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Cochrane reviews' authorship has become more gender-diverse but remains geographically concentrated: a meta-research study

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Abstract

Objectives: The aim of this study was to examine the distribution of country, region, language, and gender diversity in the authorship of Cochrane reviews and compare it to non-Cochrane systematic reviews.

Study Design and Setting: We retrieved all published articles from the Cochrane Library (until November 6, 2023) using a web crawling technique that extracted prespecified data fields, including publication date, review category, and author affiliations. For comparison, non-Cochrane systematic reviews were identified through PubMed using E-utility calls. We determined the country, region of affiliations and gender of the first, corresponding, and last authors for Cochrane reviews; the same fields were determined for first authors only for non-Cochrane reviews due to data availability. Trends in geographical and gender diversity over time were evaluated using logistic regression. Fisher's exact test was used for comparisons. Diversity trends between Cochrane and non-Cochrane reviews were explored through visual presentation, Pearson's product-moment correlation, and the Granger Causality Test.

Results: This comprehensive analysis included 22,681 Cochrane reviews and 224,484 non-Cochrane reviews. Cochrane reviews showed increasing diversity in several areas: representation of first authors from non-English speaking countries rose substantially (from 16.7% in 1996 to 42.8% in 2023), and female first authorship more than tripled (from 15.0% in 1996 to 55.6% in 2023). Representation from lower-and-middle-income countries (LMICs) in Cochrane reviews has declined recently (from a peak of 23.2% in 2012 to 18.4% in 2023). Among Cochrane Review Groups, diversity varied notably, with Sexually Transmitted Infections achieving the highest representation from LMICs (68.1% of first authors). In 2023, non-Cochrane reviews showed higher representation from non-English speaking

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countries (56.9%) and LMICs (50.8%) compared to Cochrane reviews. The patterns of gender diversity between Cochrane and non-Cochrane reviews showed strong correlations for female first authorship ($r = 0.829$, $P < .001$), suggesting parallel evolution over time.

Conclusion: Both Cochrane and non-Cochrane reviews demonstrate important progress in author diversity, particularly in gender representation and inclusion of authors from non-English speaking countries. While non-Cochrane reviews show stronger representation from LMICs, both review sources reflect the evolving landscape of global evidence synthesis.

Keywords: Review; Diversity; Equity; Inclusion; Publications; Authorship; Cochrane

1. Introduction

Systematic reviews play a crucial role in guiding clinical practice, policy development, and research agendas in health care. A broad representation of authors from different countries, regions, and languages brings a wider range of experiences, knowledge, and perspectives to the review process. Gender balance in authorship teams is likewise important, but despite progress in recent decades, gender disparities persist across scientific disciplines, potentially limiting the breadth of perspectives in evidence synthesis. Diversity is crucial for ensuring that reviews consider aspects of health equity and that their findings are applicable to a wide range of populations and healthcare settings [1,2].

Organizations like Cochrane have been at the forefront of producing high-quality systematic reviews for over 30 years [3,4]. While collaboration is one of the core values in its organizational strategy [5], the global representation in the authorship of these reviews remains a concern [6]. Previous research has highlighted disparities in the authorship of systematic reviews, with a predominance of authors from high-income, English-speaking countries [1,7–9]. This imbalance extends to gender representation, with women being underrepresented among review authors [10,11]. These issues are not unique to Cochrane reviews and have been observed in non-Cochrane reviews as well [12]. Approximately, a third of Cochrane Geographic groups are based in Spanish-speaking countries [5] and have a dedicated conglomerate, Cochrane Iberoamerica. However, whether this results in a sizable representation of authors from Spanish-speaking countries among Cochrane reviews is unknown.

While previous studies have examined authorship diversity in systematic reviews, they have often focused on specific medical specialties or geographical regions. A comprehensive analysis of authorship diversity across a broad range of systematic reviews, including both Cochrane and non-Cochrane reviews, is lacking. Therefore, this meta-research study aimed to address this gap by assessing the distribution of country, region, language, and gender diversity in both Cochrane and non-Cochrane review authorship. We compared representation based on country income status and primary language, and gender of the first, last, and corresponding authors. By including non-Cochrane reviews in our analysis, we aim to provide a more comprehensive picture of authorship diversity in systematic reviews and allow for comparisons between different sources of reviews.

2. Methods

This study employed a fully automated and reproducible approach to systematically extract and analyze author information from both Cochrane and non-Cochrane reviews. We followed a preregistered protocol (Open Science Framework (OSF): https://osf.io/bxj2e). However, we performed several expansions to enhance the comprehensiveness of our analyses (detailed in Appendix 1). These expansions maintained the core methodological approach while adding complementary analyses to provide broader context and additional insights. Briefly, the key expansions were [1] applying the approach to non-Cochrane reviews and comparing trends over time [2], including all Cochrane reviews instead of most recent versions, and [3] considering lower-and-middle-income countries (LMICs) instead of nonhigh-income Organization for Economic Co-operation and Development countries. We also evaluated authorship from Spanish-speaking countries due to their representation among active geographic groups and dedicated, active Iberoamerican network. All datasets and codes for the workflows used in this study are publicly available (OSF: https://osf.io/fv5ys, GitHub: https://github.com/choxos/cochraneauthors); codes with corresponding outputs are detailed in a dedicated document (Appendix 2).

2.1. Data sources and retrieval

All reviews published by Cochrane on the Cochrane Library website (cochranelibrary.com) were retrieved (up to November 6, 2023). Since the Cochrane Library provides only the latest version of reviews in their search interface, links to all review versions were automatically created using standard patterns for the digital object identifier (DOI). A typical DOI has the format: ‘‘10.1002/14,651,858.CD’’ + Review ID + ‘‘.pubN’’.

The first version is usually the protocol, and does not include ‘‘.pubN’’. The *N* represents subsequent protocol versions, eg, ‘‘.pub2’’ for version 2. All the possible DOIs

What is new?

