

Characteristics, Trends, and Factors Associated With Publication Among Residents of Oman Medical Specialty Board Programs

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ABSTRACT

Background Research during residency is associated with better clinical performance, improved critical thinking, and increased interest in an academic career.

Objective We examined the rate, characteristics, and factors associated with research publications by residents in Oman Medical Specialty Board (OMSB) programs.

Methods We included residents enrolled in 18 OMSB residency programs between 2011 and 2016. Resident characteristics were obtained from the OMSB Training Affairs Department. In April 2018, MEDLINE and Google Scholar databases were searched independently by 2 authors for resident publications in peer-reviewed journals using standardized criteria.

Results Over the study period, 552 residents trained in OMSB programs; 64% (351 of 552) were female, and the mean age at matriculation was 29.4 ± 2.2 years. Most residents (71%, 393 of 552) were in the early stages of specialty training ($R \leq 3$) and 49% (268 of 552) completed a designated research block as part of their training. Between 2011 and 2016, 43 residents published 42 research articles (range, 1–5 resident authors per article), for an overall publication rate of 8%. Residents were the first authors in 20 (48%) publications. Male residents (odds ratio [OR] = 2.07; $P = .025$, 95% CI 1.1–3.91) and residents who completed a research block (OR = 2.57; $P = .017$, 95% CI 1.19–5.57) were significantly more likely to publish.

Conclusions Research training during residency can result in tangible research output. Future studies should explore barriers to publication for resident research and identify interventions to promote formal scholarly activity during residency.

Introduction

Dissemination of research findings is an integral part of the scientific communication process.¹ Non-publication wastes limited resources, delays progress, results in unnecessary study duplication, and erodes trust in evidence-based medicine.² Although research findings can be disseminated in different ways, publication in peer-reviewed journals is the widely accepted and preferred method of scientific communication for researchers, academic institutions, and funders of research.³

In 1994, the Accreditation Council for Graduate Medical Education (ACGME) introduced a requirement for residency programs to teach basic principles of research, and for residents to participate in scholarly activities.⁴ Over time, research has become a core competency in most residency programs. Research experience during residency is associated with better clinical performance, improved critical

thinking skills, and increased interest in academic medicine as a future career.^{5,6}

The Oman Medical Specialty Board (OMSB), established in 2006, is an ACGME-International accredited national sponsoring institution that oversees graduate medical education in Oman.⁷ The OMSB research training curriculum, a mandatory component of all residency programs, consists of 2 research blocks/rotations (each corresponding to 28 working days).⁸ It offers residents avenues to promote research, including faculty mentorships, protected research time, lectures and workshops covering methodology, ethics, critical appraisal of the literature, biostatistics and research dissemination, and annual program-level and institutional research days.^{7,8} OMSB residents are expected to conduct a study from proposal to manuscript writing.⁸ Submitting a research report is a prerequisite for the completion of training; publishing the findings in a peer-reviewed journal is encouraged but not required.⁸

There has been growing interest in exploring trends in resident research and publishing.^{9–11} A study found

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the publication rate of resident abstracts presented at 2 OMSB research meetings was 22%, lower than the 40% to 64% reported in the literature.¹²

We sought to evaluate publication of OMSB resident research projects. Our aims were 2-fold: (1) assess resident research publications as a marker for research output, and (2) examine factors associated with resident research publications in peer-reviewed journals.

Methods

Our cross-sectional bibliometric study examined peer-reviewed publications authored by OMSB residents. We obtained a list of residents in OMSB programs and included OMSB residents between 2011 and December 2016. The cut-off date allowed for time from project completion to journal publication.³

Search Strategy and Data Collection

In April 2018, PubMed and Google Scholar databases were searched independently by 2 authors (I.S.A. and A.K.A.) for peer-reviewed publications using standardized criteria. We combined the last and first names of residents with “Oman” and “Oman Medical Specialty Board.” A publication was included if the resident was a co-author, the article was published during or soon after residency, and the resident was affiliated with OMSB. Confirmation of publications was based on independent searches conducted by 2 authors with Cohen’s kappa score of 1.0, indicating complete agreement.

