Cancer research activity in the Arab world: a 15-year bibliometric analysis

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Abstract

Background: The Arab region comprises 22 countries located in the Middle East and North Africa, sharing cultural and linguistic ties. Arab countries have continued to lag in terms of biomedical research compared to other nations for several past decades. Cancer is a major public health concern, being the second leading cause of death globally. Given that high research activity on cancer reflects positively on screening programs, awareness, and clinical practice, this article aimed to examine the activity and trend of cancer research in the Arab world between 2005 and 2019.

Methods: Between 2005 and 2019, the number of cancer-related articles published by each Arab country, and regarding 27 different types, was assessed using the PubMed database. Numbers were normalized with respect to each country’s average population and average Gross Domestic Product (GDP).

Results: Arab countries contributed to 1.52% of total cancer publications. The number of cancer publications has steadily grown since 2005, with the last 7 years alone witnessing 75.69% of the total Arab cancer-related publications. In terms of publications per million persons, Qatar ranked first (393.74 per million persons), while in terms of publications per national GDP, Egypt ranked first (464.27 per billion US dollars). Breast, liver, and colorectal cancers had the highest numbers of all Arab cancer-related publications, while testicular, vulvar, and gallbladder cancers had the least.

Conclusions: This paper pools information and insight for scientists, clinicians, funders, and decision-makers on the actualities and developments of cancer research in the Arab world. Addressing the barriers facing cancer research remains a cornerstone in the plan to improve the Arab world’s output and contribution to the field of oncology.

Keywords: Bibliometric analysis, Arab countries, Cancer, Research productivity

1 Background

Descriptions of cancer date back to 3000 B.C. and the earliest evidence of the disease was found among mummies in ancient Egypt and fossilized bone tumors [1]. Nowadays, cancer remains a major public health concern. In 2020, it is estimated that the global cancer burden rose to 19.3 million new cases and 10.0 million deaths. Approximately one in 5 people worldwide develop cancer during their lifetime, whereas one in 8 men and one in 11 women die from the disease [2]. This makes cancer the second leading cause of death globally, behind heart disease, according to the World Health Organization (WHO) [3].

The Arab region comprises 22 countries located in the Middle East and North Africa. With over 400 million inhabitants in total, these countries made up 5.5% of the world population and contributed 3.2% to the world gross domestic product (GDP) in 2019. While they share cultural and linguistic ties, they are markedly diverse in terms of education, economic development, and healthcare infrastructure [4]. Particularly, discrepancies within the Arab world are significant when it comes to scientific research output [5–10]. Furthermore, Arab countries have continued to lag behind in terms of biomedical research compared to other nations for several past decades [5, 11]. Cancer incidence varies remarkably within and between Arab populations [12]. Given that high research
activity on cancer reflects positively on screening programs, awareness, epidemiological data, and clinical practice, interest and investment in research have been steadily growing. However, cancer research output among Arab countries is yet to be comprehensively assessed. Within this context, this article aimed to examine the activity and trend of cancer research in the Arab world between 2005 and 2019.

2 Methods
2.1 Database and search strategy
Screening for cancer-related publications was done for all 22 Arab countries, for 15 years, between 2005 and 2019. These countries include Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen.

Using Boolean operator, we searched PubMed for:

- MeSH Term: “cancer” OR “neoplasm” OR “tumor” OR “carcinoma” OR “adenocarcinoma” OR “leukemia” OR “leukaemia” OR “sarcoma” OR “lymphoma” OR “malignant” OR “oncology” OR “metastasis” OR “oncogene” OR “chemotherapy”.
- Affiliation: Arab countries, representing authors’ countries. We excluded cities in the USA called Lebanon using Boolean operator NOT. Regarding Palestine, we used West Bank and Gaza.
- MeSH Date: 2005–2019.

Inclusion and exclusion criteria are as follows:

- All types of articles were included.
- Articles with no authors from the targeted countries were excluded.
- Articles published before 2005 or after 2019 were also excluded.

Figure 1 is a PRISMA chart that clarifies the selection process of publications that were included in this study.

