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Research Letter

The association between surgical disease burden and research productivity in surgery across the globe: a big data comparative analysis using artificial intelligence

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Profound disparities in access to surgery across the world have led to the need for benchmarks for surgical care to design initiatives that reduce the surgical burden of disease[1]. This study measures research productivity and human capital in surgery across nations and investigates associations with the shares of the population and surgical burden of disease. Understanding the country differences in human capital and innovation in surgery is crucial in quantifying access to surgeons and quality of surgical care across the world[2].

We followed Karamitros and Goulas (2022, 2023) in deploying Artificial Intelligence (AI) technology by means of a web-scraping algorithm to obtain first author and country information from PubMed for every publication between 2010 and 2022 in the 50 most-cited and influential surgical journals according to the SCImago classification, shown in *Table S1*[3,4]. We identified 90.3 per cent of extracted publications (further details on journal selection, the AI methodology, and the role of first authors in research productivity are provided in the *Supplementary Appendix*). This study was approved by the Institutional Review board at Stanford University (#68322) and followed the STROBE reporting guidelines.

Our study brings forth two contextual benchmarks of surgical research: population and surgical burden of disease, proxied by deaths possibly preventable with surgery[5]. The surgical burden of disease is calculated using total burden of disease (that is, fatal discontinuity deaths obtained from the Global Burden of Disease Project) multiplied with an estimate of the share of the surgical burden of disease (which accounts for 30 per cent of the global burden of disease, measured by Shrime *et al.*[5]). (Further details on estimating the surgical burden of disease are provided in the *Supplementary Appendix*.)

We identified 178 309 publications and 102 935 first authors in 102 countries. Research production and research-producing human capital (that is first authors) per country are shown in *Table S2*. We identified a significant positive correlation between research production and human capital ($\rho = 0.997$ with $P < 0.0001$). The USA, the UK, China, Japan, and Germany dominate in terms of both research production and the share of global first authors in surgery.

Country population is significantly positively associated with research production ($\rho = 0.224$ with $P = 0.024$) and human capital ($\rho = 0.252$ with $P = 0.011$). The top 20 countries in research production represent a little less than 60 per cent of global population. Major research contributors such as the USA and the UK produce 23.0 and 16.3 publications per 100k population, respectively. At the same time, China, which is the third most productive country, produces only 0.7 publications per 100k of population. This suggests that resources might matter more than population for research production.

The surgical burden of disease is weakly negatively correlated with research production ($\rho = -0.041$ with $P = 0.682$) and human capital ($\rho = -0.047$ with $P = 0.641$), suggesting that surgical research and researchers are not where surgical needs are the gravest. *Figure 1* shows that European countries represent a significant share of research production and human capital but hold an insignificant surgical disease burden relative to the rest of the world. In contrast, China, Japan, and India hold more balanced shares of the surgical global disease load and of the research volume and human capital in surgery. More than 90 per cent of the global surgical disease burden is found in countries outside the top 20 countries in research production.

Our analysis shows that a significant proportion of the world's population and surgical disease burden are not represented on the research map, limited focus on surgical research in developing countries. We provide benchmarks for human capital and innovation in surgery in relation to trans-border health disparities, supporting initiatives such as the Global Initiative for Emergency and Essential Surgical Care and Global Fund for Surgery[1].

