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

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Research Article

Keywords: Research contributions, publication practices, postgraduate students, Syrian crisis, residents' attitudes, institutional barriers, resident physicians, pharmacy postgraduates, dentistry postgraduates

Posted Date: April 5th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-382753/v1

Abstract

Introduction:

The huge workload on doctors especially residents, who are the main healthcare 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 for the focus on research. Postgraduate students in the medical and paramedical fields must conduct original research projects as part of their graduation requirements. However, that does not reflect on the research publications coming from Syria.

Methods:

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 towards research, perceived barriers, and previous research experiences.

Results:

The sample consisted of 429 residents representing about 21.5% of the target population. Nearly all the participants had positive opinion towards 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. Poor internet connectivity and poor reading and writing English skills were decisive negative factors in previous research experiences. Active mentors' support and self-paced education on research skills had a significant positive impact on students' research contributions with odds ratios of 2.24 [1.34-3.74] (P=0.003) and 2.28 [1.47-3.52] (P<0.001) respectively.

Conclusion:

The attitudes of postgraduate students towards research were quite positive but hindered by several obstacles. Further integration of research practical training in the curriculums, allowing long-distance mentoring, enhancing collaboration between peers, as well as narrowing the distance between students and mentors may significantly boost research productivity in Syria despite the conflicts.

Introduction

Research is undeniably a critical tool to address complex health systems problems and challenges and to provide guidance on what works better under different circumstances (1). Its importance is more prominent in developing countries that suffer from poverty, wars, endemic diseases, and low levels of investment in the healthcare system. Healthcare providers in such countries need to find innovative solutions to overcome the challenges by performing research projects that are feasible in their

circumstances. The ten-year-long Syrian crisis has deeply affected all aspects of Syrians' lives, especially healthcare and education. Over half of their healthcare facilities became out of service after only five years of war, because of the repeated attacks and bombing (2), which became even worse over time. The decline in healthcare infrastructure, along with the increased number of war-related victims, directly and indirectly led to an increased burden on the other remaining hospitals and their staff who had to significantly increase their efforts and the time spent working. The global surge in physician and medical staff burnout (e.g. in the US (3)) not only also affects Syrian medical personnel, but it affects them at a staggeringly more severe level. This erodes their skills and productivity during work and leaves them depleted and with less work-life satisfaction (4). In Syria, this problem is more evident among residents during the crisis and the percentage of this debilitating syndrome was estimated to be among the highest worldwide (5). This is aggravated by the increase in workplace violence in Syrian hospitals, which triggered physiological stress and loss of confidence among resident doctors (6). These serious socio-economic situations, in addition to the vanishing income and lack of personal safety, 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).

Nevertheless, medical, dental, and pharmacy residents are considered the main possible contributors to research conduct in Syria for many reasons. Firstly, a research project is a requirement for their graduation. Secondly, they are in direct contact with patients as doctors and dentists or they spend most of their time in university labs as pharmacists. Thirdly, they have more time and motivation to investigate than the elder practicing specialists. Finally, they see a wide variety of cases because of working in central and 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). Before 2010, Diab et al. reported that general research productivity was growing steadily for three decades, however, their analysis showed a very limited number of clinical and biomedical publications (10).

In a recent report, the most important barriers were the limited financial support, the lack of research-related skills, the lack of research equipment and the absence of stable internet and electricity (12). Another report shed light on the attitudes, barriers, and practices of medical research among medical students in Damascus University and had found comparable results (13). However, there is a lack of comprehensive evidence regarding research productivity of postgraduate medical and paramedical students in all of Syria (14). The aim of this study is to investigate attitudes towards research, perceived barriers, current needs, and previous research experiences of postgraduates in all medical and paramedical fields in Syria, and to compare them against different demographic determinants to lay the groundwork for suggesting fact-based solutions.

Materials And Methods

Participants:

The Ministry of Higher Education in Syria runs eight universities, including seven schools of medicine. However, only three of them have higher education programs, which are based in Damascus (Damascus University), Aleppo (Aleppo University), and Latakia (Tishreen University). Syria also has three schools for pharmacy and three for dentistry with higher education programs in the aforementioned cities, 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 are considered postgraduate master programs in the Syrian higher education system and they require the students to conduct and defend an original research study (thesis) in order to graduate. However, generally it is not obligatory to publish their work in any journal. The target participants are specifically students of these programs who are at the phase of planning for their research studies. This was the best time point at which to investigate the attitudes towards 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 considered the third year for the schools of medicine, the second for dentistry and the first for pharmacy. A small proportion of students prepared their research proposals in the year preceding or following the defined year above, and those were also included in the sample.

