Barriers to participation in research as perceived by undergraduate medical students: A cross-sectional study from Qassim. [version 1; peer review: awaiting peer review]

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Abstract
Background: Medical students’ engagement in research activities continues to be below the expectation. In this study we aimed to investigate students’ views about research, and to identify the barriers preventing them from participation in research projects.
Methods: A cross-sectional study was carried out in Qassim University. A total of 230 students were included. The perceptions of students were assessed using a 16-item questionnaire. The mean scores were compared between students using Mann-Whitney test. Factors associated with students’ perception of research barriers were analyzed using four separate logistic regression models.
Results: The overall response rate was 89.4%. The results indicate that the students generally possess a moderately positive attitude towards research with a mean score of 14.8±2.7 (range: 5-25). A substantial number of participants reported their willingness to take part in any research-related task (77.0%). However, the participants highly agreed that lack of time (70.4%), lack of supervision and guidance (72.6%), lack of research training and support (73.9%), and lack of research exposure and opportunities (75.2%) were major barriers to their participation in research. We found that students having lower CGPA ranks are almost three times more likely to indicate lack of time as a challenge (AOR: 2.94; 95% CI: 1.09, 7.94; p.value=0.033). Overall, female students were more likely to report concerns about research training and availability of research opportunities, while male students were more likely to indicate lack of time and lack of supervision as research barriers.
Conclusions: The barriers addressed in the current study —both discretely and cumulatively—are highly demotivating for students, and negatively affect their participation in research. Efforts should be
invested to shift the focus from providing superficial research exposure to incorporating more in-depth and effective research training for undergraduate students

**Keywords**
Undergraduate, Medical students, Research barriers, Saudi Arabia.
Introduction

It is vital for healthcare practitioners to have the necessary skills and competence to review the literature and critically appraise research evidence. However, there is a global concern about the declining numbers of “physician researchers.” Medical students are seen as potential researchers and thus research training is essential during their undergraduate years. It is well documented that participating in research while being a student positively influences students’ attitude toward medical science. Engagement of medical students in research has been found to enhance their knowledge and research capacity.

The importance of incorporating research training into medical curricula has been extensively discussed in the literature. Various methods have been used to engage medical students in research. For examples students may participate in research through funded research training programmes, research time-out periods, and extracurricular research assistant opportunities. However, early students’ exposure to research during their undergraduate years has been cited as a more realistic goal. Several medical schools around the world follow that approach including Saudi Arabia. On the other hand, “add-on” approaches to research training are used in some medical schools where research training can be provided only to volunteers and or academically disguised students. Research competence comes high up on the agenda of medical education in Saudi Arabia. The SaudiMEDs framework outlines six core competencies essential for undergraduate medical students in Saudi Arabia one of which is research and scholarship.

Qassim University College of Medicine offers a five year undergraduate programme. It follows the Problem-based learning system. Devoting time for teaching research skills comes in its mission to graduate doctors who are capable to actively participate in research and critically appraise evidence for clinical decision-making. In the second year students are taught principles of research and research designs. The entire third year is devoted for data collection and analysis. Each group of students is required to submit a research report for the final assessment. Students are also required to present their research work during a conference day organized annually by the college. Awards are granted to outstanding research projects. Taken together the research proposal and the final dissertation contribute to 20% of the overall final course mark.

Despite all efforts to continually improve the quality of research instruction and training for undergraduate students, some obstacles to successful implementation remain. Providing time in a busy PBL curriculum is one barrier, however, some authors assume that this barrier is more “imagined than real” since there are many possible options to offer opportunities for students. Other barriers could be lack of motivation among students, funding, faculty commitment, and lack of awareness among students about the relevance of research skills to their future career.

The students’ engagement in research activities continues to be below the expectation. Actual reasons are yet to be explored. We need to assess our current situation and obtain information about the students’ perception of their research skills competencies to determine how support can be provided. In addition, it would be helpful to investigate the barriers particular to our setting and try to offer explanations in order to propose effective solutions. In this study we aimed to investigate students’ views about research, to identify the barriers preventing them from participating in research projects, and to propose solutions for improving the research component in the undergraduate medical curriculum. Although the results of this study would be helpful to inform decision makers about how to improve the research training component during curriculum review, we hope that these results will be of benefit to all curriculum planners who wish to gain a deeper understanding of potential barriers to engaging undergraduate medical students in research.

