling to ensure maximum variation; inclusion criteria required that students had completed the research block, and supervisors had mentored at least one student group. Interviews were conducted between March and June 2022, after the quantitative data retrieval was complete, to allow qualitative exploration of patterns identified in the quantitative analysis.

The interview guide was developed based on the literature and the research objectives, reviewed by two experts in medical education research, and piloted with three participants (not included in the final sample) to assess clarity and relevance. The interview guide addressed the following key areas: for students—efficacy of research skills acquisition, applicability of learned skills, supervisor mentoring quality, and RU support services; for supervisors—mentoring style, previous mentoring experience, student preparedness, and access to quality data; for RU personnel—coordination challenges, policy adaptations, and facilitators of student publication ([Supplementary Material](#)).

A structured (closed, fixed-response) questionnaire was also administered to complement the interview data. The questionnaire was piloted with 15 participants (students and faculty not included in the final sample) and demonstrated acceptable internal consistency (Cronbach's alpha = 0.78) and content validity as assessed by an expert panel of three medical education researchers.

## Study Design

This study employed a concurrent triangulation mixed-methods design in which quantitative and qualitative data were collected in parallel, analyzed independently, and then integrated during interpretation. The quantitative strand analyzed associations between the multi-level factors and publication outcomes. The qualitative strand, informed by a transcendental phenomenological approach,<sup>25–27</sup> explored the lived experiences and perceptions of stakeholders to contextualize and explain quantitative patterns. In the transcendental phenomenological tradition (following Husserl), the researchers practiced epoché (bracketing of preconceptions) during data analysis and focused on identifying the essential structures of participants' experiences.<sup>28,29</sup> Triangulation was achieved by comparing and contrasting quantitative statistical findings with qualitative thematic findings during the interpretation phase, identifying areas of convergence and divergence.

## Sample Size

The sample size was calculated based on a 5% significance level, 80% power, and an estimated 30% publication prevalence (based on regional publication rate data from Gulf countries).<sup>8</sup> The minimum calculated sample size was 174 groups. The actual included sample of 187 groups exceeded this requirement.

## Sampling Technique

Comprehensive convenience sampling of all accessible institutional records, student groups, and faculty was employed. Since the study aimed to analyze all available records from the institution, random or stratified sampling was not applicable. This approach, while pragmatic, may introduce selection bias, as it reflects a single institution's experience and may not generalize to other settings.

## Data Management and Analysis Plan

Quantitative data were presented using descriptive statistics, including frequencies, percentages, and means with standard deviations. Associations between categorical independent variables and publication status were analyzed using chi-square tests. Correlation coefficients were used to assess relationships between continuous variables. All tests were performed at a significance level of 0.05. Data analysis was performed using JMP Pro 16 (SAS Institute Inc., Cary, NC, USA).

Qualitative interview data were audio-recorded, transcribed verbatim, and analyzed using thematic analysis following a six-step approach: familiarization with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Two researchers independently coded the transcripts, and discrepancies were resolved through discussion and consensus. Trustworthiness was established through methodological triangulation (comparing interview data with quantitative findings), member checking (returning summaries to a subset of participants for verification), and peer debriefing (regular discussion of emerging findings with colleagues not involved in data collection).<sup>25</sup>

## Ethical Considerations

This study was approved by the institutional review board at King Abdullah International Medical Research Center (SP21R-454-11) in accordance with the Declaration of Helsinki. All participants provided written informed consent, including consent to the publication of anonymized responses and direct quotes. Participating students and faculty members were informed that their identities would remain anonymous and would be replaced with numerical identifiers. All data were stored electronically, kept confidential, and shared only among the study investigators.

