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Narrowing gender gap in the research on echinococcosis and editorial contribution of women in parasitology journals

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Abstract

Gender equity and authorship diversity are believed to be the essential parts of building a dynamic scientific atmosphere. The purpose of the present study was to determine the status of gender equity in research on echinococcosis and the editorial diversity in major parasitology journals over the past four decades. All articles were retrieved from major databases from the years 1980, 2000, 2010, 2015, and 2020. Journals belonging to the four quartiles of parasitology journals listed in the Journal Citation Report were selected, and the gender and region of each editorial member were identified. Among the 3583 first authors of the articles published in all selected years, 2236 (62.4%) were men, whereas 1040 (29%) were women. There was a significant increase in women's contributions as the first author, from 6.8% in 1980 to 35.8% in 2020 ($P < .001$). A greater gender gap was found for the senior authors, showing 2391 (66.7%) men and 837 (23.4%) women. The gender gap has been narrowed in most of the six regions of the world, particularly for the Western Pacific region, where the gender inequity had almost diminished in 2020; i.e. the man-woman ratios of the first and last authors from this region were 2.25 and 1.75 in 1980, reaching 1.04 and 0.97, in 2020, respectively. Our findings also indicated that articles authored by men received 2.5 to 3.1 times more citations than women authors. Gender distribution of the editors-in-chief, associate editors, and editorial board members across all quartiles showed that 78.7%, 69.5%, and 72.7% were men, respectively, and mostly affiliated with the European and American regions. Findings of the present study showed that gender inequity is still present and women researchers continue to be the minority in the field of parasitology, particularly in the research on echinococcosis.

Introduction

Over the past several decades, the number of published scientific articles has increased by 8% to 9% annually, and the number tripled from about 1 million in 1990 to 3 million in 2016. Each year, more than 1 million biomedical articles are indexed in PubMed (Landhuis 2016). This is partly because of the two-fold increase in global collaboration for publishing scientific articles from 1990 to 2011. As a result, productive scientists from different countries across the globe are participating in international scientific studies (Wagner *et al.* 2015). However, less research focus has been placed on neglected tropical diseases (NTDs) as well as other parasitic infections. Marginalized societies have long been battling with this group of communicable diseases that cause significant burdens to local public health systems (Engels and Zhou 2020). An important zoonotic NTD, echinococcosis, also known as hydatid disease, is a group of tapeworm infections, mainly caused by the larval stages of the two species of *Echinococcus*, namely *E. granulosus* and *E. multilocularis*, causing cystic and alveolar echinococcosis, respectively (Deplazes *et al.* 2017; McManus *et al.* 2003). Echinococcosis causes significant morbidity as well as high economic burden on endemic communities worldwide. It is estimated that echinococcosis imposes about 1 million disability-adjusted life years worldwide each year (Parandin *et al.* 2021). The direct and indirect costs of echinococcosis worldwide have been estimated at US$ 3 billion (WHO 2021).

Despite several other NTDs, echinococcosis has widespread distribution across all continents, however the disease is believed to be a "neglected neglected tropical disease". Echinococcosis has not been prioritized for research at local or global levels and has often been excluded from the list of major tropical diseases supported by different international research funding bodies (Budke *et al.* 2009). As a result, inadequate human resources have been allocated to the research and training on echinococcosis. Although the number of published scientific articles related to echinococcosis has dramatically increased over the past several decades, it does not reflect a fair diversity in terms of geographical and gender distribution of the researchers involved in echinococcosis research (Ma *et al.* 2019). In many endemic countries, men are more involved in major field studies on echinococcosis than women.

Recently, the academic community has shown an increased interest in gender inequity because it was proved to be persistent in academic publishing (Anonymous, 2023). Several proposals have been suggested for evaluating researchers' scientific activities including number of publications, number of citations, and editorial contributions to scientific publishing. The concept of 'gender equity' implies that every individual has the same rights, opportunities, and privileges (International Labour Organization 2000). Gender inequity is still present in the world of science. Over the past two decades, whereas the number of women graduate students from medical schools has increased steadily (Association of American Medical Colleges 1994), cohort studies showed that women physicians get fewer promotions to full professorship in academic institutions, and are less likely to hold leadership in high academic positions (Nonnemaker 2000; Richter *et al.* 2020). Another study found that women account for almost more than half of the physicians in OECD (Organisation for Economic Co-operation and Development) countries; however, women medical researchers still continue to be the minority (Catalyst 2020).

According to the report on women in science, in 2016, less than 30% of the world's researchers were women, despite the increasing representation of women in all fields of science since the 1990s. A narrower gender gap was found in biomedical sciences compared to other fields of science (UNESCO 2019). In life sciences, although women make up approximately half of the student population, women only constitute one in four professors in these same fields, according to data from more than 500 scientific institutions worldwide (English *et al.* 2020). In another study, women's representation as first author of academic literature in the field of critical care has been evaluated. The study found that women contributed to less than one third of first authors and one fourth of senior authors, with minimal increase over the past decade (Vranas *et al.* 2020).