Methods

Study design & setting

A cross-sectional survey was carried out in the College of Medicine at Qassim University, which is situated in the center of the kingdom of Saudi Arabia. Qassim College of Medicine was established in 2000-2001 and was the first medical school to adopt the problem-based learning approach in the kingdom. It offers a five-year MBBS programme. In Years one, two and three, the focus of the curriculum is on basic medical sciences. Alongside that the students are introduced to the essentials of research methods and core clinical skills. At the end of Year three, students should complete a research project of their own choosing as part of their final assessment before progressing to the clinical years four and five. During the clinical years, students may participate in faculty projects or conduct their own as extracurricular activities to strengthen their personal academic profile.

The study has been approved by the Research Ethics Committee at Qassim University (Reference Number: 19-14-03). Participation was voluntary, and a signed consent was obtained from participants prior to completing the on-line questionnaire.
Participants
The study targeted year four and year five medical students at Qassim University College of Medicine in the 2020-2021 academic year. A total of 230 students, 139 male students (60.4%) and 91 (39.5%) female students were targeted in the current survey employing universal sampling. We addressed these two groups since they have already completed their formal research training and are expected to be able to reflect on their research experience. An electronic invitation to participate in an anonymous survey was sent to all fourth and fifth year students. Data were collected between 3rd and 23rd of October 2020. Students were contacted through their class representatives who sent out the invitation for participation via the class WhatsApp group for each batch. The on-line survey instructions clearly emphasized voluntary participation and that the submitted responses would be kept confidential. To enhance the response rate, reminder emails were sent to late responders. No monetary compensation was offered to students for completing the online survey.

Data collection & the study instrument
Data were collected online through a self-administered questionnaire using Google forms. Participants were provided with an informed consent which they were required to read through and sign before taking the survey.

The online questionnaire used in this study was adapted from a previous study undertaken by Achi et al., with permission from the authors.26

The questionnaire in the current study comprised of two major sections. The first section included questions about the demographic characteristics of participants, their academic performance and previous research experience. The second section was further subdivided into four sub-sections; Students’ demographic characteristics of participants, their academic performance and previous research experience. The second section was presented in five-point Likert scale ranging from “strongly disagree” to “strongly agree”. Total scores for each of the four subscales of the questionnaire were then computed. The mean total scores were used for comparison. The higher scores suggest that students responded more positively.

Statistical analysis
Submitted responses were exported from Google forms to MS Excel 2010 for data cleaning and coding. Subsequently, the dataset was sent to SPSS 24.0 (SPSS Inc., Chicago, IL) for statistical analysis. Descriptive statistics was used to present categorical data in frequencies and proportions. Gender differences regarding age, academic level, cumulative grade point average, and prior research experience were obtained using chi-square test and Fisher’s exact test as appropriate.

The perception of students towards research and its barriers was assessed using a 16-item questionnaire organized as follows; Students’ attitudes towards research (5 items), Students’ perception of research benefits (3 items), Students’ willingness to participate in research (4 items), and Students’ perception of research barriers (4 items). Participants were asked to rate the extent to which they agreed with each statement of the questionnaire using a 5-point Likert scale: 1=strongly disagree, 2=disagree, 3=uncertain, 4=agree, and 5=strongly agree. Statements not favoring research were reverse coded (items 1, 3, 13-16).

All responses on all items for each subscale were added up and then a mean score was calculated. The mean scores of these four subscales were compared between students using Mann-Whitney Test to determine if there are any significant gender differences. Next, factors associated with students’ perception of barriers to participation in research were analyzed using logistic regression. Four barriers to student participation were investigated in this study including lack of time, lack of supervision, lack of training and lack of research opportunities. Students’ responses on perceived barriers were collapsed into a binary variable. A dichotomized scale was generated by combining responses for 1 through 3 from the original scale to 0=disagree (i.e strongly disagree, disagree and uncertain collapsed into one category) and 4 and 5 to 1=agree (i.e strongly agree, and agree collapsed into a second category).

