

## Original Article

## Comparing the gender diversity and affiliation trends of the authors for two orthopaedics journals from the Arab world



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### المخلص

**أهداف البحث:** تعتبر خصائص مؤلفي البحوث العلمية بما في ذلك إسهامات المرأة كمؤلفة ونسبة المشاركة والتعاون بين مختلف المؤسسات البحثية، مجالاً مثيراً للاهتمام في المجال الطبي. الهدف الرئيس للبحث الحالي هو تقرير ومقارنة أعداد المؤلفين المشاركين في البحوث بما في ذلك نسبة مشاركة المرأة كمؤلف عن طريق مقارنة البحوث الصادرة في مجال جراحة العظام والمنشورة في مجلتين صادرتين من العالم العربي. أما الأهداف الثانوية فكانت تقييم خصائص الأنتماءات المؤسسية للمؤلفين ونمط تعاون المؤسسات وإسهاماتها في البحوث المنشورة.

**طرق البحث:** دراسة مقطعية للمقالات الواردة في أرشيف مجلة جراحة العظام المصرية (المجلة الرسمية لجمعية جراحة العظام المصرية) ومجلة جراحة وبحث العضلات والعظام (المجلة الرسمية لجمعية جراحة العظام السعودية) حتى يوليو ٢٠٢٠.

**النتائج:** بعد تقييم ٣٨٣ للمجلة المصرية و١٢٢ مقالة للمجلة السعودية. كان متوسط عدد المؤلفين لكل مقال أفضل بكثير وذا دلالة إحصائية بالنسبة للمجلة السعودية (١.٧±٤.٣) مقارنة بمتوسط (٢±١) للمجلة المصرية. كانت إسهامات المؤلفين الإناث أكبر بشكل ملحوظ في المجلة السعودية (٧٥؛ ٢.١٤٪) مقارنة بالمجلة المصرية (٢؛ ٠.٣٪). وكان الفارق ذا دلالة إحصائية. كان متوسط عدد المؤسسات لكل مقال أكبر وذا دلالة إحصائية في المجلة السعودية (٢.١±١.٢).

مقارنة بمتوسط (١.١ ± ٠.٣) للمجلة المصرية. وكانت نسبة تعاون المؤسسات الوطنية (٢٧.٩٪) وإسهامات المؤسسات الدولية (٥٣.٣٪) في المجلة السعودية أفضل بكثير وذات دلالة إحصائية مقارنة بالمجلة المصرية التي كانت النسب فيها ٧.٤٪ و ٦٠٪ على التوالي.

**الاستنتاجات:** أظهرت المجلة السعودية تفوقاً فيما يتعلق بعدد المؤلفين لكل مقال ونسبة مشاركة المؤلفين الإناث. وكان حدوث تعاون المؤسسات الوطنية والإسهامات الدولية أفضل في المجلة السعودية مقارنة بالمجلة المصرية.

**الكلمات المفتاحية:** اتجاهات الأنتماء؛ العالم العربي؛ المؤلفين الإناث؛ التنوع بين الجنسين؛ جراحة العظام

### Abstract

**Objectives:** Authorship trends, female authors' contributions, and the collaboration among institutions have been a concern in the medical field. This study primarily aims to report and compare the number of authors per article and the prevalence of female authors by comparing two orthopaedics journals from the Arab world. The secondary objective of this study is to evaluate the characteristics of the authors' affiliations and the pattern in institutions' collaborations and contributions to the published articles.

**Methods:** This cross-sectional study reviewed all articles (until July 2020) published in the Archives of the Egyptian Orthopaedic Journal (EOJ) (the official journal of the Egyptian Orthopaedic Association) and the Journal of Musculoskeletal Surgery and Research (JMSR) (the official journal of the Saudi Orthopaedic Association).

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**Results:** We evaluated 383 and 122 articles from the EOJ and JMSR, respectively. The average number of authors per article was significantly higher for JMSR ( $4.3 \pm 1.7$ ) than EOJ ( $2.0 \pm 1.0$ );  $p = 0.000$ . There was a significantly larger number of contributions by female authors in JMSR (75, 14.2%) than EOJ (2, 0.3%);  $p = 0.000$ . The average number of institutions per article was significantly larger for JMSR ( $2.1 \pm 1.2$ ) than EOJ ( $1.1 \pm 0.3$ );  $p = 0.000$ . For the JMSR, the incidence of national institutions' cooperation (27.9%) and international institutions' contributions (53.3%) were significantly higher than their counterparts for the EOJ—6% and 4.7%, respectively;  $p = 0.000$ .

**Conclusion:** The JMSR showed superiority regarding the number of authors per article and the prevalence of female authors. The incidence of national institutions' cooperation and international contributions were higher in the JMSR compared with the EOJ.