Study design and data collection:

This cross-sectional study targeted postgraduate students at all Syrian medical, dental, and pharmacy schools with higher education programs, and 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 eight-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 to them, and at the end 100% of them completed the questionnaire. The process of data collection took place over two 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. Participation was completely voluntary, with the assurance of confidentiality. Ethical approval for this study was obtained through Damascus University, and it complies with the declaration of Helsinki 1975, as revised in 2008.

The questionnaire:

This study used a questionnaire developed by a prior 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 higher education postgraduate students. The questionnaire was in Arabic, which is the mother language for all participants. The final version of the questionnaire was first piloted on ten participants from different specialties of the target group to confirm that all responders can follow the instructions and answer the questions without concern regarding the language, understanding, consistency, and structure.

The first section in the questionnaire included questions about the participants` demographic data and self-reported English proficiency. The second section used a 5-point Likert scale to assess participants' beliefs and attitudes towards medical research, as well as the current barriers for conducting medical research. The third section included multiple-choice questions to capture self-reported participants' sources of knowledge, levels of supervisors' encouragement, and possible previous research experience. The fourth and last section was added by us and it focused only on their needs to plan, conduct and publish their master theses in peer reviewed journals. We also added a question to indicate their interest in attending an online workshop that focused on these needs.

Statistical analysis

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, United States).

The year of study was coded according to the usual year of registering the research proposal in each specialty into three categories: "Early registration", "Normal registration", and "Late registration". The different medical specialties were grouped into four categories: a) Internal medicine and psychiatry; b) Surgical specialties, pediatrics, obstetrics, and gynecology; c) Otolaryngology, dermatology, and ophthalmology (Clinics Specialties); d) Other medical specialties including radiology, pathology, and laboratory medicine (Translational Specialties). The results of descriptive statistics were presented as frequencies and percentages. Chi-square and Fisher's exact tests were used for categorical data. An alpha value of 0.05 was used to determine the threshold of statistical significance, with the usage of Bonferroni correction when needed to adjust for multiple testing. For a measure of association, we used odds ratios (ORs) with corresponding 95% confidence intervals (CIs).

Results

Demographic characteristics:

The sample consisted of 429 postgraduates who showed interest in the suggested extracurricular support. This sample represented 21.5% out of the whole targeted population of nearly two thousand students actively working or studying under the medical, dental, and pharmacy higher education programs in Syria. This response rate was the highest at Hama University (35.7%), followed by the three largest universities of Damascus, Aleppo and Tishreen (26.5%, 23% and 20.9% respectively). Regarding the different specialties, the response rate was highest for the translational specialties (46.1%), while internal medicine and out-patient clinic specialties had equally the second highest response rate (34%). Surgical specialties came lowest with a response rate of only 11% (Table 1).

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)	23.0%
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(3.0)	7.6%
Specialties groups		
Clinics specialties	56 (13.1)	34.1%
Surgical specialties	60 (13.9)	11.0%
Internal medicine specialties	103 (24.0)	34.5%
Translational specialties	41 (9.6)	46.1%
Pharmacy	56 (13.1)	22.1%
Dentistry	100 (23.3)	23.8%

Factors	n (%)	Response rate (total = 21.5%)
Medical education	13 (3.0)	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)	-
Theoretical encouragement	257 (59.9)	-
Yes	75 (17.5)	-
n: Number of participants who chose the corresponding answer, %: Percentage of participants who chose the corresponding answer		

The participants were 267 (62.2%) females and 162 (37.8%) males, and more than 56% of them were preparing their proposals in the usual year of registration. Damascus, Latakia and Aleppo had the largest universities and they contributed to more than 90% of the sample. Internal medicine and dentistry specializing students comprised the largest percentages of the participants, while the lowest percentage came from students of medical education (13 students; 3%) (Table 1).

Two-hundred-seventy-eight students (64.8%) of our sample reported their reading and comprehending abilities in English to be good to excellent, while only 193 (45%) of them thought they had good writing skills in English. Nearly half of the respondents did not consider the training they had already received regarding medical research sufficient to rely on, and only 75 (17.5%) of them had received active practical encouragement by their mentors to conduct research (Table 1).