Multivariate logistic regression analyses were then used to determine factors independently influencing students’ perception of barriers to participation in research. In total, there were separate four logistic regression models in our study, each having the same independent variables but estimated using a different barrier as the dependent variables. The dependent variables were the four perceived barriers to undertaking research; lack of time, lack of supervision, lack of training and lack of opportunity, respectively. The independent variables used in all logistic regression models included categorical and continuous variables. Categorical variables were gender, Cumulative Grade Point Average (CGPA), and prior research experience. Continuous variables were mean scores of students’ responses on Attitude towards research, Students’ perception of research benefits, and Students’ willingness to participate in research. Adjusted odds ratios (AOR) with corresponding 95% confidence interval (CI) were reported. The cut-off point for significance level was set at 5% for all analyses.
Results
A total of 230 medical students (91 females & 139 males) completed the online questionnaire. The overall response rate was 89.4%. Response rates by academic level of students were: Year 4: 118/134 (88.0%) and Year 5: 112/123 (91%). The characteristics and research experience of participants stratified by gender are summarized in Table 1. The majority of students aged between 22-24 years (83.5%), from fourth year (51.3%), earned a “very good” CGPA (60.4%), and have at least one previous research experience (80.0%). The results show statistically significant gender differences with regard to age (p value=0.025), CGPA (p value=0.022), and prior research experiences of participants (p value=0.037), but no significant differences by gender for academic level.

The mean score of students’ responses for the four domains of the questionnaire are presented in Table 2. The results indicate that the students generally possess a moderately positive attitude towards research with a mean score of 14.8±2.7 (range: 5-25). Students agreed that research is valuable (83.9%) and that they feel excited to take part in research (55.2%), however, the majority of them reported that research is time-consuming (74.8%) and complicated (77.0%) as shown in Table 3. No significant differences were found in the students’ attitudes towards research by gender in this domain. Additionally, the results indicate a more positive response expressed by students towards benefits of research 11.8±1.9 (range: 5-15) with statistically significant gender difference in this domain (p value=0.014). The vast majority of participants reported that research promotes critical thinking (81.7%), allows one to acknowledge his/her career prospect (70.0%), and enhances one’s knowledge (87.0%).

Furthermore, although students demonstrated a greater readiness to participate in research shown as a mean score of 13.5±2.6 (range:5-20), they acknowledged the barriers of undertaking research expressed as a low mean score of 8.2±3.1 (range: 5-20). A substantial number of participants reported their willingness to take part in any research-related task

Table 1. Characteristics and research experience of the study participants stratified by gender, Qassim 2020 (N=230).

| Variable                      | Female (n=91) | Male (n=139) | Total (n=230) | p value |
|-------------------------------|---------------|--------------|---------------|---------|
| Age (Fisher’s exact)          |               |              |               | 0.025   |
| 19-21 years                   | 6 (75.0%)     | 2 (25.0%)    | 8 (3.5%)      |         |
| 22-24 years                   | 78 (40.6%)    | 114 (59.4%)  | 192 (83.5%)   |         |
| More than 24 years            | 7 (23.3%)     | 23 (76.7%)   | 30 (13.0%)    |         |
| Academic year                 |               |              |               | 0.723   |
| Fourth                        | 48 (40.7%)    | 70 (59.3%)   | 118 (51.3%)   |         |
| Fifth                         | 43 (38.4%)    | 69 (61.6%)   | 112 (48.7%)   |         |
| CGPA                          |               |              |               | 0.022   |
| Excellent                     | 18 (42.9%)    | 24 (57.1%)   | 42 (18.3%)    |         |
| Very good                     | 62 (44.6%)    | 77 (55.4%)   | 139 (60.4%)   |         |
| Good & below                  | 11 (22.4%)    | 38 (77.6%)   | 49 (21.3%)    |         |
| Prior research experience     |               |              |               | 0.037   |
| Yes                           | 79 (42.9%)    | 105 (57.1%)  | 184 (80.0%)   |         |
| No                            | 12 (26.1%)    | 34 (73.9%)   | 46 (20.0%)    |         |

Table 2. Mean scores (SD) of the questionnaire subscales/domains stratified by the students’ gender (Mann-Whitney Test).