**Keywords:** Affiliation trends; Arab world; Female authors; Gender diversity; Orthopaedics

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## Introduction

The increased complexity in research subjects and the added demand for scientific publications to achieve a career promotion were among the reasons the authorship criteria changed in different scientific research fields.<sup>1–3</sup> The gender, number, and affiliations of authors have been the topic of various reports in different medical and scientific fields<sup>1,2,4–8</sup>; in the orthopaedic literature in particular, this issue has been thoroughly examined in many publications.<sup>9–16</sup>

Many studies have found an increasing trend regarding the number of female authors, an improvement in the cooperation among institutions, and the involvement of a larger number of authors per article,<sup>9,15,17–20</sup> However, the gender gap in the number of authors is still an issue of concern across different medical specialities,<sup>17,21–23</sup> including orthopaedic and trauma surgery, as discussed in many studies.<sup>24–27</sup>

Controversies regarding the percentage of female authors in different orthopaedic bibliometric reports still exist; a study by Wininger et al. counting the number of female authors contributing to the Journal of Bone and Mineral Research over a 30-year period found that the average number of authors per article in 2015 was  $8.5 \pm 4.2$ , and the percentage of female first authors increased significantly from 35.8% in 1986 to 47.7% in 2015 ( $p = 0.02$ ).<sup>10</sup> However, a cross-sectional study by Brown et al. examining six of the top orthopaedic and trauma journals from 1987 to 2017 found that females as a senior author or first author

represented only 1.7% and 4.4% of the total authors' count, respectively.<sup>24</sup>

To the best of our knowledge, there exist no reports on the contribution of female authors in medical journals originating from the Arab world. The primary objective of the current study was to report and compare the number of contributing authors per article and the prevalence of females co-authoring in two specialised medical journals published in two different Arab countries. Specifically, the study examined the Egyptian Orthopaedic Journal (EOJ) and the Journal of Musculoskeletal Surgery and Research (JMSR), representing the Egyptian Orthopaedic Association (EOA) and the Saudi Orthopaedic Association (SOA), respectively. The secondary objective was to determine and compare authors' affiliations characteristics and the trend of different institutions' cooperation and contribution to both journals' publications.

## Materials and Methods

The EOJ and JMSR are multidisciplinary, open-access, peer-reviewed orthopaedics and trauma journals, respectively, published quarterly; the JMSR is relatively younger as its first online volume was issued in 2017, while the EOJ has online volumes since 2012. We conducted a cross-sectional analysis of articles published in both journals until the end of July 2020 by obtaining articles from the journals' archives (<http://www.eoj.eg.net/backissues.asp> and <https://www.journalmsr.com/backissues.asp> for the EOJ and JMSR, respectively). Original articles, review articles, case reports, and technical notes were included. Editorials, Letters to the Editor, questions bank articles, book chapters, radiology quizzes, commentary articles, and articles with missing data were excluded from the final analysis. After the authors agreed which data should be collected, manual data collection into a pre-designed excel sheet was performed by accessing the abstract (the full article was inspected whenever needed) by one team for each journal (each team included two of the authors). After finalising the data collection process, the data were revised for accuracy by the most senior author; he randomly accessed an issue in each year of the publications and compared the data in the journal archives with the data collected by the two teams. We agreed to classify the articles' subspecialties into arthroplasty, foot and ankle, trauma, upper limb (including hand and microsurgery), spine, sports medicine, paediatrics, oncology, and general orthopaedics (including infection, bone disease, and deformity correction).

The number of authors per article was collected. The lists of authors were examined to detect female authors. If we could not determine the gender from the author name, we conducted a web search for the institutional personal profile of the author, searched for the author's professional social media (on LinkedIn and ResearchGate), or contacted the corresponding author asking for details.

Affiliation was classified as either national or international, according to the nationality of the institution with which the authors were affiliated. Cooperation between different institutions was classified into the following

categories: Category I, when all the authors are affiliated with the same national institution; Category II, when the authors are affiliated with different national institutions; Category III, when all the authors are from the same international institution; Category IV, when the authors are affiliated with different international institutions; and Category V, when some of the authors are affiliated with national and some with international institutions. Category II represented national cooperations, while Categories III, IV, and V were considered international contributions to the journals.

### Statistical analysis

To ensure transparency and prevent bias in the data analysis, the assessor was blinded to the name of the journal from which the data were collected. The averages and standard deviations for the quantitative variables and the frequencies and percentages for the qualitative variables were calculated by using the Statistical Package for Social Science (SPSS) version 25 (IBM Corp., released in 2017; IBM SPSS

Statistics for Windows, Version 25.0, Armonk, NY: IBM Corp). The comparison of the bibliometric data from the two journals was performed using Mann–Whitney U and chi-square tests. P-values less than 0.05 indicated statistical significance.

### Results

For the studied period, a total of 404 and 157 articles from EOJ and JMSR, respectively, were found eligible, and after applying the exclusion criteria, 383 articles for EOJ and 122 articles for JMSR were included in the final analysis (Table 1). There was a significant difference between the two journals' article types and subspecialties (the JMSR showed more variability in both aspects), as shown in Figure 1. The number of authors per article in the JMSR and EOJ was  $4.3 \pm 1.7$  and  $2.0 \pm 1.0$ , respectively, and the female authorship prevalence was 14.2% and 0.3%, respectively. In both cases, the values for the JMSR were significantly higher than those for the EOJ ( $p = 0.000$ ), as shown in

