








Medical Research Conduct and Publication during Higher Education in Syria: Attitudes, Barriers, Practices, and Possible Solutions

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Abstract

Background: The huge workload on doctors especially residents, who are the main health care providers in public hospitals, in addition to the vanishing incomes and lack of personal safety during the decade-long Syrian crisis, led to further hurdles in the focus on research. Postgraduate students in the medical and paramedical fields must conduct original research projects as part of their graduation requirements. However, this does not reflect on research publications coming from Syria.

Methods: This is a nation-wide cross-sectional study targeting medical, dental, and pharmacy postgraduate students who are at the phase of planning for their required projects. The questionnaire aimed to capture their attitudes toward research, perceived barriers, and previous research experiences in order to suggest evidence-based recommendations.

Results: The sample consisted of 429 residents representing about 22% of the target population. Nearly all the participants had positive opinion toward the important role of medical research and the significance of their participation. Agreement was also clear regarding perceived barriers, including the lack of adequate training and research facility. Seventy-one percent of the participants were not involved in any research before the time of their master theses, less than 13% of them had submitted an article for publication, and less than 5% had submitted more than one paper. Despite that,

Keywords

- ▶ research contributions
- ▶ publication practices
- ▶ postgraduate students
- ▶ Syrian crisis
- ▶ residents' attitudes
- ▶ institutional barriers

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high-quality internet connectivity and rich English writing skills were associated with further research experiences. Additionally, mentors' support and self-paced learning of research skills had significant positive impact on students' research contributions with odds ratios of 2.04 [[95% Confidence Interval]: 1.02–4.06] and 2.68 [1.48–4.84], respectively.

Conclusion: Lack of training and mentorship, in addition to several common barriers to medical research, hampered residents' capacity of conducting and publishing research despite their positive attitudes toward it. Nevertheless, the variance within our sample exposed a promising window for implementing low-cost institutional and individual solutions such as peer-run self-paced training opportunities and long-distance mentoring.

Introduction

Health care providers in developing countries need to find innovative solutions to overcome challenges by performing research projects that are feasible in their circumstances. The 10-year-long Syrian crisis has deeply affected all aspects of Syrians' lives, especially health care and education. Over half of their health care facilities became out of service because of the repeated attacks and bombing.¹ The decline in health care infrastructure, along with the rising numbers of war-related victims, led to an increased burden on the remaining hospitals and their staff, who had to increase their efforts and working hours significantly. The global surge in medical staff burnout (e.g., in the United States)² also affects Syrian medical personnel at a staggeringly more severe level. This erodes their skills and productivity during work and leaves them depleted and with less work-life satisfaction.³ In Syria, this problem is more evident among residents during the crisis, and the percentage of this debilitating syndrome is among the highest worldwide.⁴ This is also aggravated by the increase in workplace violence in Syrian hospitals, which triggered physiological stress and loss of confidence among resident doctors.⁵ These serious socioeconomic situations, in addition to the vanishing income and lack of personal safety, exaggerated the already evident brain drain⁶ and caused half of the medical personnel to flee Syria by 2016.^{7–9} Those who stayed in Syria are still facing lifestyles that leave them with no time or enthusiasm to get involved in research activities.⁹

Medical, dental, and pharmacy residents are considered the main possible contributors to research conduct in Syria for many reasons. First, a research project is a requirement for their graduation. Second, they are in direct contact with patients as doctors and dentists or they spend most of their time in university labs as pharmacists. Third, they have less duties and responsibilities and more time to investigate than the elder practicing specialists. Finally, they see a wide variety of cases because of working in central academic health centers with a very high flow of patients. However, the falling numbers of available medical personnel and the high workload are factors hindering the increase in research

output from Syria, which was already lower before the Syrian war in comparison to other wealthier Arab countries.^{10,11}

A recent report about the problems and challenges of medical research in Syria demonstrated that the most important barriers were the limited financial support and research equipment and the lack of research-related skills.¹² Another report shed light on comparable results from undergraduate students at Damascus University.¹³ However, there is a lack of comprehensive evidence regarding research productivity of postgraduate medical personnel.¹⁴

The aim of this study is to investigate attitudes toward research, perceived barriers, current needs, and previous research experiences of postgraduates in all medical and paramedical fields in Syria to lay the groundwork for suggesting evidence-based solutions.

Methods

Setting and Participants

The Syrian Ministry of Higher Education runs seven schools of medicine; only three of them have higher education programs (i.e., Damascus University, Aleppo University, and Tishreen University in Latakia). Each of these has higher education programs for pharmacy and dentistry, in addition to a fourth school for pharmacy in Homs (Al-Baath University) and a fourth school for dentistry in Hama. There is also a virtual master's program for medical education from the Syrian Virtual University. All these programs required the students to conduct and defend an original research study (thesis) to graduate. However, generally it is not obligatory to publish their work. The target participants in this cross-sectional study are students of all these programs who are specifically at the phase of planning for their research studies. This was the best time point to investigate the attitudes toward conducting a high-quality study and the barriers for publishing this work later. The year of planning and registering these master theses differed between specialties and disciplines due to the different lengths of the programs (2–6 years). However, it is generally the third year for medicine, the second for dentistry, and the first for pharmacy.