This is the first comprehensive study examining the authorship diversity in Cochrane reviews compared to non-Cochrane systematic reviews. We assessed trends in country representation, language background, and gender of authors over time.

Key findings

- Cochrane reviews show increasing diversity in some areas:
  - More authors from non-English speaking countries (42.8% in 2023, up from 16.7% in 1996)
  - More female first authors (55.6% in 2023, up from 15.0% in 1996)
- However, representation from lower-and-middle-income countries (LMICs) in Cochrane reviews has decreased recently:
  - First authors from LMICs peaked at 23.2% in 2012, dropping to 18.4% in 2023
  - Last authors from LMICs decreased from 25.0% in 1996 to 16.2% in 2023
- Non-Cochrane reviews in 2023 showed higher diversity:
  - 56.9% of first authors from non-English speaking countries
  - 50.8% of first authors from LMICs
  - 42.3% female first authors

What this adds to what was known?

- Despite progress in some areas of diversity, particularly gender and non-English speaking representation, there is a concerning trend of decreasing participation from LMICs in Cochrane reviews. This contrasts with the higher representation of LMIC authors in non-Cochrane reviews.

Implications and what should change now?

- Cochrane should investigate barriers to participation for authors from LMICs and implement strategies to increase their involvement.
- Further research is needed to understand the factors driving the differences in diversity between Cochrane and non-Cochrane reviews.
- Efforts to maintain and improve gender diversity and representation from non-English speaking countries should continue.
- Tools and processes for assessing diversity in systematic review authorship may need to be developed or refined to better capture and address these trends.

were created automatically and used for the final extract of Review titles.

We applied a web crawling technique using R [13] and the *rvest* package [14] to extract prespecified data fields for each review from their dedicated information page on the Cochrane Library website (including date, review category, review stage, review group, author position, and author affiliation for all authors). The web address of the review information page was structured as follows: "https://www.cochranelibrary.com/cdsr/doi/" + DOI + "/information".

Authorship position/role was determined (first, last, corresponding) automatically. Affiliations were categorized according to country and World Bank economic status. We then categorized the country of the first, corresponding, and last authors in the following three different ways: (A) high-income vs LMICs, (B) high-income English-speaking vs non-English-speaking, and (C) Spanish-speaking vs non-Spanish-speaking. The list of the countries in each of these categories is available in Appendix 3.

The authors' gender was attributed using the World Gender Name Dictionary (WGND) 2.0 [15]. This database includes approximately 3.5 million names from different languages across the world, and the probability that a name is considered male or female is higher. For this study, we considered the higher probability as the definitive gender and assigned a dichotomous gender variable for all authors.

Review updates can have the same author composition as the previous version, although there are deviations. For example, see [16] and its previous version [17,18] in which the composition and affiliation of the authors, including the first author has changed from the USA in the first version to New Zealand and Australia in the next versions. Also, in this study, the unit of analysis is a published paper and not a project. Therefore, we included all the updates of a review in our analyses.

To contextualize our findings within the broader landscape of systematic reviews, we expanded our analysis to include non-Cochrane reviews. We retrieved all non-Cochrane systematic reviews from PubMed using the following search query: ("Systematic Review"[PT]) NOT ("The Cochrane database of systematic reviews"[Journal], using Entrez Programming Utility (E-utility) calls [19] from inception to 2023. However, to compare with Cochrane reviews, whose first set of reviews are available on the internet since 1996, we ran the analyses for non-Cochrane reviews from 1996 onwards. The E-utilities are a set of server-side programs that provide a stable, structured interface for accessing and retrieving data from National Center for Biotechnology Information's diverse biomedical databases through standardized web address syntax and input parameters. We extracted the PMID, publication date, name, and affiliation of the first author for each review and applied the approach detailed above to ascertain the gender, country, and region. All the data and

codes for the non-Cochrane reviews are available in Section 2.5 of Appendix 2 (pages 53−62).

To ensure consistent and meaningful comparisons between Cochrane and non-Cochrane reviews, we standardized our analysis periods. While we retrieved non-Cochrane systematic reviews from PubMed's inception (1987) through 2024, we focused comparative analyses on the period from 1996 onwards to align with Cochrane's first available reviews. However, due to substantial missing author name data for non-Cochrane reviews before 2002, trend analyses comparing Cochrane and non-Cochrane reviews for gender were limited to 2002−2023.

2.2. Analysis

We reported descriptive analysis and trends over time using descriptive tabulations and graphical illustrations. To explore diversity within Cochrane, we conducted subgroup analyses based on Cochrane Review Groups (CRGs). CRGs are specialized groups responsible for coordinating the development, publication, and maintenance of systematic reviews within specific health domains. Analyzing diversity at the CRG level allows for a more detailed understanding of how different health topics or disciplines may approach inclusivity. While some CRGs have recently closed [20], we included both active and historical CRGs to provide a comprehensive view of their impact. This approach offers valuable insights into variation across the organization, which could inform future diversity policies and practices.

Building on our protocol's planned descriptive analyses, we implemented additional statistical methods to test observed patterns and relationships. We used logistic regression to explore whether geographical and gender diversity has changed over the years. We also used a random intercept generalized linear model to investigate the trend of geographical and gender diversity among different CRGs. To compare the geographical and gender differences between the first, corresponding, and last author between CRGs, we performed Fisher's exact test with 2000 replicates.

To compare the trend of first authorship diversity between Cochrane and non-Cochrane reviews, alongside visual presentation and Pearson's product-moment correlation, we also used the Granger Causality Test [21,22]. This test assesses whether past values of one time series can predict future values of another. The null hypothesis is that one time series does not cause the other.

2.3. Validation

While maintaining our protocol's core automated data extraction approach, we added a validation step to ensure data quality. We randomly sampled 5% of the dataset of Cochrane reviews (Appendix 4) and 1000 non-Cochrane reviews (Appendix 5), and one of the authors (SK) manually verified the names and countries of the first, corresponding, and last authors. There were no discrepancies between the automatic algorithm and manual checking.

