Research Article

Who is responsible? An insight into the factors influencing the publication of undergraduate medical students' research projects

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ABSTRACT

Background: Research influences the quality of health care as well as the committed evidence-based medicine by clinicians. Worldwide, undergraduate medical students conduct research and its recognized that their research helps them understand medicine and improve clinical skills furthermore, they are able to apply what they have learned. **Objective:** To quantify the number of research publications of undergraduate research course projects and the factors affecting its publication. **Materials and Methods:** This quantitative, observational, questionnaire-based, and cross-sectional study was conducted at the College of Medicine, King Saud University (KSU), during the academic year 2014-2015. The participants were 164 research group leaders of the course, including internship, 4th and 5th academic year students. A self-administered questionnaire was used to collect data. We analyzed the data using the SPSS version 21.0 (IBM Corporation, Armonk, NY, USA) statistical software. Karl Pearson's Chi-square test and odds ratios (OR) were used in bivariate analysis and binary logistic regression in multivariate analysis. **Results:** Out of 164 research groups, 161 (98.2%) had responded to the study. Among them, 36 (22.4%) had published their research projects. The publications of internship students (n = 49; 30.2%) and 5th year students (n = 53; 32.9%) were higher than 4th year students (P = 0.014). Furthermore, research groups with 5-7 members (n = 91; 56.5%) had published their projects more than the group with 2-4 members (P = 0.013). The higher publication was also associated with the supervisors' high academic rank and attended extra research methodology courses skilled training. The improvement of curriculum vitae, supervisor support and skilled training were the motivating factors to publish their projects. Less number of students' publications were due to lack of time, insufficient support from supervisors and supervisors' academic ranks. **Conclusion:** The results of this study also suggest for the manuscript writing skill training could be included in such academic course. Many students are lacking the sufficient research training; therefore, appropriate training could be included. Further, emphasis should be given by training department and academic supervisors to overcome the perceived barriers.

KEY WORDS: Undergraduate Research; Medical Students; Student Support; Medical Curriculum; Saudi Arabia

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INTRODUCTION

Research has a major impact on the quality of health care and the practicing evidence-based medicine by clinicians.[1] Research is a systematic process of collecting and analyzing information to increase understanding of a phenomenon, topic or issue. The new generation of researchers mostly

attempts to uncover the hidden knowledge using various research strategies.[2] Usually, researchers have moved from purely descriptive to more analytic and experimental studies, directing toward a better understanding of the process and theory-based interventions.[3]

Research is not limited for postgraduate training candidates or working physician. Around the globe, undergraduate medical students are obligated to carry out research during their course.[4] Studies have identified that undergraduate medical research helps the students to understand medicine and improve clinical skills,[5] apply what they study in a practical way,[6] improve confidence and problem-solving skills,[7] and communication skills.[8,9]

A research activity requires to adopt the steps and procedure in a rational routine. There is to be a perfect link between the steps, initiated with the purpose of the study, resulting through literature review, theoretical framework, research question, methodology section, data analysis, and the findings.[10] Reputable scientific journals may publish any research findings after extensive peer review. Peer reviewers' comments usually benefit to gather more information related to the research question.[11] Any peer-reviewed study gets published in a scientific journal will be easily available to the scientific community, stakeholders or organizations. Usually, most of these findings bring major changes at an institutional level.[12]

Literature review showed that the publication rate of undergraduate research projects ranges from 15% to 50%, depending on many factors.[13-15] They found main factor which encourages undergraduate medical student to carry out a study or to submit their research projects for publication is to improve their curriculum vitae.[16,17] Other factors which lead students to publish their projects are a research supervisor encouragement and availability,[1,15,18] high academic rank of supervisors,[19] colleges regulation and institutional encouragement,[20] the use of statistical tests for the significance of a study finding,[21] research field and specialty,[22] student attendance to research methodology courses[16] and students who had a physician in their family are more likely to publish.[23] Nevertheless, many barriers have been identified. Studies have shown that the main barriers for not publishing were lack of time,[18,23,24] lack of important research skills,[25] lack of institutional motivation, insufficient training,[26] lack of supervisor guidance,[27,28] and studies results not required to practice medicine.[14] Furthermore, students' perception that the participation in a research project will not allow them to maintain their educational level and affect their academic achievement in terms of their grade point averages.[29] Even though there was lots of reporting about student's research in literature, but none of the studies had briefed about the research methodology courses. To learn research methodology principles, students at College of Medicine, King Saud University (KSU), Riyadh, KSA, has to undergo the following mandatory course.