Attitudes towards research and its perceived barriers:

The vast majority of the participants showed strong inclination to believe that research played an important role in the medical fields, that participating in it was important for them as students, and that research methodology should be a part of their curricula. Similarly, a remarkable proportion of them (nearly 70%) agreed or strongly agreed that they saw research as part of their career plans. However, only 47 participants (10.9%) agreed with the statement that “medical research does not require a lot of money” (Fig. 1).

Considering the barriers for research, over 80% agreed that the inadequate training in the 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, difficulties in accessing medical journals and in obtaining ethical and scientific approvals for research projects were also important factors to 60–65% of the participants (Fig. 1).

Conducting research and publishing scientific papers:

Seventy-one percent of the included participants had not worked on any research project before the time of their master theses, and 17.5% of the rest had only worked on one project. However, less than 13% reached the phase of submitting an article for publication, and less than 5% submitted more than one paper. A third of the reported projects were single case reports or case series, while the other types of articles had various lower percentages. “An important skill to learn” and “to relay scientific information” were the most common reasons for conducting research, while only 2.5% did not find research contribution important at all. In contrast, the most common reasons for not conducting any research were the lack of guidance and supervision (41.3%) as well as the lack of opportunities (36.7%; Table 2).

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)

Question	N (%)	Question	N (%)
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)

Only seventy-five out of the 172 studies that the responders contributed to were submitted for publication (43.6%). However, the rate for basic laboratory-based projects was about 25%. The outcomes of paper submissions ranged from “None were accepted” 30%, “Few were accepted” 27.5%, “Most were accepted” 22.5% and “All were accepted” 20%. Submissions to peer reviewed journals were driven mostly by the necessity for relaying information (36.2%), career progression (34%) and personal interest (23.4%). On the other hand, the most important reasons for not submitting scientific papers for publication were insufficient academic writing experience (30.3%), insufficient time (27.3%) and the lack of guidance and supervision (27.3%; Table 2).

Factors affecting contributing to and publishing scientific papers:

Contributing to and submitting papers for publication varied significantly among the specialties and the year of registration but were homogenous within genders and universities. Those who were preparing their proposals later than usual, as compared to those doing it on time or earlier, had a higher probability

of conducting and submitting research papers for publication with odds ratios of 3.8 (95% confidence interval (CI) [2.3–6.3]; $P < 0.001$) and 2.9 ([1.6–5.3]; $P < 0.001$) respectively (Table 3).

Table 3
Associations between conducting research projects/submitting scientific papers and participants' characteristics

Factors	Conducting research projects			Scientific papers submitted for publication		
	n (%)	P Value	OR (95% CI)	n (%)	P Value	OR (95% CI)
By gender		0.584*	-		0.657*	-
Female (n = 267)	75 (28.1)		0.875 [0.571–1.341]	36 (13.5)		1.173 [0.648–2.124]
Male (n = 162)	50 (30.9)		1.143 [0.746–1.752]	19 (11.7)		0.853 [0.471–1.544]
By Year of study		< 0.001†‡	-		0.001†‡	-
Early registration (n = 105)	23 (21.9)	0.065*	0.610 [0.363–1.025]	15(14.3)	0.616*	1.183 [0.625–2.242]
Normal registration (n = 242)	58 (24)	0.010*	0.565 [0.371–0.859]	20(8.3)	0.002*§	0.391 [0.218–0.704]
Late registration (n = 82)	44 (53.7)	< 0.001*§	3.802 [2.306–6.271]	20(24.4)	0.001*§	2.876 [1.557–5.310]
By University		0.230†	-		0.239†	-
Damascus University (n = 190)	48 (25.3)	0.220*	0.750 [0.483–1.165]	18 (9.5)	0.096*	0.591 [0.319–1.096]
University of Aleppo (n = 89)	24 (27.0)	0.791*	0.919 [0.541–1.560]	13 (14.6)	0.468*	1.288 [0.650–2.550]
Tishreen University (n = 117)	40 (34.2)	0.112*	1.494 [0.937–2.382]	18 (15.4)	0.245*	1.455 [0.778–2.720]
By Specialties groups		0.011†‡	-		0.003†‡	-
Clinics specialties (n = 56)	12 (21.4)	0.208*	0.628 [0.319–1.233]	9 (16.1)	0.399*	1.361 [0.626, 2.961]
Surgical specialties (n = 60)	16 (26.7)	0.760*	0.867 [0.469–1.603]	9 (15.0)	0.538*	1.239 [0.572, 2.684]