3. Results

3.1. Overall perspective of cochrane reviews

We extracted 22,681 articles, of which 9153 (40.4%) were the most recent review version and 7157 (31.6%) were protocols. The annual number of published articles (from 1995 to November 2023) is presented in Appendix 2 (mean = 782.1, standard deviation = 446.02). We excluded 1995 from our main analyses due to the identification of only one article from that year. Publications peaked in 2012 (n = 1508) and the most recent total was 376 (in 2023). Most articles represented interventional reviews (n = 21,965, 96.8%). Diagnostic reviews (n = 358, 1.6%) and overviews (n = 140, 0.6%) had minor representation.

The CRGs with the highest number of published reviews were Pregnancy and Childbirth (now closed) (n = 1,634, 7.2%), Neonatal (n = 1,118, 4.9%), and Airways (n = 873, 3.8%). Lower representation was apparent for Sexually Transmitted Infections (n = 47, 0.2%), Methodology (n = 104, 0.5%), and Work (n = 108, 0.5%) Groups. Twenty-three reviews were collaborations between two CRGs. The yearly trend of the number of reviews by each group is available in Appendix 6.

3.2. Geographical diversity

The affiliation for 318 (1.4%) first, 112 (0.5%) corresponding, and 442 (1.9%) last authors could not be identified. Similar results were observed across different author types (Table 1). First authors were from a greater number of countries compared to the last authors (102 vs 94). Across author types, 107 countries were represented. Regardless of the author type, most authors were from high-income and English-speaking countries (more than 80% and 60%, respectively). Most authors were from the United Kingdom, Australia, and the United States (approximately one-third, 12%, and 7%, respectively). A World heat map of the countries based on the number of authors is presented in Figure 1; raw data are available in Appendix 7.

Author representation by their country's income status (high/LMIC) and language (English/non-English speaking and Spanish/non-Spanish speaking) over time and by author type are presented in Figure 2. In a given year, LMIC representation was at most 26.7% (first authors in 1996), and non-English country representation was at most 43.8% (corresponding authors in 2020). The first authors exhibited a greater representation of LMIC and non-English countries than the last authors. Following initial growth, the rate plateaued from about 2009 for non-English representation, and exhibited a

Table 1. Summary of the number of Cochrane authors by each diversity index (from 22,681 reviews)

Characteristic	First authors	Corresponding authors	Last authors
Number of countries	102	98	94
Number of affiliations where a country could not be identified	318 (1.4%)	112 (0.5%)	442 (1.9%)
Number of countries represented by only one review	12 (11.8%)	12 (12.2%)	8 (8.5%)
Most represented countries			
United Kingdom	7426 (33.2%)	7412 (33.2%)	7720 (34.7%)
Australia	2595 (11.6%)	2619 (11.7%)	2640 (11.9%)
United States	1559 (7.0%)	1537 (6.9%)	1626 (7.3%)
Income status			
High-income	18,195 (81.9%)	18,234 (80.4%)	18,682 (82.4%)
Lower-and-middle-income	4016 (18.1%)	4446 (19.06%)	3998 (17.6%)
English speaking country			
Yes	13,866 (62.0%)	13,871 (62.1%)	14,252 (64.1%)
No	8497 (38.0%)	8469 (37.9%)	7987 (35.9%)
Spanish speaking country			
Yes	753 (3.4%)	743 (3.3%)	651 (2.9%)
No	21,610 (96.6%)	21,597 (96.7%)	21,588 (97.1)
Gender (by first name)			
Female	10,545 (50.8%)	9947 (48.1%)	7804 (37.3%)
Male	10,207 (49.2)	10,720 (51.9%)	13,106 (62.7%)

The total number for each diversity index is different due to different number of missing values.

decrease after 2012 for LMIC status. The results of the logistic regression modeling showed that the effect of year on the proportion of articles in each diversity index varied between 0.997 and 1.029 with P values <0.001 except for Spanish-speaking and the last author from LMICs models (Appendix 8). This means that for most diversity measures, we observed small but statistically significant changes over time, with the likelihood of an article meeting a diversity criterion changing by 0.3% to 2.9% per year.

3.3. Gender diversity

Over time, female first authorship increased from 15.0% in 1996 to more than half in 2023 (55.6%). Percentages of female corresponding and last authors likewise increased; however, growth was less pronounced for the last authors (39.4% in 2023; Fig 3). It should be noted that while the percentage of female last authors in 1997 peaked, the number of Cochrane reviews in 1997 was the all-time lowest ($n = 47$). Logistic regression modeling showed that the coefficient for the year ranged between 1.015 and 1.030 with P values <0.001 (Appendix 8). This means that for each year, the odds of an article being more gender-diverse increased by between 1.5% and 3.0%, indicating a small but statistically significant improvement in diversity measures over time.

3.4. Diversity among Cochrane Review Groups (CRGs)

Overall, we identified reviews from 53 CRGs. Across author categories, most CRGs had 10%-25% reviews with authors from LMICs and 25%−50% of reviews with authors from non-English speaking countries, across author categories (Fig 4). Seven CRGs had less than 10% of reviews with first authors from LMICs, and seven CRGs had 10%−20% of first authors from non-English countries. The Sexually Transmitted Infections Review Group had the highest proportion of reviews with authors from LMICs (first = 68.1%, corresponding = 66.0%, and last authors = 57.4%). This was the only CRG with representation above 50% of LMICs for all three author categories. HIV/AIDS and Infectious Diseases had the next highest LMIC representation, with 50.6% and 41.1% of first authors from these countries. Childhood Cancer ($n = 118$ reviews; now closed) had the highest proportion of reviews with authors from non-English-speaking countries (87% of the three author categories combined). Lower geographical diversity was observed in the Consumers and Communication group, with 1.6% and 13.3% of reviews with first authors from LMICs and non-English countries, respectively.