Research Methodology Course

Research methodology course (CMED-305) is conducted during the third undergraduate medical academic year. The objective of this course is to teach students, how to conduct a research project. The course contents are interactive lectures to introduce the concepts and principles of conducting a study and step by step approach to ask research questions, develop a protocol, collect data and analyze and finally, write the manuscript. All these activities are conducted under an assigned supervisor through practical sessions. At the beginning of the course, 3-7 students formed a research group and conduct independent research project under a supervisor assigned by the department. At the end of each academic year, all research groups submit their projects to the department for the final evaluation.

During an extensive literature review, we could not find any local or regional study which has evaluated the undergraduate medical students' publication of their research projects. Therefore, this study was initiated to identify the number of publications of the undergraduate research methodology course research projects and the barriers or influential factors that effect on publishing these projects.

MATERIALS AND METHODS

Data Source

This was a quantitative observational, questionnaire-based, and cross-sectional study conducted at the College of Medicine, King Saud University (KSU), Riyadh, Saudi Arabia, during the academic year 2014-2015. The study was approved by the Intuitional Review Board in the College of Medicine, KSU. All participants were provided a consent form that contains the objective and purpose of the study. The participants were assured of confidentiality, and their identity will not be revealed.

Inclusion and Exclusion Criteria

The study included all the leaders of the groups of research projects from the academic years fourth, fifth and intern junior doctors who have completed the Research Methodology (CMED-305) course of their 3rd academic year. The total research groups during these 3 academic years were 164. The students who, during their 3rd academic year did not complete the CMED course were excluded from the study. Moreover, incomplete responses from the participants were also excluded from the study.

The contact information of the group leaders of each research project was collected from the database of the Department of the Family and Community Medicine, College of Medicine.

For our study, we developed a self-administered questionnaire based on an extensive literature review and reviewed by

expert faculty members in the college. 10 questionnaires were distributed to test the questionnaire validity and to estimate the time needed for filling it, as a pilot study. After a pilot study, the questionnaire was modified based on the feedback of the participants. The questionnaire contains 44 items which included personal data (gender, current academic year, and marital status), questions related to the project publication, the factors that helped students to publish their projects, and the barriers which were perceived by students that prevent the publication. Factors and barriers questions were given as five points Likert scale starts as strongly disagree and end up by strongly agree.

Completeness of the questionnaire was checked. After collection of the data, each student's research project, which was recorded as published by students, were re-checked again for its publication to improve the authenticity of the data. This was done by searching the titles of research, name of supervisors and student research members in PubMed. To ensure that the study is not indexed in PubMed, Google Scholar search was carried out, too. Furthermore, each study was checked, if published in the Institute for Scientific Information (ISI) journals by searching in the Thomson Reuters database.

Analysis

We analyzed data using the SPSS version 21.0 (IBM Corporation, Armonk, NY, USA) statistical software. The descriptive statistics (mean, standard deviation, and percentages) were used for the quantitative and categorical study data and outcome variables. Karl Pearson's Chi-square test and odds ratios (OR) were used to observe and measure the association between the categorical data and outcome variables. Multiple binary logistics regression was used for identity, independent variables associated with binary outcome variables. A $P \leq 0.05$ and 95% confidence intervals were used to report the statistical significance and precision of the results.

RESULTS

A total of 164 research groups were involved in conducting research during the academic year 2011-2014 (the total of 3 academic years) under the mandatory CMED-305 course. Of the 164 research projects, 161 research project group leaders participated in this study, with a response of 98.2%. Among the participants, 90 (55.9%) were males, and 71 (44.1%) were female research group leaders. Of the 161 research projects, 49 (30.4%) were during the academic year 2011-2012 (students are in internship year), 53 (32.9%) during 2012-2013 (students are in 5th year), and 59 (36.6%) conducted during 2013-2014 (students are in 4th year). The academic ranks of research supervisors were professor in 49 (30.4%) research projects, - Associate Professor in 58 (36%) and assistant professor in 54 (33.5%) (Table 1).