The data were collected via an online questionnaire created using Google Form. First, chief residents in each

department shared an invitation to an online extracurricular 8-hour workshop with all the residents and fellows. The workshop objectives were to practically provide peer support to residents in preparing their upcoming research projects. Then the form was sent to those who showed interest in that support individually. Three days later, a reminder was sent, and all the interested students ($n = 429$, 100%) completed the questionnaire. Data collection took place over 2 weeks in July 2020. Participants were informed about the aims of the study and were asked to provide their consent to participate at the beginning of the questionnaire.

Questionnaire and Outcomes Measured

This study used an Arabic questionnaire developed in a previous study to investigate attitudes, barriers, and practices toward scientific research among undergraduate medical students in Damascus.¹³ However, some of the terms were modified to suit postgraduate students. The questionnaire was then piloted on 10 participants from different specialties to confirm that all responders can follow the instructions and answer the questions without concerns regarding the language, understanding, consistency, and structure.

The first section in the questionnaire included questions about participants' demographic data and self-reported English proficiency. The second section used a 5-point Likert scale to assess participants' attitudes toward research, as well as their barriers for conducting it. The third section included multiple-choice questions about participants' sources of training (intra- or extracurricular), levels of supervisors' encouragement, and previous research experiences. The last section focused on participants' needs to plan, conduct, and publish their master theses in peer-reviewed journals.

Analysis of the Outcomes

The data were exported from the online questionnaire to Microsoft Excel 365 version 2011 (year 2020) and then imported into the Statistical Package for the Social Sciences version 23.0 (SPSS Inc., Chicago, IL).

The year of study was coded according to the usual year of registering the research proposal in each specialty into three categories (early, normal, and late registration). The different human medicine specialties were grouped into four categories: (1) internal medicine and psychiatry; (2) surgical specialties, pediatrics, obstetrics, and gynecology; (3) otolaryngology, dermatology, and ophthalmology (clinics specialties); and (4) other medical specialties including radiology, pathology, and laboratory medicine (translational specialties). Binary logistic regression analysis was used to investigate the effect of different variables on participation in research and submission of manuscripts for publication, combined with corresponding odds ratios (ORs) and 95% confidence intervals (CIs). An alpha value of 0.05 was used to determine the threshold of statistical significance.

Institution Review Board Statement

The ethical approval was obtained through Damascus University, and it complies with the Declaration of Helsinki

1975, as revised in 2013. Participation was completely voluntary, with the assurance of confidentiality.

Results

The sample consisted of 429 postgraduates who showed interest in the suggested extracurricular support. They represented 21.5% of the targeted population of nearly 2000 students actively working or studying under the medical, dental, and pharmacy higher education programs in Syria. Damascus, Latakia, and Aleppo had the largest universities and they contributed to more than 90% of the sample, and 62.2% of the participants (267/429) were females. Nearly half of the respondents did not consider the training they had already received regarding medical research sufficient to rely on, and 77.4% (332/429) had received encouragement by their mentors to conduct research (–Table 1).

Attitudes toward Research and Its Perceived Barriers

Most of the participants showed strong inclination to believe that research plays an important role in the medical fields, that research methodology should be a part of their curricula, and that participating in it was important for them as students and as part of their career plans. However, only 10.9% of the participants (47/429) agreed with the statement “medical research does not require a lot of money.” Regarding the barriers for research, over 80% agreed that the inadequate training in research methodology and in reading and evaluating research articles, as well as the lack of research facilities, were important obstacles. Similarly, around 70% faced barriers such as the lack of research opportunities, the absence of reward, and the unavailability of research mentors. Lack of time and difficulties in accessing medical journals and in obtaining ethical and scientific approvals for research projects were also important factors to 60 to 65% of the participants (–Fig. 1).