| Variable                                      | Female | Male   | Total  | p value |
|-----------------------------------------------|--------|--------|--------|---------|
| Students’ attitudes towards Research          | 15.0 (2.6) | 14.6 (2.8) | 14.8 (2.7) | 0.297   |
| Students’ perception of Research benefits     | 11.5 (2.0) | 12.0 (2.0) | 11.8 (1.9) | 0.014   |
| Students’ willingness to participate in research | 13.3 (2.6) | 13.6 (2.5) | 13.5 (2.6) | 0.528   |
| Students’ Perception of Research Barriers     | 8.3 (3.0) | 8.2 (3.1) | 8.2 (3.1) | 0.673   |
However, the participants highly agreed that lack of time (70.4%), lack of supervision and guidance (72.6%), lack of research training and support (73.9%), and lack of research exposure and opportunities (75.2%) were major barriers to their participation in research. No gender differences were observed between students in the present study regarding their willingness to participate in research or in their perception of research barriers.

The factors influencing students’ perception of various research barriers were tested by means of four separate logistic regression models (Table 4). We found that students’ perception of lack of time as a barrier was significantly associated with their CGPA. Students having lower CGPA ranks are almost three times more likely to indicate lack of time as a challenge (AOR: 2.94; 95% CI: 1.09, 7.94; p value=0.033). However, the association between students’ perception of lack of supervision as a barrier and their perception of research benefits was marginally statistically significant. Students with higher perception of research benefits are more likely to report concerns about research supervision (AOR: 1.65; 1.00, 2.72; p value=0.051). Importantly, our results showed that students’ perception of lack of research training was significantly and negatively associated with their attitudes towards research. Students with more positive attitudes towards research were 60% less likely to indicate lack of research training as a problem for their participation in research (AOR: 0.40; 0.21-0.77; p value=0.006). The last regression model showed a significant association between students’ perception of lack of research exposure and their willingness to participate in research. Students with greater willingness to participate in research were 1.78 times more likely to report lack of research opportunities as a barrier (AOR: 1.78; 1.06, 2.99; p value=0.029). Overall, female students were more likely to report concerns about research training and availability of research opportunities, while male students were more likely to indicate lack of time and lack of supervision as research barriers (Table 4). However, no significant statistical associations were found between gender and any of the four barriers investigated in this study.

### Table 3. Students’ responses to the individual items of the questionnaire (N=230).

| Statement                                                                 | Agreed N (%) | Uncertain N (%) | Disagreed N (%) |
|---------------------------------------------------------------------------|--------------|-----------------|-----------------|
| Students’ attitudes towards Research                                       |              |                 |                 |
| 1. Medical research is time-consuming                                     | 172 (74.8%)  | 34 (14.8%)      | 24 (10.4%)      |
| 2. Medical research is enjoyable                                          | 78 (33.9%)   | 80 (34.8%)      | 72 (31.3%)      |
| 3. Medical research is complicated                                        | 177 (77.0%)  | 33 (14.3%)      | 20 (8.7%)       |
| 4. It is exiting to take part in medical research                         | 127 (55.2%)  | 65 (28.3%)      | 38 (16.5%)      |
| 5. Medical research is valuable                                           | 193 (83.9%)  | 28 (12.2%)      | 9 (3.9%)        |
| Students’ perception of Research benefits                                 |              |                 |                 |
| 6. Medical research promotes critical thinking                             | 188 (81.7%)  | 30 (13.0%)      | 12 (5.2%)       |
| 7. Medical research allows one to acknowledge his/her career prospect      | 161 (70.0%)  | 51 (22.2%)      | 18 (7.8%)       |
| 8. Medical research enhances one’s knowledge                              | 200 (87.0%)  | 20 (8.7%)       | 10 (4.3%)       |
| Students’ willingness to participate in research                           |              |                 |                 |
| 9. I’m willing to Spend more than 2 months on a medical research project   | 173 (75.2%)  | 32 (13.9%)      | 25 (10.9%)      |
| 10. I’m willing to Take part in any research related task (data entry, data analysis, manuscript writing, etc.) | 177 (77.0%)  | 30 (13.0%)      | 23 (10.0%)      |
| 11. I’m willing to Devote the same time for medical research as for my university studies. | 69 (30.0%)   | 71 (30.9%)      | 90 (39.1%)      |
| 12. I’m willing to take part in a medical research project even if it does not lead to a publication | 93 (40.4%)   | 58 (25.2%)      | 79 (34.3%)      |
| Students’ Perception of Research Barriers                                  |              |                 |                 |
| 13. Lack of time                                                           | 162 (70.4%)  | 48 (20.9%)      | 20 (8.7%)       |
| 14. Lack of supervision and guidance                                      | 167 (72.6%)  | 29 (12.6%)      | 34 (14.8%)      |
| 15. Lack of research training and support                                 | 170 (73.9%)  | 32 (13.9%)      | 28 (12.2%)      |
| 16. Lack of research exposure and opportunities                            | 173 (75.2%)  | 37 (16.1%)      | 20 (8.7%)       |