2.2 Interpretation and comparison
The average population was calculated for each country between 2005 and 2019 using the 2019 World Prospect Population (WPP-2019). Besides, the average GDP was calculated in the same period from the World Bank [4, 13]. For each country, the number of publications per 1,000,000 persons was calculated, as well as per GDP. Similar approaches were used in other bibliometric analyses [5–7]. The number of publications for 27 types of cancer was also quantified, using similar methods to those of a study assessing the representation of cancer in the medical literature [14].

2.3 Statistical analysis
Data were analyzed using SPSS (Statistical Package for Social Sciences) version 22, to assess the strength of the relation between the number of cancer publications and both the average population and average GDP.
3 Results

Our findings revealed that a total of 26,656 cancer-related studies were published in the Arab world between 2005 and 2019, representing 13.4% of the total Arab biomedical research papers, and 1.52% of the world’s cancer-related studies published during that period. Overall, the total Arab publications accounted for 1.42% of the world’s biomedical literature during these 15 years (Table 1).

Among the 22 Arab countries, only Comoros had no cancer-related publication during these 15 years. Moreover, Djibouti, Mauritania, and Somalia each had fewer than 4 publications, accounting for no more than 0.012% of total Arab cancer-related studies. On the other hand, Egypt published the biggest number of cancer-related studies (8917) among Arab countries, followed by Saudi Arabia (6589). These two countries alone collectively contributed to ~58.2% of the total cancer-related publications among Arab countries during the studied period.

As for each country’s share of cancer-related papers out of its total research, Morocco was in the first position, with 16.75% of its total publications being cancer-related, just ahead of Egypt (16.73%) and Lebanon (16.51%).

The number of cancer publications has steadily grown since 2005, with the last 7 years alone witnessing 75.69% of the total Arab cancer-related publications (Fig. 2).

In terms of publications per million persons, Qatar ranked first with a ratio of 394.74 publications per million persons, followed by Lebanon and Saudi Arabia (Table 2).

A significant relationship between the number of cancer-related publications and the average population was revealed ($P<0.001$), with $R=0.7$ suggesting a strong

| Table 1  | Number and percentage of cancer-related publications in Arab countries |
|----------|---------------------------------------------------------------|
| Country  | Number of publications on cancer | Number of total publications | % cancer of total |
| Egypt    | 8917                          | 53,290                      | 16.73            |
| Saudi Arabia | 6589                  | 53,898                      | 12.23            |
| Lebanon  | 2019                          | 12,227                      | 16.51            |
| Tunisia  | 1811                          | 14,633                      | 12.38            |
| Jordan   | 1327                          | 10,817                      | 12.27            |
| Morocco  | 1276                          | 7618                        | 16.75            |
| United Arab Emirates | 932 | 9731                     | 9.58             |
| Qatar    | 880                           | 8265                        | 10.65            |
| Kuwait   | 708                           | 5646                        | 12.54            |
| Oman     | 484                           | 4835                        | 10.01            |
| Iraq     | 476                           | 4407                        | 10.80            |
| Algeria  | 314                           | 4062                        | 7.73             |
| Sudan    | 271                           | 3069                        | 8.83             |
| Syria    | 175                           | 1356                        | 12.91            |
| Bahrain  | 170                           | 1460                        | 11.64            |
| Libya    | 131                           | 997                         | 13.14            |
| Yemen    | 129                           | 1178                        | 10.95            |
| Palestine| 39                            | 1042                        | 3.74             |
| Mauritania | 3                           | 108                         | 2.78             |
| Somalia  | 3                             | 94                          | 3.19             |
| Djibouti | 2                             | 97                          | 2.06             |
| Comoros  | 0                             | 39                          | 0.00             |
| Total    | 26,656                        | 198,869                     | 13.40            |
| Worldwide| 1,750,749                     | 13,995,404                  | 12.509           |
correlation. The number of cancer-related publications may therefore be considered to be increased by the average population ($R^2$ was 0.49).

