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RESEARCH ARTICLE

Visualizing highly cited scientific output of Indian physiotherapists: A bibliometric study [version 1; peer review: awaiting peer review]

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Abstract

Background: Physiotherapy research supports the advancement of evidence-based practice and development of a highly skilled workforce. This study aims to visualize highly cited scientific output of Indian physiotherapists from 1999 to 2018.

Methods: A descriptive study design was adopted to visualize highly cited scientific output of Indian physiotherapists using the Web of Science (WoS) database from 1999 to 2018. A search was carried out using the following term "((TS=(physiotherapy) OR TS=("physical rehabilitation") OR TS=("physical therapy")) AND AD=(India))Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=1999-2018". Data collected were analyzed using Incites from WoS and VOSviewer software.

Results: A total of 489 articles were published between 1999 and 2018, with a peak of 103 in 2016 with 2420 citations. A decline in publication count was observed after 2016. The journal International Journal of Physiotherapy published the highest number of articles (n=35). Manipal University (n=26) was found to be the most active institution for physiotherapy research in India, as determined by producing the most articles. Indian physiotherapists published the highest number of research articles in collaboration with US authors (n=24).

Conclusion: There is an increasing trend in the scientific output of Indian physiotherapists over the past two decades; however, a decline is observed after 2016. It is recommended that research collaborations across the globe are increased and scientific output should be improved, leading to a higher
number of citations. Future research should explore factors influencing scientific production of Indian physiotherapists and devise appropriate strategies to attain further improvement.

**Keywords**
Bibliometric study, India, Physiotherapy, Scientific output

This article is included in the Science Policy Research gateway.

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Introduction
Scientific output of a profession is recognized by the frequency of publications, which are published in peer-reviewed journals and indexed in bibliographic databases. In physiotherapy, this scientific output is utilized to enhance existing knowledge and develop guidelines for highly effective clinical practice. Accordingly, the analysis of scientific output allows definition of baseline indicators in knowledge and clinical practice in physiotherapy. Various studies investigated the scientific output of physiotherapists across the globe. Among these studies, several utilized electronic searches, whereas others were limited to document reviews. Concerning the Indian context, only two studies have been performed to reveal the research productivity of Indian physiotherapists from 2000 to 2014, which were limited to the Medline database. Moreover, Li et al. (2018) recently stated that Clarivate Analytics’s Web of Science (WoS) is the World’s foremost scientific citation search and analytical platform, which can be used as both a research tool and dataset. Hence, there is a need for further research that should involve the WoS database to detect high-quality research publications by Indian physiotherapists up until 2018 (this study took place in 2019). Therefore, this study intended to conduct a bibliometric study on the scientific output of Indian physiotherapists using WoS during the last two decades (from 1999 to 2018).

Methods
A descriptive study design was adopted to reveal the scientific output of Indian physiotherapists using an electronic literature search in the WoS database during the period from 1999 to 2018.

Article selection
The search was conducted on 14th October 2019. The term ‘Indian physiotherapists’ denotes physiotherapy professionals employed in any of academic or clinical establishments in India in the study period. The search was carried out in WoS using the following term “((TS=(physiotherapy) OR TS=("physical rehabilitation") OR TS="physical therapy") ANDAD=(India)) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=1999–2018”. The search started from 1999 since this study aimed to retrieve data from the past two decades.

Article screening
The search methodology is described in Figure 1. Based on the inclusion criteria, 489 publications were included and proceeded for further analysis.

Data analysis
Retrieved articles were analysed using Incites in WoS and VOSviewer 1.6.11. Incites was used to gather information.
publication year, authorship ranking, source journal productivity, collaborating institutions, country-wise research collaboration, and citations. In addition, the information related to h-index was obtained from the Incites in WoS. The data, which is exported from the WoS database as an ISI common export (.ciw) format, were imported into VOSviewer to explore the co-occurrences of keywords used by the authors in their articles. The flowchart describing the procedures for carrying out both Incites and VOSviewer analysis is depicted in Figure 2.

Since Incites in WoS used in this study are proprietary software, the researchers could alternatively use a tab-delimited file downloaded from WoS and use it in VOSviewer.

Results
A total of 489 articles were included in the study; 381 research articles, 53 reviews, 34 proceedings, 9 meeting abstracts, 8 letters, 3 editorial material, and one correction.