(77.0%). However, the participants highly agreed that lack of time (70.4%), lack of supervision and guidance (72.6%), lack of research training and support (73.9%), and lack of research exposure and opportunities (75.2%) were major barriers to their participation in research. No gender differences were observed between students in the present study regarding their willingness to participate in research or in their perception of research barriers.
Table 4. Multivariate logistic regression analysis of factors influencing students’ perception of barriers to participation in research, Qassim (N=230).

| Factors                                | Lack of Time | Lack of Supervision | Lack of Training | Lack of Opportunity |
|----------------------------------------|--------------|---------------------|------------------|---------------------|
|                                        | AOR (95% CI) | p.value             | AOR (95% CI)     | p.value             | AOR (95% CI)    | p value         |
| Gender                                 |              |                     |                  |                     |                  |                 |
| Male                                   | 1            | 1                   | 1                | 1                   |                  |                 |
| Female                                 | 0.714 (0.40-1.33) | 0.291               | 0.77 (0.41-1.46) | 0.426               | 1.27 (0.68-2.40) | 0.457           | 1.43 (0.75-2.71) | 0.278           |
| CGPA                                    |              |                     |                  |                     |                  |                 |
| Excellent                              | 1            | 1                   | 1                | 1                   |                  |                 |
| Very good                              | 1.32 (0.62-2.81) | 0.469               | 1.25 (0.57-2.76) | 0.580               | 1.25 (0.55-2.83) | 0.600           | 1.62 (0.73-3.60) | 0.232           |
| Good & below                           | 2.94 (1.09-7.94) | **0.033**           | 1.23 (0.48-3.19) | 0.664               | 0.97 (0.37-2.58) | 0.953           | 1.43 (0.54-3.80) | 0.470           |
| Prior research experience              |              |                     |                  |                     |                  |                 |
| No                                     | 1            | 1                   | 1                | 1                   |                  |                 |
| Yes                                    | 1.09 (0.52-2.27) | 0.819               | 0.72 (0.33-1.56) | 0.398               | 0.69 (0.31-1.55) | 0.367           | 0.53 (0.22-1.28) | 0.157           |
| Students’ Attitude towards research    | 0.655 (0.36-1.19) | 0.165               | 0.57 (0.31-1.05) | 0.071               | 0.40 (0.21-0.77) | **0.006**       | 0.74 (0.39-1.40) | 0.353           |
| Students’ perception of Research benefits | 1.32 (0.81-2.12) | 0.271               | 1.65 (1.00-2.72) | **0.051**           | 1.63 (0.98-2.74) | 0.062           | 1.30 (0.78-2.17) | 0.307           |
| Students’ willingness to participate in research | 0.64 (0.38-1.08) | 0.092               | 0.94 (0.57-1.55) | 0.806               | 1.16 (0.70-1.94) | 0.567           | 1.78 (1.06-2.99) | **0.029**        |
Discussion
This study was undertaken in Qassim University primarily to assess medical students’ perception of barriers to their participation in research. To that end, we first investigated personal and research-related factors that could potentially influence students’ perception of various research barriers. Overall, students in the present study demonstrate a moderately positive attitude towards research although they acknowledged its educational benefits. Previous studies in Saudi Arabia, Baharian, Kuwait, Ireland, and New Zealand have shown higher levels of positive attitudes.\textsuperscript{16,27–29} This finding could be explained by the considerably high percentage of the participants who opted to remain neutral to the questions related to research enjoyment (34.8%) and excitement (28.3%) in the attitude domain. Nevertheless, this result indicates that although the majority of participants consider research to be valuable, many of them are hesitant and challenged in their ability to possess positive attitudes towards research. This result might be attributed to anxiety in conducting research, insufficient background knowledge in research or lack of ability to apply research skills in real life. As observed, a substantial number of participants were unsure or less confident about how they perceive research.