Most CRGs had more than 50% of reviews with female first and corresponding authors; however, a majority of CRGs had 20%−50% of reviews with female last authors, suggesting a ‘‘ceiling’’ for this author category. Fertility

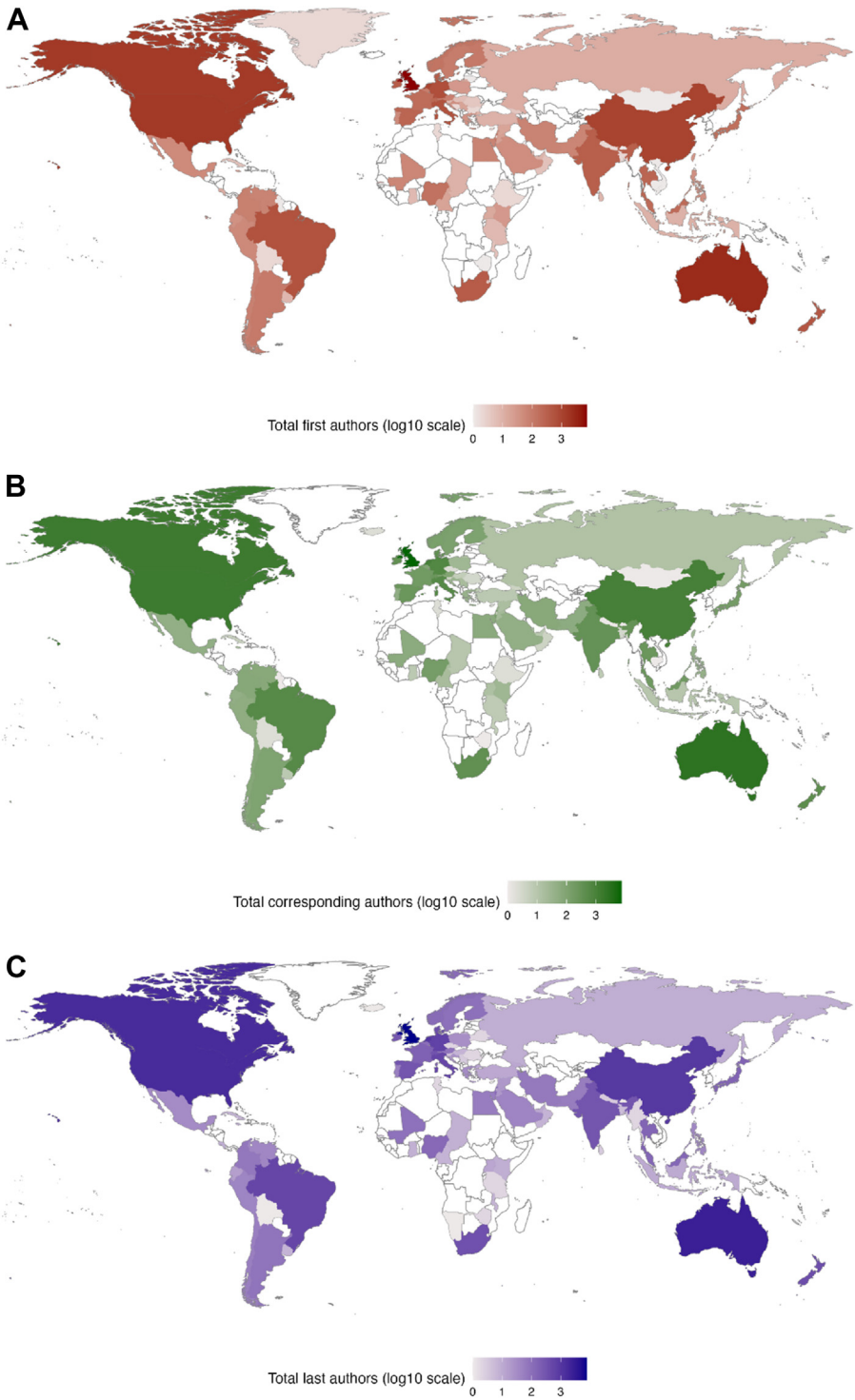

Figure 1. World heat map of the countries based on the number of (A) first, (B) corresponding, and (C) last authors (in log10 scale).

Regulation had the highest percentage of female first authors (72.1%), followed by Consumers and Communication (69.1%), and Skin (66.6%). Lower representation of female first authors was observed for reviews from the Urology, Hepato-Biliary, and Colorectal Groups (less than 35%). Appendix 9 shows bar plots of geographical and gender diversity for each CRG; raw data are available in Appendix 10.

Our analysis revealed differences in geographical and gender diversity between CRGs (Fisher's exact test,