In terms of publications per national GDP, Egypt ranked first with a ratio of 464.27 publications per billion US$, far ahead of Lebanon in second place with 47.38 publications per billion US$ (Table 3).

A moderate ($R=0.42$) yet significant ($P<0.001$) correlation seemed to exist between the number of cancer-related publications and the average GDP. The number of cancer-related publications may be considered to be increased by the GDP ($R^2$ was 0.17).

The publications on 27 types of cancers were tracked, and breast cancer was found to have the highest number of Arab papers among all cancer-related publications (2241). Colorectal and hepatic cancers each also had more than 1000 publications during the studied period, whereas testicular, vulvar, and gallbladder cancers had the least publications (< 60) (Table 4).

Case reports were the most conducted types of studies in the Arab world (4060 publications). Different types of reviews made up of 4087 publications (3226 reviews, 452 systematic reviews, and 409 meta-analyses) (Table 5).

4 Discussion
Notwithstanding the heavy healthcare burden of cancer, research efforts in the field of oncology remain limited in the Arab world. Collectively, all 22 Arab countries contributed to a mere 1.52% of the world’s literature on cancer during the studied period. The overall trend revealed steady growth in the number of papers from the Arab world over the last 15 years. Egypt ranked first in terms of publications per average GDP, whereas Qatar ranked first concerning publications per average population. Comoros was revealed to have no cancer-related publications. The most reliable metric to assess and compare the research activity on cancer in Arab world countries was found to be the average population size which exhibited a strong correlation with the number of publications, whereas the correlation was weaker with GDP. This finding was echoed by another study on psoriasis research in the Arab world [15]; nevertheless, GDP was found to be the most accurate measure to assess stroke publications [16].

Several socioeconomic factors may play a role in hindering cancer publications and research activity in the Arab world. First of all, Arab funding of research is still relatively modest. In 2013, the gross expenditure on

| Country          | Average population | Number of publications per million persons |
|------------------|--------------------|--------------------------------------------|
| Qatar            | 2,235,000          | 393.74                                     |
| Lebanon          | 6,152,000          | 328.19                                     |
| Saudi Arabia     | 31,459,000         | 209.45                                     |
| Kuwait           | 3,588,000          | 197.32                                     |
| Tunisia          | 11,653,000         | 155.41                                     |
| Jordan           | 8,719,000          | 152.20                                     |
| Oman             | 3,952,000          | 122.47                                     |
| Bahrain          | 1,390,000          | 122.30                                     |
| United Arab Emirates | 8,901,000 | 104.71                                     |
| Egypt            | 93,895,000         | 94.97                                      |
| Morocco          | 35,797,000         | 35.65                                      |
| Libya            | 6,739,000          | 19.44                                      |
| Iraq             | 35,151,000         | 13.54                                      |
| Syria            | 20,294,000         | 8.62                                       |
| Palestine        | 4,592,000          | 8.49                                       |
| Algeria          | 40,594,000         | 7.74                                       |
| Sudan            | 39,399,000         | 6.98                                       |
| Yemen            | 26,525,000         | 4.86                                       |
| Mauritania       | 1,272,000          | 2.36                                       |
| Somalia          | 1,335,000          | 2.25                                       |
| Djibouti         | 939,000            | 2.13                                       |
| Comoros          | 785,000            | 0.00                                       |