Resident characteristics obtained from the OMSB Training Affairs Department included residents’ gender, age at residency matriculation, program, training level (ie, R1, R2, R3), completion of a research block, and higher academic degrees.

For each identified publication, we collected data on authors (number published, resident authorship order, affiliation of first author, gender of resident author(s), training level, and program) and article-related data (type and year of publication, original article type, journal name, and impact factor at publication, using Clarivate Analytics, Philadelphia, Pennsylvania, USA). The quality of publications was evaluated using article type (original study versus reviews) and impact factor.

The study was approved by the Oman Medical Specialty Board Research and Ethics Committee.

Data Analysis

Data were entered into an Excel spreadsheet (Microsoft Corp, Redmond, WA, USA). Resident characteristics were summarized using descriptive statistics,

What was known and gap

Scholarly activity is important to the intellectual and professional development of residents, yet the scholarly output of residents in ACGME-International accredited programs has not been studied.

What is new

A study of research publications by residents in Oman shows only about 8% of resident research resulted in publications. Surgical residents had higher publication rates.

Limitations

Single nation study limits generalizability to other international settings.

Bottom line

Barriers to residents publishing their research may include time constraints and lack of incentives for publication.

and we used the chi-square goodness-of-fit test to determine variance from an equally proportioned distribution for resident gender. Statistical significance was set at $P < .05$. Analyses were performed using SPSS for Windows Version 20.0 (IBM Corp, Armonk, NY, USA).

Direct logistic regression was performed to examine the impact of a number of factors on the likelihood of publication. Our model contained 4 independent variables we hypothesized to be associated with resident publication: gender, age at residency matriculation, training level (junior [$R \leq 3$] versus senior [$R \geq 4$] residents), and completion of a research block. The full model was statistically significant (χ^2 4, $N = 552$) = 16.23, $P = .003$), indicating it was able to distinguish between residents who published in peer-reviewed journals and those who did not.

Results

Resident Characteristics

A total of 552 residents were enrolled in 18 different OMSB training programs between 2011 and 2016. Of these, 351 (64%) were female. The 3 training programs with the highest representation were internal medicine (93 residents, 17%), family medicine (79 residents, 14%), and pediatrics (70 residents, 13%). Most residents (71%, 393 of 552) were in the early stages of specialty training ($R \leq 3$). As of April 2018, about half of the residents (49%, 268 of 552) had completed a designated research block. Residents’ demographic characteristics are presented in TABLE 1.

Publication Data

By the end of April 2018, 43 unique residents had published 42 articles (range, 1–5 residents per article) for an overall publication rate of 8% (TABLE 1). A higher percentage of male (53%, 23 of 43) than

TABLE 1
Demographic Characteristics of Residents (n = 552)

Characteristic	n (%)
Gender	
Female	351 (64)
Male	201 (36)
Age at matriculation, years	
Mean \pm SD (range)	29.38 \pm 2.23 (25-38)
Academic degrees/qualifications	
Doctor of Medicine (MD)	541 (98)
Bachelor of Dental Surgery (BDS)	8 (1)
MD/Master of Science	1 (0.2)
MD/BDS	2 (0.4)
Training program	
Anesthesia	23 (4)
Biochemistry	3 (1)
Dermatology	11 (2)
Emergency Medicine	26 (5)
Family Medicine	79 (14)
Hematology	13 (2)
Histopathology	8 (1)
Internal Medicine	93 (17)
Medical Microbiology	14 (3)
Obstetrics and Gynecology	38 (7)
Oral and Maxillofacial Surgery	10 (2)
Ophthalmology	14 (3)
Orthopedics	25 (5)
Pediatrics	70 (13)
Otolaryngology, Head and Neck Surgery	31 (6)
Psychiatry	26 (5)
Radiology	38 (7)
Surgery	30 (5)
Training level	
R1	146 (26)
R2	122 (22)
R3	125 (23)
R4	111 (20)
R5	43 (8)
R6	5 (1)
Completed research block	
Yes	268 (49)
No	284 (51)
Published at least one article	
Yes	43 (8)
No	509 (92)
Number of residents per article	
1	30 (71)
2	10 (24)
3	1 (2)
5	1 (2)

female residents (47%, 20 of 43) had published articles. Only 11 of the 18 training programs had residents with publications, with surgery trainees publishing the most (12 publications, 28%). Around 70% (30 of 43) of residents who had published had completed a research block.