Conducting Research and Publishing Scientific Papers

Seventy-one percent (304/429) had not worked on any research project before the time of their master theses, and 17.5% (75/429) had only worked on one project. However, less than 13% (55/429) reached the phase of submitting an article for publication, and less than 5% (21/429) submitted more than one paper. A third of the reported projects were single case reports or case series (57/172). “An important skill to learn” and “to relay scientific information” were the most common reasons for conducting research, while only 2.5% (11/429) did not find research contribution important at all. The most common reasons for not conducting any research were the lack of guidance and supervision (41.3%; 118/286) as well as the lack of opportunities (36.7%; 105/286). Only 75 of the 172 (43.6%) reported studies were submitted for publication. However, the rate for basic laboratory-based projects was about 25%. Only 20% (8/40) of the participants who reached submission reported that all their submissions were eventually published. Submission of research articles was driven mostly by the necessity for relaying information (36.2%; 17/47) and career progression

Table 1 Composition and demographic information of the participants

Factors	n (%)	Response rate (total = 21.5%)
Gender		
Male	162 (37.8)	–
Female	267 (62.2)	–
Year of postgraduate study		
1st year	48 (11.2)	–
2nd year	147 (34.3)	–
3rd year	157 (36.6)	–
4th year	74 (17.2)	–
5th year	3 (0.7)	–
Year of study		
Early registration	105 (24.5)	–
Normal registration	242 (56.4)	–
Late registration	82 (19.1)	–
University		
Damascus University	190 (44.3)	26.5%
University of Aleppo	89 (20.8)	23%
Tishreen University	117 (27.3)	20.9%
University of Hama	10 (2.3)	35.7%
Al-Baath University	10 (2.3)	12.3%
Syrian Virtual University	13 (3)	7.6%
Specialties groups		
Clinics specialties	56 (13.1)	34.1%
Surgical specialties	60 (13.9)	11%
Internal medicine specialties	103 (24)	34.5%
Translational specialties	41 (9.6)	46.1%
Pharmacy	56 (13.1)	22.1%
Dentistry	100 (23.3)	23.8%
Medical education	13 (3)	7.6%
Internet connection accessibility		
Low quality	281 (65.5)	–
High quality	148 (34.5)	–
English language skills: writing		
Poor or intermediate	236 (55)	–
Good or excellent	193 (45)	–
English language skills: reading and comprehension		
Poor or intermediate	151 (35.2)	–
Good or excellent	278 (64.8)	–
Sources of education/training about research		
No training	188 (43.8)	–
University training	108 (25.2)	–
Self-paced training	133 (31)	–
Encouraged by mentors to participate in research?		
No	97 (22.6)	–
Yes	332 (77.4)	–

Note: *n* is the number of participants who chose the corresponding answer, and % represents the percentage of participants who chose the corresponding answer.

(34%; 16/47). On the other hand, the most important reasons for not submitting scientific papers for publication were insufficient academic writing experience (30.3%; 20/66) and the lack of guidance and supervision (27.3% each; 18/66; ▶ [Table 2](#)).

The Impact of Attitudes, Barriers, and Demographic Factors on Research Experiences

Logistic regression analysis of the attitudes was significant regarding participation ($R^2 = 0.06$, $p = 0.005$) and submission of research studies ($R^2 = 0.08$, $p = 0.001$). A similar analysis regarding barriers was also significant for both participation ($R^2 = 0.07$, $p = 0.030$) and submission ($R^2 = 0.10$, $p = 0.006$). Participants who reported submitting research articles for publication or even just participating in research projects previously had relatively higher attitudes toward research. Having research among long-term career goals and believing it is not always costly were reported significantly higher in participants who had submitted at least one manuscript for publication (OR [95% CI]: 1.76 [1.12–2.74] and 1.52 [1.13–2.04], respectively). The perceived barriers did not show a pattern as clear as the attitudes. However, the lack of training and mentors' support were notably more reported in the group who had never participated in research. Additionally, language limitations were significantly lower in participants with submitted manuscripts (OR [95% CI]: 0.69 [0.49–0.94]; ▶ [Table 3](#)).

A binary logistic regression analysis of the demographic characteristics revealed a significant model for research participation ($R^2 = 0.25$, $p < 0.001$) and submission ($R^2 = 0.28$, $p < 0.001$). Internet connectivity and English writing skills had significant associations with submitting manuscripts for publication (OR [95% CI]: 1.96 [1.02–3.77] and 4.55 [1.86–11.14], respectively). The results also illustrated a statistically significant association between research contributions on one side and the source of research training and the support of mentors on the other side. Students relying on self-training in research skills were 2.68 (95% CI: 1.48–4.84) times more likely to conduct research and 3.64 (95% CI: 1.62–8.19) times more likely to submit it in comparison to those who reported insufficient training. They even had higher odds of participation and submission than students who reported being properly trained by a formal university curriculum. On the other hand, students who were encouraged by their mentors were 2.04 (95% CI: 1.02–4.06) times more likely to have conducted research than the rest of the sample, but that did not induce significant impact on the rate of submitting manuscripts. Studying at Tishreen University and specializing in pharmacy, dentistry, or medical education were also positive factors for participation in research projects, with no effect on submitting manuscripts. Finally, research contributions were homogenous between genders, study years, and participants with different levels of English reading skills (▶ [Table 4](#)).

Research Needs for Preparing Master Theses

Most of the participants (93.5%) reported their need to attend trainings to plan, conduct, and publish their studies.