Table 1: Demographic characteristic of research groups of medical students in CMED 305 research course, College of Medicine, King Saud University

Characteristic	*n* (%)
Gender	
Male	90 (55.9)
Female	71 (44.1)
Current year of study	
4th year	59 (36.6)
5th year	53 (32.9)
Internship year	49 (30.4)
Number of members/group	
2-4	70 (43.48)
5-7	91 (56.52)
Meeting with supervisor (times/month)	
1-2	81 (50.3)
3-4	53 (32.9)
5-6	20 (12.4)
≥7	7 (4.3)
Past research experience	
Yes	25 (15.5)
No	136 (84.5)
Topic related to interest	
Yes	23 (14.3)
No	138 (85.7)
Supervisor academic rank	
Professor	49 (30.4)
Associate Professor	58 (36.0)
Assistant Professor	54 (33.5)

Out of the 161 research projects, only 36 (22.4%) research projects were published, in which most of the studies (n = 19, 52.8%) were published by research groups during their internship year, followed by students of 5th year (n = 13, 36.1%) and 4th year (n = 4, 11.1%). Two-third (n = 24, 66.7%) of research published in international journals, while 8 (33.3%) published in national journals. However, only about two-third (n = 25, 69.4%) indexed in the ISI. The time taken for publication of most of the research projects (n = 22, 61.1%) was up to 1 year, while the time is taken in 13 (36.1%) other projects was up to 2 years and only 1 (2.78%) project published after 3 years. The motivational factors reported for the publication of CMED-305 course research project were, the improvement of curriculum vitae (86.1%), interest in publication (83.3%), the effective role of supervisor (83.3%) and research topic per say which helped in the publication (72.2%).

The bivariate analysis between categorical study variables and binary outcome variable (published research projects: Yes/No), showed a highly statistically significant association between the current year of study of research groups and

their publications. The odds ratios of publication of their 3rd year research project by the students of internship year were 8.71 (95%, confidence interval (CI): 2.71-27.96) and students of 5th year were 4.47 (95%, CI: 1.36-4.72) when compared with 4th year students. Interestingly, the numbers of students in a group affect the publication of their research projects. The odds of publication were higher with a research group of 5-7 members (OR = 2.86, 95%, CI: 1.25-6.57) when compared to the group having only 2-4 members. The students who conducted a research project under the supervisor with a rank of professor had higher odds of publishing their research projects (OR = 2.54, 95%, CI: 1.0-6.66) when compared to the research projects conducted under the supervisor with a rank of Assistant professor. The other study variables: Gender of the research group leader, past research experience, a topic related to interest and frequency of meetings with research supervisor were not statistically significantly associated with the publication of their research projects (Table 2).

In multivariable analysis, bivariate logistic regression was used to identify independent variables related to the publication of research projects. A model with the variables: Research group current year of study for publication (5th year and internship year), number of research group members (5-7), research supervisor rank (Professor and Associate Professor) against a model with only constant was statistically significant, indicating that the above variables as a set distinguishing between the research groups who had published their research projects and the research groups who had not published, (χ^2 = 31.92; P = 0.001; df = 11). Hosmer and Lemeshow test which tests for the goodness of fit for logistic regression models (an alternative to model Chi-square test) had a value of 5.965 (P = 0.651; df = 8). As the $P > 0.05$, it can be inferred that the model's estimates fit the data at an acceptable level. This non-significance indicates that the model prediction does not significantly differ from the observed. Nagelkerke's R^2 = 0.275 indicates a moderate relationship between prediction and grouping. The Wald criterion demonstrated that the variables in the model (as given in Table 3) made a significant contribution to the prediction of publication of research projects. The final model validation was carried out using a classification table which summarizes the observed group and predicted group classification. The overall prediction success was 82.6%

Table 2: Association between publication of CMED 305 course research projects and study variables

