

Research Article

Global Tendency and Frontiers of Research on Plantar Fasciitis: A Bibliometrics Analysis

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Introduction

Plantar Fasciitis (PF), occurring in 11% to 15% of adults, has become a common public health concern. Mechanical overload, whether the result of biomechanical faults, obesity, or work habits of prolonged standing and running, contributes most to PF [1,2]. The damage from overloading leads to aseptic inflammation of the fascia or tendon [3,4]. Patients usually feel painful on initiation of weight bearing, and the plantar heel pain usually occurring at the origin of the plantar fascia from the medial tubercle of the calcaneus. The pain tends to decrease after a few minutes' adaptation.

PF has progressed in the past few decades both in theory and in therapy, but many topics still remain controversial, such as the natural history of PF, scoring system to evaluate the severity of PF, objective judgment to choose between conservative and surgical treatment, predictors of treatment outcome, and so on [5,6].

Abstract

Background: This study aimed to summarize the overall knowledge structure and development trends of plantar fasciitis.

Methods: The research datasets were collected from the Web of Science, limited to articles published before Mar, 2024. We summarize the data of annual trends of publications, distribution, h-index status, citations status, co-authorship status and research hotspots by VOS viewer and Citespace software.

Results: 1429 publications met the requirement. The number of publications showed an upward trend with a stable rise in recent years. In the fields of plantar fasciitis, the United States published most papers (493, 34.50%), both total citations (13268) and h-index (65) ranked first of all the countries; the most productive institution was *La Trobe University* (30); *Foot & Ankle International* (122) published the most papers. Growth factor, wave therapy, corticosteroid, foot function index and physical therapy were the research hotspots in the recent years.

Conclusion: The research of PF has progressed rapidly and attracted more attention in the global medical field in the recent decades, but still concentrated in America, China, Germany, UK and Australia. Research hotspot tends to change every few years, growth factor, wave therapy, corticosteroid, foot function index and physical therapy were the research hotspots in the recent years.

Keywords: bibliometric analysis, citespace software, plantar fasciitis, research trends, visualization, VOS viewer

Abbreviations: PF: Plantar Fasciitis; WOS: Web of Science

Bibliometrics is a special type of analysis method regarding both quantity and quality, using mathematics, statistics, philology and other professional knowledge and methods to comprehensively analyze the distribution of research results. Therefore, bibliometric analysis has been a mature tool to quantify the characteristics and scholarly impact of a specific field, and can be applied vastly to assess the merits of a specific field and provide great insights to the growth and development of a subject [7-12]. However, as far as we know, there hasn't been any bibliometric study about the trend of published articles of PF. This research aims to visually present the research framework, overall knowledge structure and development trends of PF. We hope that this study will help scientific researchers better understand the research status and frontier trends. In addition, the results can also provide useful information and references for further research and publication.

Materials and Methods

Search Strategy and Refined Data

We collected the data from the Web of Science (WOS). WOS has strict evaluation process, so it's a widely accepted tool for the subsequent bibliometric analysis. We chose *plantar fasciitis* as the search term. The literature search was limited to articles published before Mar, 2024. We only included original articles and reviews, while excluded basic research article, editorial material, letter and correction. Two independent researchers were asked to review and evaluate the cited articles respectively to guarantee the accuracy of the research. All different points were discussed until we reached agreements.

Data Analysis

The collected data was imported into Microsoft Excel 2017. It analyzes the annual trends of publications, distribution, citation, H-Index status, co-authorship status, research hotspots and co-citation status of the published paper in terms of quantity and quality. We use SPSS 20.0 to perform the statistical analyses, the statistical significance was considered at $P < 0.05$. We also use VOS viewer and Citespace software to create visualized pictures by the statistical results mentioned above [13-15].

Results

The Current Status and Annual Trend of Study

We finally collected 1429 articles from the WOS according to the inclusion criteria, including 180 reviews and 1048 original articles. Figure 1A shows the selection flow chart. The sum number of citation is 31204, and 19336 without self-citations. The average citation of all the papers is 21.84 times. The H-index of all the publications is 85. Figure 1B shows the annual trends of publication numbers. Overall, there was a stable rise of the number of publications since 1995. A total of 107 (7.49%) articles were published in 2018, the highest in all years, followed by the year 2020 (106, 7.42%) and the year 2019(100, 7.00%). The result indicated that scientific researchers had paid more attention to the field of PF.

The Distribution and Co-authorship Analysis of Countries

A total of 59 countries contributed to the field of PF research. Figure 2A shows the top 10 most productive countries in PF field. We can find that the majority of the papers were published in only a few countries. The papers published by the top 5 countries account for 66.5% (950 papers). The United States published the largest number of articles (493, 34.50%), followed by China (129, 9.03%), Germany (117, 8.19%), UK (109, 7.63%), and Australia (102,7.14%). H-index is a reliable and authentic parameter for academic evaluation. The H-index of USA ranked first (65), followed by Germany (34), UK (31), and Australia (31). Furthermore, the sum of times cited can reflect the quality of a paper.

Articles from USA were cited 13268 times, ranked first, followed by Germany (3325) and Australia (3320). The result shows that USA is the most productive country both in quality and quantity. China, Germany, UK and Australia are the other most contributing countries. Figure 2C shows a map of worldwide research productivity, only countries published more than 10 articles were included. It shows that research on PF was concentrated in only a few countries during recent decades, with more regions hadn't participated yet. Figure 2B is the visualized network of co-authorship relationship during countries ana-

lyzed by Citespace software. USA was at the center of the research, and the cooperation between countries were relatively weak.