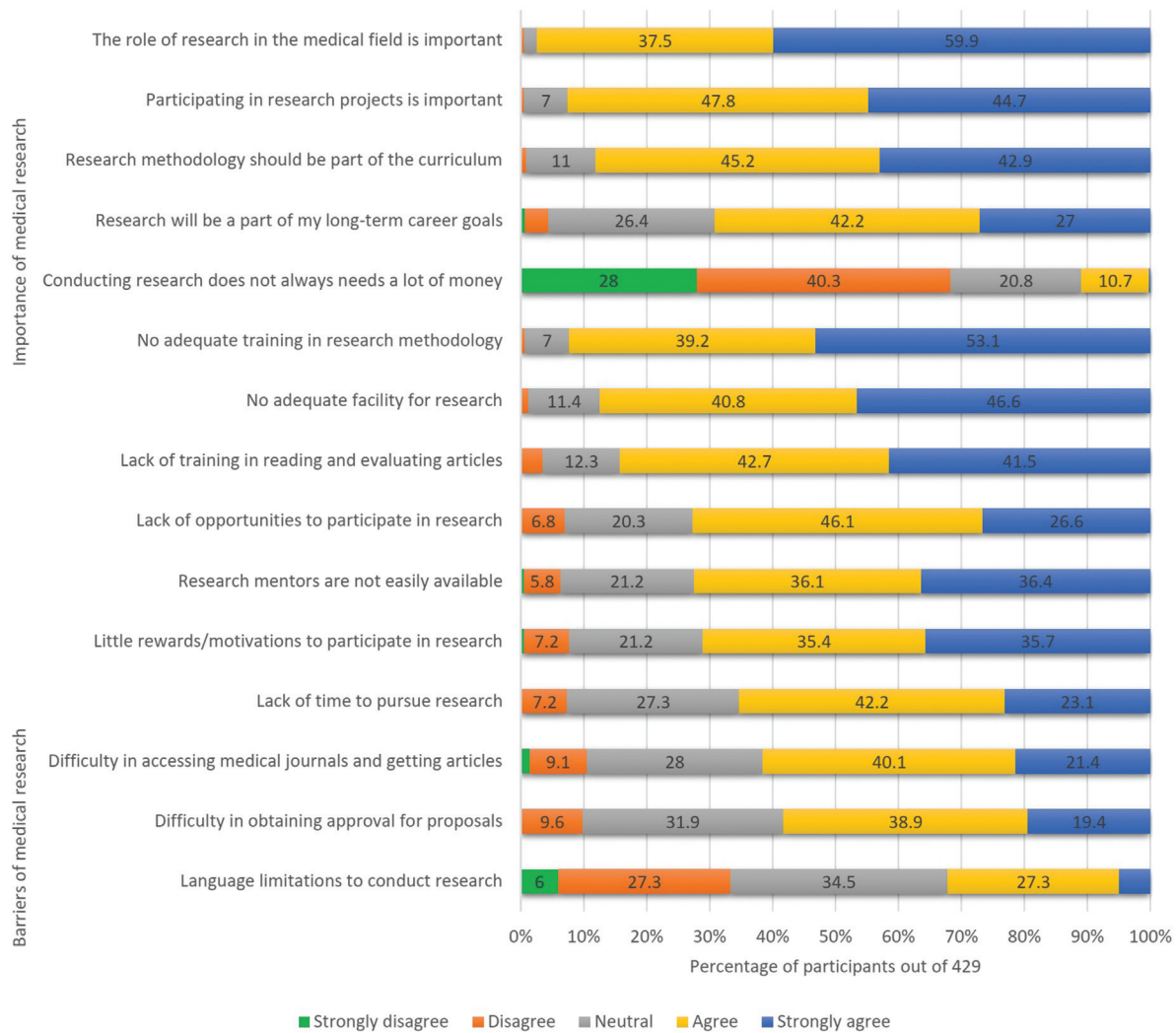


Fig. 1 Participants' personal perspectives of the importance and the barriers of research. Questions were flipped when needed to always make the agreement to the right side of the figure, and then they were ordered in descending order according to the percentage of the answers "agree" and "strongly agree" combined. Percentages lower than 5% were represented but not labelled.

With regard to the components of this training, academic writing was the most commonly reported need (91.2%), followed by peer review processes (86.8%) and preparing research proposal (85.8%; **Fig. 2**).

Discussion

With our findings and the large representative sample, this study could successfully uncover postgraduate students' attitudes toward research and their perceived barriers hindering the publication of the conducted projects. It could also investigate the contributions of these factors and the demographic characteristics toward previous research experiences in order to identify the main gaps and to suggest evidence-based solutions to improve medical research productivity in Syria.