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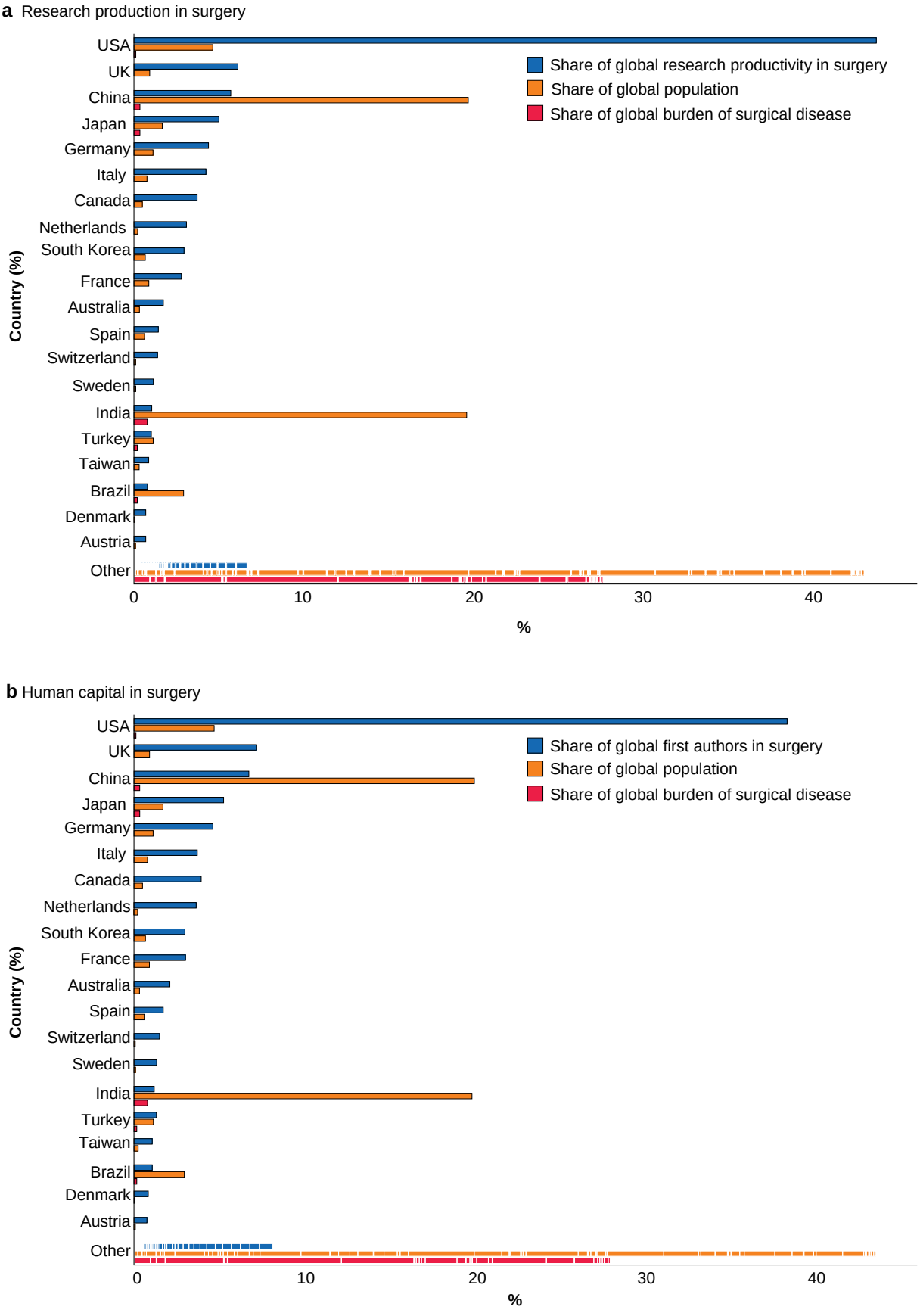

Fig. 1 Surgical burden of disease and research productivity in surgery across the world

Panel A: Research Production in Surgery. Panel B: Human Capital in Surgery. *Notes:* Panel A plots the share of first author publications in surgery across the world associated with each country. Panel B plots the share of first authors in surgery across the world associated with each country. The surgical burden of disease is calculated using total burden of disease (that is fatal discontinuity deaths) multiplied with an estimate of the share of the surgical burden of disease (which accounts for 30 per cent of the global burden of disease, measured by the Global Burden of Disease Project[5]). Further details are provided in the *Supplementary Appendix*.

Author contributions

Sofoklis Goulas (Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Visualization, Writing—original draft, Writing—review & editing), and Georgios Karamitros (Conceptualization, Data curation, Methodology, Resources, Supervision, Validation, Visualization, Writing—original draft, Writing—review & editing).

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Disclosure

The authors declare no conflict of interest.

Supplementary material

Supplementary material is available at *BJS* online.

Data availability

Data and code are available upon request for replication purposes.

Ethical approval

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

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