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Correspondence and Communications

Women representation in plastic surgery across the globe: A cross-sectional study of human capital and research output using artificial intelligence

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The alarm of women under-representation in surgery has been going off for decades.[1] Even in plastic surgery, women have been under-represented among researchers, faculty members, and invited speakers.[2,3] This study documents country-level female representation among first authors and publications in influential research outlets in plastic surgery. Diagnosing gender disparities across the globe is crucial in promoting equitable representation in plastic surgery research.

Our analysis goes beyond previous research in three important ways. First, we are the first to employ an Artificial Intelligence (AI) big data approach to investigate the female under-representation in plastic surgery across the world. Our approach allowed us to retrieve detailed information for every publication in multiple outlets and make inference at the macro level. This approach can be applied to other

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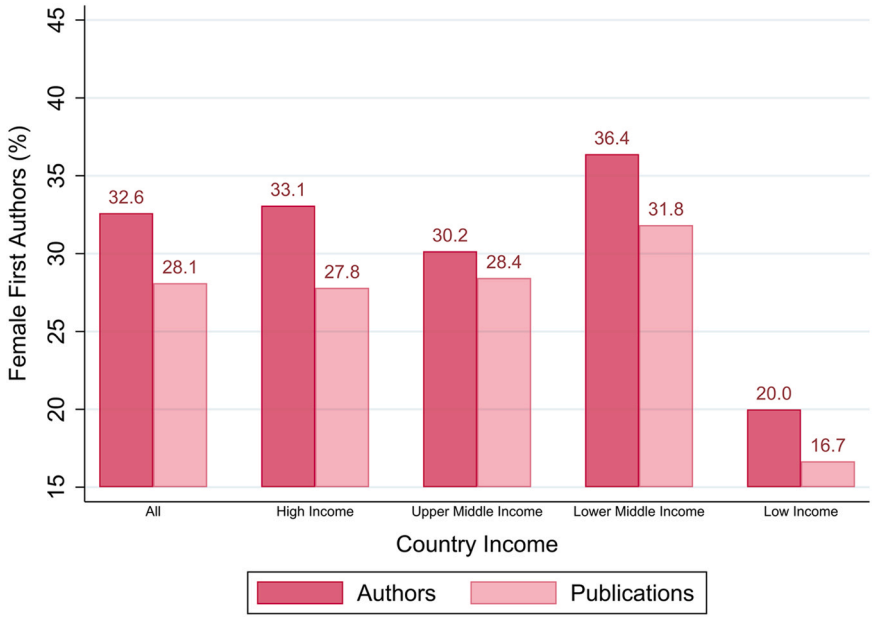

Figure 1 Women representation in human capital and productivity in plastic surgery research. *Note:* This figure shows the representation of females among first authors and plastic surgery publications between 2015 and 2021 across the entire sample and by country income.

contexts across the medical literature. Any research design in which accurate extraction of large-scale information from established repositories is needed could benefit from our web scraping approach.[4,5] Second, we document each country's gender disparity in research productivity. Third, we investigate the association between each country's gender gaps in productivity and human capital. We proxy human capital using first authors in each country. First authors are usually researchers of adequate expertise with the potential to contribute to research in the future.

We followed Karamitros and Goulas in deploying AI technology by means of a web-scrapping algorithm on PubMed to retrieve author names and affiliated country for each publication from 2015 to 2021 from the 10 most-cited plastic surgery journals based on the Google Scholar category for "Plastic and Reconstructive Surgery".[4,51] We identified the affiliated country and first author's gender for 92.5% of the extracted publications (see Figure S1 *in the* Supplementary Appendix). This study was approved by the Institutional Review Board at Stanford University (#68322) and follows the STROBE reporting guidelines for cross-sectional studies.

We identified 30,374 publications and 17,095 first authors in 107 countries. Table S2 reports the gender gap in representation and productivity in plastic surgery research in each country. On average, less than 25% of first authors are females and they publish half a paper less than their male counterparts. Most importantly, in half of the countries, females represent less than 20% of authors.

Figure 1 shows that across all publications females are represented in 32.6% of first authors and 28.1% of publications, revealing substantial gender gaps in representation and research productivity. The positive difference in the representation of females in authors and publications (32.6%-28.1%) indicates the gender gap in research productivity. The gender representation gap is the largest in low-income countries (20%), while the gender productivity gap is the largest in high-income countries (33.1%-27.8%). Figure S2 confirms the statistically significant gender gap in research productivity. Overall, male and female first authors have published 1.9 and 1.5 papers in the studied period, respectively ($p\text{-value} < 0.001$ for two-sided test of equality). Figure 2 compares the gender gaps in representation and productivity among the countries producing 80% of plastic surgery papers globally. We find substantial productivity gaps in every country except for China, where female representation in authors equals female representation in publications. Figure S3 plots each country's gender gaps in representation and research productivity along with the fitted regression line. We find sizable positive association between the gender gaps in representation and productivity at the margin of statistical significance ($\rho = 0.23$ with $p\text{-value} = 0.051$). The results indicate that countries with low female representation also have a substantial gender productivity gap in plastic surgery research. This points to dual occurrence of obstacles for females to enter and to progress in the field of plastic surgery research.