The gender bias has even affected the parasite nomenclature and editorial diversity in the field of parasitology. A recent study found a consistent gender bias among species named after eminent scientists, with men researchers being over-represented compared to women. Among scientists whose names were proposed for different new species of parasites, only eight of 71 were women. This type of gender gap has shown no improvements over the past two decades (Poulin *et al.* 2022). Lack of diversity in editorial boards can also affect science as a whole. The quality of the parasitology field can be affected by the lack of representation and low diversity (Calvani *et al.* 2023; Mahdjoub *et al.* 2022). Our understanding needs to be improved about different aspects of gender and geographic biases in editorial boards of the scientific journals in each specific field of science.

The present study investigated the status of gender distribution in the research on echinococcosis over the past four decades and explored the editorial contribution of women in parasitology journals. We chose to study echinococcosis because echinococcosis has a widespread distribution across all continents including both high- and low-income countries, whereas most of the other helminth NTDs are more or less limited in distribution to the low- and middle-income countries.

Materials and methods

This study is a descriptive analysis of the data related to the trends and patterns of gender gap. We conducted this study to investigate gender inequity in the authorship of the articles published on echinococcosis and hydatid disease. Also, in the present study the editorial team of the selected parasitology journals were evaluated on a gender basis. In the present study, we consider 'gender' and 'equity' as defined by the United Nations (UNICEF 2017), in comparison to other related terms including 'sex' and 'equality/parity'. Sex is a biological category usually assigned at birth, based on physical characteristics. On the other hand, 'gender' is a concept shaped by society and culture, representing a diverse range of identities that exist along a spectrum. The concept of 'gender equity' implies a fair treatment for all genders so that every individual has equal chances, opportunities, responsibilities, and outcomes. Another issue is related to the concept of gender. The present study was established on the gender binary in which individuals are considered as men or women. The glossary of gender-related terms has been expanded and gender is now defined as a spectrum (Rioux *et al.* 2022). However, we were not able to ascertain the gender of some authors with nonbinary identities.

All the steps of this study followed the ethical principles of Kerman University of Medical Sciences and was approved by the institute with the approval code IR.KMU.REC.1401.539.

We performed a comprehensive literature search using various combinations of the keywords 'Hydatid Cyst,' 'Hydatid Disease,' 'echinococcosis,' and 'echinococcus'. To understand the temporal evolution in gender contribution to scientific publishing, we compared five representative years from 1980 to 2020 including 1980, 2000, 2010, 2015, and 2020. We collected data from the two major biomedical databases: NCBI PubMed and Scopus. All types of scientific publications matching the keywords were included in the study with no language limitations. All the articles with no available author names were excluded from the study.

Based on the selected keywords and years, all the article features were exported to a spreadsheet file (Microsoft Excel) and were classified based on the year of the publication. The features of each article include title, publication year, publisher (for 2010 and 2020), number of citations, first author gender, first author affiliation, last author gender, and last author affiliation. In this study, last authors were considered as a proxy for senior authorship. We established the first and last authors' region based on their country of affiliation. World Health Organization global classification was considered, in which the member states are categorized into six regions including Africa (AFR), Americas (AMR), Southeast Asia (SEAR), European (EUR), Eastern Mediterranean (EMR), and Western Pacific (WPR) (https://en.wikipedia.org/wiki/List_of_WHO_regions).

Author first names were used to determine the gender of the first and last authors of the selected articles. We determined the gender of the first and last authors manually using a gender guesser application (https://www.popular-babynames.com/). In the exported file, some of the authors' first names were initials or were unisex; in those cases, we determined the author's gender by visiting the article webpage and/or the affiliation website of the author. If the author's first name was not mentioned in the databases, we searched for it in the journal webpages, the article full-text, or on the website of the author affiliation. Despite all these efforts, for some of the articles, we could not determine the gender with confidence because the first names of the authors were written in initials, particularly in the decades before 2000.

To investigate the gender diversity and regional distribution of the editorial team of parasitology journals, the top 10% of each of the four quartiles of the journals listed in the category of Parasitology in Clarivate's Journal Citation Report (JCR) were selected. For the editors-in-chiefs (EICs), in total, all 36 journals listed in the parasitology category on Clarivate's JCR were considered (Supplementary Table 4). For each journal, the publisher was

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recorded, and based on each journal's information available on the journal webpages, the editors and editorial board of each journal were classified into three categories including editors-in-chief, associate editor, and editorial board member. The EICs of all journal titles within the category were included because of the small number of EICs. Gender, country of affiliation, and the region of each editorial team member were identified as described in the previous section.

Statistical analyses were conducted using SPSS version 26 (IBM Corp., Armonk, NY). Chi-square test for trend was used to explore gender differences in authorship, geographical regions, and citation counts across the five representative years. A P value < .05 was considered statistically significant. The graphs in the manuscript were produced using GraphPad Prism software, version 6.