## Results

### Overall Publication Rate of Student Research Projects

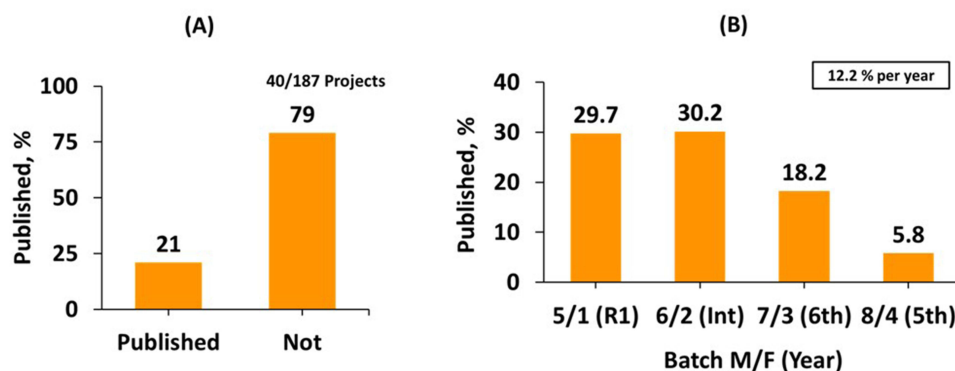
A total of 187 student research proposals were analyzed, representing the academic output of medical students at COM-J over four academic years (2017–2021). Of these, only 40 (21.4%) resulted in peer-reviewed publications in indexed journals, yielding an average annual publication rate of approximately 5.4%. This rate is comparable to regional averages reported in the Gulf Cooperation Council (GCC) context but notably below the publication benchmarks of some Western institutions, which report rates of 25–32%.<sup>5,8,13</sup> (Figure 1)

### Student-Related Factors Affecting Publication

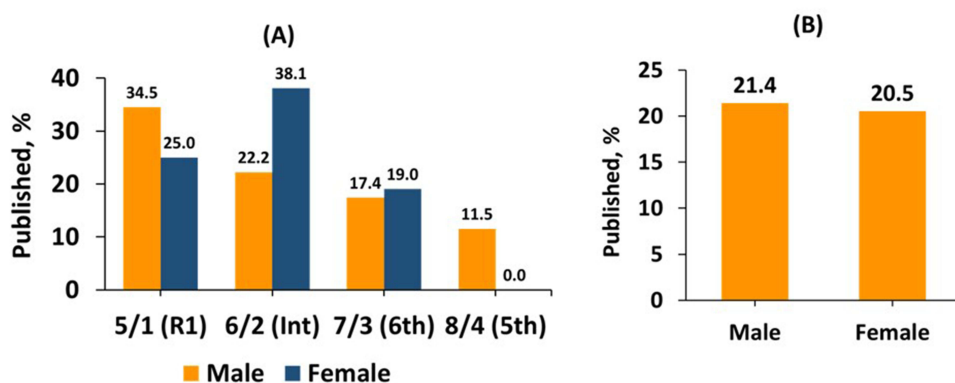
#### Gender Distribution and Publication Output

An analysis of research publications over a four-year period revealed dynamic trends in gender-based contributions among student research groups (Figure 2A). In the first year, male students demonstrated a higher publication output (34.5%) compared with their female counterparts (25.0%). In the second year, this trend reversed, with female-led groups (38.1%) surpassing male groups (22.2%). In the third year, both groups showed declining publication rates. Notably, in the fourth year, only male students contributed to publications (11.5%), and no publications came from female-led groups.

Among the 778 student curriculum vitae (CVs) assessed, male-led research groups ( $n = 105$ ) outnumbered female-led groups ( $n = 82$ ). However, no statistically significant association was found between the gender of the student group and



**Figure 1** Overall publication rates among student research projects. The figure displays the total number of student research proposals ( $N = 187$ ) and the proportion that achieved peer-reviewed publication ( $n = 40$ , 21.4%) (A) over four academic years (B).



**Figure 2** Gender distribution and publication output. (A) Year-by-year comparison of publication rates between male-led and female-led student research groups over four academic years. (B) Overall publication distribution by gender across the four-year study period, showing no statistically significant gender-based differences ( $\chi^2 = 0.13$ ,  $p = 0.72$ ).

publication success ( $\chi^2 = 0.13$ ,  $p = 0.72$ ) (Figure 2B), with both male and female groups contributing comparably to the 40 published studies. These year-to-year variations should be interpreted as descriptive trends rather than evidence of meaningful gender effects.