Between 1999 and 2008, scientific output of Indian physiotherapists is minimal, reaching a peak of 9 in 2008. Subsequently, the publication count starts to rise gradually from 2009 to 2016, which has a peak of 103 articles. Publications decreased after 2016 and rose slightly in 2018, but not to levels seen in 2016 (Table 1 and Figure 3). Regarding citation count, there was a gradual rise over the research period, with a total of 2420 citations between 1999 and 2018, more than 100 of which have been documented since 2012. The highest average citation (citations/article) of ≥10 was observed only in 2006 (mean, 11.00) and 2014 (mean, 10.20).

A total of 264 journals had published the 489 retrieved articles. The top 20 journals in which Indian physiotherapists published over the study period are displayed in Table 2. The top 20 journals published 174 articles, 35.58% of total publications (N=489) in the research period. Out of the top 20 ranked journals, 11 were journals based in India, 26.79% of the total publications.

The International Journal of Physiotherapy published 35 articles, with six citations for these 35 articles, an average citation of 0.17. It was the most active journal found in this study and contributed to 7.16% of total publications. In contrast, the journal Haemophilia published seven articles with 68 citations...
### Table 1. Publication trend of articles published by Indian physiotherapists between 1999 and 2018. Data obtained from Web of Science. Includes all articles types. N articles = 489.

| Publication year | Articles | % of total publications | Citations total | Average citation (citations/article) |
|------------------|----------|-------------------------|-----------------|-------------------------------------|
| 1999             | 1        | 0.20                    | 0               | 0.00                                |
| 2000             | 1        | 0.20                    | 0               | 0.00                                |
| 2001             | 4        | 0.82                    | 1               | 0.25                                |
| 2002             | 1        | 0.20                    | 2               | 2.00                                |
| 2003             | 1        | 0.20                    | 3               | 3.00                                |
| 2004             | 6        | 1.23                    | 8               | 1.33                                |
| 2005             | 7        | 1.43                    | 8               | 1.14                                |
| 2006             | 1        | 0.20                    | 11              | 11.00                               |
| 2007             | 7        | 1.43                    | 18              | 2.57                                |
| 2008             | 9        | 1.84                    | 17              | 1.89                                |
| 2009             | 16       | 3.27                    | 34              | 2.13                                |
| 2010             | 11       | 2.25                    | 69              | 6.27                                |
| 2011             | 18       | 3.68                    | 93              | 5.17                                |
| 2012             | 21       | 4.29                    | 131             | 6.24                                |
| 2013             | 26       | 5.32                    | 184             | 7.08                                |
| 2014             | 25       | 5.11                    | 255             | 10.20                               |
| 2015             | 82       | 16.77                   | 297             | 3.62                                |
| 2016             | 103      | 21.06                   | 356             | 3.46                                |
| 2017             | 75       | 15.34                   | 426             | 5.68                                |
| 2018             | 74       | 15.13                   | 507             | 6.85                                |
| Total            | 489      | 100.00                  | 2420            |                                     |

### Figure 3. Publication trend of articles published by Indian physiotherapists between 1999 and 2018. Data obtained from Web of Science. Includes all articles types.
Table 2. Top 20 journals Indian physiotherapists published in between 1999 and 2018. Data obtained from Web of Science. Includes all articles types. N articles = 489.