Factors	Conducting research projects			Scientific papers submitted for publication		
Internal medicine specialties (n = 103)	20 (19.4)	0.013*	0.507 [0.295–0.871]	13 (12.6)	1.000*	0.977 [0.502, 1.901]
Translational specialties (n = 41)	11 (26.8)	0.857*	0.881 [0.427–1.819]	7 (17.1)	0.458*	1.458 [0.612, 3.473]
Pharmacy (n = 56)	23 (41.1)	0.041*	1.852 [1.038–3.304]	6 (10.7)	0.830*	0.793 [0.323, 1.949]
Dentistry (n = 100)	36 (36)	0.102*	1.517 [0.943–2.440]	5 (5)	0.006*	0.294 [0.114,0.758]
Medical education (n = 13)	7 (53.8)	0.062*	2.946 [0.970–8.950]	6 (46.2)	0.003*	6.420 [2.073,19.882]
By Internet connection Accessibility		0.010*‡	-		0.004*‡	-
Low quality (n = 281)	70 (24.9)		0.561 [0.365–0.862]	26 (9.3)		0.418 [0.236–0.742]
High quality (n = 148)	55 (37.2)		1.783 [1.161–2.738]	29 (19.6)		2.390 [1.349–4.236]
English language skills – writing		< 0.001*‡	-		< 0.001*‡	-
Poor or intermediate (n = 236)	52 (22.0)		0.465 [0.304–0.710]	17 (7.2)		0.317 [0.172–0.581]
Good or Excellent (n = 193)	73 (37.8)		2.153 [1.409–3.288]	38 (19.7)		3.158 [1.720–5.800]
English language skills - reading and comprehension		0.008*‡	-		0.365*	-
Poor or intermediate (n = 151)	32 (21.2)		0.535 [0.337–0.850]	16 (10.6)		0.726 [0.391–1.349]
Good or Excellent (n = 278)	93 (33.5)		1.869 [1.177–2.970]	39 (14)		1.377 [0.741–2.557]

Factors	Conducting research projects			Scientific papers submitted for publication		
Sources of education/training about research		< 0.001†‡	-		< 0.001†‡	-
No training (n = 188)	31 (16.5)	< 0.001*§	0.309 [0.194–0.491]	12 (6.4)	< 0.001*§	0.314 [0.160–0.614]
University training (n = 108)	39 (36.1)	0.068*	1.544 [0.971–2.456]	14 (13)	1.000*	1.017 [0.531–1.949]
Self -paced training (n = 133)	55 (41.4)	< 0.001*§	2.277 [1.471–3.524]	29 (21.8)	< 0.001*§	2.896 [1.628–5.149]
Encouraged by mentors to participate in research?		< 0.001†‡	-		0.080†	-
No (n = 97)	14 (14.4)	< 0.001*§	0.336 [0.182–0.618]	7 (7.2)	0.083*	0.460 [0.201–1.053]
Theoretical encouragement (n = 257)	78 (30.4)	0.517*	1.159 [0.755–1.778]	34 (13.2)	0.883*	1.096 [0.613–1.962]
Yes (n = 75)	33 (44.0)	0.003*	2.238 [1.338–3.741]	14 (18.7)	0.126*	1.752 [0.900–3.410]

** Fisher's exact test; † Chi-square test; ‡ Significant at the level of 0.05 for the major categorization; § Significant at the level of 0.0026 for the individual subcategories' comparisons (Bonferroni correction for multiple tests 0.05/19); ⊠ The three smaller universities were excluded from the analysis and the total n = 396; OR: Odds ratio, CI: Confidence interval*

Internet connectivity as well as reading and writing English skills had statistically significant associations with having contributed to medical research ($P = 0.01$, 0.008 and < 0.001 respectively). However, only writing skills and internet connectivity showed statistically significant relations with submission of research articles ($P < 0.001$ and 0.004 respectively). The results also illustrated a statistically significant association between research contribution on one side and the source of research training and the support of mentors on the other side ($P < 0.001$ for both). The same trend held true for the association between the source of training and submission attempts to peer reviewed journals ($P < 0.001$). The odds ratio of contributing to and submitting medical research papers among those who had reported no significant training were both around 0.3 ([0.19–0.49]; $P < 0.001$). In contrast, students relying on self-training in research skills were 2.3 [1.5–3.5] times more likely to conduct research and 2.9 [1.6–5.1] times more likely to submit it in comparison to the rest of the sample ($P < 0.001$). The latter were even higher than the odds ratio of participation and submission in students who had reported being trained properly by a formal curriculum. Lastly, mentors' support also showed a statistically significant association with

contributing to research. Students who did not receive active encouragement from their mentors were 0.3 times less likely to have conducted research than the rest of the sample ([0.18–0.62]; $P < 0.001$; Table 3).