Participants reported positive attitudes toward research similarly to what was reported in Saudi Arabia,¹⁵ one of the leading Arab countries in medical research.^{16,17} These attitudes were also higher compared with those of Damascus University's medical students in 2018 using the same ques-

tionnaire.¹³ However, this contrasted with two studies from Iran and Pakistan that reported lower attitudes toward research for postgraduates in comparison to undergraduates.^{18,19} The reasons for this in the Syrian sample might be that participants were in daily contact with the uncertainties in disease management and the limitations of relevant guidelines, along with the limited resources during the crisis.²⁰ The sensed limited resources might have also caused more postgraduates to believe that all medical research is costly, in comparison to undergraduates.¹³

These attitudes were faced with a wide variety of barriers, the most important of which was the absence of adequate training. This reason had also been singled out as the main barrier for residents in Saudi Arabia.¹⁵ It is worth noting that all the included programs had at least one module for research methodology during the first, second, or third year of higher medical education.¹⁵ However, these modules were deemed ineffective in equipping students with the necessary tools to conduct research independently. The unavailability of research mentors was another important

Table 2 Experience of participants and their motivations and practical limitations regarding conducting and publishing research

Question	N (%)	Question	N (%)
Number of research projects participated in (total n = 429)		Number of scientific papers submitted for publication (total n = 429)	
Never did	304 (70.9)	Never did	374 (87.2)
One	75 (17.5)	One	34 (7.9)
Two	25 (5.8)	Two	10 (2.3)
Three	10 (2.3)	Three	3 (0.7)
More than three	15 (3.5)	More than three	8 (1.9)
Types of research projects participated in (total n = 172 running projects)		Types of scientific papers submitted for publication (total n = 75 submitted papers)	
Laboratory based	19 (11)	Laboratory based	5 (6.7)
Case report/case series	57 (33.1)	Case report/case series	28 (37.4)
Cross-sectional	21 (12.2)	Cross-sectional	9 (12)
Case-control	16 (9.3)	Case-control	3 (4)
Cohort	8 (4.7)	Cohort	4 (5.3)
Randomized control trials	8 (4.7)	Randomized control trials	4 (5.3)
Systematic review	14 (8.1)	Systematic review	4 (5.3)
Other	29 (16.9)	Other	18 (24)
Reasons why it is important to participate in research (total n = 429)		Main motivation to consider publication (total n = 47)	
An important skill to learn	115 (26.8)	Relay information	17 (36.2)
To relay information	100 (23.3)	Career progression	16 (34)
To improve career	68 (15.9)	Personal interest	11 (23.4)
To improve the research situation in my country	63 (14.7)	Reasons for not submitting scientific papers for publication after writing (total n = 66)	
For personal interest	51 (11.9)	Lack of experience in academic writing	20 (30.3)
To keep up with peers	21 (4.9)	Lack of guidance and supervision	18 (27.3)
It is not important	11 (2.5)	Lack of time	18 (27.3)
Reasons for not participating in research (total n = 286)		Research team problems	7 (10.6)
Lack of guidance and supervision	118 (41.3)	Outcome of paper submissions (total n = 40 submitted papers)	
Did not have the opportunity to take part in research	105 (36.7)	None were accepted for publication	12 (30)
Lack of time	38 (13.3)	Only few were accepted for publication	11 (27.5)
Not interested in doing research	20 (7)	Most were accepted for publication	9 (22.5)
		All were accepted for publication	8 (20)

obstacle reported from our participants, which was in line with results even in the most productive countries in medical research in the area such as Saudi Arabia and Iran.^{15,19} However, that did not reflect the true importance of this limitation because lack of time, funding, and reward as well as stress were factors of more importance than mentors' unavailability to the Saudi, Pakistani, and Iranian participants.^{15,19,21} On the contrary, our sample put the need for mentors' support prior to these barriers, possibly because of the exaggerated drain of Syrian mentors during the war.⁶⁻⁹ Another reason might be that 65.2% of Pakistani postgrad-

uates thought they could conduct research without supervision,²¹ which again reflects higher students' knowledge, experience, and confidence.

Although lack of time remained an important limitation to medical research in Syria, especially during the current war,²² it was more significant to resident physicians worldwide.²³⁻²⁵ Nevertheless, together with the previous barriers, this might explain why participants seemed to focus more on quick short studies that require less methodological knowledge, support by mentors, and funding, such as case reports and cross-sectional studies. Yet the number of published case reports

Table 3 The association between the attitudes and barriers and participating in research projects or submitting papers for publication