| Journals                                           | Country       | Articles | % of total articles | Total citations | Average citation (citations/article) |
|----------------------------------------------------|---------------|----------|---------------------|-----------------|--------------------------------------|
| International Journal of Physiotherapy            | India         | 35       | 7.16                | 6               | 0.17                                 |
| Journal of Evolution of Medical and Dental Sciences-JEMDS | India         | 30       | 6.14                | 4               | 0.13                                 |
| Journal of Clinical and Diagnostic Research       | India         | 26       | 5.32                | 40              | 1.54                                 |
| Haemophilia                                        | UK            | 7        | 1.43                | 68              | 9.71                                 |
| Indian Journal of Critical Care Medicine           | India         | 7        | 1.43                | 53              | 7.57                                 |
| Indian Journal of Orthopedics                     | India         | 7        | 1.43                | 17              | 2.43                                 |
| Journal of Orthopaedic Surgery                    | France        | 6        | 1.23                | 36              | 6.00                                 |
| Physiotherapy Theory and Practice                 | England       | 6        | 1.23                | 25              | 4.17                                 |
| Indian Pediatrics                                 | India         | 5        | 1.02                | 34              | 6.80                                 |
| International Journal of Scientific Study         | India         | 5        | 1.02                | 17              | 3.40                                 |
| Journal of Back and Musculoskeletal Rehabilitation| Netherlands   | 5        | 1.02                | 0               | 0.00                                 |
| Nitte University Journal of Health Science        | India         | 5        | 1.02                | 0               | 0.00                                 |
| Annals of Indian Academy of Neurology             | India         | 4        | 0.82                | 43              | 10.75                                |
| Hong Kong Physiotherapy Journal                   | Hong Kong     | 4        | 0.82                | 35              | 8.75                                 |
| International Journal of Oral and Maxillofacial Surgery | Denmark     | 4        | 0.82                | 29              | 7.25                                 |
| Journal of Maxillofacial Oral Surgery             | India         | 4        | 0.82                | 13              | 3.25                                 |
| Journal of Physical Therapy Science               | Japan         | 4        | 0.82                | 12              | 3.00                                 |
| Leprosy Review                                    | UK            | 4        | 0.82                | 5               | 1.25                                 |
| Annals of Neurosciences                           | India         | 3        | 0.61                | 16              | 5.33                                 |
| Bangladesh Journal of Medical Science             | Bangladesh    | 3        | 0.61                | 0               | 0.00                                 |

for these articles, an average citation of 9.71. Similarly, Annals of Indian Academy of Neurology published four articles, with citations of 43, giving it the highest average citation of 10.75 (Table 2).

Table 3 shows the top 20 authors who worked with Indian physiotherapists to publish physiotherapy articles. These authors contributed 22.09% of total publications (N=489) in collaboration with Indian physiotherapists. Kumar S, Mahadevappa M, and Samuel AJ collectively have accounted for 5.73% of total publications (N=489). An Indian author named Kumar R (ICMR-National Institute of Occupational Health) is the Indian physiotherapist with the highest h-index (18) and had published five articles, which were cited 1372 times.

The top 20 institutions that collaborated and published articles with Indian physiotherapists for physiotherapy research are displayed in Table 4. Among these institutions, Manipal University (India) has the highest number of publications, with 7.36% of total publications, followed by Christian Medical College Hospital (India; 3.89%), the Indian Institute of Technology (India; 3.68%) and King Saud University (KSU; Saudi Arabia; 3.68%). In total, 90% of collaborating institutions were based in India. Internationally, KSU and the University of London (UK; 1.23%) had the most active cooperation with Indian physiotherapists over this time period.

Out of the total publications (N=489), articles published by Indian physiotherapists in collaboration with authors belonging to international countries was as follows: United States (4.91%), Saudi Arabia (4.50%), UK (3.68%), Canada (1.84%), and Sweden (1.02%). Australia, Brazil, Italy, Malaysia, Mexico, and Pakistan contributed 0.82% each to total publications (Table 5). Out of the top 20 countries, Indian physiotherapists collaborated the most with the US (after India), publishing 24 articles, which secured 370 citations (average citation 15.42). Notably, articles published by Indian physiotherapists in collaboration with German authors had the highest number of average citation (41.00), though only three articles were published.

Using VOSviewer, the authors created a keyword table and graphic representation of the co-occurrence of keywords across articles. The top 20 keywords used in articles (from a total of 2477 keywords) are shown in Figure 4. An article’s keyword may represent its primary material, and to some degree, the
Table 3. Top 20 authors Indian physiotherapists collaborated with between 1999 and 2018. Data obtained from Web of Science. Includes all articles types. N articles = 489.