**Table 1: Article counts and authorship criteria.**

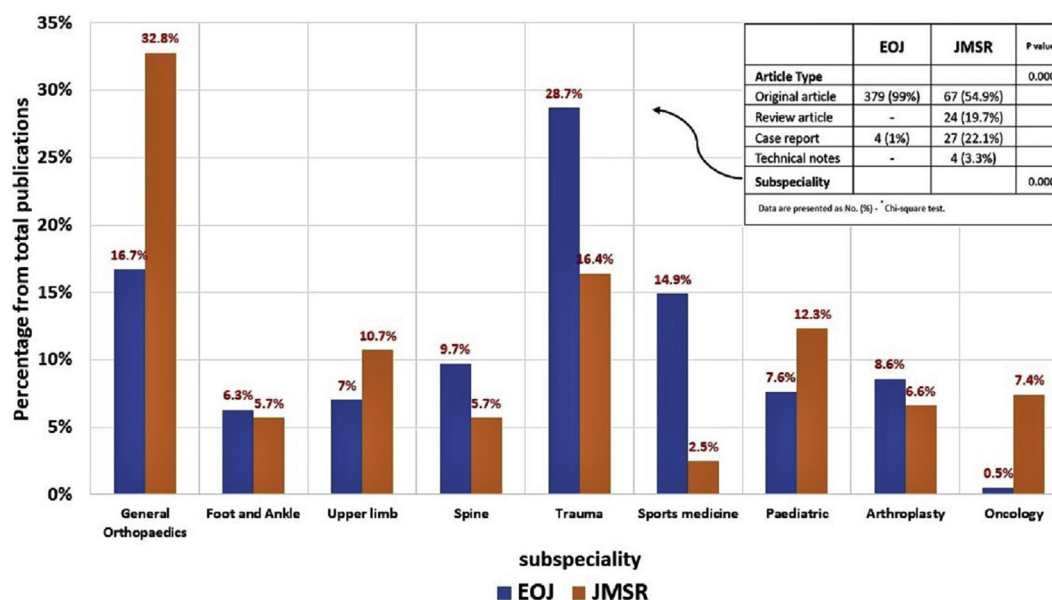
	EOJ (2012–2020)	JMSR (2017–2020)	p-value*
No. of articles	383	122	—
No. of issues	28	13	—
Articles per issue <sup>a</sup>	$13.7 \pm 1.4$ (10–16)	$9.4 \pm 5.8$ (5–27)	0.000 <sup>c</sup>
Articles per year <sup>d</sup>	$47.9 \pm 15.2$ (14–60)	$30.5 \pm 20.6$ (10–59)	0.283 <sup>c</sup>
Total No. of authors	751	530	—
No. of authors per article <sup>a</sup>	$2.0 \pm 1.0$ (1–6)	$4.3 \pm 1.7$ (1–9)	0.000 <sup>c</sup>
Total No. of female authors <sup>b</sup>	2 (0.3)	75 (14.2)	0.000 <sup>d</sup>
No. of female authors per article <sup>a</sup>	$0.01 \pm 0.07$ (0–1)	$0.6 \pm 0.9$ (0–4)	<sup>a</sup> 0.000

<sup>a</sup> Data are presented as average  $\pm$  standard deviation (range).

<sup>b</sup> Data are presented as No. (%).

<sup>c</sup> Mann–Whitney test.

<sup>d</sup> Chi-square test. EOJ: Egyptian Orthopaedic Journal; JMSR: Journal of Musculoskeletal Surgery and Research, No.: number.



**Figure 1:** Comparison of the two journals in terms of article types and subspecialties (EOJ: Egyptian Orthopaedic Journal; JMSR: Journal of Musculoskeletal Surgery and Research).

**Table 2: Authors' affiliations trends and institutions' cooperation criteria.**

		EOJ (2012–2020)	JMSR (2017–2020)	<i>p</i> -value*
Authors' affiliations	No. of institutions per article <sup>a</sup>	1.1 ± 0.3 (range: 1 to 4)	2.1 ± 1.2 (range: 1 to 5)	0.000 <sup>c</sup>
	No. of local institutions <sup>b</sup>	370 (96.6)	68 (55.7)	0.000 <sup>d</sup>
	No. of international institutions <sup>b</sup>	18 (4.7)	65 (53.3)	0.000 <sup>d</sup>
Institutions' cooperation <sup>b</sup>	Category I	342 (89.3)	23 (18.9)	0.000 <sup>d</sup>
	Category II	236	34 (27.9)	0.000 <sup>d</sup>
	Category III	13 (3.4)	28 (23.0)	0.000 <sup>d</sup>
	Category IV	0 (0)	26 (21.3)	0.000 <sup>d</sup>
	Category V	5 (1.3)	11 (9.0)	0.000 <sup>d</sup>

<sup>a</sup> Data are presented as average ± standard deviation (range).

<sup>b</sup> Data are presented as No. of articles (%).

<sup>c</sup> Mann–Whitney test.

<sup>d</sup> Chi-square test. EOJ: Egyptian Orthopaedic Journal, JMSR: Journal of Musculoskeletal Surgery and Research. No.: number.