The total number of authors for publications involving residents was 193, with 58 (30%) of the authors being residents. Sultan Qaboos University Hospital and OMSB were the 2 most prolific institutions, accounting for 36% (15 of 42) and 31% (13 of 42) of all publications, respectively. TABLE 2 summarizes resident and publications' characteristics.

Publishing Journals

Articles with OMSB resident authors were published in 16 journals. Twenty-eight articles (67%) were published in Omani journals (*Sultan Qaboos University Medical Journal*, n = 13; *Oman Medical Journal*, n = 13; *Oman Journal of Ophthalmology*, n = 2). Data on impact factor were available for 5 articles (12%), and the median impact factor of publishing journals was 1.55 (SD \pm 0.13; range 1.39–2.12).

Factors Associated With Publication

Authors' male gender (odds ratio [OR] = 2.07; $P = .025$; 95% confidence interval [CI] 1.1–3.91) and having completed a research block (OR = 2.57; $P = .017$; 95% CI 1.19–5.57) were the 2 statistically significant factors associated with resident publication (TABLE 3).

Discussion

Our findings provide insight into research output and factors associated with successful publication for OMSB residents. To our knowledge this is the first study from Oman that reports resident research output using objectively verified databases. Our findings confirm previous reports that research training during residency results in tangible research output.^{9–11} However, our reported publication rate was lower than rates reported in the literature.^{9–11,13} Recent studies reported variable publication rates between programs depending on programmatic interventions,¹⁴ ranging from 10% in internal medicine⁹ to 54% in general surgery.¹¹

Although women represented nearly two-thirds of all enrolled residents, men were 2 times more likely to publish in peer-reviewed journals. This is consistent with previous studies related to gender disparities in postgraduate training and academic medicine.^{15,16} Studies suggested academic editors and peer reviewers

TABLE 2
Descriptive Statistics of Residents and Publications

Characteristic	n (%)
Resident-specific measures (n = 43)	
Gender	
Female	20 (47)
Male	23 (54)
Age at matriculation, years	
Mean \pm SD (range)	29.4 \pm 2.4 (25-35)
Academic degrees/qualifications	
Doctor of Medicine (MD)	37 (86)
Bachelor of Dental Surgery (BDS)	3 (7)
MD/Master of Science	1 (2)
MD/BDS	2 (5)
Training program	
Anesthesia	4 (9)
Biochemistry	0 (0)
Dermatology	0 (0)
Emergency Medicine	2 (5)
Family Medicine	3 (7)
Hematology	0 (0)
Histopathology	0 (0)
Internal Medicine	3 (7)
Medical Microbiology	0 (0)
Obstetrics and Gynecology	0 (0)
Oral and Maxillofacial Surgery	5 (12)
Ophthalmology	1 (2)
Orthopedics	2 (5)
Pediatrics	5 (12)
Otolaryngology, Head and Neck Surgery	3 (7)
Psychiatry	3 (7)
Radiology	0 (0)
Surgery	12 (28)
Training level	
R1	9 (21)
R2	9 (21)
R3	7 (16)
R4	12 (28)
R5	5 (12)
R6	1 (2)
Completed research block	
Yes	30 (70)
No	13 (30)
Publication-specific measures (n = 42)	
Resident authorship order	
First author	15 (36)
Co-author	22 (52)
Both (multiple resident authors)	5 (12)

