BJS, 2023, 1–3
https://doi.org/10.1093/bjs/znad205
Research Letter

Human capital and productivity in surgery research during a pandemic: an artificial intelligence approach

Sofoklis Goulas[1,2,3,4] and Georgios Karamitros[5,6,*]

[1]Economic Studies, Brookings Institution, Washington, DC, USA
[2]South Asia Gender Innovation Lab, World Bank, Washington, DC, USA
[3]Gap Analysis and Policy Solutions (GAPS), Aletheia Research Institution, Palo Alto, CA, USA
[4]Hoover Institution, Stanford University, Stanford, CA, USA
[5]Department of Plastic Surgery, University Hospital of Ioannina, Ioannina, Greece
[6]Medical School, University of Ioannina, Ioannina, Greece

*Correspondence to: Georgios Karamitros, Medical School, Department of Plastic Surgery, University Hospital of Ioannina, University of Ioannina, Stavrou Niarxou Avenue, Ioannina, Epirus, 45500, Greece (email: karamitrosgiorgos@gmail.com; georgios.karamitros@ldh.nhs.uk; pmd100116@uoi.gr)

Dear Editor

During the coronavirus disease 2019 (COVID-19) pandemic, heath-care systems across the world scrambled to adjust to new operational priorities and research resources in surgery were often directed to COVID-related topics[1]. Karamitros and Goulas (2023) documented the distribution of surgery research across the world and over time and found a 25.3 per cent increase in surgery publications during the pandemic compared with the previous 10-year average[2]. In this study, we investigate each country's representation in the volume and the authors of COVID-related surgery publications since the pandemic outbreak through the end of 2022. This study was approved by the Institutional Review Board at Stanford University (#68605) and followed the STROBE reporting guidelines.

We followed Karamitros and Goulas (2023) in deploying artificial intelligence (AI) technology by means of a web-scrapping algorithm on PubMed to retrieve author names, title, and affiliated country for each publication between 2020 and 2022 from the 50 most-cited surgery journals based on the SCImago classification[3] (further details on the data extraction methodology are provided in the Supplementary Appendix). We identified 91.9 per cent of the extracted publications. COVID-19-related articles were identified via text analysis on publication titles using the terms: 'COVID', 'SARS', 'pandemic', 'corona' (this allowed us to capture all derivative terms such as 'coronavirus', 'corona-virus', or 'corona virus'). We represent each country's research production in the context of its research-producing human capital, proxied by the number of first authors in a country. First authors are usually researchers of sufficient expertise to contribute to research in the future (further details on the human capital definition are provided in the Supplementary Appendix).

We identified 52 538 publications and 35 094 first authors in 95 countries. We found 2649 COVID-19-related publications (5 per cent) from 2269 first authors (6.5 per cent) in 65 countries. Eighty-eight per cent of COVID-19 authors wrote exactly one COVID-related paper. *Figure 1* shows wide variation in the degree to which surgery communities redirected research resources to COVID-19. *Table S2* shows that the USA is the global leader in terms of both overall production and human capital but devoted only a fragment of its research capacity towards COVID-19 (that is, around 5 per cent) during the pandemic. In contrast, the UK, another major contributor to surgery research, had 10.1 per cent of its publications and 11.8 per cent of its authors working on COVID-19.

Our analysis reveals that only nine countries are represented in 80 per cent of COVID-19-related surgery publications and authors. The capacity to contribute to research during a health crisis may be driven by resources, incentives, access to funding, and appetite for academic excellence, which may not be ubiquitous across all research communities. This suggests that communities with fewer system-wide supports may have greater pressure to redirect research resources to COVID-19. In fact, using data from Organization for Economic Cooperation and Development (OECD) countries, we find significant correlations between healthcare resilience and system-wide response and the share of COVID-19 publications ($\rho = -0.473$ with $P = 0.013$ for resilience; $\rho = 0.485$ with $P = 0.009$ for response), and the share of COVID-19 authors ($\rho = -0.444$ with $P = 0.021$ for resilience; $\rho = 0.459$ with $P = 0.014$ for response)[4]. COVID-19 mortality to the end of 2021 is moderately correlated with the share of COVID-19 publications ($\rho = -0.155$ with $P = 0.133$) and the share of COVID-19 authors ($\rho = -0.161$ with $P = 0.120$).