| Author         | Institution                                      | Country       | Articles | % of total articles | h-index | Total citations |
|----------------|--------------------------------------------------|---------------|----------|---------------------|---------|-----------------|
| Kumar S        | King George Med University                       | India         | 12       | 2.45                | 2       | 21              |
| Mahadevappa M  | JSS Mahavidyapeetha                             | India         | 8        | 1.64                | 13      | 1026            |
| Samuel AJ      | Maharishi Markandeshwar                          | India         | 8        | 1.64                | 2       | 20              |
| Biswas A       | Jadavpur University                              | India         | 6        | 1.23                | 15      | 544             |
| Singh S        | Banaras Hindu University                        | India         | 6        | 1.23                | 2       | 231             |
| Kumar R        | ICMR-National Institute of Occupational Health  | India         | 5        | 1.02                | 18      | 1372            |
| Prakash V      | Charotar University of Science and Technology    | India         | 5        | 1.02                | 9       | 480             |
| Iqbal ZA       | King Saud University                             | Saudi Arabia  | 5        | 1.02                | 6       | 119             |
| Lenka PK       | National Institute of Occupational Health       | India         | 5        | 1.02                | 5       | 105             |
| Pattnaik M     | National Institute of Technology                | India         | 5        | 1.02                | 6       | 92              |
| Hariomh K      | Center for Evidence based Neurehabilitation     | India         | 5        | 1.02                | 3       | 28              |
| Kumar A        | Basaveshwara Teaching and General Hospital      | India         | 5        | 1.02                | 0       | 0               |
| Kumar N        | Central Scientific Instruments Organisation      | India         | 5        | 1.02                | 0       | 0               |
| Gupta A        | National Institute of Mental Health and Neurosciences | India     | 4        | 0.82                | 14      | 513             |
| Maiya AG       | Manipal University                               | India         | 4        | 0.82                | 7       | 53              |
| Goregaonkar AB | Lokmanya Tilak Municipal General Hospital        | India         | 4        | 0.82                | 4       | 38              |
| Arumugam N     | Punjabi University                               | India         | 4        | 0.82                | 3       | 35              |
| Dutta A        | North Bengal Medical College                     | India         | 4        | 0.82                | 3       | 33              |
| Gupta M        | Vardhaman College of Engineering                 | India         | 4        | 0.82                | 3       | 30              |
| Gupta P        | Pt JNM Medical College Raipur                    | India         | 4        | 0.82                | 2       | 2               |

frequency of occurrence. Likewise, co-occurrence can indicate centered themes of research in a field. Among the top 20 keywords, those with a considerable rate of occurrence are “Physiotherapy” (n=72; 2.91%), “Rehabilitation” (n=48; 1.94%), “Management” (n=46; 1.86%), and “Exercise and Therapy” (n=25; 1.01%). The keyword “Randomized Controlled-Trial” had the highest average citations (16.50%) among the top 20 keywords.

Discussion

Publication count

Previously, using data from Scopus, it had been observed that Italian physiotherapists published 1083 articles with 13,373 citations. The number of publications by these authors had gradually increased over the years from before 1995 (10 articles) to 2016 (143 articles). More than 50% of the total publications were produced between the years 2012 and 2016. In India, Hariomh et al. observed a considerable increase in the research output of Indian physiotherapists, using the MEDLINE database, between 2000 and 2014, with a total of 182 articles. This study observed that Indian physiotherapists had published 489 articles in WoS from 1999 to 2018, with a peak of 103 articles in 2016. However, there was a drastic drop in publication count from 103 in 2016 to 74 in 2018. Remarkably, the number of articles from 2016 to 2018 accounted for 50% (n=252) of total publications (N=489). From these results, it is inferred that Indian physiotherapists are increasingly aware of publishing more articles in high-quality journals in recent years and have enhanced their research competencies gradually to raise their scientific output. Nevertheless, a drastic drop in their publication count after 2016 indicates that there is a need for further research to reveal individual and institutional factors causing this decline and create appropriate strategies to improve the scientific output of Indian physiotherapists.

Citations

A total of 489 articles published by Indian physiotherapists from 1999 to 2018 secured a total of 2420 citations. Citations in each year gradually increased and reached 507 by 2018, and this rise was observed with a substantial count from 2012.
to 2018. Littman et al. analyzed the research output of 45 physical therapy faculty in southeastern US from 2000 to 2016 using their curriculum vitae. The range of publications and the citations of these faculty was observed as 0 to 43, and 0 to 943, respectively. Another study by Sturmer et al. found that 222 articles were published by Brazilian physical therapy researchers in WoS in 2010, which had a total of 1805 citations. Contrary to these findings, this study reported that Indian physiotherapists published only 65 articles with 171 citations up to the year 2010 in WoS. Even though the

Table 4. Top 20 institutions collaborating with Indian physiotherapists between 1999 and 2018. Data obtained from Web of Science. Includes all articles types. N articles = 489.