**Table 1.** For the JMSR, single authorship was reported in 7 (5.7%) of the articles, while in the EOJ, in 153 (39.9%) of the articles. For the EOJ, a total of 42 unique institutions contributed to the journal publications [28 (66.7%) national and 14 (33.3% international institutions)] while for the JMSR, a total of 133 unique institutions [60 (45.1%) national and 73 (54.9%) international]. The criteria for the authors' affiliations and the cooperation between different institutions are presented in **Table 2**. Articles from the JMSR exhibited a larger number of cooperations between local institutions (Category II) as well as a larger number of contributions from international institutions (Categories III, IV, and V) ( $p = 0.000$ ).

## Discussion

Active participation in scientific research and subsequent article publication is essential for scientists in general and orthopaedic surgeons in particular (both males and females, either juniors or seniors) for the sake of career improvement and academic upgrading.<sup>3,9</sup> Conducting bibliometric studies that discuss and analyse aspects like authorship and affiliation trends is of utmost importance to monitor the scientific advancement of a specific journal or a medical community.<sup>9</sup> The authorship gender gap in medical and surgical fields has become a specific area of concern in the past decade.<sup>1,2,5,10,20,28–31</sup> Although there has been excellent advancement in the Arab world's scientific research activities in the last decade,<sup>32</sup> the existing bibliometric studies monitoring this advancement are deficient.

The limited bibliometric analysis in the current study, evaluating and comparing two orthopaedic journals originating from the Arab world, showed a significant discrepancy between the two journals: compared with the EOA, the JMSR showed significantly larger numbers of authors per article as well as larger numbers of female authors. Further, for the JMSR, the numbers of national institution cooperations and international contributions were remarkably larger as well.

Although there are 22 Arab countries in the Arab League, and most of them have orthopaedic associations, the EOA and the SOA are the only two associations holding annual conferences regularly and having official journals. Siddiqi et al. evaluated the Middle East and North African (MENA) countries'

contribution to global scientific publications (almost all Arab countries were included). The study found that in 2013, KSA was the MENA country contributing the highest percentage of studies to global scientific publications (0.54%), followed by Egypt (0.48%). The combined number of studies from KSA and Egypt constituted approximately 50% of the total MENA countries' contribution to global scientific publication.<sup>32</sup> According to the recent update (October 2020) of the SCIMAGO journal and country ranking evaluating the scientific production from the Arab world in the period from 1996 to 2019 (<https://www.scimagojr.com/countryrank.php?region=ARAB%20COUNTRIES>), Egypt ranked first and KSA second. However, in orthopaedics and sports medicine (<https://www.scimagojr.com/countryrank.php?area=2700&region=ARAB%20COUNTRIES&category=2732>), KSA moved to the fourth position while Egypt remained in the first place.

An increasing trend in the number of authors per article has been observed in the last decade, as reported in some studies.<sup>5,10,33</sup> This increase serves as an indicator of the improved collaboration among researchers and institutions to address the increased research complexity.<sup>10</sup> Ojerholm and Swisher-McClure, analysing the authorship trends in various medical and scientific journals, found that the average number of authors per article nearly doubled in 30 years and there was a decline in the old trend of single authorship.<sup>34</sup> In the current study, the JMSR exhibited an average of  $4.3 \pm 1.7$  authors per article, which was significantly larger than that for the EOJ, which presented an average of  $2.0 \pm 1.0$  authors per article. Moreover, the old trend of single authorship prevailed in the EOJ, with an incidence of 39.9%; in contrast, the incidence was only 5.7% in the JMSR. The increase in the number of authors per article in the JMSR was comparable to that found by previous studies. For example, by examining the authorship trends in the American Journal of Sports Medicine (AJSM) in 2014, Schrock et al. reported an average of 5.8 authors per article for that journal.<sup>20</sup> In a study by Vora et al., assessing the authorship trends in three foot and ankle journals during a 24-year period, the average number of authors per article was  $3.6 \pm 1.9$ .<sup>35</sup> Seetharam et al., evaluating the publications from the Journal of Orthopaedic Research (JOR) during a 30-year period, detected a significant increasing trend in the number of authors per article; the average number of authors was

6.9 ± 2.7 in 2015 compared with 3.7 ± 1.9 in 1983, and there was a decline in the old trend of single authorship.<sup>14</sup> Camp and Escott conducted a bibliometric analysis (including authorship and affiliation trends) of the orthopaedic literature during 1949–2009 and found that the number of authors per article increased from an average of 1.6–5.1 over the 60-year period.<sup>5</sup> The increase in the number of co-authors, that is, enhanced scientist collaboration, helped change the approach to solving difficult problems and led to more innovation compared with that in the past decades.<sup>36</sup>