Results

According to the study objectives and inclusion criteria, all articles were retrieved from PubMed and Scopus for the years 1980, 2000, 2010, 2015, and 2020. After removing duplicates, a total of 3583 relevant articles were identified in the literature search. Research publications showed an increasing trend of publications in the past four decades, from 322 articles in 1980 to 1093 in 2020.

Gender diversity among authors

Figure 1 shows the comparative contribution of men and women authors of articles published on echinococcosis between 1980 and 2020. Among the 3583 first authors of the articles published in all selected years, 2236 (62.4%) were men, whereas 1040 (29%) were women. The gender of 307 (8.6%) authors could not be determined. The findings indicate a statistically significant increase in women's contribution as the first author, from 6.8% in 1980 to 35.8% in 2020 (P < .001) (Supplementary Table 1). Looking into the last authors' gender, the findings of the study indicate a greater gender gap than in the first authors, showing 2391 (66.7%) men and 837 (23.4%) women last authors (Figure 1). However, we were not able to identify the gender of 355 last authors. Analysis of the total number of last authors in the selected years showed that female last authors composed only around 23.4% of all last authors, with an increasing trend ranging from 9.6% in 1980 to 28.5% in 2020, indicating that the gender gap among the last authors has been narrowing over time (Figure 1).

Gender disparity in authorship by geography

Analysis of the distribution of first authors by region showed that the European region (EUR) led in the number of first authors during 1980 to 2020, whereas EMR and WPR showed the most remarkable rise in the number of first authors. Across the six regions covered in our study, EUR is the leading region in the total number of last authors for all studied years (Figure 2, Supplementary Table 3).

Looking at all-year data, men's dominance in authorship was almost similar among different regions, except for WPR in which the gender gap was not remarkable. However, the time trend analysis showed the gaps are significantly reduced between 1980 and 2020 (P < .001) (Fig. 2, Supplementary Table 3). Authors from all six regions showed a substantial gender gap over the past four decades. However, the gap has been narrowed in most of the regions. This is particularly true for the WPR, where the gender inequity is almost diminished in 2020; i.e. men-women ratios of the first and last authors were 2.25 and 1.75 in 1980, reaching 1.04 and 0.97 in 2020, respectively. Tables 1 and 2 show the top 10 countries from where the first and senior authors publishing articles on echinococcosis were affiliated. First and senior authors from Turkey, China, India, and Iran led this list. Regarding women's contribution in publishing, China leads the list as more than 40% of the first and last authors were women. Nevertheless, it should be mentioned that 35 (10%) of the Chinese first and last authors' gender is unknown.

Gender disparity in citations

Our findings indicated that, on average, articles authored by women received fewer citations than those authored by men, with only 22.5% and 26.6% of total citations received by women first

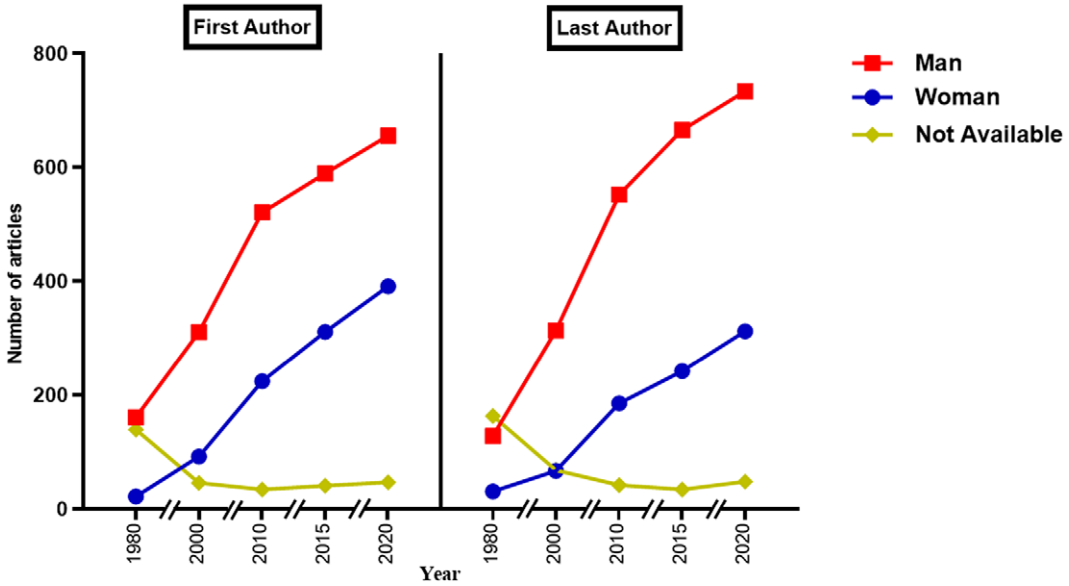

Figure 1. The trend of the total number of articles published on echinococcosis between 1980 and 2020 according to male and female contributions as first and last author.