| Institutions                                      | Country      | Articles | % of total articles |
|---------------------------------------------------|--------------|----------|---------------------|
| Manipal University                                 | India        | 36       | 7.36                |
| Christian Medical College Hospital                 | India        | 19       | 3.89                |
| Indian Institute of Technology                    | India        | 18       | 3.68                |
| King Saud University                               | Saudi Arabia | 18       | 3.68                |
| All India Institute of Medical Sciences           | India        | 14       | 2.86                |
| Dr Dy Patil Vidyapeeth Pune                        | India        | 12       | 2.45                |
| Nitte Deemed to Be University                     | India        | 12       | 2.45                |
| Maharishi Markandeshwar University                | India        | 11       | 2.25                |
| Sri Ramachandra University                        | India        | 11       | 2.25                |
| National Institute of Mental Health Neurosciences | India        | 10       | 2.05                |
| Indian Institute of Technology IIT Kharagpur       | India        | 8        | 1.64                |
| Apollo Hospital                                   | India        | 6        | 1.23                |
| Banaras Hindu University                          | India        | 6        | 1.23                |
| Charotar University of Science Technology Charusat | India        | 6        | 1.23                |
| Jamia Millia Islamia                              | India        | 6        | 1.23                |
| Punjabi University                                | India        | 6        | 1.23                |
| University of London                              | UK           | 6        | 1.23                |
| Pgimer Chandigarh                                  | India        | 5        | 1.02                |
| St John S Medical College                         | India        | 5        | 1.02                |
| St John S National Academy of Health Sciences     | India        | 5        | 1.02                |

Table 5. Top 20 countries collaborating with Indian physiotherapists between 1999 and 2018. Data obtained from Web of Science. Includes all articles types. N articles = 489.

| Countries                | Articles | % of total articles | Citations | Average citation (citations/article) |
|--------------------------|----------|---------------------|-----------|--------------------------------------|
| India                    | 489      | 100.00              | 2819      | 5.76                                 |
| USA                      | 24       | 4.91                | 370       | 15.42                                |
| Saudi Arabia             | 22       | 4.50                | 90        | 4.09                                 |
| UK                       | 18       | 3.68                | 245       | 13.61                                |
| Canada                   | 9        | 1.84                | 29        | 3.22                                 |
| Sweden                   | 5        | 1.02                | 35        | 7.00                                 |
| Australia                | 4        | 0.82                | 23        | 5.75                                 |
| Brazil                   | 4        | 0.82                | 37        | 9.25                                 |
| Italy                    | 4        | 0.82                | 52        | 13.00                                |
| Malaysia                 | 4        | 0.82                | 11        | 2.75                                 |
| Mexico                   | 4        | 0.82                | 0         | 0.00                                 |
| Pakistan                 | 4        | 0.82                | 50        | 12.50                                |
| Denmark                  | 3        | 0.61                | 14        | 4.67                                 |
| France                   | 3        | 0.61                | 32        | 10.67                                |
| Germany                  | 3        | 0.61                | 123       | 41.00                                |
| Singapore                | 3        | 0.61                | 102       | 34.00                                |
| Argentina                | 2        | 0.41                | 12        | 6.00                                 |
| Ethiopia                 | 2        | 0.41                | 1         | 0.50                                 |
| Iran                     | 2        | 0.41                | 33        | 16.50                                |
| Japan                    | 2        | 0.41                | 8         | 4.00                                 |
articles published by Indian physiotherapists were suitable enough for several researchers to cite them often, there is a need to improve the citation count of their publications in the future.

Journals

Out of 264 journals, the top 20 journals that Indian physiotherapists published in contributed to 35.58% of total publications (N=489) in the WoS database. Notably, it is observed that Indian-based journals published 26.79% of the total publications; no publications were observed in US-based journals. Further, the highest count of publications was observed in an Indian-based journal *International Journal of Physiotherapy*. This affinity of Indian physiotherapy researchers towards Indian-based journals might be due to the nature of their research articles, or interest in country-based journals. However, those researchers should expand their contribution to other high-quality international journals. Exploring the reasons behind Indian physiotherapists’ choice to publish in these Indian journals is beyond the scope of this study, and further research is warranted to address this critical issue. Besides, a high number of articles published by Indian physiotherapists in *International Journal of Physiotherapy* had only a small number of citations, giving a low average citation. Nevertheless, other journals, such as *Haemophilia* and *Annals of Indian Academy of Neurology*, showed considerable citations and a high average citation for only a few articles published in these journals. This implies that these articles must possess information that is cited often by other researchers.