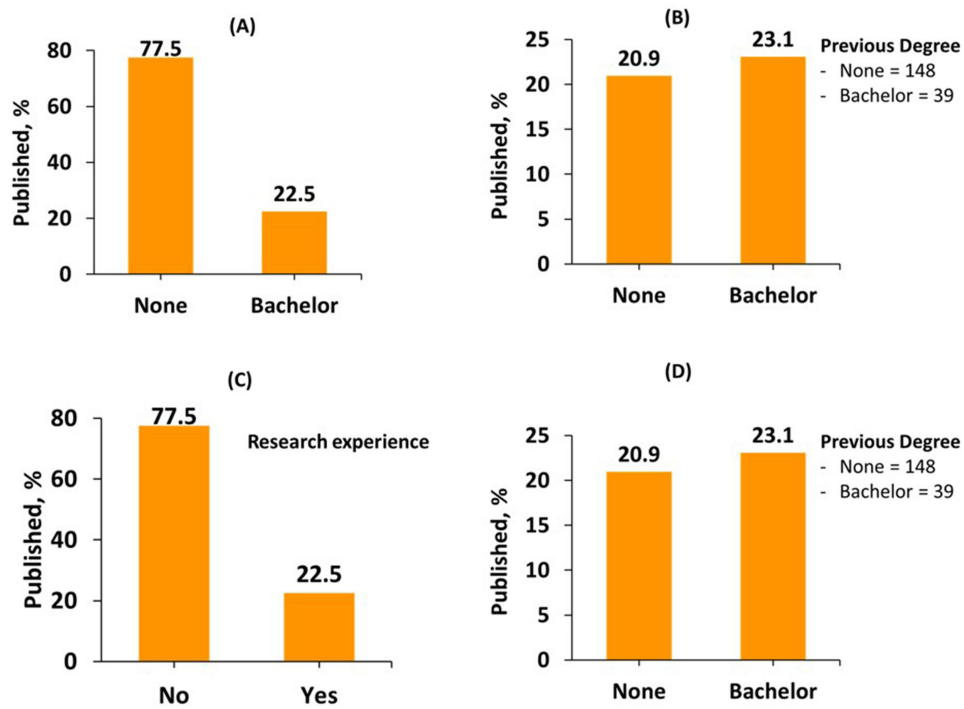
## Previous Degree Attainment and Research Experience

Of the students included, 22.5% had previously attained a bachelor's degree, while 77.5% had entered directly without prior degrees (Figure 3A). A slightly higher proportion of publications originated from research groups that included students with previous degrees (23.1%) compared with those without (20.6%) (Figure 3B); however, this difference did not reach statistical significance ( $\chi^2 = 0.12$ ,  $p = 0.73$ ). Prior research experience was reported by 22.5% of students (Figure 3C). Groups involving students with previous research engagement demonstrated a marginally higher, though non-significant, publication output (25.0% vs. 20.6%,  $\chi^2 = 0.31$ ,  $p = 0.58$ ) (Figure 3D).