In the current study, the prevalence of female authors in the JMSR (14.2%) was significantly larger compared to that in the EOJ (0.3%), with the latter showing a profound deficiency of female involvement in the authorship. The results from JMSR are encouraging as they are relatively comparable to reports from western journals; evaluating 6597 articles, Vora et al. found that female authors (regardless of their numerical order in the authors' lists) exhibited a 19.2% prevalence.<sup>35</sup> Evaluating female authorship in the spine literature and more than 24,000 articles published during a 39-year period, Sing et al. reported that female authors constituted 31.8% of the authors, with a significant increase in female authorship (which nearly doubled) during the studied period.<sup>26</sup> Examining 18,354 articles spanning a period of over 46 years, Kim et al. evaluated female authors' contributions to four orthopaedic sports medicine journals originating in the United States. They found that out of the total number of authors, 16.6% were females—with an increase of 2.6% from 1972 to 1979 to an increase of 14.7% from 2010 to 2018.<sup>37</sup> The latter three studies were conducted on subspecialty orthopaedic journals (foot and ankle, spine, and sports medicine). Authorship characteristics for multidisciplinary orthopaedic and trauma journals (like the two journals in the current study) were reported by Brown et al.<sup>24</sup> In another study by Seetharam et al. evaluating the publications from the JOR during a 30-year period, the prevalence of a female being the first or corresponding author improved significantly from 5% and 3% in 1985 to 34% and 27% in 2015, respectively.<sup>14</sup> Although the two latter studies were performed on multidisciplinary orthopaedic and trauma journals and showed a higher prevalence of female authors compared with that for the JMSR, a direct comparison of the results may be inappropriate as both studies reported only on the first and corresponding authors.

In scientific publications, the increase in the cooperation among authors from different institutions both nationally and internationally has recently become more prominent.<sup>14,38</sup> This increase was attributed in part to the advancement in communication technology, which has eased the connection between research groups and authors in different locations.<sup>6,39,40</sup> In the current study, the average number of institutions contributing to the articles was significantly larger for the JMSR compared with that for the EOJ: these averages were 2.1 ± 1.2 and 1.1 ± 0.3 institutions per article, respectively. The results from the JMSR were comparable to those in J. Dynako et al., who evaluated the bibliometric characteristics of the AJSM and the Arthroscopy journal and reported that the average numbers of contributing institutions per article were 2.5 ± 1.8 and 2.4 ± 1.4, respectively.<sup>9</sup> Wininger et al.

noticed an increase in the number of institutions contributing to the articles with the average number of institutions collaborating on a manuscript being 3.4 ± 3.1.<sup>10</sup> Russell et al., analysing the bibliometric characteristics of the Journal of Orthopaedic Trauma and the Injury Journal over 30 years, found that their average numbers of institutions per article were 1.8 ± 1.3 and 2.0 ± 1.4, respectively.<sup>13</sup> In J. Dynako et al., 68% of institutions contributing to the AJSM were national while 32% were international; in the Arthroscopy journal, 60% and 40% of the publications were from national and international institutions, respectively.<sup>9</sup> In our study, we found that the number of national institutions contributing to the articles in the EOJ (96.6%) was significantly larger than that for the JMSR (55.7%); however, the number of cooperations among these local institutions (Category II) was significantly higher in the JMSR (27.9%) compared with that for the EOJ (6%). Moreover, the JMSR showed a significantly higher incidence of contributions from international institutions (Category III, IV, and V), representing 53.3% of all publications vs only 4.7% in the EOJ. The increased incidence in the number of contributions from international institutions reported in the current study for the JMSR was also noted by Wininger et al., who suggested that this was an indicator of a decrease in what they called 'the degree of publications' domesticity'.<sup>10</sup> The same trend of an increase in international institutions' contributions was noted in Schrock et al.<sup>20</sup> and Camp and Escott.<sup>5</sup> The cooperation among different research groups or authors affiliated with various national or international institutions allows for expertise exchange. This leads to solving complex problems more efficiently (especially when a specific problem prevails in some geographical regions) and the eventual improvement in both quantitative and qualitative scientific research.<sup>39–41</sup>

Why is the prevalence of female authorship almost zero in the EOJ and, in the JMSR, relatively lower than that in reports from western literature? The identification of the reasons for this was not the focus of the current study; however, we encountered many suggestions reported in previous studies that may apply to the situation in the current study. Females' academic underrepresentation has been attributed to their lack of exposure or avoidance of all surgical subspecialties (including orthopaedics and trauma) in medical school.<sup>42,43</sup> The misperception that orthopaedic surgery presents great physical demands and the reputation of the orthopaedic field as being 'masculine' may be two other causes.<sup>44,45</sup> Knobloch-Westerwick et al. found that reviewers considered a research article to be of low scientific quality if the topic was considered 'masculine' and the author was female.<sup>46</sup> Alshammari et al., evaluating the challenges and barriers that a female orthopaedic resident in the Gulf Cooperation Council (GCC) region may face, they found that 'gender intolerance' exists among the surveyed orthopaedic residents, where about half of the female responders believed that they were expected to fail, and approximately 43% of the females reported that they were treated differently by the hospital staff compared with a male resident; the authors suggested that this may discourage female physicians from seeking an orthopaedics career.<sup>47</sup> Another reason for this reported by Alshammari

et al. was the lack of a female orthopaedics society, like those present in some countries, like the Ruth Jackson Orthopaedic Society in the United States.<sup>42,47</sup> Female scientists may have extra non-work-related responsibilities, which could be attributed to familial obligations.<sup>43</sup> Further, the possibility of exposure to more radiation and its risk to pregnancy may hinder a female from considering orthopaedics as a speciality.<sup>44,47,48</sup> Although it may also apply in other specialities, the lack of a specific policy regulating maternity and paternity leaves and compensations may be another factor.<sup>48</sup> Additionally, unconscious gender biases and exposure to sexual harassment have been reported in some studies.<sup>49,50</sup>