Research needs for preparing master theses:

The vast majority of the participants (93.5%) reported that they were in need and willing to attend a training to plan, conduct, and publish their studies. With regards to the components of this proposed training, academic writing and preparing the manuscript were the most commonly reported needs (91.2%), followed by the guidance on the submission and peer review processes, as well as preparing the initial research proposal (86.8% and 85.8% respectively). Around three-quarters of the participants also reported a need for training in the aspects of cleaning and analyzing data and finding an idea for their projects, whereas only half of them referred to a need of help in building their studies' teams and in data collection (Fig. 2).

Discussion

Contribution of Arab countries to the global wealth of biomedical research production has been subpar (15), even when compared to other middle eastern countries such as Iran and Turkey (16). Furthermore, medical research production in Syria has been amongst the lowest of the Arab world, including when comparing to its neighbor Lebanon (10, 15, 16). Starting in 2011, Syria has also had a decade-long war that severely crippled its healthcare system. This created an unfortunate, yet an important opportunity and need, for research in healthcare (17). Many facets now require further study and analysis, including the effects of lack of medicines and healthcare services accessibility, the spread of endemic diseases, and the war-related injuries. One might reasonably argue for a global duty to share expertise about these aspects (18), especially that Syria has seen the most severe humanitarian crisis since world war two (19). Under such conditions, although it is crucial to equip post-graduate students with updated clinical knowledge and skills, it is equally important to empower them with scientific research skills to enhance research production in a way that improves the healthcare services (14, 20, 21). It is also indispensable to assess the attitude of resident doctors towards research in order to suggest solutions that meet their true needs.

Participants in this survey study reported high positive attitudes towards medical research similarly to what was reported in Saudi Arabia (22), one of the leading Arab countries in medical research conduct (15, 16). These attitudes were also higher in comparison to the attitudes of medical students at Damascus University, which were captured in 2018 using the same tool of measurement (13). However, this contrasted with two studies from Iran and Pakistan that reported postgraduates to have had lower attitudes towards research than undergraduates (23, 24). The reasons for that in the Syrian sample might have been that postgraduates were in daily contact with the uncertainties in disease management, the limitations of relevant guidelines, along with the limited resources as in Syria especially during the crisis (25). The results reflected the participants' willingness to contribute to research even while suffering from the devastating consequences of this war, and the main motivations for that were to relay evidence-based knowledge and to develop a flourishing academic career.

These attitudes were faced with a wide variety of barriers, the most important of which was the absence of adequate training of research methodology in higher education. Similarly, the latter reason had also been singled out as the main barrier in a sample of nearly 200 medical residents in Saudi Arabia (22). 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. However, these modules were deemed ineffective in equipping students with the necessary tools. The unavailability of research mentors was another important obstacle reported by our studied group of students. This finding was in line with several other studies even in the most productive countries in medical research in the area such as Saudi Arabia and Iran (22, 24). However, that did not clearly 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 (22, 24, 26). On the contrary, this study showed that Syrian postgraduates were in need of mentors' support more than being affected by these aforementioned detrimental factors. For example, Khan et al. reported that 65.2% of Pakistani postgraduate medical trainees thought they could plan and conduct research without supervision, and only 11% of participants considered the unavailability of mentors as a hindrance (26). However, that was different to the case in Syria, because the knowledge, experience, and confidence of this Pakistani sample regarding research seemed to have been much higher than the ones reported by our participants.

As reported by the current sample, lack of time remained an important limitation to medical research in Syria, especially during the current war (27), and this limitation was specifically more significant to resident physicians worldwide (28–30). The participants seemed to focus more on the studies that required less methodological knowledge, less support by mentors, and the ones that could be conducted without funding, such as case reports, followed by cross-sectional studies. However, the number of published case reports remained modest (31, 32), and these studies were less likely to fulfill the unmet research needs of the Syrian healthcare system.

Research contribution by postgraduates of the different Syrian universities was similar in the current study, which was a remarkable improvement from the article published in 2011 which had reported that more than half of the Syrian publications had originated from Damascus University (10). This finding was supported as well by a recent review of the published articles from the different Syrian cities (17). This might have been due to a higher rate of mentors leaving the country from the capital, or due to a safer environment in Tishreen University in Latakia. Furthermore, higher-education students at Tishreen University reported higher rates of contributing to and publishing medical research in comparison to the other two largest universities, Damascus and Aleppo, although this difference was not statistically significant.