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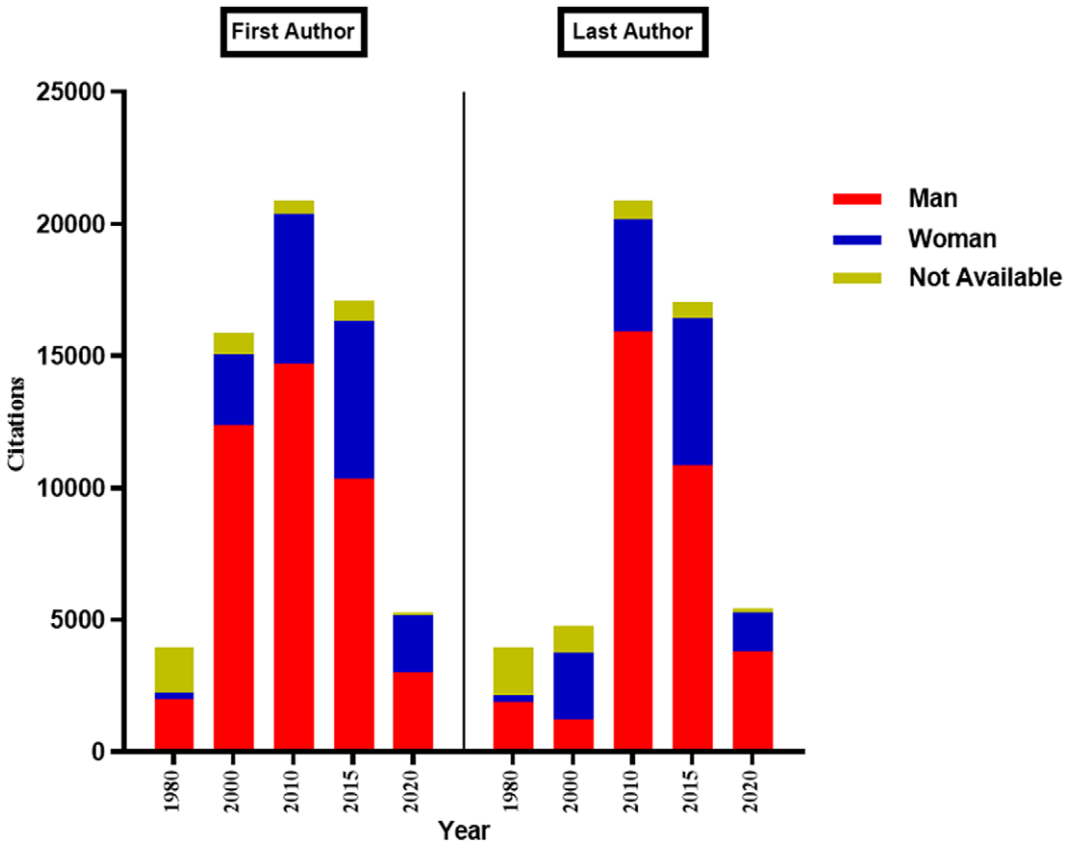

Figure 2. The trend of the total number of articles published on echinococcosis between 1980 and 2020 according to male and female contributions as first and last author in six geographical regions of the world.

Table 1. Top 10 countries with the highest number of publications on echinococcosis according to first authors' gender in 1980, 2000, 2010, 2015 and 2020 (total count)

Country	Total number of publications	No. women first authors, (%)	No. of men first authors (%)	N/A, No. (%)
Turkey	423	94 (22.2)	328 (77.5)	1 (0.3)
China	351	159 (45.3)	153 (43.6)	39 (11.1)
India	301	87 (28.9)	196 (65.1)	18 (6)
Iran	224	66 (29.4)	156 (69.6)	2 (0.9)
USA	138	41 (29.7)	94 (68.1)	3 (2.2)
France	135	33 (24.4)	81 (60)	21 (15.6)
Germany	135	29 (21.5)	83 (61.5)	23 (17)
Italy	131	42 (32)	82 (62.6)	7 (5.4)
Spain	124	35 (28.2)	79 (63.8)	10 (8)
Tunisia	120	40 (33.3)	74 (61.7)	6 (5)

N/A = not available.

and last authors, respectively. However, the number of citations to women authors considerably increased over time, especially for the women first authors, in which the number of citations has increased from 17.2% in 2000 to 41.8% in 2020 (Figure 3). Because these findings in the study stand true, it may be worth mentioning that 6.3% and 6.8% of total citations received by first and last authors are not determined, respectively (Supplementary Table 1).