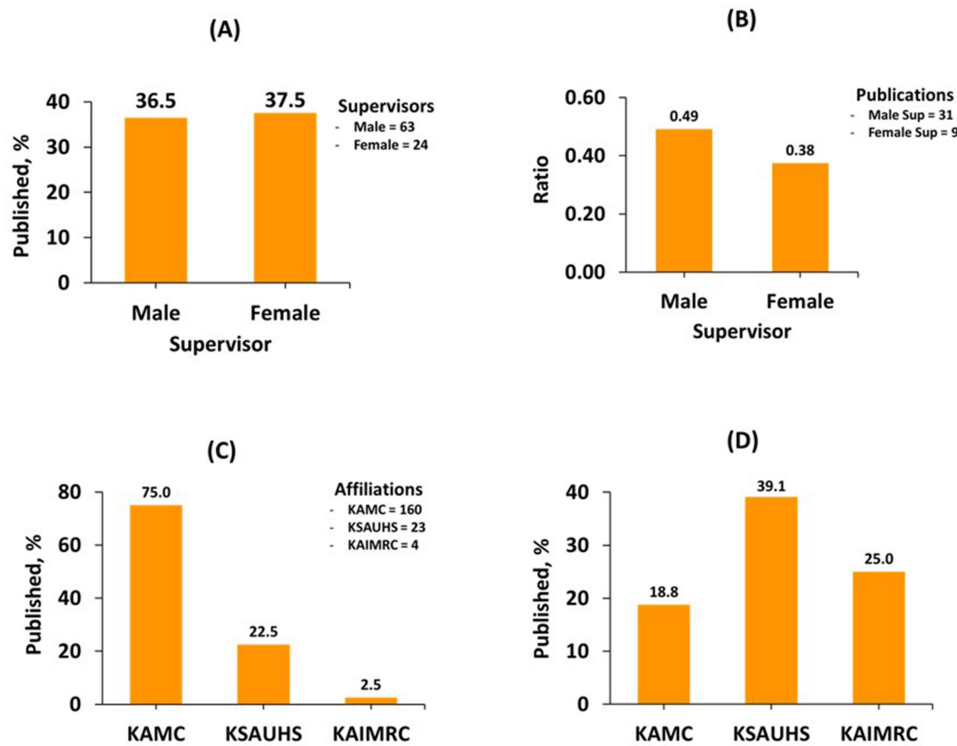
## Supervisor-Related Factors

### Gender and Publication Productivity

Of the 87 supervisors involved in student research projects, 63 (72.4%) were male and 24 (27.6%) were female (Figure 4A). Among the published projects, 31 were supervised by male faculty and 9 by female faculty, representing publication rates of 49.2% and 37.5%, respectively (Figure 4B). This trend may be influenced by the higher proportion of male supervisors and does not necessarily indicate gender-based differences in mentoring competency. The underlying reasons merit further investigation.



**Figure 3** Previous degree attainment and research experience among medical students. (A) Distribution of students with and without a previous bachelor's degree. (B) Publication rates by previous degree status (23.1% vs. 20.6%,  $p = 0.73$ ). (C) Distribution of students with and without prior research experience. (D) Publication rates by prior research experience status (25.0% vs. 20.6%,  $p = 0.58$ ).



**Figure 4** Supervisor characteristics and publication outcomes. (A) Gender distribution of supervisors (male: 72.4%, female: 27.6%). (B) Publication rates by supervisor gender. (C) Supervisor distribution by institutional affiliation (KAMC, KSAUHS, KAIMRC). (D) Publication rates by supervisor institutional affiliation.

## Supervisor Affiliation and Institutional Influence

Most supervisors were affiliated with KAMC (n = 63, 72.4%), followed by KSAU-HS (n = 20, 23.0%) and KAIMRC (n = 4, 4.6%) (Figure 4C). Supervisors from KAMC were often described by students in qualitative interviews as less available due to demanding clinical workloads. The publication rate was highest among KSAU-HS-affiliated supervisors (39.1%), followed by KAIMRC (25.0%) and KAMC (17.5%) (Figure 4D).

## Experience and Publication Profile

Supervisors were categorized by professional experience as beginner (n = 24), intermediate (n = 43), and expert (n = 20) (Figure 5A). The expert group was associated with the highest student publication rate (57.5%) (Figure 5B). Academic publication profiles were classified as beginner (n = 44), moderate (n = 14), and prolific (n = 29) (Figure 5C). However, even among prolific and expert-level supervisors, publication output varied, suggesting that personal research excellence does not necessarily translate to higher student publication rates in the absence of institutional support and mentorship incentives.