| Country          | Average GDP (in billion US$) | Number of publications per billion US$ |
|------------------|------------------------------|----------------------------------------|
| Egypt            | 19.21                        | 464.27                                 |
| Lebanon          | 42.62                        | 47.38                                  |
| Jordan           | 30.30                        | 43.79                                  |
| Tunisia          | 41.90                        | 43.22                                  |
| Syria            | 6.84                         | 25.58                                  |
| Morocco          | 95.27                        | 13.39                                  |
| Saudi Arabia     | 607.29                       | 10.85                                  |
| Oman             | 63.82                        | 7.58                                   |
| Qatar            | 134.00                       | 6.57                                   |
| Bahrain          | 28.76                        | 5.91                                   |
| Kuwait           | 132.53                       | 5.34                                   |
| Yemen            | 29.89                        | 4.32                                   |
| Sudan            | 68.65                        | 3.95                                   |
| Palestine        | 9.98                         | 3.91                                   |
| United Arab Emirates | 323.86       | 2.88                                   |
| Iraq             | 165.99                       | 2.87                                   |
| Libya            | 54.45                        | 2.41                                   |
| Algeria          | 169.76                       | 1.85                                   |
| Djibouti         | 1.71                         | 1.17                                   |
| Somalia          | 4.22                         | 0.71                                   |
| Mauritania       | 4.87                         | 0.62                                   |
| Comoros          | 0.97                         | 0.00                                   |
research and development (GERD) by the entire Arab world constituted only 1.0% of total global expenditures on research [17]. Indeed, Arab states with the least publications in cancer research were mostly low-income countries such as Comoros, Djibouti, Mauritania, and Somalia. These countries suffer from poor health services, widespread poverty, and a lack of education [18]. On the other hand, Gulf countries such as the United Arab Emirates (UAE), Saudi Arabia, and Qatar have been increasingly pouring oil revenues into technology and science research [19–21], which was markedly illustrated on February 9th, 2021, when the United Arab Emirates became the first Arab country and the fifth country worldwide to send a probe to Mars [22]. Deficient funding can impede the establishment of robust research infrastructures within Arab medical schools and medical centers. As a matter of fact, most Arab medical schools and hospitals remain patient-centered and clinically oriented, as only recently has a research culture been prioritized [20, 23].

Furthermore, wars, internal turmoil, and ongoing conflicts may further jeopardize research activity in the Arab world by channeling funds usually allocated for biomedical research activity towards military action and into fulfilling basic needs. War-torn countries also suffer from brain drain and insecure environments that can hamper research activity [24, 25]. This would thereby explain why Iraq, Libya, Palestine, Somalia, Sudan, Syria, and Yemen have fared relatively poorly in terms of research outcomes in the studied period.

In this study, Egypt had the highest productivity in publishing cancer-related research among Arab states. Major reasons include that the country boasts the biggest population among the studied countries [4], and one which suffers from alarmingly increasing rates of cancer [12, 26]. The most common diagnoses among the Egyptian population include liver cancer in males (33.6%) and breast cancer in females (32.0%) [27].

Cancer is one of the leading causes of death in the Arab world, and its incidence remains on the rise in this region [31, 32]. To the best of the authors’ knowledge, this is the first study assessing the Arab world’s contribution to the field of oncology and the distribution of publications regarding each type of cancer.

Table 4 Number of total publications per cancer type in the Arab world

| Cancer          | Number of publications |
|-----------------|------------------------|
| Breast          | 2241                   |
| Colorectal      | 1169                   |
| Liver           | 1017                   |
| Leukemia        | 972                    |
| Lung            | 761                    |
| CNS             | 753                    |
| Lymphoma        | 731                    |
| Uterine         | 562                    |
| Prostate        | 501                    |
| Mouth           | 468                    |
| Urinary, bladder| 435                    |
| Ovarian         | 379                    |
| Thyroid         | 320                    |
| Kidney          | 296                    |
| Melanoma        | 292                    |
| Pancreases      | 253                    |
| Stomach         | 230                    |
| Hodgkin         | 157                    |
| Myeloma         | 140                    |
| Soft Tissue     | 136                    |
| Small Intestine | 90                     |
| Esophageal      | 84                     |
| Laryngeal       | 81                     |
| Mesothelioma    | 68                     |
| Testicular      | 59                     |
| Vulvar          | 37                     |
| Gallbladder     | 23                     |

Table 5 Number of cancer-related publications in Arab countries according to the type of paper

| Type of paper      | Number of publications |
|--------------------|------------------------|
| Case report        | 4060                   |
| Reviews            | 3236                   |
| Clinical trials    | 2171                   |
| Letter             | 564                    |
| Systematic reviews | 452                    |
| Meta-analysis      | 409                    |
| Commentaries       | 302                    |
| Observational      | 282                    |
| Editorials         | 157                    |
| Technical notes    | 0                      |
4.1 Limitations
Despite its strengths, this bibliometric analysis should also be viewed in light of some limitations. The publications were obtained only from one database, PubMed, since it is the world’s largest medical library and contains only biomedical work. In contrast, when collecting studies from multiple databases, some publications may be counted more than once resulting in duplicate studies. Besides, only publications written in English were gathered in this study, therefore omitting papers in Arabic, French, or other languages. On this basis, the credibility of our results may be affected as the number of publications might be underestimated.