Factor	Conducting research projects			Submission of papers for publication		
	At least once (n = 125) ^a	None (n = 304) ^a	OR [95% CI] ^b	At least once (n = 55) ^a	None (n = 374) ^a	OR [95% CI] ^b
Importance of research						
The role of research in the medical field is important	5 (4–5)	5 (4–5)	1.13 [0.68–1.85]	5 (4–5)	5 (4–5)	0.97 [0.48–1.98]
Participating in research or publishing scientific papers during higher education	5 (4–5)	4 (4–5)	1.40 [0.89–2.19]	5 (4–5)	4 (4–5)	1.13 [0.61–2.08]
Teaching research methodology should be part of the curriculum	5 (4–5)	4 (4–5)	1.13 [0.80–1.58]	5 (4–5)	4 (4–5)	1.27 [0.76–2.09]
Research will be a part of my long-term career goals	4 (4–5)	4 (3–4)	1.31 [0.96–1.76]	4 (4–5)	4 (3–4.3)	1.76 [1.12–2.74] ^c
Conducting research does not always need a lot of money	2 (1–3)	2 (1–3)	1.05 [0.84–1.31]	2 (2–3)	2 (1–3)	1.52 [1.13–2.04] ^c
Barriers of research						
There is a lack of time during higher education to pursue research	4 (3–4)	4 (3–4)	1.10 [0.85–1.42]	4 (3–5)	4 (3–4)	1.38 [0.96–1.96]
There is no adequate training in research methodology during higher education	4 (4–5)	5 (4–5)	0.77 [0.50–1.19]	4 (4–5)	5 (4–5)	0.82 [0.47–1.42]
There is a lack of training in reading and evaluating scientific literature in higher education	4 (4–5)	4 (4–5)	0.73 [0.51–1.03]	4 (3–5)	4 (4–5)	0.67 [0.42–1.05]
Research mentors are not easily available	4 (3–5)	4 (4–5)	0.85 [0.64–1.11]	4 (3–5)	4 (3–5)	1.29 [0.88–1.87]
There is a lack of opportunities to participate in research during higher education	4 (3–4)	4 (3–5)	1.01 [0.74–1.36]	4 (3–4)	4 (3–5)	0.79 [0.53–1.17]
There is no adequate facility for research	4 (4–5)	4 (4–5)	1.33 [0.92–1.91]	4 (4–5)	4 (4–5)	0.98 [0.61–1.57]
It is not easy to access medical journals and get all wanted papers during higher education	4 (3–4)	4 (3–4)	0.93 [0.71–1.20]	4 (3–4)	4 (3–4)	0.81 [0.57–1.14]
It is not easy to obtain approval for conducting research	4 (3–4)	4 (3–4)	0.98 [0.73–1.31]	4 (3–4)	4 (3–4)	1.11 [0.74–1.65]
Not enough rewards/motivations to participate in research	4 (3–5)	4 (3–5)	1.15 [0.87–1.49]	4 (3–5)	4 (3–5)	1.03 [0.72–1.47]
There are language limitations to conduct research	3 (2–4)	3 (2–4)	0.88 [0.69–1.10]	3 (2–3)	3 (2–4)	0.69 [0.49–0.94] ^c

Abbreviations: CI, confidence interval; OR, odds ratio.

^aThe ranks are presented as median (1st quartile–3rd quartile), where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

^bBased on binary logistic regression analysis using Likert scale findings as ordinal independent covariates, with “strongly disagree” as the lowest value and “strongly agree” as the highest one.

^cSignificant independent predictor.

remained modest,^{26,27} and these studies were less likely to fulfill the unmet research needs of the Syrian health care system.

The variability of participation in medical research in our sample could be better explained by the demographic characteristics than the self-reported attitudes and perceived barriers. This might be due to students' inadequate awareness of the factors that carry the most impact on hindering or

boosting research productivity, as well as the lack of comprehensive advice on how to fill in the gap and help postgraduate students to publish (i.e., the aim of our survey). The extensive and overall analysis achieved in this study could reveal specific institutional and individual recommendations that should be able to mitigate these barriers, allowing for the publication of at least the projects being conducted as a requirement for graduation.

Table 4 Associations between conducting research projects/submitting scientific papers and participants' characteristics (n = 429)