## Characteristics of Research Projects

### Research Design, Subjects, and Fields

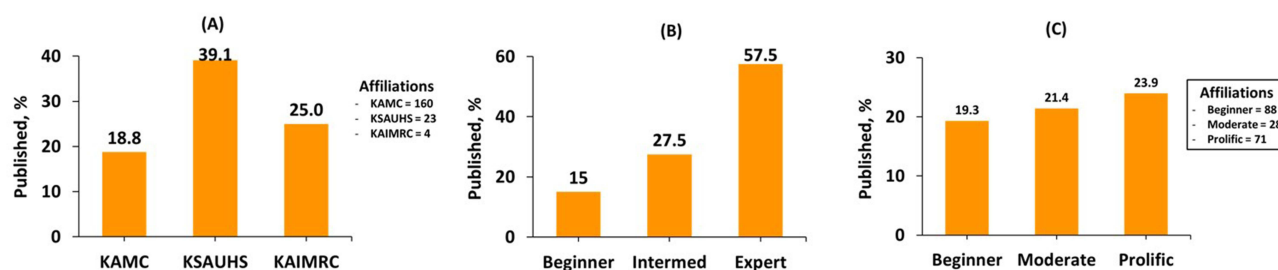
The 187 projects comprised observational (n = 116) and survey-based studies (n = 71) (Figure 6A). No significant differences in publication rates were observed between the two study designs ( $\chi^2 = 0.85$ ,  $p = 0.36$ ) (Figure 6B). Projects targeted patients (n = 136), students (n = 17), the general public (n = 18), and healthcare professionals (n = 16) (Figure 6C). Student-targeted projects achieved the highest publication rate (52.9%), possibly due to easier data access (Figure 6D).

## Time to Publish and Publication Rate by Academic Level and Gender

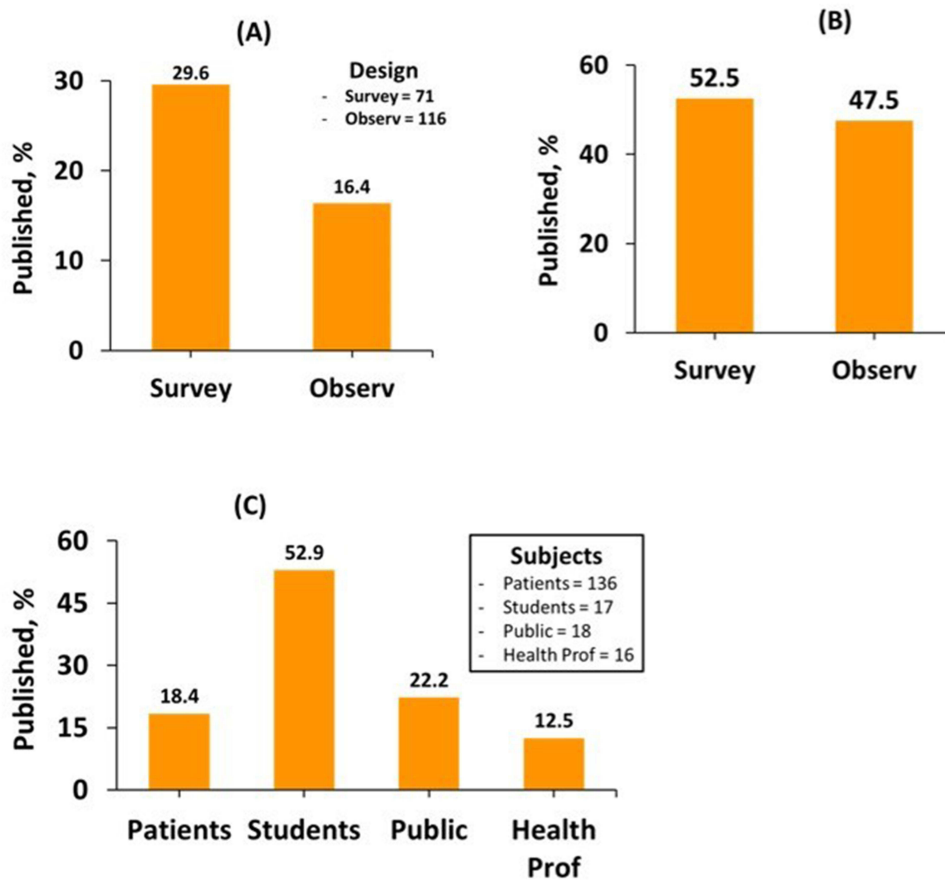
Analysis of publication timelines revealed notable variations (Table 1). The mean time from project completion to publication ranged from 1.1 to 3.1 years, with the longest duration observed at the R1 level (3.1 years), followed by interns (2.7 years), sixth-year students (1.8 years), and fifth-year students (1.1 years). In terms of annual publication rate, the highest was observed among interns (11.2%), followed by sixth-year students (10.1%) and R1 (9.6%). Fifth-year students had the lowest publication rate (5.3%). By gender, male students published slightly faster at most levels (eg., R1: 2.8 years for males vs. 3.3 years for females). Among fifth-year students, only male students achieved publications (mean 1.1 years), with no publications recorded for females at this level. The absence of fifth-year female publications likely reflects the combination of shorter observation time and smaller cohort size rather than a gender-based barrier.