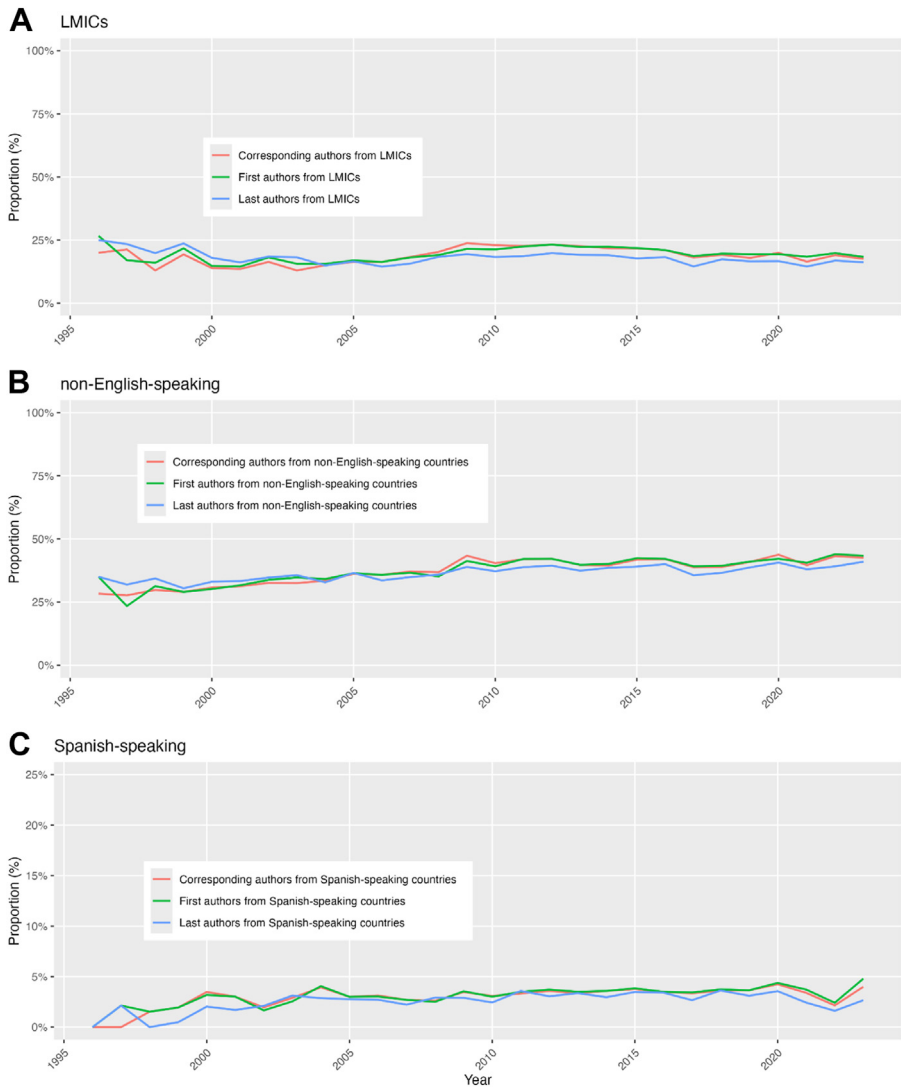

Figure 2. Region diversity in Cochrane Reviews authorship. (A) low-and-middle-income countries (LMICs) (B) non-English-speaking countries (C) Spanish-speaking countries. The y-axis for (C) is magnified to 0%–25%.

$P < .001$ for all comparisons). When examining the influence of CRGs on diversity measures, we found that their impact varied depending on the specific diversity aspect. The effect of CRGs was particularly strong for Spanish-speaking authorship (random effects variance ≈ 1), while it had a much smaller influence on female authorship (random effects variance < 0.2; Appendix 11).

3.5. Comparison with non-Cochrane reviews

We retrieved 224,484 non-Cochrane systematic reviews, representing the period 1987 (inception) to 2024. Lack of information in first author affiliations precluded assigning country and language status for 41,266 (18.4%), and income region for 43,315 (19.3%) of reviews. Gender could not be assigned for 39,619 (17.6%) first authors. Due to substantial missing author name data for non-Cochrane reviews before 2002, trend analyses comparing Cochrane and non-Cochrane reviews for gender were limited to 2002–2023. After excluding reviews with missing data, our final analysis included 184,865 reviews.

The proportion of first authors from non-English-speaking countries increased steadily from 18.3% in 1996 to 56.9% in 2023. First authors from LMICs showed particularly strong growth, from around 15% in 1996 to 50.8% in 2023 (Fig 5).

Geographical trends over time exhibit notable differences between the two review sources. The proportion of first authors in non-Cochrane reviews from LMICs is above 15% from 1996 to 2012, then exhibits a sharp increase to 41.0% in 2014, followed by a steady increase to 50.8% in 2023 (Fig 5); all in all, proportions over the period are higher than for Cochrane reviews, which exhibit a relatively plateaued rate of growth (Fig 2). The proportion of non-Cochrane reviews first authors from non-English speaking countries starts at about 20% in 1996 and increases steadily

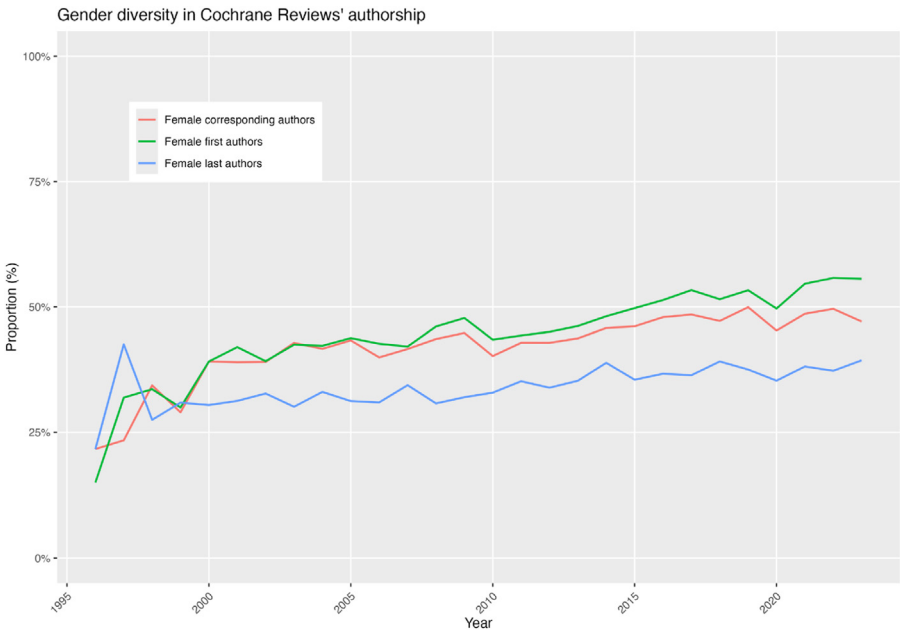

Figure 3. Proportion of female authorship in Cochrane reviews, from 1996 to 2023.