This study has some limitations. First, the data covered two surgical specialities (orthopaedics and traumatology), making the generalisability of the results of the current study to other medical specialities less accurate. Second, as this was a cross-sectional observational study, we were able to detect the differences among the studied variables but not the causes behind them. Third, a study by Shafiq et al. evaluating the reasons why females choose to join the orthopaedic residency program in the GCC region reported that at the time of the study, a total of 569 residents were identified, of whom only 48 (8.4%) were females.<sup>51</sup> However, apart from the aforementioned study, we did not have access to any database for which we could accurately determine the number of female orthopaedic surgeons registered with each association or practising in each of the Arab countries studied. Fourth, we did not evaluate other bibliometric factors related to the quality of research, such as the level of evidence and number of citations per article or the female authors' numerical position within the author names' lists or their medical degrees. Fifth, the difference in the study period (eight years of publications for the EOJ versus three years for the JMSR) may introduce a bias in our comparisons. Finally, the inconsistency in reporting the institution names in the published articles may have led to undiscovered duplications or omissions in the affiliations results.

## Conclusion

**In conclusion**, although the JMSR is relatively younger than the EOJ, it exhibited better results regarding the number of female authors per article and remarkable contributions by female authors. For JMSR, the number of institutions contributing to an article, the number of co-operations among national institutions, and the number of contributions by international institutions were also larger than those for the EOJ. Further bibliometric studies on other medical journals in sub-specialities different from the ones considered here are highly encouraged.

## Recommendations

Further comparative bibliometric studies evaluating journals in different medical specialities from our area are highly recommended. The number of female authors should be improved by encouraging female scientists on a personal as well as an institutional level. Lewis et al. suggested recruiting female medical students to orthopaedic surgical

careers and preferably female orthopaedic surgeons to act as role models for other females.<sup>45</sup> Alshammari et al. suggested that female orthopaedic residents should be offered a one-year leave for family planning. During this year, they may obtain a master's degree in clinical research, which will increase their chances of participating in research and independently publish articles without the need for male co-authors.<sup>47</sup> Zhuge et al. recommended that institutions should be more flexible by offering paid research time and providing special considerations for familial obligations.<sup>45</sup> Given the cultural and religious characteristics of our region, Alshammari et al. stated that one of the reasons a female physician should be encouraged to join the orthopaedic surgery field is that in an Arabic region, female patients prefer to be seen by female physicians.<sup>47</sup> The creation of national research networks to promote national cooperation among different institutions should be encouraged. Participation in multicentre studies and invitation of international experts to submit their work to journals published in our area are also recommended.

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## Conflict of interest

The authors have no conflict of interest to declare.

## Ethical approval

This article does not contain any experimental studies with human participants or animals performed by any of the authors. Thus, it was exempt from ethical approval.

## Authors contributions

AAK conceived and designed the study; ASE., AES, EMA, and MH acquired the data; and AAK & AMA conducted the analysis of the data and the interpretation of the results. All authors drafted the manuscript and designed the figures and tables, with AAK making the critical revisions. All authors discussed the results and commented on the manuscript. All authors read and approved the final manuscript and are responsible for the content and similarity index of the manuscript. The authors testify that all persons designated as authors qualify for authorship and have examined the article for plagiarism. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

## References

1. Chow DS, Ha R, Filippi CG. Increased rates of authorship in radiology publications: a bibliometric analysis of 142,576 articles published worldwide by radiologists between 1991 and 2012. *AJR Am J Roentgenol* 2015; 204(1): W52–W57.
2. Dotson B, McManus KP, Zhao JJ, Whittaker P. Authorship and characteristics of articles in pharmacy journals: changes