## Qualitative Findings: Semi-Structured Interviews

The semi-structured interviews with 15 students, 10 supervisors, and 5 RU personnel revealed multidimensional insights into the student research program. Nine key themes emerged from the thematic analysis following the transcendental phenomenological approach: motivation for research, outcomes and benefits, barriers and challenges, student commitments, effective communication, institutional support, coordination dynamics, adaptive developments, and student behaviors (Figure 7).



**Figure 5** Supervisor experience and publication outcome. (A) Distribution of supervisors by professional experience level (beginner, intermediate, expert). (B) Student publication rates by supervisor experience category. (C) Distribution of supervisors by academic publication profile (beginner, moderate, prolific).



**Figure 6** Research design, subjects, and fields among medical students. **(A)** Distribution of projects by research design (observational vs. survey-based). **(B)** Publication rates by research design ( $\chi^2 = 0.85, p = 0.36$ ). **(C)** Distribution of projects by target study population.

### Motivation and Outcomes

Students identified portfolio building (defined as the accumulation of research experiences, publications, and academic achievements for residency and career advancement) and fulfilling academic requirements as primary motivations. Students who successfully published reported stronger intrinsic motivation: “When I published the first, I got the desire to do it again as an elective, and now I really like doing medical research” (Student, 6th year, published).

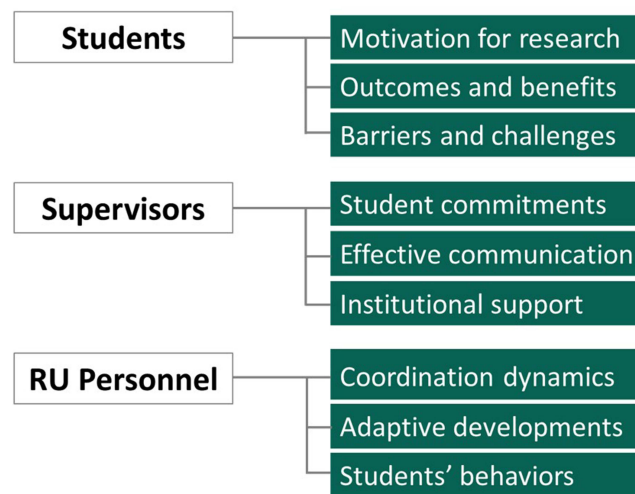
### Barriers and Challenges

Both students and supervisors noted significant challenges, including the demanding nature of research and difficulty accessing supervisors due to clinical commitments. Supervisors observed: “Students are not well aware of the uncertain nature of the

**Table I** Mean Time From Project Completion to Publication, by Academic Level and Gender

Academic Level	Mean Time to Publish (Years)	Annual Publication Rate (%)	Mean Time: Male (Years)	Mean Time: Female (years)
R I	3.1	9.6	2.8	3.3
Intern	2.7	11.2	2.5	2.8
5th Year	1.1	5.3	1.1	N/A*
6th Year	1.8	10.1	1.7	1.9

**Notes:** \*No publications were recorded for female students at the fifth-year level during the study period. N = 40 published projects total from 187 proposals.



**Figure 7** Semi-structured interview thematic flow chart. The figure displays the nine major themes identified through thematic analysis following the transcendental phenomenological approach: motivation for research, outcomes and benefits, barriers and challenges, student commitments, effective communication, institutional support, coordination dynamics, adaptive developments, and student behaviors.

research environment. take as an assignment” (Supervisor, expert, KAMC-affiliated). Communication breakdowns were common: “Students disappear until time for assignments. they contact the day before for help” (Supervisor, intermediate).