5 Conclusions
Cancer research is a growing field in the Arab world and for valid reasons. Yet, the Arab contribution to the field of oncology remains a humble share of the world’s output due to diverse socioeconomic factors that impede research activity. Our paper pools background information for scientists, clinicians, funders, and decision-makers by providing insight on the actualities and trends of cancer research in the Arab world, and its distribution upon cancer types, thereby laying the groundwork for future developments.

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Authors’ contributions
MM and JEM contributed to the study conception and design. Material preparation, data collection, and analysis were performed by JEM and LMA. The first draft of the manuscript was written by MM and JEM, and BM commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Not applicable

Consent for publication
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Competing interests
The authors declare that they have no competing interests.

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References
1. American Cancer Society. Early history of cancer. Available from: http://www.cancer.org/cancer/cancerbasics/thehistoryofcancer/the-history-of-cancer-what-is-cancer-2014.
2. World Health Organization (WHO). International Agency for Research on Cancer. Latest Global Cancer Data (2020, December 15). Press Release Nº 292. 2020.
3. World Health Organization (WHO). Cancer. Available from: https://www.who.int/cancer/en/ 2019.
4. World Bank. Arab World. Available from: https://data.worldbank.org/region/arab-world 2019.
5. El Ayoubi LM, El Masri J, Machaalani M, El Hage S, Salameh P. Contribution of Arab world in transplant research: a PubMed-based bibliometric analysis. Transpl Immunol. 2021:68. https://doi.org/10.1016/j.triim.2021.101432.
6. Chanbour H, El Masri J, Bsat S, Bsat A, Jiblawi A, Sunna T. A bibliometric analysis of neurosurgery research productivity in Arab Countries between 2005 and 2019. World Neurosurg. 2021;154:e313–9. https://doi.org/10.1016/j.wneu.2021.07.026.
7. El MD, Alsaayed B, El MJ, Zreika B, Chanbour H, Salameh P. Contribution of Arab Countries to familial Mediterranean fever research: a PubMed-based bibliometric analysis. Rheumatol Int. 2021. https://doi.org/10.1007/s00296-021-04852-0.
8. El Masri J, El Hage S, Akoum A, Awaida I, Kourani F, Chanbour H, et al. Contribution of Arab countries to Behçet disease research: A PubMed-based bibliometric and altmetric analysis. Rheumatol Int. 2022;42:133–40. https://doi.org/10.1007/s00296-021-04990-5.
9. El Masri J, Dankar R, El Masri D, Chanbour H, El Hage S, Salameh P. The Arab Countries’ contribution to the research of neurodegenerative disorders. Cureus. 2021;42:133–40. https://doi.org/10.7759/cureus.17589.
10. Wakim E, El Hage S, Safi S, El Kareh A, El Masri J, Salameh P. Insights in neuropsychiatry: suicide and self-mutilation in the men region- a bibliometric quantitative and co-occurrence medline-based analysis. Cureus. 2021. https://doi.org/10.7759/cureus.18680.
11. Benamer HT, Bakouch O. Arab nations lagging behind other Middle Eastern countries in biomedical research: A comparative study. BMC Med Res Methodol. 2009;9. https://doi.org/10.1186/1471-2288-9-26.
12. Salim EI, Moore MA, Al-Lawati JA, Al-Sayad J, Bawazir A, Barbarashi S, et al. Cancer epidemiology and control in the Arab world - past, present and future. Asian Pacific J Cancer Prev. 2009;10:3–16.
13. United Nations (UN). World Population Prospects. Population Division. 2019.
14. Glynn RW, Chin JZ, Kerin MJ, Sweeney KJ. Representation of cancer in the medical literature - a bibliometric analysis. PLoS One. 2010;5. https://doi.org/10.1371/journal.pone.0013902.
15. Dauu L, El Hage S, Wakim E, Saif S, El Kareh A, El Masri J, Salameh P. Poroiasis: A bibliometric analysis in the Arab World (2004–2019). Australas J Dermatol. 2021,62:19–23. https://doi.org/10.1111/ajd.13407.
16. Sallhab HA, Salameh P, Haji H, Hosseini H. Stroke in the Arab World: A bibliometric analysis of research activity (2002–2016). ENeurologicalSci. 2018;13:40–5. https://doi.org/10.1016/j.enasco.2018.11.010.
17. United Nations Educational Scientific and Cultural Organization (UNESCO). Gross domestic expenditure on R&D (GERD). Institute for Statistics. Science, technology and innovation 2013.
18. Kuncic A. How Similar are Arab Countries and what are their Characteristics, 2016. p. 1–25.
19. Giles J. Arab state pours oil profits into science. Nature. 2006;441:132–3. https://doi.org/10.1038/441132a.
20. Almansour S. The crisis of research and global recognition in Arab universities. Near Middle East J Res Educ. 2016:1. https://doi.org/10.5339/nmejer.2016.1.
21. Masood E. Blooms in the desert. Nature. 2002;416:120–2. https://doi.org/10.1038/416120a.
22. Gibney E. UAE ramps up space ambitions with Arab world’s first Moon mission. Nature. 2020;587:186–7. https://doi.org/10.1038/d41586-020-03054-1.
23. Aboshady OA, Gouda MA. Student research in Arab world. What is the current state? Saudi Med J. 2016;37:707–8. https://doi.org/10.15537/smj.2016.6.15073.