Gender diversity among the editorial team

To investigate the gender diversity and regional distribution of the EICs of parasitology journals, a total of 36 journals listed in the parasitology category on Clarivate's JCR were considered. A total of 816 editorial team members were found, of which only 224 (27.4%) were women (Figure 4). Of a total of 61 EICs, 48 (78.7%) were men. Members affiliated with the EUR and AMR regions constitute

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Table 2. Top 10 countries with the highest number of publications on echinococcosis according to last authors' gender in 1980, 2000, 2010, 2015, and 2020 (total count)

Country	Total number of publications	No. of women last authors, (%)	No. of men last authors, (%)	N/A, No. (%)
Turkey	425	84 (19.8)	338 (79.5)	3 (0.7)
China	352	156 (44.3)	161 (45.7)	35 (10)
India	301	70 (23.3)	205 (68.1)	26 (8.6)
Iran	219	60 (27.4)	153 (69.9)	6 (2.7)
USA	148	42 (28.4)	102 (68.9)	4 (2.7)
Italy	138	38 (27.5)	91 (66)	9 (6.5)
Germany	134	15 (11.2)	101 (75.4)	18 (13.4)
Spain	131	36 (27.5)	86 (65.6)	9 (6.9)
France	129	23 (17.8)	76 (58.9)	30 (23.3)
Tunisia	120	18 (15)	92 (76.7)	10 (8.3)

N/A = not available.

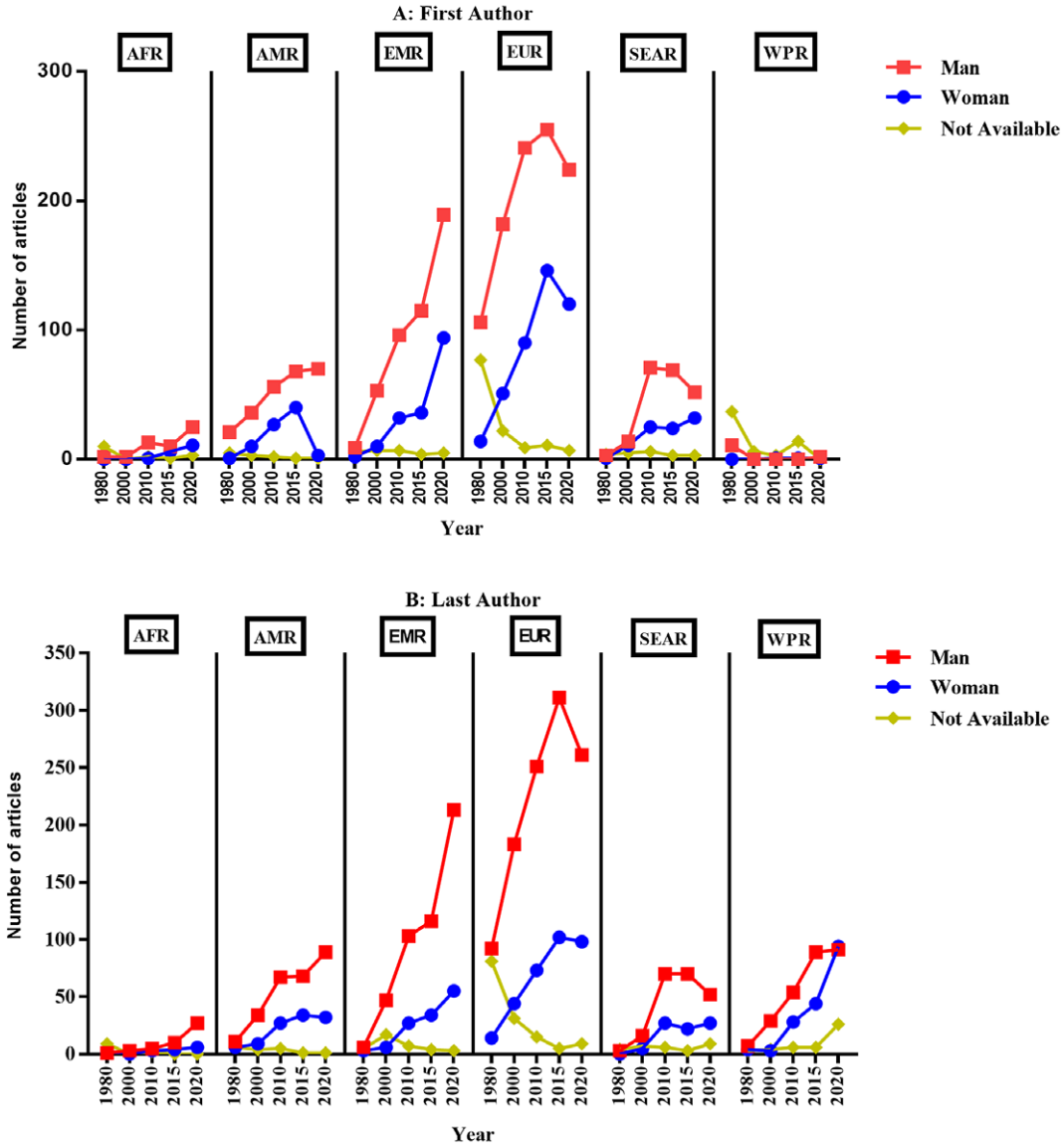

Figure 3. Total number of citations to the articles published on echinococcosis between 1980 and 2020 according to the gender of the first and last authors.