According to Bandura, self-efficacy influences the way people think.\textsuperscript{30} Self-efficacy has been defined in the literature as “the confidence to carry out the courses of action necessary to accomplish desired goals”.\textsuperscript{31} Positive attitudes have been linked with higher levels of perceived self-efficacy. It has been stated that when students hold positive attitudes towards a particular subject, they are more likely to possess a higher self-efficacy in studying that subject.\textsuperscript{32} Self-efficacy is pivotal for student learning and development.\textsuperscript{33} Students who are unconfident in the skills they possess are less likely to take part in activities which require those skills, and are also less likely to continue working on those activities when faced with challenges.\textsuperscript{34} It is noteworthy however that, background and cultural factors can adversely influence students’ views of research. A previous review of the literature revealed lower level of positive attitudes towards research in developing countries compared to developed countries.\textsuperscript{32}

Concerning the willingness of students to undertake research, we found that 77% of participants were willing to take part in any research-related task. In addition, most of the participants in the current study reported that research is important for their future career. The SaudiMEDs framework for undergraduate medical programs in Saudi Arabia has recommended that learning outcomes for all medical graduates should incorporate research skills to enable them to contribute to the advancement of medical practice.\textsuperscript{35} Overall, 80% (184/230) of participants in this study had some prior experience of research. Prior evidence has shown that students who participated in research while still at the medical school demonstrated positive reaction toward their research experiences and contributed positively to the published output of their university.\textsuperscript{6}

Factors influencing students’ motivation and willingness to participate in research whilst at medical school have been discussed in literature. Strong extrinsic motivators include; availability of role models such as faculty members, financial reward, and the widespread perception that research provides a career advantage and enhances their chances of entering specialty training.\textsuperscript{7} Furthermore, students are intrinsically motivated by feeling of competence, clinical relevance of research and ability to work with a group of colleagues.\textsuperscript{35} On the other hand, bureaucracy such as time taken to get ethical approval, lack of self-confidence, limited prior research experience, and uncertainties about the possible outcomes of research constitute important research de-motivators.\textsuperscript{7} In our context, offering opportunities for collaborative research work as part of a compulsory course work, in addition to students’ interest to improve their research profiles might be the main reasons behind their strong willingness to participate in research. A similar finding has been reported by a previous study in Saudi Arabia.\textsuperscript{27}

Students, however face enormous research barriers. Firstly, lack of time was reported by the vast majority of students. Our finding is consistent with other studies.\textsuperscript{15,18,27,36–38} Given the competing and overwhelming study demands in medical schools, it is unsurprising that lack of time is a big research obstacle facing students. The amount of workload is often burdensome, and there is little time left for research during working hours. In addition, frequent examinations, particularly in a problem-based learning curriculum make students prioritize other demands of the curriculum ahead of research. In such a high-pressure environment it is difficult for students to provide protected time for research, particularly those students with lower levels of academic achievement as observed in our study. Not only time is a challenge for students but also for supervisors. Although completing a group research project is a compulsory component of the curriculum, however the allotted time seems insufficient and research opportunities are limited in scope. Interestingly, in the literature various innovative initiatives have produced encouraging results such as the introduction of a five-year multifaceted program into the undergraduate medical curriculum,\textsuperscript{39} and the use of a web-based platform to enhance the collaboration between students and faculty on extra-curricular research projects.\textsuperscript{40}