## Institutional Support and Coordination

The RU was repeatedly highlighted as a critical facilitator. Students credited the office with enabling publications, and supervisors appreciated its mediating role. RU personnel noted the complexity of multi-stakeholder coordination: “We deal with many parties. and we face unexpected issues from students and supervisors” (RU staff). The introduction of mandatory full-time co-principal investigators improved guidance and accessibility.

## Adaptive Development

The RU demonstrated commitment to continuous improvement: “We continuously make changes. we are in a trend of increasing student publications every year” (RU staff). However, the two-year program duration led some students to report knowledge attrition and disengagement between research blocks.

## Discussion

The findings of this mixed-methods study at COM-J, KSAU-HS reveal a complex landscape shaped by student, supervisor, project, and institutional factors. The 21.4% overall publication rate underscores persistent systemic challenges and reflects regional trends. This rate is comparable to those reported for other Saudi medical colleges<sup>8,11</sup> and falls within the lower range of global figures (10–32%), where structural requirements and institutional support appear to be key differentiators.<sup>5,9,13</sup> In comparison, US medical schools with mandatory research components and structured mentorship programs report publication rates of 25–32%,<sup>5</sup> while European institutions with integrated research tracks report similar ranges.<sup>13</sup> The gap suggests that curricular mandates alone are insufficient without complementary institutional support.

## Student-Related Factors: Experience, Academic Background, and Gender

Analysis of student demographics revealed that previous research experience and degrees were associated with modestly elevated, though non-significant, publication rates (25% vs. 20.6%). The absence of a statistically significant effect may reflect the standardized research block structure at KSAU-HS, where all students receive the same curricular training regardless of prior experience, potentially equalizing outcomes. Other studies have similarly reported limited correlation between pre-existing academic metrics and research output.<sup>5,8,10</sup> No significant gender-based differences were observed in publication rates, suggesting that both genders receive comparable academic training and institutional support. However, the absence of fifth-year female

publications warrants attention. This finding likely reflects the shorter observation window at this level, combined with smaller female cohort sizes, rather than indicating a systemic gender barrier. Supporting this interpretation, female-led groups outperformed males in publication output in the second study year. Contemporary literature shows fluctuating gender dynamics that are often context-dependent.<sup>5,8,30</sup>

## Supervisor Influence: Experience, Affiliation, and Mentorship

Supervisor characteristics were associated with variations in student publication success. Projects supervised by experienced or prolific faculty yielded higher publication rates (up to 57.5%), highlighting the importance of mentorship quality. However, supervisory capacity was constrained by clinical workloads and a lack of protected research time—barriers well documented in the literature.<sup>19–21</sup> Qualitative data revealed that even supervisors with strong academic backgrounds may not translate their expertise into effective mentorship without institutional incentives and dedicated time. As one supervisor noted, students often lack an understanding of the research process and only engage near deadlines, further straining the mentorship relationship. Institutional affiliation was associated with differential publication rates, with KSAU-HS supervisors (39.1%) outperforming KAMC-affiliated supervisors (17.5%). This may reflect the greater research orientation and protected time available at academic institutions compared with primarily clinical settings.<sup>11,19</sup>

## Characteristics of the Project: Design, Population, and Feasibility

No significant differences in publication rates were found between observational and survey-based studies. Projects targeting students as subjects reported the highest publication rates (52.9%), likely due to easier participant access and data collection logistics. These results suggest that execution quality and mentorship, rather than project design, are more strongly associated with successful dissemination.<sup>10</sup> International data corroborate that mandatory research programs and well-structured curricular frameworks are associated with higher publication rates, with the highest rates observed where research is an embedded, scaffolded requirement.<sup>7,13</sup>

## Barriers to Publication: Time, Resources, Motivation

Time constraints were ranked as the most prevalent barrier, with 80% of students and 60% of supervisors reporting them in the structured questionnaire. This challenge reflects a heavy workload distribution and competing academic demands, issues that are magnified by limited institutional support. Lack of motivation and insufficient research skills were also frequently cited, underscoring the need for early and sustained engagement with practical research education rather than solely theoretical exposure.<sup>23,24</sup> Qualitative data contextualized these barriers: students described long waiting periods (2–3 weeks) for supervisor meetings, while supervisors noted that students often lacked realistic expectations about the research process. These findings align with global patterns where student interest in research is undermined by workload pressures and insufficient enabling environments.<sup>5,8,24</sup>