Factor	Conducting research projects		Submission of papers for publication	
	n (%)	OR [95% CI] ^a	n (%)	OR [95% CI] ^a
By gender				
Female (n = 267)	75 (28.1)	Reference	36 (13.5)	Reference
Male (n = 162)	50 (30.9)	1.08 [0.66–1.77]	19 (11.7)	0.89 [0.45–1.78]
By year of study				
Early registration (n = 105)	23 (21.9)	Reference	15 (14.3)	Reference
Normal registration (n = 242)	58 (24)	0.55 [0.26–1.18]	20 (8.3)	0.55 [0.22–1.38]
Late registration (n = 82)	44 (53.7)	2.24 [0.94–5.31]	20 (24.4)	1.87 [0.66–5.32]
By university ^b				
Damascus University (n = 190)	48 (25.3)	Reference	18 (9.5)	Reference
University of Aleppo (n = 89)	24 (27)	1.43 [0.74–2.76]	13 (14.6)	2.06 [0.87–4.83]
Tishreen University (n = 117)	40 (34.2)	2 [1.08–3.68] ^c	18 (15.4)	2.04 [0.89–4.68]
By specialties groups				
Clinics specialties (n = 56)	12 (21.4)	Reference	9 (16.1)	Reference
Surgical specialties (n = 60)	16 (26.7)	1.13 [0.42–3.07]	9 (15)	0.68 [0.21–2.20]
Internal medicine specialties (n = 103)	20 (19.4)	1.50 [0.55–4.11]	13 (12.6)	1.08 [0.33–3.53]
Translational specialties (n = 41)	11 (26.8)	1.88 [0.66–5.33]	7 (17.1)	1.49 [0.44–5.05]
Pharmacy (n = 56)	23 (41.1)	2.86 [1.07–7.70] ^c	6 (10.7)	0.58 [0.16–2.07]
Dentistry (n = 100)	36 (36)	3 [1.21–7.47] ^c	5 (5)	0.34 [0.09–1.21]
Medical education (n = 13)	7 (53.8)	5.09 [1.18–22.09] ^c	6 (46.2)	4.79 [1–22.96]
By Internet connection accessibility				
Low quality (n = 281)	70 (24.9)	Reference	26 (9.3)	Reference
High quality (n = 148)	55 (37.2)	1.45 [0.89–2.38]	29 (19.6)	1.96 [1.02–3.77] ^c
English language skills (writing)				
Poor or intermediate (n = 236)	52 (22)	Reference	17 (7.2)	Reference
Good or excellent (n = 193)	73 (37.8)	2.04 [1.15–3.61] ^c	38 (19.7)	4.55 [1.86–11.14] ^c
English language skills (reading and comprehension)				
Poor or intermediate (n = 151)	32 (21.2)	Reference	16 (10.6)	Reference
Good or excellent (n = 278)	93 (33.5)	1.01 [0.54–1.90]	39 (14)	0.44 [0.17–1.13]
Sources of education/training about research				
No sufficient training (n = 188)	31 (16.5)	Reference	12 (6.4)	Reference
University training (n = 108)	39 (36.1)	2.17 [1.14–4.15] ^c	14 (13)	3.24 [1.24–8.43] ^c
Self-paced training (n = 133)	55 (41.4)	2.68 [1.48–4.84] ^c	29 (21.8)	3.64 [1.62–8.19] ^c
Encouraged by mentors to participate in research				
No (n = 97)	14 (14.4)	Reference	7 (7.2)	Reference
Yes (n = 332)	111 (33.4)	2.04 [1.02–4.06] ^c	48 (14.5)	1.47 [0.58–3.75]

Abbreviations: CI, confidence interval; OR, odds ratio.

^aBinary logistic regression results.

^bThe three smallest universities were excluded from the analysis and the total is n = 396.

^cSignificant independent predictor according to the regression analysis.

To ameliorate the lack of training, Syrian institutions should implement more practical workshops to supplement the current research curricula, which was rated insufficient by our participants. An example of successful affordable

alternatives was the peer-liable four workshops based on the Introduction to the Principles and Practice of Clinical Research (IPPCR) course,^{14,28} presented by the U.S. National Institutes of Health.²⁹ Online workshops can also provide a

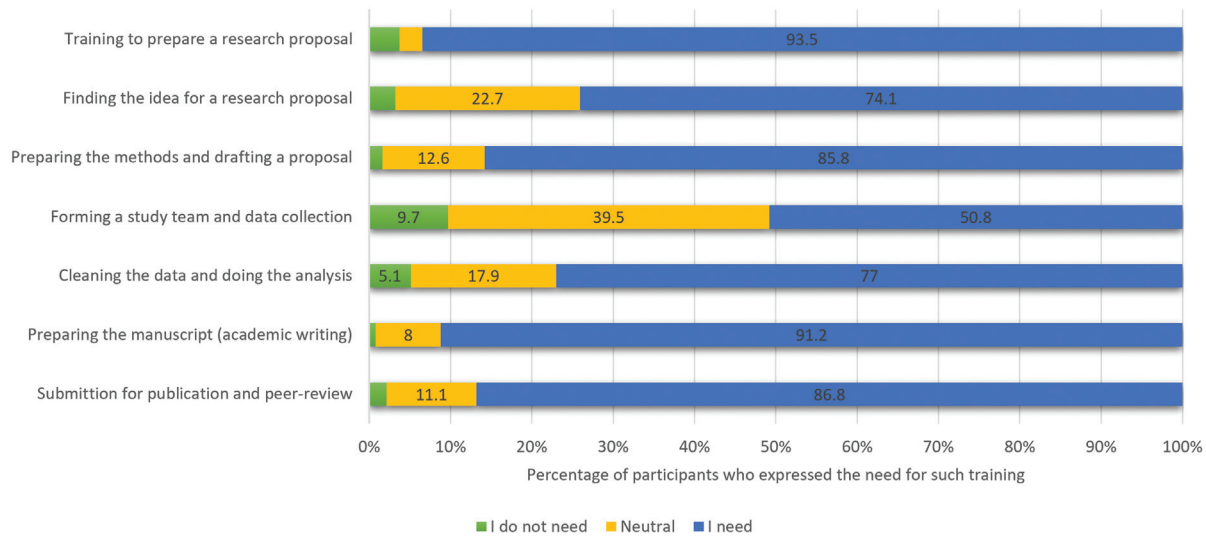


Fig. 2 The training needs for preparing master theses among medical higher studies trainees. Percentages lower than 5% were represented but not labelled.