Variables	Research projects published; *n* (%)		Odds ratio (95% CI)	*P*
	Yes (*n*=36)	No (*n*=125)		
Gender				
Male	25 (27.8)	65 (72.2)	2.10 (0.95,4.63)	0.066
Female	11 (15.5)	60 (84.5)	1 (ref.)	
Current year of study				
4th year	4 (6.8)	55 (93.2)	1 (ref.)	
5th year	13 (24.5)	40 (75.5)	4.47 (1.36,4.72)	0.014
Internship year	19 (38.8)	30 (61.2)	8.71 (2.71,27.96)	0.0003
Group members				
2-4	9 (12.9)	61 (87.1)	1 (ref.)	0.013
5-7	27 (29.7)	64 (70.3)	2.86 (1.25,6.57)	
Past research experiences				
No	30 (22.1)	106 (77.9)	1 (ref.)	0.830
Yes	6 (24.0)	19 (76.0)	1.12 (0.41,3.04)	
Topic related to interest				0.318
No	29 (21.0)	109 (79.0)	1 (ref.)	
Yes	7 (30.4)	16 (69.6)	1.64 (0.62,4.37)	
Meeting with supervisor (months)				
1-2	16 (19.8)	65 (80.2)	1 (ref.)	-
3-4	13 (24.5)	40 (75.5)	1.32 (0.57,3.03)	0.512
5-6	5 (25.0)	15 (75.0)	1.35 (0.43,4.28)	0.605
≥7	2 (28.6)	5 (71.4)	1.63 (0.29,9.15)	0.582
Supervisor academic rank				
Professor	15 (30.6)	34 (69.4)	2.54 (1.0,6.66)	0.050
Associate Professor	13 (22.4)	45 (77.6)	1.66 (0.63,4.39)	0.306
Assistant Professor	8 (14.8)	46 (85.2)	1 (ref.)	

Table 3: Independent variables associated with publication of research projects (by multivariable analysis)

Current year of study					
4th year	-	-	-	1.0 (ref.)	-
5th year	1.52	0.641	5.62	4.57 (1.30,16.08)	0.018
Internship year	2.22	0.635	12.23	9.20 (2.65,31.92)	<0.0001
Group members					
2-4	-	-			-
5-7	1.21	0.489	6.13	3.36 (1.29,8.76)	0.013
Supervisor academic rank					
Professor	1.12	0.553	4.12	3.07 (1.04,9.08)	0.042
Associate Professor	0.79	0.550	2.09	2.21 (0.75,6.49)	0.149
Assistant Professor	-	-	-	1.0 (ref.)	-
Model χ^2=31.92 (*P*=0.001) Nagelkerke Pseudo R^2=0.275 Goodness of fit Hosmer and Lemeshow=5.965 (*P*=0.651)					

Other variables included in the model: Gender of research group leader, past research experience, frequency of meetings with research supervisor and topics related to interest

(36.1% for publication of research projects and 96.0% for non-publication of research projects) (Table 3).

Of 125 (77.6%) research projects which were not published, 49 (39.2%) project members commented that they are in the process of the publication, 42 (33.6%) were planning, while 34 (27.2%) project members did not show any interest in publication. The barriers that hindering the publication of CMED-305 research course projects, and perceived by the participants, were lack of time due to pressure of work (62.4%), lack of time from the supervisor (45.6%), lack of cooperation between members of research groups (38.4%), lack of sufficient training (36%), and lack of support from research supervisor (36%) (Table 4).

Table 4: The barriers which hindered the publication of CMED-305 course research projects

Statements	*n* (%)		
	Disagree	Neutral	Agree
Lack of time due to pressure of work	33 (26.4)	14 (11.2)	78 (62.4)
Lack of time from supervisor	41 (32.8)	27 (21.6)	57 (45.6)
Lack of cooperation between members	59 (47.2)	18 (14.4)	48 (38.4)
Lack of sufficient training	52 (41.6)	28 (22.4)	45 (36.0)
Lack of support from supervisor	61 (48.8)	19 (15.2)	45 (36.0)
Lack of interest from supervisor	71 (56.8)	20 (16.0)	34 (27.2)
Lack of personal motivation	73 (58.4)	20 (16.0)	32 (25.6)
Lack of significant result	84 (67.2)	13 (10.4)	28 (22.4)
Lack of positive result	82 (65.6)	22 (17.6)	21 (16.8)
Absence from research course lectures	85 (68.0)	19 (15.2)	21 (16.8)
Lack of manuscript writing skills	86 (68.8)	18 (14.4)	21 (16.8)
Topic of the article was not interesting for me	90 (72.0)	15 (12.0)	20 (16.0)
Lack of interest in publication	98 (78.4)	12 (9.6)	15 (12.0)
Lack of English language writing skills	104 (83.2)	8 (6.4)	13 (10.4)
Involvement in publication will decrease my GPA	91 (72.8)	24 (19.2)	10 (8.0)
Lack of self-confident	107 (85.6)	10 (8.0)	8 (6.4)
Lack of value for postgraduate admission	112 (89.6)	9 (7.2)	4 (3.2)