Collaborating authors

A previous study by Man et al. found that four Hong Kong physiotherapy professors had a median h-index of 30.5 and their average total number of citations was 2930.3. Moreover, Brazilian physical therapy researchers had a median h-index of 3, according to WoS. Recently, Vercelli et al. reported that the mean h-index of 363 Italian physiotherapists was 2.2, which ranged from 0 to 16; mean citations per author were observed as 58. This study reported that the top 20 authors who worked with Indian physiotherapists contributed to 22.09% of total publications (N=489). Kumar S (India) was the leading author who collaborated with other Indian physiotherapists in physiotherapy research with 12 publications. Another Indian author, Kumar R, had the highest h-index of 18.

Collaborating institutions

Among the top 20 collaborating institutions, Manipal University in India was the leading institution that had the most collaborations with Indian physiotherapists, contributing to 7.36% of total publications (N=489). In line with our findings, Hariom et al. revealed that Manipal University is an active research institution with 59 articles in the MEDLINE database from 2000 to 2014. Of the top 20 institutions, 90% were based in India, whereas only two institutions were based in the UK and Saudi Arabia. This implies that Indian physiotherapists had more collaborations with institutions in their own country. However, there is a need for Indian physiotherapists to collaborate with international institutions to improve their scientific output.

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**Figure 4.** Top 20 keywords co-occurring in articles published by Indian physiotherapists between 1999 and 2018. Graphic created using VOSviewer.
Collaborating countries

The international country with the highest number of articles published with Indian physiotherapists (contributing to 4.91% of total publications in this research period) was the US, followed by Saudi Arabia (4.50%). The total percentage of publications with other countries is minimal. Articles published in collaboration with the US had a high citation count, and Germany had the highest average citation. Hence, this study recommends that Indian physiotherapists should enhance their research collaboration with other countries since collaborative research allows the development of networks with early-career researchers in other countries and, therefore, is frequently regarded as an indicator of quality to develop and disseminate scientific knowledge to newly developing countries.

Keywords by co-occurrence

Lastly, this study revealed the top 20 keywords that occurred in various articles using VOSviewer software. The term “Physiotherapy” had the highest occurrence rate (2.91%). “Randomized controlled trial” was associated with the highest average citation (16.50).

Conclusion

This study observed that the scientific output of Indian physiotherapists shows an uptrend in performance since 1999, excluding 2017/18 where a drastic decline was noticed. Indian physiotherapists are mostly publishing and collaborating with Indian-based journals and institutions, respectively. Even though there are high-quality publications, there is a need to enhance both the quality and quantity of scientific papers, to increase the high number of citations and average citation. This study also recommends that Indian physiotherapists should expand their research collaboration internationally to improve their scientific output. Future studies can focus on analyzing individual and institutional factors influencing research productivity of Indian physiotherapists and develop suitable strategies to enhance their scientific production.

Data availability

Underlying data

Open Science Framework: Visualization pattern of the highly cited scientific output of Indian Physiotherapists: A bibliometric study, https://doi.org/10.17605/OSF.IO/YC6VK

This project contains the following underlying data:
- Article level and citation data for all 489 articles retrieved.
- Journal, author, institution and country data for all 489 articles retrieved.

Data are available under the terms of the Creative Commons Zero “No rights reserved” data waiver (CC0 1.0 Public domain dedication).