- over a 20-year interval. *Ann Pharmacother* 2011; 45(3): 357–363.
3. Ence AK, Cope SR, Holliday EB, Somerson JS. Publication productivity and experience: factors associated with academic rank among orthopaedic surgery faculty in the United States. *J Bone Jt Surg Am Vol* 2016; 98(10): e41.
  4. Tilak G, Prasad V, Jena AB. Authorship inflation in medical publications. *Inquiry : J Med Care Organ Prov Financ* 2015; 52: 1–4.
  5. Camp M, Escott BG. Authorship proliferation in the orthopaedic literature. *J Bone Jt Surg Am* 2013; 95(7): e44.
  6. Cvetanovich GL, Fillingham YA, Harris JD, Erickson BJ, Verma NN, Bach Jr BR. Publication and level of evidence trends in the American journal of sports medicine from 1996 to 2011. *Am J Sports Med* 2015; 43(1): 220–225.
  7. Reich MS, Shaw J, Barrett I, Goldberg VM, Schnaser E. Level of evidence trends in the journal of bone and joint surgery, 1980–2010. *Iowa Orthop J* 2014; 34: 197–203.
  8. Diamond SJ, Thomas Jr CR, Desai S, Holliday EB, Jagsi R, Schmitt C, et al. Gender differences in publication productivity, academic rank, and career duration among U.S. Academic gastroenterology faculty. *Academic medicine. J Assoc Am Med Colleg* 2016; 91(8): 1158–1163.
  9. Dynako J, Owens GW, Loder RT, Frimpong T, Gerena RG, Hasnain F, et al. Bibliometric and authorship trends over a 30 year publication history in two representative US sports medicine journals. *Heliyon* 2020; 6(3): e03698.
  10. Wininger AE, Fischer JP, Likine EF, Gudeman AS, Brinker AR, Ryu J, et al. Bibliometric analysis of female authorship trends and collaboration dynamics over JBMR's 30-year history. *J Bone Miner Res : Off J Am Soc Bone Min Res* 2017; 32(12): 2405–2414.
  11. Khan F, Sandelski MM, Rytlewski JD, Lamb J, Pedro C, Adjei MBN, et al. Bibliometric analysis of authorship trends and collaboration dynamics over the past three decades of BONE's publication history. *Bone* 2018; 107: 27–35.
  12. Brinker AR, Liao JL, Kraus KR, Young J, Sandelski M, Mikesell C, et al. Bibliometric analysis of gender authorship trends and collaboration dynamics over 30 Years of spine 1985 to 2015. *Spine* 2018; 43(14): E849–E854.
  13. Russell AF, Nguyen M, Bhuiya M, Likine EF, Fischer JP, Grassel K, et al. Comparative analysis of bibliometric, authorship, and collaboration trends over the past 30-year publication history of the journal of orthopaedic trauma and Injury. *J Orthop Trauma* 2018; 32(8): e327–e333.
  14. Seetharam A, Ali MT, Wang CY, Schultz KE, Fischer JP, Lunsford S, et al. Authorship trends in the journal of orthopaedic research: a bibliometric analysis. *J Orthop Res: Off Publ Orthopaed Res Soc* 2018; 36(11): 3071–3080.
  15. Gu A, Almeida N, Cohen JS, Peck KM, Merrell GA. Progression of authorship of scientific articles in the journal of hand surgery, 1985–2015. *J Hand Surg* 2017; 42(4): 291. e1–e6.
  16. Fischer JP, Wininger AE, Scofield DC, Tucker A, Kacena-Merrell EJ, Whipple EC, et al. Historical analysis of bibliometric trends in the journal of pediatric orthopaedics with a particular focus on sex. *J Pediatr Orthoped* 2018; 38(3): e168–e171.
  17. Andry D, Moliver C, Phillips LG. An analysis of female plastic surgery authorship: where are we today? *Plast Reconstr Surg* 2019; 143(1): 327–331.
  18. Bergeron JL, Wilken R, Miller ME, Shapiro NL, Bhattacharyya N. Measurable progress in female authorship in otolaryngology. *Otolaryngology–head and neck surgery. Off J Am Acad Otolaryngol-Head Neck Surg* 2012; 147(1): 40–43.
  19. Gayet-Ageron A, Poncet A, Perneger T. Comparison of the contributions of female and male authors to medical research in 2000 and 2015: a cross-sectional study. *BMJ open* 2019; 9(2): e024436.
  20. Schrock JB, Kraeutler MJ, McCarty EC. Trends in authorship characteristics in the American journal of sports medicine, 1994 to 2014. *Am J Sports Med* 2016; 44(7): 1857–1860.
  21. Mimouni M, Zayit-Soudry S, Segal O, Barak Y, Nemet AY, Shulman S, et al. Trends in authorship of articles in major ophthalmology journals by gender, 2002–2014. *Ophthalmology* 2016; 123(8): 1824–1828.
  22. Campbell JC, Yoon SC, Grimm LJ. Collaboration metrics among female and male researchers: a 5-year review of publications in major radiology journals. *Acad Radiol* 2018; 25(7): 951–954.
  23. Erden Aki O, Ozcelik Eroglu E, Uslu E. Longitudinal analysis of female authorship of psychiatry articles in Turkey. *Noro psikiyatri arsivi* 2015; 52(1): 95–98.
  24. Brown MA, Erdman MK, Munger AM, Miller AN. Despite growing number of women surgeons, authorship gender disparity in orthopaedic literature persists over 30 years. *Clin Orthop Relat Res* 2020; 478(7): 1542–1552.
  25. Long MT, Leszczynski A, Thompson KD, Wasan SK, Calderwood AH. Female authorship in major academic gastroenterology journals: a look over 20 years. *Gastrointest Endosc* 2015; 81(6): 1440–1447. e3.
  26. Sing DC, Jain D, Ouyang D. Gender trends in authorship of spine-related academic literature—a 39-year perspective. *Spine J : Off J North Am Spine Soc* 2017; 17(11): 1749–1754.
  27. Okike K, Liu B, Lin YB, Torpey JL, Kocher MS, Mehlman CT, et al. The orthopedic gender gap: trends in authorship and editorial board representation over the past 4 decades. *Am J Orthoped* 2012; 41(7): 304–310.
  28. Amankwah N, Park M, Gu A, Choi BG. Trends in authorship demographics for manuscripts published in the American journal of cardiology. *Am J Cardiol* 2018; 122(7): 1255–1259.
  29. Abdellatif W, Ding J, Jalal S, Nguyen T, Khorshed D, Rybicki FJ, et al. Lack of gender disparity among administrative leaders of Canadian health authorities. *J Wom Health* 2020; 29(11): 1469–1474.
  30. Arrighi-Allisan AE, Shukla DC, Meyer AM, Kidwai SM, Barazani SH, Cosetti MK, et al. Gender trends in authorship of original otolaryngology publications: a fifteen-year perspective. *Laryngoscope* 2020; 130(9): 2126–2132.
  31. Bendels MHK, Muller R, Brueggemann D, Groneberg DA. Gender disparities in high-quality research revealed by Nature Index journals. *PLoS One* 2018; 13(1): e0189136.
  32. Siddiqi A, Stoppani J, Anadon LD, Narayanamurti V. Scientific wealth in Middle East and North africa: productivity, indigeneity, and specialty in 1981–2013. *PLoS One* 2016; 11(11): e0164500.
  33. Aboukhalil R. The rising trend in authorship. *The winnower* 2014; 2:e141832.
  34. Ojerholm E, Swisher-McClure S. Authorship in radiation oncology: proliferation trends over 30 years. *Int J Radiat Oncol Biol Phys* 2015; 93(4): 754–756.
  35. Vora M, Kuripla C, Ouyang D, Sing DC. Gender trends in authorship of foot and ankle academic literature over 24 years. *J Foot Ankle Surg : Off Publ Am Coll Foot Ankle Surg* 2019; 58(5): 898–903.
  36. Larivière V, Gingras Y, Sugimoto CR, Tsou A. Team size matters: collaboration and scientific impact since 1900. *J Assoc Inform Sci Technol* 2015; 66(7): 1323–1332.
  37. Kim CY, Sivasundaram L, Trivedi NN, Gilmore A, Gillespie RJ, Salata MJ, et al. A 46-year analysis of gender trends in academic authorship in orthopaedic sports medicine. *J Am Acad Orthop Surg* 2019; 27(13): 493–501.
  38. Pinter A. Changing authorship patterns and publishing habits in the European journal of pediatric surgery: a 10-year analysis. *Eur J Pediatr Surg : Off J Austr Assoc Pediatr Surg [et al]= Zeitschrift fur Kinderchirurgie* 2015; 25(4): 353–358.