DISCUSSION

This is the first study, which quantified the number of publications of undergraduate research which was conducted under the research methodology course (CMED-305). The study has investigated the factors which influence or hinder the publication of research findings. In this study, the average publication was only 22.4 %, this finding partially agreed with the other studies which reported an overall publication rate of undergraduate projects ranging between 5.8% and 70%.[13-16,18,19,22,30] The highest publication rate was reported by the US undergraduate students.[13,22] A study from the US reported publication rate of 41%, while another study reported 70%. However, in both studies, the students have taken a longer time to publish their projects, seems to be one of the reasons of high publication rate.[13,22] A local study reported low publication rate (5.8%) in King Abdul-Aziz University, while another local study reported quit high publication rate (50%) in Al-Faisal University.[20,24] The high publication rate of undergraduate research in Al-Faisal University may be due to the financial support for the students-research

training provision and follow-up of research conduction and publication by the Undergraduate Research Committee.[20] The low publication rate of undergraduate medical students at KSU may be due to some hindered factors which were mentioned earlier. However, publication of a student's manuscript leads to an improvement of the student's skills and makes them experienced and enables them to conduct more research in the future.[31]

In this study, the most influencing factor for publication was the improvement of convection volume (CV). Furthermore, most of the students conceded that the publication has a value in postgraduate admission. This result is similar to the worldwide studies, as reported, that the improvement of CV was a main influential factor which encourages undergraduate medical student for research work and publishes their research finding.[16-18] In addition, students' interest and effective role of supervisor also considered as strong influential factors. Our result agreed with the other findings who also, reported that the role of supervisor is an important factor in the publishing of students' research findings.[1,15,18] About 36% of students who did not publish their research projects, reported lack of support from their supervisors. The other factors like the topic of research and research course training have also an effective role in publication. In addition, this study found a significant effect of group members' number on the publication rate. The increase group members have a positive correlation with the publication, and this is most probably because high members' number would distribute the work among them, which eventually will reduce the load on students, which probably, dependent on of the guidance of a supervisor. The supervisor's academic rank also has an effect on publication rate, as most of published articles were under the supervision of an academic rank of professor followed by Associate Professor.

Lack of time was the leading hindrance to publication of the research project. About 60% of students reported lack of time due to pressure of work, while 45% students reported lack of time of supervisor. The time factor clearly reflected on the publication rate of 3 academic year groups. The result showed that the students during their internship have highest publication rate probably due to the availability of time, followed by the 5th year students. Worldwide studies also reported that the main barriers for not publishing were lack of time.[18,24,32] Possibly, this is the reason as about 39% are still processing for publication, and 33% are planning to publish.

Our study showed that undergraduate students are worried about their GPA and think that participation in a research project will not allow them to maintain their educational level, this concern was also shown in another study.[29] In addition, this study revealed lack of scheduled time with their supervisors for research activity and was considered as a strong barrier, which was also found in another study.[26] A study reported that the student would not be able to manage their studying time for research projects and therefore need more supervisor guidance for such activities.[30] Furthermore, lack important research skills and poor writing skills believed to be one of the main obstacles that prevent undergraduate students from publications.[19,25] Lack of sufficient training was considered as the facilitating factor by the 36% of the respondents in this study. A local study found that the barrier for publishing could be insufficient research methodology training.[24]

This study confronted limitation as is being cross-sectional, and questionnaire-based, which could be linked with some recall bias. Furthermore, we have included only the leaders of the study groups. Although all attempts were taken to improve the data by cross-checking the publication in Pubmed and Google scholar search engines. Possibly, some studies could be published after the collection of the data and were not considered as published projects.

Limitation

The present study has been limited to testing the leaders of the groups of research projects from the academic years 4th, 5th and intern junior doctors who have completed the Research Methodology (CMED-305) course of their 3 academic years only in College of Medicine, KSU. Moreover, the result revelation is based on a limited number 164 of research groups.

CONCLUSION

In summary, the result of this study provided evidence for the publication of students' research projects during their research methodology course. The present study showed a relatively low publication rate. However, most of the students reported that un-published researchers are either in the process or planning to publication. The study found that low publication rate is due to lack of time, insufficient support from supervisor and lack of cooperation between the group members. Our result also found that the low supervisor skills or interest could hinder in the student's research publication. The results of this study also suggest for the manuscript writing skill training could be included in such academic course. Many students are lacking the sufficient research training; therefore, appropriate training could be included. Further emphasis should be given by training department and academic supervisors to overcome the perceived barriers.

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