The second barrier reported by students in this study was lack of supervision and guidance. Prior studies have also addressed this barrier.\textsuperscript{8} Inadequate support from supervisors, among other factors has been frequently reported as a main reason preventing students from participation in research despite their awareness of the huge benefits linked to it.\textsuperscript{12}
Similarly, we have found that students who have highly acknowledged the educational benefits of research were more likely to perceive lack of supervision as a barrier. This finding could be attributed to students’ expectations. At every stage in the research journey students, particularly those who highly value research expect some kind of support and feedback from supervisors. We can reasonably assume that not meeting the expectations of students could have a negative impact on their engagement in research. A previous analysis revealed that supervisor’s support is one of the most significant factors that encourage students of all levels of study to take part in research projects. Another study confirmed that medical students can be encouraged to undertake research with appropriate supervision and support from faculty and administrators. However, the intensity of daily workload might limit the number of faculty members who are willing to become research supervisors. It has been recommended that potential benefits, including academic promotion obtained through working with students should be clearly explained to supervisors. Furthermore, securing a pool of supervisors ready to work with students is paramount for supporting student research.

Lack of research training was the third research barrier addressed in this study. Although formal research instruction is part of the medical curriculum at Qassim College of Medicine, yet a high number of students perceived lack of training as a barrier. Our analysis further showed that students who hold negative attitudes towards research are more likely to report lack of training as a barrier. This barrier could possibly be a consequence of the above two barriers; lack of time, and lack of supervision. It is very likely that the inadequate time devoted for research instruction within the formal curriculum, absence of extracurricular research training programmes, busy timetables for students and faculty, limited supervisor-student interaction, and inadequate support may have jointly resulted in the negative perception of students towards research training. A variety of initiatives have been described in the literature to strengthen research training during undergraduate years. It has been suggested that providing a built-in research training component within the curriculum seems to be a more realistic goal, and has already been implemented in several settings including Saudi Arabia. However, since research interest and competence differ among medical students, an alternative approach would be to offer research opportunities only for volunteers and/or high academic achievers. The latter approach has been followed in different countries worldwide. Lastly, lack of research exposure was investigated in this study. Our findings explicitly show that the over 75% of participants identified lack of research exposure and opportunities as an obstacle to their participation in research. Offering research opportunities for medical students during their undergraduate constitutes a real challenge for many medical schools and has commonly been cited in the literature. Apart from the compulsory research project, limited opportunities are available for students at Qassim College of Medicine. Student engagement in research during the clinical years is largely dependent on the interest of students and availability of supervisors. Interestingly, our analysis showed that lack of opportunity was highly ranked by students who are keen and more willing to conduct research. A previous study proposed a model to explain student motivations to conduct research at various levels during their medical programme based on Self-Determination Theory. It suggested that student motivation to do research is higher among students who have completed a compulsory group research project and have embarked on clinical training. Those conditions typically apply to the cohort of students enrolled in the present study. Therefore, it is plausible to explain the high perception of lack of research opportunities as a barrier among students with their increased motivation to do research.

Limitations
Although the current study provides valuable information about the factors that hinder the engagement of medical students in research, however it was carried out in a single institution which limits the generalizability of the obtained results. Studies with larger sample size from various medical colleges across Saudi Arabia are required. Furthermore, compared to the quantitative cross-sectional design used in this study, the qualitative approach is expected to produce more in-depth analysis of the factors that motivate or demotivate students’ participation in research. However, despite these limitations we believe that our study adds significantly to a pool of literature on the perception of research barriers among undergraduate medical students in Saudi Arabia.

Conclusion
Our findings call for better understanding of the needs and expectations of students with regards to their participation in research. The barriers addressed in the current study—both discretely and cumulatively—are highly demotivating for students, and negatively affect their participation in research. There is a necessity for providing curricula and research training programmes that are more responsive to the needs of students. In light of the global vision as well as the national recommendations set forward by the SaudiMed frame work it has become critical to improve undergraduate research training. On the basis of our findings and as Qassim college of Medicine is undertaking a large-scale curriculum reform effective strategies should be introduced to strengthen the research component in the new curriculum. It is vital to strike a balance between clinical competency and research competency. Efforts should be made to shift the focus from providing superficial research exposure to incorporating more in-depth and effective research training for students. Providing adequate time for research instruction, offering elective research courses, securing a pool of trained supervisors, emphasizing hands-on research training and maximizing research opportunities are thus recommended.
Data availability
Figshare. Barriers to participation in research as perceived by medical students _Abeer Atta Elmanan et al., sav. DOI: https://doi.org/10.6084/m9.figshare.19920410.v4.

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

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