to reach approximately 70% in 2023; the rate of growth for non-English speaking authors, regardless of author type, is lower in Cochrane reviews, where proportion does not reach 50% (Fig 2). First authors from Spanish-speaking countries comprise less than 4% over the period, similar to Cochrane reviews, which were approximately 4% over the period. Lack of similarity in trends is consistent with the results of the Granger Causality Test, with *P* values

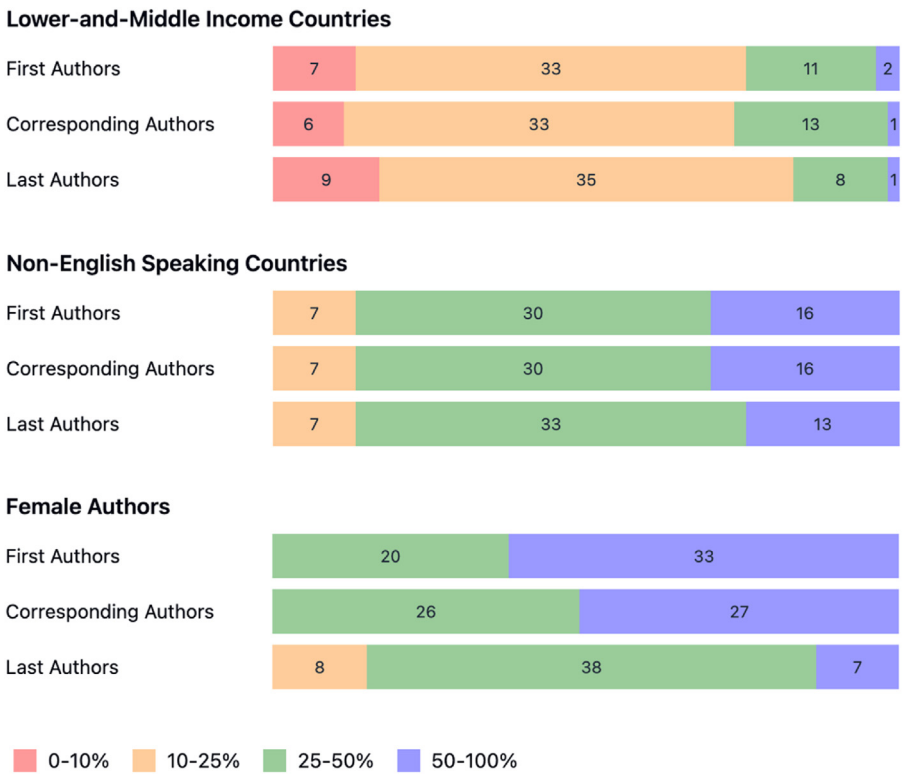

Figure 4. Number of CRGs with indicated proportions of reviews that have first, corresponding, and last authors, stratified by low-and-middle-income countries, non-English speaking countries and female authors. Proportion categories were selected to best represent the data.

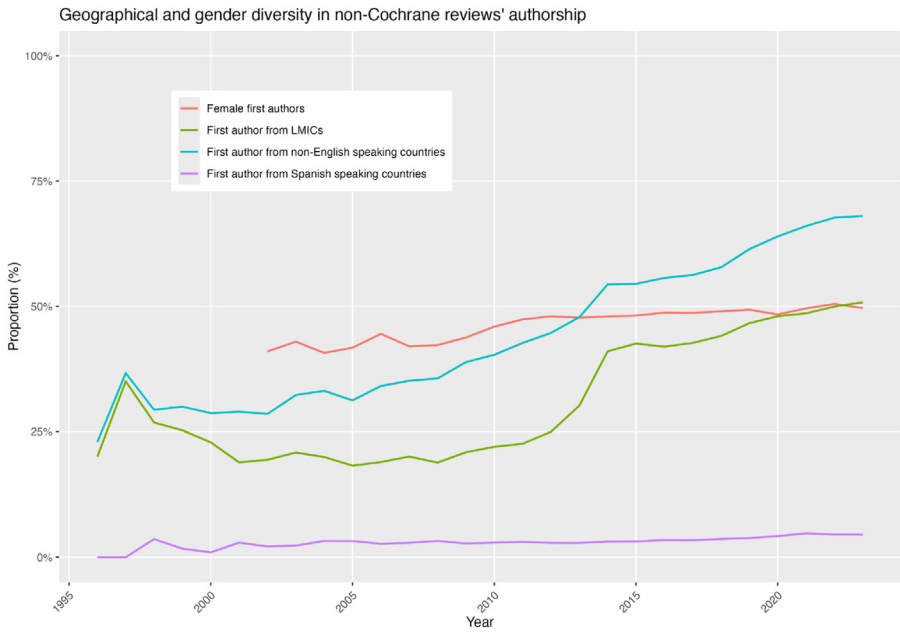

Figure 5. Geographical and gender diversity in the first authorship of non-Cochrane reviews.

of 0.062, 0.701 and 0.483 when comparing between the two review sources for LMIC, non-English speaking and Spanish-speaking authorship. Similarly, Pearson's product-moment correlations were 0.265 ($P = .450$), 0.823 ($P < .001$), and 0.634 ($P < .001$), respectively.

Concerning gender, in 2002, female first authors were marginally better represented in non-Cochrane reviews (28.0% vs 39.2%, non-Cochrane and Cochrane, respectively), while in 2023 they were marginally better represented in Cochrane reviews (49.6% vs 55.6%). All-in-all, female first author trends between the two review sources are similar over the period, consistent with the Pearson's product-moment correlation of 0.829 ($P < .001$). The non-significant P value for the Granger Causality Test (0.499) might reflect a slightly higher growth for female first authors in Cochrane reviews.