24. Puddington A. Freedom in the world 2012: The Arab uprisings and their global repercussions: Selected data from Freedom House’s annual survey of political rights and civil liberties: Free House; 2012.

25. Zahlan A. The Arab brain drain. Popul Bull U N Econ Comm West Asia. 1979:19–38. https://doi.org/10.1017/s0026318400053608.

26. Ibrahim AS. Cancer: The Growing Monster in Egypt. J Cancer Prev Curr Res. 2016:6. https://doi.org/10.15406/jcpcr.2016.06.00217.

27. Ibrahim AS, Khaled HW, Mikhail NN, Baraka H, Kamel H. Cancer incidence in Egypt: Results of the national population-based cancer registry program. J Cancer Epidemiol. 2014;2014. https://doi.org/10.1155/2014/437971.

28. Parkin DM, Bray F, Ferlay J, Pisani P. Global Cancer Statistics, 2002. CA Cancer J Clin. 2005;55:74–108. https://doi.org/10.3322/cacin.55.2.74.

29. Jawad Hashim M, Al-Shamsi FA, Al-Marzooqi NA, Al-Qasemi SS, Mokdad AH, Khan G. Burden of breast cancer in the Arab world: Findings from global burden of disease, 2016. J Epidemiol Glob Health. 2018;8:54–8. https://doi.org/10.2991/j.egh.2018.09.003.

30. Araf A, Farhat K. Colorectal cancer in the Arab world - Screening practices and future prospects. Asian Pac J Cancer Prev. 2015;16:7425–30. https://doi.org/10.7314/APJCP.2015.16.74.7425.

31. Mokdad AH, Jaber S, Abdel Aziz MI, Al Buhairan F, Al Ghairi A, Al Hamad NM, et al. The state of health in the Arab world, 1990-2010: An analysis of the burden of diseases, injuries, and risk factors. Lancet. 2014;383:309–20. https://doi.org/10.1016/S0140-6736(13)62189-3.

32. Araf A, Rabah DM, Farhat KH. Rising cancer rates in the Arab world: Now is the time for action. East Mediterr Heal J. 2020;26:638–40. https://doi.org/10.26719/emhj.20.073.

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