The implications of this research are multi-fold. First, understanding country differences in COVID-19-related surgery research and human capital is crucial in identifying leaders in emerging research priorities. Second, by gauging each country's surgical personnel's agility to redeploy resources during a crisis, we are able to infer the level of system and community preparedness to manage crises. Specifically, the percentage of authors in a country switching to COVID-19-related research during the pandemic may proxy the country's level of response to an emergency. Effective crisis management and appropriate government and institutional response will prove crucial in

Received: June 02, 2023. **Accepted:** June 12, 2023
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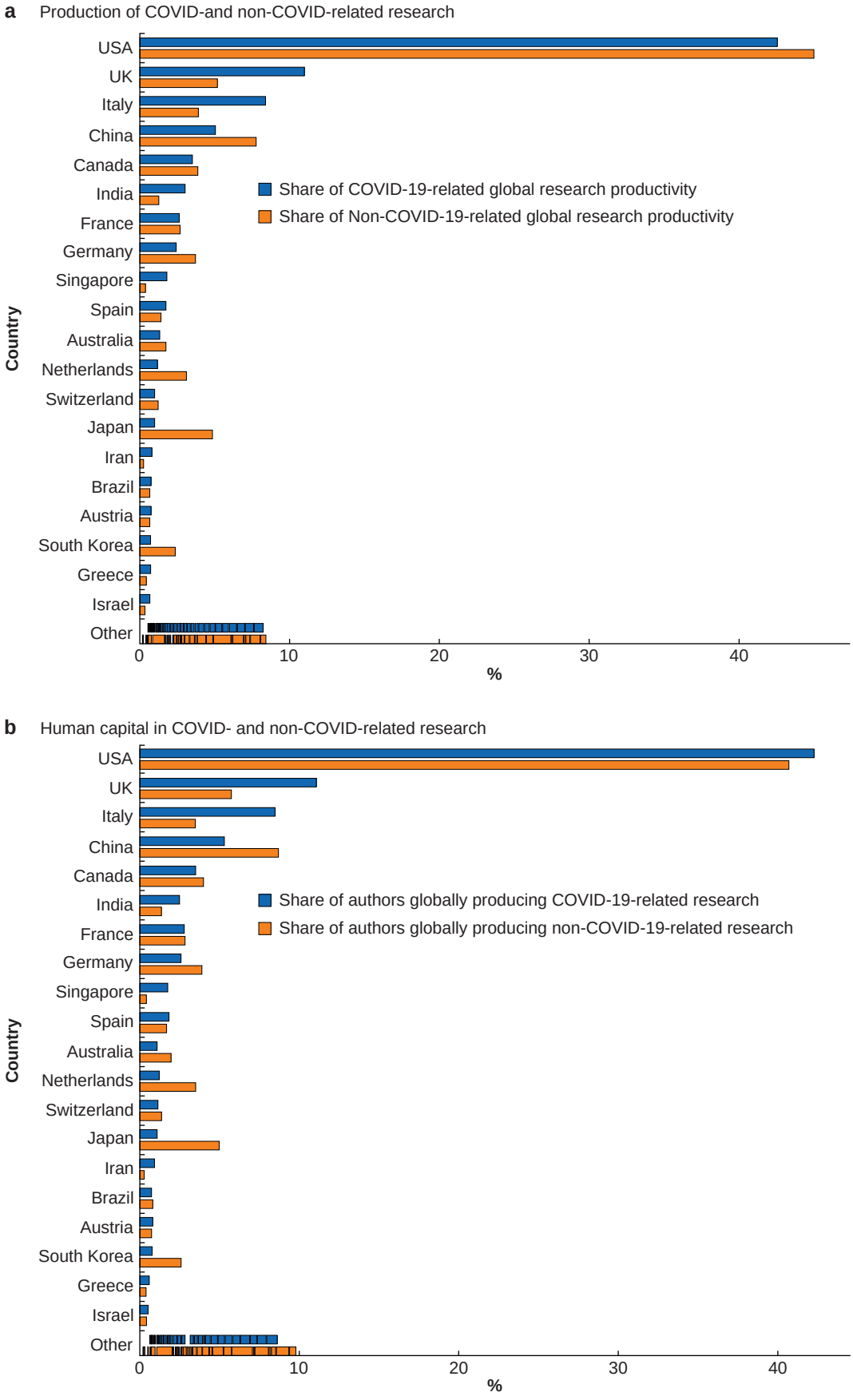

Fig. 1 Productivity and human capital in COVID-19-related surgery research

Notes: Panel **a** plots the share of articles in COVID-19- and non-COVID-19-related topics across the world published by each country. Panel **b** plots the share of authors across the world publishing in COVID-19- and non-COVID-19-related topics affiliated with each country.

designing system policies and procedures to shield against future epidemics, climate change, and geopolitical instabilities[5]. It is also important to recognize the nations in which researchers took on projects that contributed to our understanding of a global threat such as COVID-19 and its downstream consequences.

Funding

Open access funding is provided by HEAL-Link Greece.

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.

Author contributions

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

Ethical approval

This study was approved by the Institutional Review Board at Stanford University (#68605).

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