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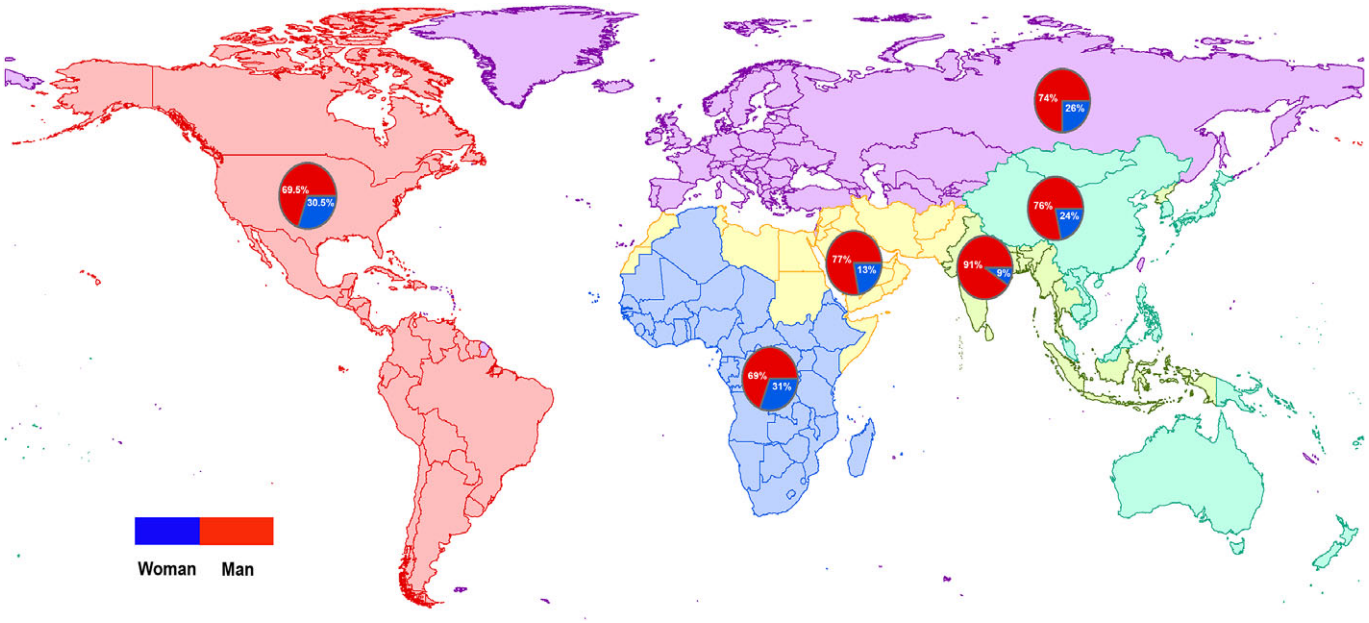

Figure 4. Global map showing the gender distribution of all the editorial team members of the selected journals in Journal Citation Report's category of Parasitology in six geographical regions of the world.

68.8% of the journals' EICs. AFR and SEAR regions had the least number of members, each having only one EIC (1.6%). Among all quartiles, journals in the Q3 category had the most diverse regional distribution, whereas the rest did not include any EIC from AFR and SEAR regions (Supplementary Table 2).

To investigate other members of the editorial board, the top 10% of the journals in each quartile were selected, making a total of 12 journals. Gender distribution of associate editors showed that 82 of 118 members (69.5%) were men (Supplementary Table 2).

Associate editors were only affiliated with AMR, EUR, and WPR regions, with AMR having the most members (n = 80, 67.8%) in total. Most of the associate editors were found in Q1 journals with 74 members of 118 (62.7%). In this category, of 74 associate editors, 70 (94.6%) were affiliated with AMR and EUR regions (Supplementary Table 2).

We found 637 editorial board members across all quartiles, of whom 463 (72.7%) were men.

In terms of regional distribution, the AMR region had the most editorial board members (n = 332, 52.1%), followed by the members from the European region (n = 207, 32.5%). Q2 and Q4 journals showed the most regional diversity, with editorial board members from all six geographical regions (Supplementary Table 2).

Discussion

Twelve parasitic infections including cystic and alveolar echinococcosis are among the most important neglected tropical diseases. Echinococcosis causes a significant burden on public health systems in endemic countries. One of the major aspects of most parasitic infections is poor funding and inadequate human resources related to the research and training for these infections (Hotez *et al.* 2020). During the past decades a remarkable body of scientific information has been produced on different aspects of echinococcosis and hydatid disease. Gender equity and authorship diversity is an essential part of building a dynamic scientific atmosphere (Yang *et al.* 2022). However, gender inequity is still present in the world of science, and women researchers continue to be the minority.

The present study investigated the progress of gender equity in research on echinococcosis, an important parasitic zoonosis, and explored the editorial diversity in major parasitology journals over the past four decades. The findings of the present study indicate that significant inequity remains despite the notable increase in women's contribution to academic publishing and leadership roles. Throughout all five representative years from 1980 to 2020, two thirds of the first authors of echinococcosis articles were men. This means for every woman first author, there are two men (Figure 1). Moreover, the gender gap between the last authors was even greater, as less than a quarter of all last authors were women (Supplementary Table 1).