In the light of the findings of this study, institutional and individual efforts should aim to mitigate these barriers and boost the positive attitudes towards research and publication productivity among post-graduate students. Syrian institutions should implement more in-house workshops based on trusted educational sources. They should also follow an approach that fits the local limited resources. For instance, a remote-site for the Introduction to the Principles and Practice of Clinical Research (IPPCR)

course, presented by the U.S. National Institutes of Health (NIH) (33), was established in Syria since 2015 and more than four annual workshops based on this course have been delivered so far (14, 34). Online workshops, on the other hand, can provide a more affordable, widely accessible, and flexible option that still leads to comparable results (14, 20, 35–37). These educational events should cover all aspects of research methodology, academic writing, and biomedical statistics. These workshops should be recorded and published afterwards for self-paced learning, which proved to be the most effective methods in the current study.

Other methods that can reduce the wasted time during research conduct might also be beneficial, such as electronic medical records which facilitate health data acquisition and processing especially in retrospective studies (14). Relaxing the restrictions and requirements for master theses might also facilitate publication, such as allowing students to conduct bibliographical studies such as systematic reviews and meta-epidemiological studies which can be done even in hospitals with low flow of patients and still produce high-quality evidence.

Another institutional suggestion is to build an online platform that archives all Master and PhD research projects, making them available for all national and international researchers. This platform can allow national collaboration between post-graduate students in different universities and different specialties, as well as between them and other healthcare researchers nationally and internationally. In addition to that, organizing a national annual conference for published master theses in peer-reviewed journals to be presented to younger students, which would spark excitement and encourage scholarly activity (38). For better applicability, this can be supplemented by publishing an Arabic concise guide targeting mentors and post-graduate students summarizing the basics of research methodology, academic writing, and medical statistics. These training and partnership attempts in addition to leadership skills lied at the heart of the recently published framework, which aimed at strengthening health research capacities in the Middle East and North Africa region (21).

The numbers of mentors in Syria dropped significantly during the years of the conflict (7, 8, 39). However, they still hold a crucial responsibility in the process of improving research conduct among their mentees. Their expertise that accumulated over the years of war might have uncovered to them many crisis-related possible research topics that are of high priority and need to be investigated and reported. Mentors' active encouragement is also one of the most established associations with higher research output in this study and in others (22, 24). However, this encouragement needs to be as practical as possible, at least by frequent meetings with students and critical revisions of each phase of the projects. Another suggestion to overcome this lack of supervisors in Syria is to allow long-distance mentoring by experts in other countries (40).

Residents also have their share of the responsibility, the first step of which may be to collaborate with colleagues to provide scientific support, conduct nation-wide studies, and reduce efforts duplication. These collaborations can take place between colleagues from the same specialty in two different institutions or across disciplines to provide a more translational and multifaceted analysis of the health

problems. Another advice is trying to get involved in other research studies before the time to do their master theses, because it was shown that medical students who were involved in research projects had superior research productivity after graduation (29, 41). Furthermore, cooperating between post-graduate students and medical undergraduate students who are interested in the same specialty may reduce the time burden for postgraduates and create additional opportunities for undergraduates to participate in the master thesis publication. The suggested platform for studies registration above can play a pivotal role in creating these collaborations.

The data in this survey study were collected using a self-reported online questionnaire. However, the individualized communication of the survey in small groups by the chief residents with all their respective resident groups had maximized the recruitment. Recruitment for participants in the surgery and medical education specialties was low in comparison to all other specialties who had a recruitment rate of 22% or more. This might have been caused by tighter lifestyles or lower research interest among trainees in these two disciplines. That might also explain the apparent higher attitudes and participation of those specific responders because they represented only the highly interested students without reflecting the true image of all students of surgery and medical education. However, the current study captured the opinions of nearly a quarter of the whole targeted population in all of Syria, fulfilling the goal to assess post-graduate students' attitudes, barriers and practices in research, and to suggest fact-based solutions that could save a lot of the currently wasted efforts by pushing master theses projects towards publication.