4. Discussion

This work represents a comprehensive evaluation of geographic, gender, and language diversity among Cochrane reviews since 1995. We showed that the first author representation from LMICs peaked in 1996 and doubled in 2020 for non-English speaking countries. Both categories exhibited growing rates through to approximately 2010, followed by plateau periods. From 2015, representation from LMICs exhibited a decline. Overall, authors were predominantly from high-income and English-speaking countries, approximately 80% and 60%, respectively, and of English-speaking countries, predominantly from the UK (approximately one-third of all authors). Despite a very active community of researchers from Spanish-speaking countries in Cochrane, evidenced by a sizable proportion of Geographic Groups (10 out of 62 centers, associate centers, and networks [5]) and a dedicated conglomerate (Cochrane Iberoamerica), author representation from Spanish-speaking countries was low. Non-Cochrane reviews were more diverse in having a higher proportion of first authors from LMICs (50.8% vs 18.4% in 2023) and non-English-speaking countries (56.9% vs 42.8% in 2023).

These results echo findings from previous work in specific medical fields, showing poor representation of Cochrane review authors from LMICs in the disciplines of hematology [10], gastroenterology [12], and cardiology [23]. In addition, just 12% of Cochrane's 111,000 members were based in an LMIC in 2022 [9]. Low representation of authors from LMICs may be, in part, due to the limited investment in research funding, academic institutions, and infrastructure in these countries, and in contrast, a greater relative investment in high-income countries [24].

The comparison between Cochrane and non-Cochrane reviews reveals several important patterns. By 2023, over half of non-Cochrane reviews had first authors from LMICs and non-English speaking countries (50.8% and 56.9%, respectively), compared to much lower proportions in Cochrane reviews (18.4% and 42.8%, respectively). However, female first authorship shows a different pattern, while both sources of reviews demonstrate increasing female representation over time; Cochrane reviews have achieved higher levels (55.6% vs 42.3% in 2023). These contrasting patterns suggest that different factors may influence author diversity in Cochrane vs. non-Cochrane reviews. The higher proportion of first authors from LMICs and non-English speaking countries for non-Cochrane

reviews compared to Cochrane reviews can largely be attributed to the surge in systematic review production from emerging economies, especially China [25]. This phenomenon has significantly reshaped the landscape of evidence synthesis in recent years. While Cochrane reviews have traditionally been dominated by authors from high-income English-speaking countries, non-Cochrane reviews have seen a dramatic influx of contributions from emerging research economies. China, in particular, has experienced an exponential increase in systematic review output, driven by factors such as substantial investments in research infrastructure, policy initiatives promoting evidence-based practice, and academic incentives favoring publication quantity. Similarly, other LMICs have also increased their participation in systematic review production, albeit to a lesser extent than China. This shift has led to a higher proportion of non-Cochrane reviews originating from these countries, effectively diluting the relative contribution of high-income countries in the non-Cochrane review landscape. In contrast, the more established and potentially more rigid structure of the Cochrane collaboration may not have adapted as quickly to incorporate this surge of new contributors, resulting in a lower proportion of reviews from China and other LMICs within the Cochrane framework; although the methodological and reporting quality of systematic reviews from China and the USA are shown to be similar [26].

These findings may suggest that the focus on international collaboration and standardized methodologies in Cochrane Reviews might unintentionally favor authors from high-income, English-speaking regions. The long time it takes to publish reviews (with a median of 2 years, which can extend to more than 5 years [27]) could also be another barrier. New mechanisms to engage qualified researchers from a more diverse range of geographical locations to participate in Cochrane reviews might be needed. These findings may also reflect limited processes in Cochrane to ensure that individuals from LMICs are trained in Cochrane review production, and are more actively included in author teams. For example, while there are initiatives such as free access for LMIC authors to a suite of state-of-the-art online training modules, perhaps greater promotion to, and engagement with, LMIC members may help to increase author representation. Similarly, initiatives such as Cochrane Engage (formerly Task Exchange), which are used to link individuals seeking assistance with health evidence projects to skilled volunteers who can offer their time and expertise [28], could potentially be used to invite authors from LMIC countries to participate in author teams more systematically, especially on topics where a global perspective is needed.

Despite the low prevalence of LMIC-led Cochrane reviews, 22,681 Cochrane reviews included authors from 107 countries across author types, including at least 59 LMIC countries (55.1%), exhibiting significant diversity and demonstrating that academic research is indeed a global endeavor that involves contributions from scholars all across the world.

Since 1996, there has been a steady increase in female authorship in Cochrane reviews across the three author categories (first, corresponding, and last). Female first authors increased from 15.0% in 1996 to 55.6% in 2023. This is in line with research by Bhat [23] who found that the representation of females as first authors of Cochrane cardiology reviews had increased over time. In contrast to non-Cochrane reviews, the rate of growth for female first authors in Cochrane reviews is higher. There are a number of reasons that may contribute to the observed changes in gender representation. It is plausible that initiatives such as the National Institutes of Health (NIH) 2022 scientific workshop on gender and health and the Athena Swan Charter [29,30], aimed at fostering gender equality in academia and research, an increasing appreciation of the importance of diversity and equity, and broader societal shifts toward recognizing and addressing gender disparities in various professional fields have played a role in encouraging and supporting female researchers to assume authorship roles. The greater proportions in 2023 (55.6% vs 42.3%%), and higher growth rate over time, for female first authors of Cochrane reviews relative to non-Cochrane reviews may suggest dedicated initiatives on this front within the organization (such as Strategy to 2020 [31]). However, the rate of growth for female last authors in Cochrane reviews is evidently lower, representing about a third of last authors in 2023, compared to approximately half of first authors the same year. Further, while 33 of 53 CRGs had more than 50% of reviews authored by female first authors, a majority of CRGs had 25%−50% female last authors ($n = 38$), similarly exhibiting a ceiling effect for this author category. This is notable given that last authors typically represent senior positions on a review team, and may suggest that additional factors or barriers may influence the advancement of women into higher-ranking authorship roles within Cochrane.