TABLE 2
Descriptive Statistics of Residents and Publications
(continued)

Characteristic	n (%)
Multiple residents per publication	
Yes	12 (29)
No	30 (71)
Resident as corresponding author	
	17 (41)
Affiliation of first author	
Al-Nahdha Hospital	2 (5)
Armed Forces Hospital	1 (2)
Khoula Hospital	2 (5)
Oman Medical Specialty Board	13 (31)
Royal Hospital	4 (10)
Sultan Qaboos University	5 (12)
Sultan Qaboos University Hospital	15 (36)
Publication type	
Original article	19 (45)
Case report	21 (50)
Review	1 (2)
Letter	1 (2)
Study design	
Cohort	1 (2)
Case-control	2 (5)
Cross-sectional	16 (38)
Case report	21 (50)
Letters/reviews	2 (5)
Original article type (n = 19)	
Clinical	19 (100)
Financial funding	
The Dean's Fund, College of Medicine and Health Sciences, Sultan Qaboos University	1 (2)

impose tougher standards on female authors making it more difficult for them to publish their work.¹⁷ Gender disparity in research and publication also has been attributed to the lack of mentorship and role models for female residents.^{13,16}

Residency is an arduous period, and female residents may be at a disadvantage for completing and publishing research, especially if they have additional family responsibilities.¹⁸

Completing a research block had a statistically significant positive association with publication during residency. Research programs are known to generally result in increased participation in scholarly activity during residency.^{14,19-21} For example, a mandatory research requirement in a general surgery residency program resulted in a 3-fold increase in the number of research presentations.¹⁹ In addition, as many physicians are introduced to research only after they enter the postgraduate training phase, it is not

TABLE 3

Logistic Regression Model of Predictive Factors Related to the Publication of Resident Research

Variable	OR	95% CI	P Value
Male gender	2.069	1.096-3.906	0.025
Age at matriculation	0.866	0.721-1.041	0.126
Senior resident (R \geq 4)	1.591	0.717-3.528	0.253
Completed research block	2.571	1.186-5.574	0.017

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

surprising that completing a structured research block would increase the chances of publication success.

To increase research output, residency programs in international settings should consider strategies to facilitate resident involvement in scholarly activities. This could include providing residents with monetary and non-monetary reward for presenting/publishing their research,²⁰ one-on-one research mentoring from project design to dissemination of findings,²¹ and making dissemination (a peer-reviewed publication and/or conference presentation) a requirement for completion of the research block.¹⁹ One study reported an increase in resident publication output after implementing a research reward system that awards residents points for each progressive step completed toward publication in peer-reviewed journals.²⁰

While we did not explore the reasons why surgical residents had the highest publication rate, previous reports suggested that surgical residents participate in research to initiate an academic career and enhance fellowship opportunities.²² This could be true for OMSB surgical residents. Another explanation could be related to the personality traits of surgical residents. One study showed that surgeons have greater achievement orientation and extraversion than internists.²³ These traits may play a role in the commitment and determination to complete a research project and pursue publication. Furthermore, unmeasured mentor-related factors such as supervisors' determination that a project should be published may be important.²⁴

This study has limitations. The search strategy used in this study may have underestimated the publication rate of OMSB resident research. Residents may have published their findings in journals not indexed in the 2 databases used in this study, or their research may not yet have been published at the time we closed data collection. We did not explore other potentially relevant predictors of resident publication, such as residents' experience on the research block, attitudes toward research, and interest in academic medicine as a career.

Results from this study could be used to inform changes to the research block for OMSB training programs. This could involve enrolling interested

residents in a full-time research-based program partway through their specialty training. Such a program should be well-supported intellectually (ie, direct research supervision and mentoring, statistical support) financially, and administratively.

Conclusion

Although OMSB residency programs provide residents with the opportunity to acquire research skills, less than 10% of residents publish their findings in peer-reviewed journals. Future research may consider exploring and overcoming barriers to publication of residents' research, and identifying additional interventions to promote resident scholarly activity.

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