Studies showed significant gender inequity in different scientific fields suggesting that women are under-represented in most scientific research positions (Holman *et al.* 2018). Moreover, compared to men, they get fewer promotions in academic institutions, are less likely to hold leadership roles in high academic positions, and are less likely to get citations for their published works (Nonnemaker 2000; Richter *et al.* 2020; Sebo and Clair 2023). An analysis of active authors in medicine subfields across various countries, including the EU28, during the two timeframes of 1999–2003 and 2014–2018, reveals the ratio of men to women was consistently higher among senior authors when compared to the overall author population (Elsevier 2020). However, in the past decade, a positive shift was found towards gender equity in recent years compared to two decades ago. Our findings also showed an increasing contribution of women in academic publishing on echinococcosis as a neglected tropical disease, indicating a five- and three-fold increase in the first and senior authorships between 1980 and 2020, respectively. Altogether, considering the data from all five years, the findings showed overall gender equity has made progress since 1980. Amongst the first authors, gender inequity had a decreasing trend from 1980 to 2020, with men's dominance falling from 43.2% in 1980 to 24.1% in 2020. In another study that looked into the gender distribution amongst American surgeons over two decades,

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women's authorship as either the first or last author was found to have a gradual increase, each almost tripling from 1997 to 2017 (Tran *et al.* 2022). In recent years more women are being recruited as faculty members and for senior positions. On the other hand, the number of women who are willing to leave the workforce for family commitments is decreasing (Metz 2011). However, according to a recent study, still many highly trained and talented individuals essential for research and education are held back in their academic careers due to gender bias (Llorens *et al.* 2021). Improving women's representation in academic activities and narrowing the gender gap is the set goal of the most scientific institutions across the world (Gmeiner *et al.* 2022).

A recent study analyzing 16,000 articles published by the people quoted directly in *Nature*'s written journalism between 2005 and 2020, found that only 13% of the people quoted directly in *Nature*'s written journalism in 2005 were women. Although women's representation was increased to 31% in 2020, this is still unacceptably low. *Nature*'s editorial teams pledged to narrow this gap and to repair women's under-representation (Anonymous 2023). In the same study, more than 75% of the people participating in *Nature*'s journalism were affiliated with North America and Europe. Therefore, it can be concluded that lower women's representation is prevailing even in high income countries of these regions. Another survey conducted by *Cell* journal, uncovered a noticeable gender imbalance among reviewers, predominantly favoring American male reviewers. Consequently, it was found that 82% of reviewers in 2018 were male, with 67% of male reviewers originating from the United States (Narasimhan 2019).

Findings of the present study indicate that the highest and lowest number of authors publishing on echinococcosis were affiliated with the EUR and AFR regions, respectively. This is in line with similar studies conducted on other fields of biomedical research. Recent studies have pointed out that most of the authors were from AMR and EUR regions indicating the under-representation of researchers from low- and middle-income countries (Gupta *et al.* 2022; Mahdjoub *et al.* 2022). A remarkable gender gap was also found within each region. Looking into the first authors' gender, categorized based on the six regions, authors affiliated with the countries in EMR and AFR regions presented the greatest gender gap, with men having 43.3% and 40.1% more contribution than women first authors, respectively. Even in the EUR region with the leading number of first authors (43.4%), the gender gap is prominently high, with more than a two-fold difference between men and women first authors (Figure 2, Supplementary Table 3).

Furthermore, considering the regional distribution of senior authors' genders, the gender gap between the regions was greater than that of the first authors. Again, the gender gap in EMR was the highest across all six regions, with a nearly four-fold difference between the two genders, followed by the EUR region with a gender inequity of more than three-fold. WPR region presents the least gender inequity among the six regions. Findings of a study showed a negative association between the country's income and the width of the gender gap (Hornstein et al. 2022). Human development indices in WPR countries have been significantly improved over the past several decades. Human development indices in China have significantly increased to the extent that they have moved from the low category to the high in past decades. China makes up the majority of the population of the WPR, and 10.7% of all senior authors in our study were affiliated with China. Therefore, as shown in Figure 2, it can be concluded that the major part of the rise in women representation in WPR is due to the improved human development status in China (UNDP 2019). Narrowing gender gap in STEM education in China might come from a shift in parents, school, and society expectations which led to fair treatment, fight stereotypes, and encourage women to participate in STEM (Hanfei 2022). This is partly due to the change of China's one-child policy. This policy was introduced in 1979 and after more than three decades was replaced by a two-child policy. Different impacts of the one-child policy include: skewing the sex ratio (male/female ratio at birth increased from 107 in 1980 to 121 in 2004) and greater parental investment on singleton daughters (Sudbeck 2012). The latter can play a role in narrowing the gender gap in STEM research, providing better chances for education for singleton girls.