References

1. Ilott I, Bury T: Research capacity. Physiotherapy. 2002; 88(4): 194–200. [Publisher Full Text]
2. Ilott I: Challenges and strategic solutions for a research emergent profession. Am J Occup Ther. 2004; 58(3): 347–352. [Publisher Abstract | Publisher Full Text]
3. Coury HJCG, Vilella I: Profile of the Brazilian physical therapy researcher. Rev Bras Fisioter. 2009; 13(4): 356–363. [Publisher Full Text]
4. Richter RR, Scholler SL, Krieger MM, et al.: Journal publication productivity in academic physical therapy programs in the United States and Puerto Rico from 1988 to 2002. Phys Ther. 2008; 88(3): 376–386. [Publisher Abstract | Publisher Full Text]
5. Mughnaini R, Packer AL, Meneghini R: Comparison of scientists of the Brazilian Academy of Sciences and of the National Academy of Sciences of the USA on the basis of the h-index. Braz J Med Biol Res. 2008; 41(4): 258–262. [Publisher Abstract | Publisher Full Text]
6. Sturmer G, Viero CC, Silveira MN, et al.: Profile and scientific output analysis of physical therapy researchers with research productivity fellowship from the Brazilian National Council for Scientific and Technological Development. Braz J Phys Ther. 2013; 17(1): 41–48. [Publisher Abstract | Publisher Full Text]
7. Robertson VJ: Research and the cumulation of knowledge in Physical Therapy. Phys Ther. 1995; 75(3): 223–232. [Publisher Abstract | Publisher Full Text]
8. Frantz JM, Rhoda A, Struthers P, et al.: Research productivity of academics in a physiotherapy department: a case study. Afr J Health Prof Educ. 2010; 2(2): 17–20. [Reference Source]
9. Coronado RA, Reddle DL, Wurtzel WA, et al.: Bibliometric analysis of articles published from 1980 to 2009 in Physical Therapy. Journal of the American Physical Therapy Association. Phys Ther. 2011; 91(5): 642–655. [PubMed Abstract | Publisher Full Text]
10. Hariohn K, Prakash V, Saravankumar J: Quantity and quality of randomized controlled trials published by Indian physiotherapists. Perspect Clin Res. 2015; 6(2): 91–97. [PubMed Abstract | Publisher Full Text | Free Full Text]
11. Hariohn K, Prakash V, Saravankumar J: Research productivity of Indian physiotherapists: A review of MEDLINE. Curr Sci. 2016; 110(12): 2226–2230. [Publisher Full Text]
12. Littman MA, Sonne JW, Smith GV: Research productivity of doctor of physical therapy faculty promoted in the southeastern United States. Med Educ Online. 2017; 22(1): 136849. [PubMed Abstract | Publisher Full Text | Free Full Text]
13. Vercelli S, Ravizzotti E, Pasic M: Are they publishing? A descriptive cross-sectional profile and bibliometric analysis of the journal publication productivity of Italian physiotherapists. Arch Physiother. 2018; 8: 1. [PubMed Abstract | Publisher Full Text | Free Full Text]
14. Man DWK, Tsang WSF, Lu EY, et al.: Bibliometric study of research productivity in occupational therapy and physical therapy/physiotherapy in four Western countries and five Asian countries/regions. Aust Occup Ther J. 2019; 66(6): 692–699. [PubMed Abstract | Publisher Full Text]
15. Li K, Rollins J, Yan E: Web of Science use in published research and review papers 1997–2017: A selective, dynamic, cross-domain, content-based analysis. Scientometrics. 2018; 118: 1–20. [PubMed Abstract | Publisher Full Text | Free Full Text]
16. Camango AA, Simpson AJ: Collaborative research networks work. J Clin Invest. 2003; 112(4): 468–471. [PubMed Abstract | Publisher Full Text | Free Full Text]
17. Carroll JK, Albada A, Farahani M, et al.: Enhancing International Collaboration Among Early Career Researchers. Patient Educ Couns. 2010; 80(3): 417–420. PubMed Abstract | Publisher Full Text | Free Full Text
18. Zutshi A, McDonald G, Kalejs L: Challenges in collaborative writing: Addressing authorship attribution. Eur Bus Rev. 2012; 24(1): 28–46. Publisher Full Text
19. Dakik HA, Kaidbey H, Sabra R: Research productivity of the medical faculty at the American University of Beirut. Postgrad Med J. 2006; 82(969): 462–464. PubMed Abstract | Publisher Full Text | Free Full Text
20. Kim KW: Measuring international research collaboration of peripheral countries: taking the context into consideration. Scientometrics. 2006; 66(2006): 231–240. Publisher Full Text
21. Freshwater D, Sherwood G, Drury V: International research collaboration: Issues, benefits and challenges of the global network. J Res Nurs. 2007; 11(4): 296–303. Publisher Full Text
22. Subbarayalu AV, Peter M, Idris M, et al.: Visualization pattern of the highly cited scientific output of Indian Physiotherapists: A bibliometric study. 2020. http://www.doi.org/10.17605/OSF.IO/YC6VX
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