39. Parker M, Kingori P. Good and bad research collaborations: researchers' views on science and ethics in global health research. *PLoS One* **2016**; 11(10):e0163579.
40. Zeng XH, Duch J, Sales-Pardo M, Moreira JA, Radicchi F, Ribeiro HV, et al. Differences in collaboration patterns across discipline, career stage, and gender. *PLoS Biol* **2016**; 14(11): e1002573.
41. Sugimoto CR, Thelwall M, Lariviere V, Tsou A, Mongeon P, Macaluso B. Scientists popularizing science: characteristics and impact of TED talk presenters. *PLoS One* **2013**; 8(4):e62403.
42. O'Connor MI. Medical school experiences shape women students' interest in orthopaedic surgery. *Clin Orthop Relat Res* **2016**; 474(9): 1967–1972.
43. Zhuge Y, Kaufman J, Simeone DM, Chen H, Velazquez OC. Is there still a glass ceiling for women in academic surgery? *Ann Surg* **2011**; 253(4): 637–643.
44. Miller EK, LaPorte DM. Barriers to women entering the field of orthopedic surgery. *Orthopedics* **2015**; 38(9): 530–533.
45. Lewis VO, Scherl SA, O'Connor MI. Women in orthopaedics—way behind the number curve. *J Bone Jt Surg Am* **2012**; 94(5): e30.
46. Knobloch-Westerwick S, Glynn CJ, Huge M. The Matilda effect in science communication: an experiment on gender bias in publication quality perceptions and collaboration interest. *Sci Commun* **2013**; 35(5): 603–625.
47. Alshammari AN, Shafiq MO, Altayeb MA, Khaja AF, Ghabban KM, Khoshhal KI. Gulf cooperation Council female residents in orthopedics: influences, barriers, and mental pressures: a cross-sectional study. *J Musculoskelet Surg Res* **2018**; 2(2): 51.
48. Mayer KL, Ho HS, Goodnight Jr JE. Childbearing and child care in surgery. *Arch Surg* **2001**; 136(6): 649–655.
49. Lu DW, Lall MD, Mitzman J, Heron S, Pierce A, Hartman ND, et al. #MeToo in EM: a multicenter survey of academic emergency medicine faculty on their experiences with gender discrimination and sexual harassment. *West J Emerg Med* **2020**; 21(2): 252–260.
50. Jagsi R, Griffith KA, Jones R, Perumalswami CR, Ubel P, Stewart A. Sexual harassment and discrimination experiences of academic medical faculty. *J Am Med Assoc* **2016**; 315(19): 2120–2121.
51. Shafiq MO, Khaja AF, Alshammari AN, Altayeb MA, Ghabban KM, Khoshhal KI. The journey of orthopaedic surgery from residency to fellowship: a cross-sectional study in the Gulf Cooperation Council countries. *J Taibah Univ Med Sci* **2019**; 14(2): 131–138.

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