Regarding other policies, Chinese government has made consistent effort in relevant policies and organizations to improve women's access to education, and various national mechanisms to guarantee women's right to education have been constantly improved. At the institutional level, China has gradually established such national institutions as the Working Committee on Women and Children under the State Council and the All-China Women's Federation to improve the status of women and promote gender equality. In addition, state funds and resources for women's education have been increasing (Lingyu *et al.* 2021)

In line with several other studies, our findings showed that compared to men, women researchers received only 1/4 to 1/5 of total citations. It has been shown that articles written by women as first/last author in high-impact general medicine journals were less cited on average than those written by men (Chatterjee & Werner, 2021). Studies indicate that women are less cited than their male counterparts with similar quality of work (Calvani *et al.*, 2023). This inequity is also reflected in academic metrics like h-index. Geraci *et al.* described the presence of a gender effect in h-index in psychology, and concluded that the h-index may reflect systematic gender differences in academic promotions (Geraci *et al.*, 2015). According to our findings, considering the number of citations as an indirect indicator of article quality it seems that women authors are also under-represented regarding this particular aspect of scientific publishing (Figure 3).

In our study, a lower contribution of women was documented in all three categories of editorial roles, including EIC, associate editor, and editorial board member. More than 70% of the editorial members of all the 36 representative parasitology journals were men. This dominance was not limited to the journals in a specific quartile, as women were under-represented in all quartiles. Across all quartiles of journals, women held less than 30% of EIC positions. Women in Q1 journals had the most contribution in this position with 32%. This is in line with other related studies. In a study on women's representation in infectious diseases and microbiology research in 167 journals, 22% and 27.3% of EICs and editorial board members were women, respectively (Ayada *et al.*, 2022). Interestingly, as shown by Grinnell *et al.*, even in women's health-related journals, women only occupied 42% of the total editorial positions, 41% of EIC positions, and 43% of associate editor positions (Grinnell *et al.*, 2020). The senior editorial roles are generally offered to academics in their mid- or late-career phases. Several key elements can be explained on the gender disparity in editorial roles. One issue in some countries is uneven gender representation among undergraduates pursuing academic careers, leading to an initial gap. In certain scientific fields, cultural and institutional barriers affect gender balance. In many countries, equal numbers of women and men are enrolled in undergraduate programs (Llorens et al., 2021). Moreover, in undergraduate biomedical programs, more women are enrolled in many academic institutions,

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and this means that we are facing greater barriers to overcome challenges related to men's dominance in senior academic positions. To address this, we need initiatives promoting equal representation of women in senior roles, aligning with the gender balance at junior and undergraduate levels (Llorens et al., 2021).

Analysis of the geographical distribution of the editorial team of the representative journals indicates that more than half of the editorial members were affiliated with AMR. Although EMR researchers publish 18% of the articles on echinococcosis, the contribution of this region in the editorial team was only 5%. This presents a geographical inequity in the scientific forum of parasitic infections that are mostly known as neglected tropical diseases.

A key limitation of this research is that we were unable to determine the gender of a proportion of authors, especially in the 1980s because the first names of the authors were written in initials in the decades before 2000. We also included 1980 and 2015 to examine the very far past and very recent gender representation trends, respectively. Fortunately, this problem is being addressed by several publishers. Currently, researchers are facing inquiries about their gender, race, and ethnicity when submitting papers as part of a broader effort to assess diversity in scientific publishing. This aligns with the larger movement to address racial and gender disparities within the scientific community. Also, misclassifications, particularly in the case of unisex names, can occur as we manually determine an author's gender using the first names. To address this issue, we searched the authors using their affiliation.

It is essential to recognize that our study focused on echinococcosis primarily because of the widespread distribution of CE across all continents, whereas most of the other NTDs are more or less limited in distribution. Moreover, numerous fields of study are involved in the research on *Echinococcus* and echinococcosis. Because the parasite is perpetuated in several types of hosts, including several different species of ruminants, rodents, and carnivores, both in domestic and sylvatic settings, in many endemic countries men are more involved in major field studies than women. In addition, looking into the clinical aspects of the disease, surgery has a major contribution in publications on echinococcosis and like many other surgical settings across the world, women are less involved in this clinical discipline (Xu *et al.*, 2022). We acknowledge the importance of other neglected parasitic diseases, and we recommend that other researchers consider exploring the gender and geographic biases in the research on other helminth parasites.

Conclusions

Findings of the present study indicate that despite all the improvements in women representation and narrowing of the gender gap in authorship and leadership positions in scientific publishing, gender inequity remains an issue, even in high-income developed countries. Over the past several decades, gender equity played an important role in the fair distribution of resources and benefits to all genders. The under-representation of women can influence their ability to improve academically while having the same competencies as their male peers. To address this issue, efforts should be made to understand the nature and determinants of gender inequity in the research and scientific publishing on neglected tropical diseases, especially in low- and middle-income countries where these conditions are prevailing.

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Availability of data and materials. All data of the present study is available upon reasonable requests from the authors.

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