Conclusion

Even with the positive attitudes among students, making research projects a requirement for medical higher education programs was not enough on its own to enhance research conduct, knowledge and practices. However, improvement may be possible with coordinated low-cost institutional and individual efforts. Universities should provide further and more flexible training opportunities, activate long-distance mentorship, and encourage collaboration among students from different specialties, universities, and study phases. Mentors should create opportunities and provide actual support for their mentees. Finally, postgraduates should take part in several research projects, seek help when needed, and follow self-paced learning whenever possible.

Declarations

Ethics 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 2008. 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.

Consent for publication

All participants gave their consent to anonymously publish their entered data.

Availability of data and materials

The dataset supporting the conclusions of this article is available and can be submitted/uploaded upon request.

Competing interests

None of the authors has conflicts to be declared.

Funding

This study was not funded by any party.

Authors' contributions

IH prepared the online questionnaire. IH, LHK, SA, MH, and OA collected the data from the different universities. SA and LHK drafted the introduction and the methods sections respectively. MH, LHK and IH analyzed the data and drafted the results section. OA, MH, LHK and IH drafted the discussion. FA and MYH supervised data collection and analysis and provided insights for the discussion. All authors critically revised and approved the final version of the manuscript.

Acknowledgments

Authors would like to acknowledge the team who developed the questionnaire in a previous study (13). They are also thankful to Bahaa Alhaffar, Marah Alsalkini and Thuraya Alaryan for contributing some ideas to the introduction and discussion.

Geolocation information

The study covered six universities in the five major cities in Syria.