4.1. Implications

The findings of this study have potential implications for Cochrane review production. It is clear that Cochrane needs to do more to improve the inclusion of individuals from LMICs. Supporting individuals from LMICs as authors of Cochrane reviews will encourage varying perspectives, interests, and priorities. This is likely to lead to a wider coverage of health topics, a stronger focus on health equity, and attention to conditions with a high global burden of disease. In turn, this will help to ensure that harder-to-reach groups within the population benefit from Cochrane evidence and that intervention-generated inequalities are avoided [32]. Also, it is shown that higher authorship of underrepresented groups in Cochrane

reviews is associated with greater considerations of equity-related analyses in the reviews (eg, females [33]). The Cochrane Health Equity Thematic Group is well positioned to help in this effort, as the Group aims to promote health equity within Cochrane, by supporting CRGs and author teams to consider health equity in their work, and by developing and evaluating methods to analyze health equity in systematic reviews and the evidence base. Working together with other organizations globally will also be crucial to improving the inclusion of people from LMICs. An example of such collaboration is the Global Evidence Synthesis Initiative [34].

The finding that there is a gender disparity in leadership roles in Cochrane reviews suggests that Cochrane would benefit from exploring ways to support female authors into senior author roles. Future research should explore potential challenges or biases that may hinder the progression of female researchers. Identifying and addressing these barriers, which could encompass institutional practices, and biases in funding and mentorship opportunities [35], is crucial for achieving a more equitable distribution of authorship responsibilities. In 2022, the U.S. NIH developed new initiatives to promote gender equity. For example, they offer additional financial support to assist researchers in maintaining their work during childbirth, adoption, and primary caregiving duties. In addition, they are acknowledging institutions that effectively tackle gender diversity and equity concerns, thereby promoting the adoption of proven, replicable strategies for enhancing faculty diversity [36].

Regarding geographical diversity, further research investigating citation metrics, collaboration patterns, and the significance of the research may provide a more comprehensive understanding of the impact of Cochrane reviews, and of the make-up of the entirety of author teams.

4.2. Strengths and limitations

Strengths of this study include that it followed a preregistered protocol and used a fully reproducible methodology to systematically extract and analyze data from Cochrane reviews. Data were extracted from Cochrane reviews using an automated technique, allowing for the collection of a large amount of data. In addition, the study was conducted by a diverse and international team of researchers with varying backgrounds in health care.

Limitations include that we were unable to identify the country for 318 affiliations of Cochrane authors due to insufficient information on the website. This proportion for non-Cochrane reviews was higher (from 17.6% to 19.3% missing data). This could be an area for improvement in data collection or reporting standards. In addition, as the variable gender was inputted with the use of the WGND 2, there is room for error in classification. Even though this dictionary includes an extensive list of names from many languages, our variable gender is a probabilistic proxy. However, we believe that even if we had the gender ground truth, our results would not change significantly given two reasons [1]: diversity increases in other variables, thus is likely to have an increase also in gender; and [2] the WGND 2 usability, thus is the closest that we have to ground truth and it has been used in research elsewhere [37–42]. However, a significant limitation of this study was the use of a binary gender framework, which we acknowledge is an oversimplification of the complex spectrum of gender identities. Due to methodological constraints and available data, we were unable to apply a more comprehensive gender concept that includes nonbinary and other gender identities. This binary approach inevitably leads to misclassifications, particularly for individuals who do not identify within the male/female binary.

The use of an automated process to collect data also has potential limitations. For example, data cleaning is a complex procedure and prone to errors if not tested adequately. However, this was a pragmatic approach and allowed for the collection of a large amount of data that would have otherwise been impossible with the available resources. An additional limitation of our study was that we did not utilize a formal reporting guideline during the preparation of this manuscript.

5. Conclusion

Our analysis of Cochrane Reviews revealed progress in gender diversity, with a significant increase in female first authors. However, geographic diversity remains limited, with an overrepresentation of authors from high-income, English-speaking countries. Notably, diversity varied across CRGs, with Sexually Transmitted Infections exhibiting the highest representation from non-English speaking and low/middle-income countries. While non-Cochrane reviews showed a similar trend of increasing diversity, no predictive relationship between Cochrane and non-Cochrane review trends was observed. These findings suggest that while progress has been made in gender representation, further efforts are needed to enhance geographic diversity within Cochrane Reviews. Strategies such as fostering international collaborations and exploring alternative authorship models could be implemented to achieve this goal.

CRediT authorship contribution statement

Ahmad Sofi-Mahmudi: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jana Stojanova:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis. **Elpida Vounzoulaki:** Writing – review & editing, Writing – original draft,

Methodology, Investigation, Conceptualization. **Eve Tomlinson:** Writing − review & editing, Writing − original draft, Formal analysis. **Ana Beatriz Pizarro:** Writing − review & editing, Writing − original draft, Investigation, Conceptualization. **Sahar Khademioore:** Writing − review & editing, Writing − original draft, Validation, Conceptualization. **Etienne Ngeh:** Writing − review & editing, Writing − original draft, Investigation. **Amin Sharifan:** Writing − review & editing, Writing − original draft, Investigation. **Lucy Elauteri Mrema:** Writing − review & editing, Writing − original draft, Investigation. **Alexis Ceecee Britten-Jones:** Writing − review & editing, Writing − original draft. **Santiago Castiello de Obeso:** Writing − review & editing, Writing − original draft, Methodology, Conceptualization. **Vivian A. Welch:** Writing − review & editing. **Lawrence Mbuagbaw:** Writing − review & editing, Visualization. **Peter Tugwell:** Writing − review & editing.

Declaration of competing interest

A.S.M., E.V., A.B.P., E.N., A.S., L.E.M., and S.C.dO. are members of the steering group of the Early Career Professionals Network in Cochrane. E.T., V.A.W., L.M., and P.T. are members of the Health Equity Thematic Group in Cochrane. A.B.P. and P.T. are members of the Editorial Board of Cochrane. V.A.W. declares funding from CIHR-PHAC Applied Public Health Chair. There are no competing interests for any other author.

Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclinepi.2025.111719.

Data availability

All datasets and codes of workflows used in this study are publicly available (OSF: https://osf.io/fv5ys, GitHub: https://github.com/choxos/cochraneauthors).

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