## Institutional Context and Strategies for Improvement

The institutional environment at COM-J both facilitates and constrains student research output. On the facilitative side, the Research Unit provides structured support, coordinates research activities, and has implemented adaptive strategies, including mandatory full-time co-principal investigators and streamlined approval processes. On the constraining side, the lack of protected research time for clinical faculty, the absence of formal research credit systems for mentors, and the two-year gap between research blocks and typical publication activity create systemic barriers. These findings are consistent with the research capacity-building literature, which emphasizes that institutional culture, incentive structures, and support infrastructure are as important as individual competencies.<sup>14,31</sup>

Specific, actionable recommendations emerging from this analysis include: (1) implementation of mandatory protected research blocks for faculty involved in student mentorship; (2) creation of a credit-based incentive system that formally recognizes research mentorship in promotion and tenure decisions; (3) formalization of Research Assistant roles to bridge the gap between clinically busy supervisors and students; (4) establishment of writing clinics and structured post-block publication support programs; and (5) introduction of regular check-in milestones throughout the publication process to maintain student engagement after the formal research block concludes.

## Research Unit (RU) Personnel: Coordination and Adaptive Support

RU personnel were essential facilitators. Students consistently reported that help from the research office was vital for seeing projects through to publication. The RU continuously adapts its approach, including implementing new mentorship systems and streamlining communication. However, the two-year program duration sometimes resulted in knowledge gaps and interruptions, highlighting the need for periodic reinforcement. Supervisors and RU staff identified communication breakdowns and insufficient awareness of program details as ongoing challenges. The literature affirms that responsive research program management can meaningfully improve both student experience and research output.<sup>9,23,24</sup>

## Limitations

This study has several limitations that should be considered when interpreting the findings. First, data were drawn from a single institution, which limits generalizability to other settings. The comprehensive convenience sampling approach, while pragmatic, introduces potential selection bias. Second, the reliance on self-reported qualitative data may introduce recall and social desirability biases. Third, the absence of multivariate regression analysis means that the independent effects of individual factors on publication outcomes could not be isolated from potential confounders; future studies with larger, multi-institutional datasets should employ logistic regression to identify independent predictors. Fourth, the follow-up period may not fully capture the publication trajectory of all projects, as some may still be in the publication pipeline beyond the study's observation window. Fifth, the retrospective nature of the quantitative component limited the ability to capture real-time changes in institutional policy and their immediate effects. Future research should employ probability-based sampling across multiple institutions and include longitudinal tracking of publication outcomes.

## Future Directions

Further research is needed to explore the long-term impact of student research publications on career trajectories. Longitudinal studies tracking graduates' research involvement over time would clarify the lasting effects of early research experiences. Interventional studies evaluating specific mentorship models (eg., research credit systems, protected time blocks) can inform evidence-based institutional reforms. Multi-institutional studies across Saudi Arabia and the Gulf region would improve generalizability and allow identification of system-level predictors of publication success.

## Conclusion

The overall publication rate of 21.4% among medical student research projects at COM-J highlights persistent systemic barriers to translating curricular research training into peer-reviewed publications. The most prominent barriers identified were time constraints, limited mentorship availability due to clinical workloads, and insufficient post-project support. While supervisor experience and institutional affiliation were associated with higher publication rates, student-level factors such as gender and prior research experience were not significantly associated with publication outcomes in this cohort. These findings, drawn from a single institution, suggest that targeted institutional interventions—including mandatory protected research time for faculty, credit-based mentorship incentives, and structured post-block publication support—may help close the gap between research training and scholarly output. Longitudinal tracking of student research outcomes and interventional evaluation of mentorship models are needed to validate these recommendations and advance evidence-based reform in medical education.

## Data Sharing Statement

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors declare no conflicts of interest.

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