more affordable, accessible, and flexible option that still leads to comparable outcomes.^{14,30–33} These educational events should be recorded and published afterward for self-paced learning, which was deemed highly effective, and should cover all aspects of research methodology, academic writing, and biomedical statistics, as training was lacking overall.

Other institutional suggestions include providing stable internet connectivity at faculties and hospitals and building a national online platform that archives students’ research proposals, in order to facilitate collaboration between students in different universities and specialties, as well as between them and other researchers nationally and internationally. In addition, organizing an annual conference for published master theses in peer-reviewed journals to be presented to younger students would spark excitement, encourage scholarly activity, and boost the belief in research feasibility even with limited funding.³⁴ These training and partnership attempts lied at the heart of the recently published framework aimed at strengthening health research capacities in the Middle East and North Africa region.³⁵

Although the numbers of mentors in Syria dropped during the conflict,^{7,8,36} they still hold crucial responsibility in the process of improving research conduct among their mentees. Their expertise that accumulated over the years of war could uncover many possible crisis-related research fields that are of high priority to be investigated. This could mitigate the barrier of rare research opportunities. Mentors’ active encouragement is also one of the most established associations with higher research output in this study and others.^{15,19} Therefore, allowing long-distance mentoring by experts worldwide might overcome the lack of supervisors in Syria,³⁷ especially that more than half of the papers published by Syrians were in collaboration with external institution³⁸ and that a large bulk of the Syrian professionals are practicing

abroad.⁶ This can additionally address language barriers and the lack of access to medical journals.

Residents also have their share of the responsibility. The first step may be to collaborate with peers in order to reduce efforts duplication, conduct multicenter studies, and provide scientific support across disciplines, especially with the evident lack of mentors’ support. Another advice is to get involved in research studies prior to the master theses because it was shown that medical students who were involved in research projects had superior research productivity after graduation.^{24,39} Furthermore, cooperation between postgraduate and undergraduate students may reduce the time burden for postgraduates and create additional opportunities for undergraduates to participate in publications.

Limitations and Strengths

Our findings resulted from a self-reported online questionnaire without objective assessment of the research-related knowledge and confidence. However, the individualized communication of the survey should have maximized recruitment (i.e., nearly a quarter of the target population in all of Syria) and improved the quality of reporting. Therefore, the suggested evidence-based solutions may save a lot of the currently wasted efforts by pushing master thesis projects toward publication. On the other hand, due to the limited number of authors in Syria, a case-control study focusing on them would represent a further step toward a more detailed understanding of the facilitating factors of medical research in Syria (e.g., dissecting the sources used for self-training on medical research skills). Lastly, the important factor of lack of research funding was marginalized in our report, including the suggested solutions, as it might be far from the current reality in Syria where crucial equipment and medications are unaffordable and where international and national funding

are extremely difficult due to the sanctions and the collapsing economy, respectively.

Conclusion

Several common barriers of medical research, including the lack of training and mentorship, prevent postgraduate students from conducting and publishing research regardless of their positive attitudes toward it. However, the intrasample contrasts regarding prior research contributions unveiled a possibility of improvement with coordinated low-cost institutional and individual efforts such as peer-run self-paced training opportunities and long-distance mentorship.

Note

The study covered six universities in the five major cities in Syria. The dataset supporting the conclusions of this article is available and can be submitted/uploaded upon request.

Ethical Approval and Consent to Participate

Ethical approval for this study was obtained through Damascus University, and it complies with the Declaration of Helsinki 1975, as revised in 2013. Participants were informed about the aims of the study and were asked to provide their consent to participate at the beginning of the questionnaire. Participation was completely voluntary, with the assurance of confidentiality.

Authors' Contributions

I.H. prepared the online questionnaire. I.H., L.H. K., S. A., M. H., and O.A. collected the data from the different universities. S.A. and L.H.K. drafted the introduction and the methods sections, respectively. M.H., L.H.K., and I. H. analyzed the data and drafted the results section. O. A., M.H., L.H.K., M.A., and I.H. drafted the discussion. F. A. and M.Y.H. supervised data collection and analysis and provided insights for the discussion. All authors critically revised and approved the final version of the manuscript.

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Conflict of Interest

None declared.

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