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Figures

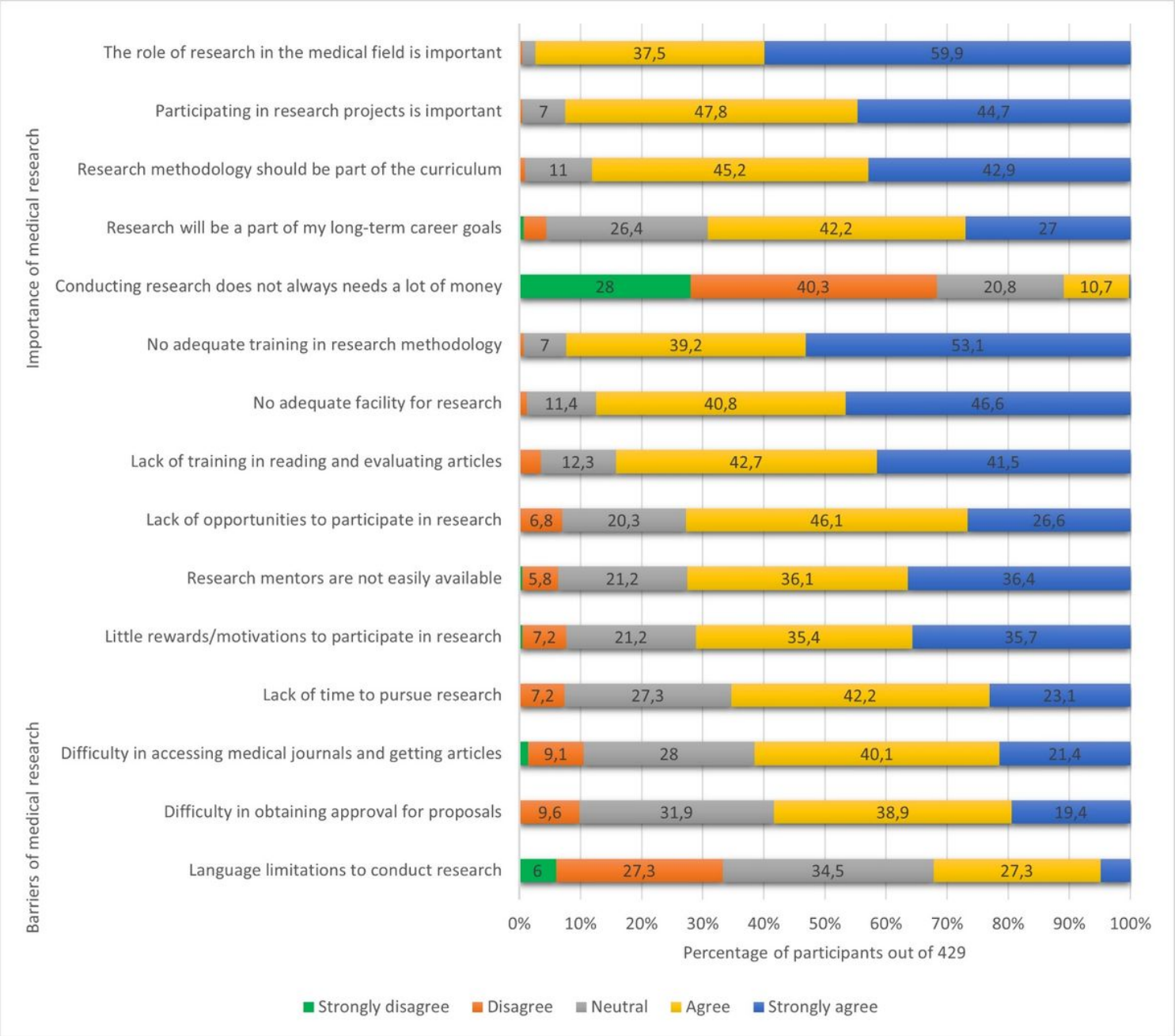

Figure 1

Participant's personal perspectives of the importance and the barriers of research. legend: Questions were flipped when needed to always make the agreement to the right side of the figure, 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.

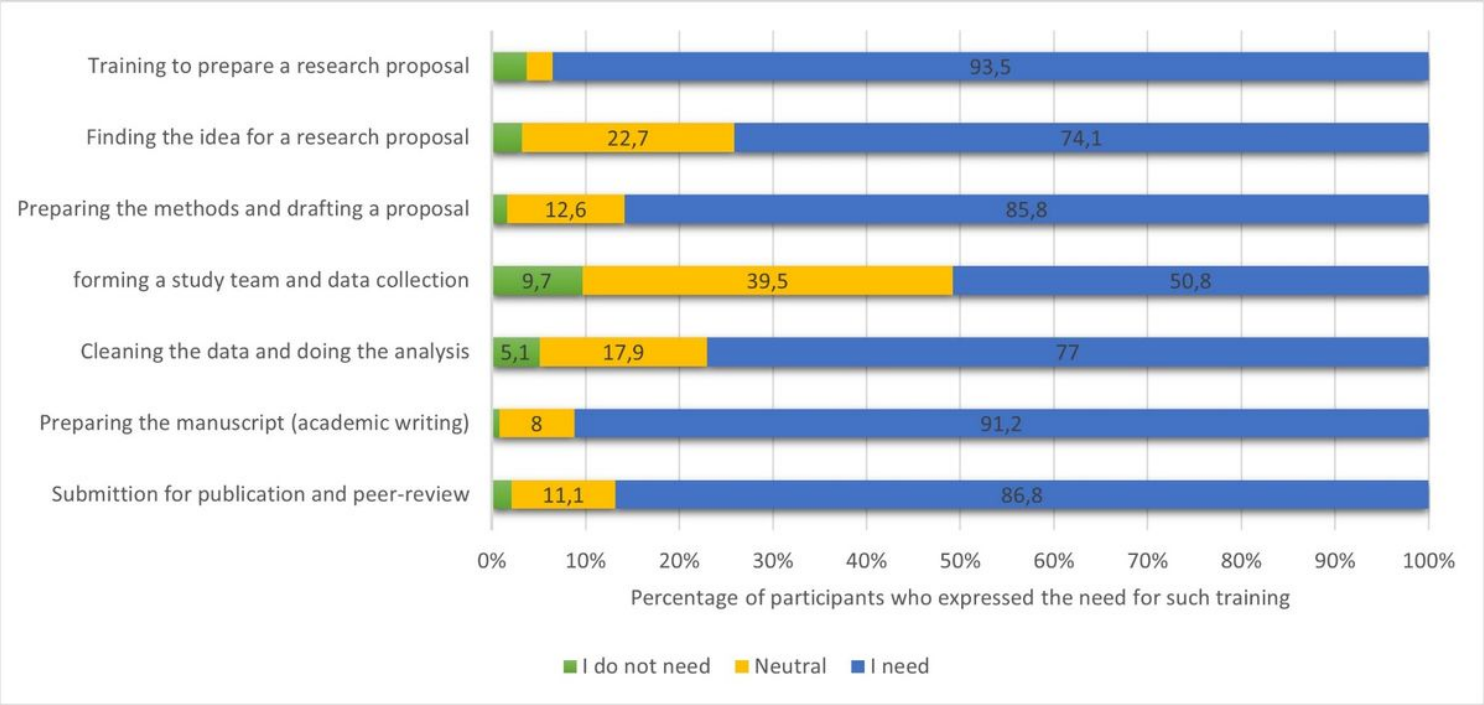

Figure 2

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