Our study expands the global evidence base for the barriers women face not only in entering plastic surgery but importantly in publishing as prolifically as men. The results show widespread female under-representation in authors and publications across the world. This suggests that resources, incentives, appetite for publications, and opportunities, which drive research productivity, the emblem of academic success, are unequal for men and women plastic surgeons. Policies and interventions aiming to attract qualified female candidates into plastic surgery research should

[1] The methodology is described in detail in the Supplementary Appendix.

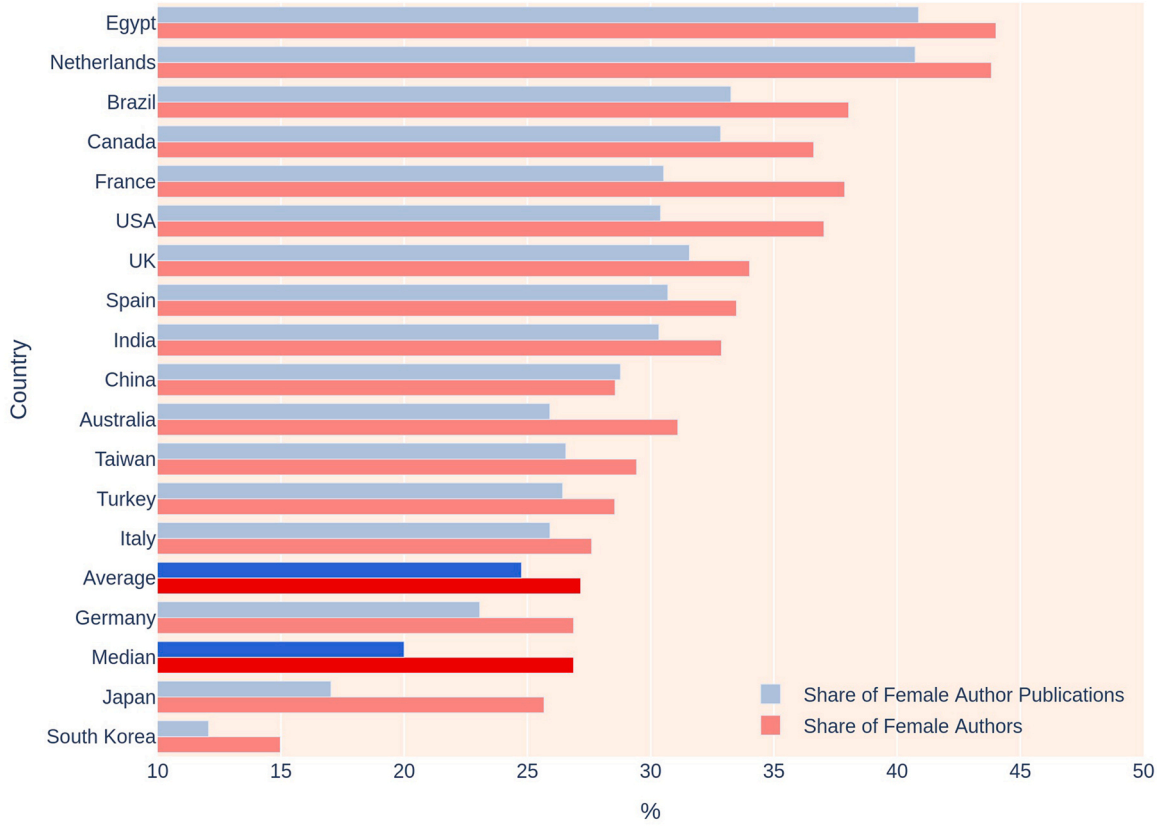

Figure 2 Women representation in human capital and productivity in plastic surgery research across nations. *Note:* This figure plots female representation in authors and publications for the countries comprising 90% of plastic surgery research globally.

be coupled with continued support and equitable access to training, mentoring, research networks, and development opportunities.

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Ethical approval

This study was approved by the Institutional Review Board at Stanford University (#68322).

Declaration of Competing Interest

None declared.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.bjps.2023.04.056.

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