The Distribution and Co-authorship Analysis of Institutions

A total of 1691 institutions contributed to the research on PF. Figure 3A summarized the top 10 most productive institutions. *La Trobe University* published the largest number of articles (30), follow by *Harvard University* (18) and *Hong Kong Polytech University* (18). The H-index of *La Trobe University* and *University Munich* ranked first (12) side by side, followed by *Harvard University* (11). The number of citations of *La Trobe University* ranked first (791), follow by *Hong Kong Polytech University* (719) and *University Munich* (663). Figure 3B is the co-authorship relationship analysis of institutions. We can find that the affiliated hospitals and research centers of *Harvard University* and *Natl Taiwan University* had close collaborations respectively. However, cooperation between the institutions were relatively weak (Figure 3B).

The Distribution and Co-authorship Analysis of Authors

The top 8 most productive authors in PF field are shown in Figure 4A. Rompe JD published the largest number of articles (23), follow by Landorf KB (22), Maffulli N (14), Menz HB (14) and Schmitz C (13). The H-index of Rompe JD (18) ranked first of all the authors, follow by Landorf KB (14) and Schmitz C (10). Rompe JD also ranked first (1115) on cited time, followed by Landorf KB (764) and Maffulli N (600). Figure 4B shows the co-authorship relationship analysis of authors. Only authors cited a minimum of 20 times were included and 95 authors met the standard. It shows that cooperation between authors from the same country was relatively strong while authors from different countries had less cooperation.

The Distribution and Co-authorship Analysis of Published Journals

All publications were published in 367 journals. The top 10 journals that published the most papers are showed in Figure 5A. The journal with the greatest number of publications was *Foot & Ankle International*, with a total of 122 (8.54%) papers. *Journal of the American Podiatric Medical Association* ranked second with 61 (4.27%) papers, followed by *Journal of Foot & Ankle Surgery* with 59 (4.13%), *American Family Physician* with 29 (3.15%) and *Journal of Orthopaedic & Sports Physical Therapy* with 28(1.96%). These top 5 journals account for 20.9% of all the papers. Only 32 (8.72%) journals published more than 10 papers. In terms of the H-index, *Foot & Ankle International* ranked first (36), followed by *Journal of the American Podiatric Medical Association* (19), *American Journal of Sports Medicine* (16), *Journal of Orthopaedic & Sports Physical therapy* (14) and *Journal of Bone and Joint Surgery-American Volume* (13). *Foot & Ankle International* (3771) ranked first on the cited time as well, followed by *Journal of Bone and Joint Surgery-American Volume* (1524) and *British Journal of Sports Medicine* (1327). Figure 5B is the co-authorship relationship of journals. Only 67 journals be cited more than 100 times were included. *Foot & Ankle International*, *Journal of Bone and Joint Surgery-American Volume* and *American Journal of Sports Medicine* were at the center of research. In general, cooperation between journals is relatively weak. Table 1 shows the top 10 cited articles in terms of title, journal, authors, years and citation numbers. Two of them were published on *Foot & Ankle International*. Eight of them were co-authored.

The Keywords Analysis of Research Hotspots on Study

We import the data of keywords into VOS viewer to create visualized pictures of keywords co-occurrence, which can reflect the research hotspots effectively. Figure 6 shows the keywords and research focuses related to PF. The bigger nodes and darker color show a larger weight of the keyword. There are 6 clusters with high-frequency in the figure. The clusters were named due to the keywords contained. The six clusters are mainly about diagnose, treatment, injury site, cause of disease, related diseases and examine.

Table 2 shows 25 meaningful keywords with the largest number of citations. The red and blue bars respectively present the frequently- and infrequently-cited keywords. Figure 7 shows the keywords timeline view of publications, which present the research frontiers. The results indicated that growth factor, wave therapy, corticosteroid, foot function index and physical therapy are the research hotspots in the recent years.

Discussion

Trends of Publications Related to PF

PF research has attracted more attention in recent years. In this article, we collected and summarized the papers related to PF, and compared the papers from different countries, institutes and journals, and showed the global trends of researches by visual tools. We hope the result can help researchers select valuable topics and find suitable teams to collaborate with.

There is a stable rising trend both in the number of published papers and relative research interest in the past 20 years. It suggests that PF research has attracted more attention in the global medical field. The study found that 66.5% of total articles were published by the top five productive countries (the United States, China, Germany, UK and Australia), and the top productive institutions were all from these countries. It indicated that worldwide research results of PF were concentrated in America, West Europe, East Asia and Australia.

USA contributes most to this area with the highest total publications (493, 34.50%) and H-index (65), we almost can say that USA dominates the study of PF. The most possible reason for USA's great contributions may be its economic and technological advantages. Stable and prominent national economy leads to more research funds investing in medical research, thus increases the quality of researches.

As far as China, the quantity and quality of researches is not at the same level. China has a large number of papers while the H-index and citation numbers don't rank top. China has an advantage in participants because of the large population, but China is still a developing country with relatively backward technological strength. Furthermore, the amount of government funds is much lower than USA. For example, Chinese government funds in medical research only account for 20% to 30% of the total governments funds.¹⁶ For all this, China's research influence is still more significant than the other counties and cannot be ignored.

La Trobe University ranked first in all kinds of indicators, total publications, H-index and citations. Only *University Munich* ranked first as well in H-index. Regarding the productive journals, *Foot & Ankle International* ranked first in total publications, H-index and cited time. It reflects the great influence of *La Trobe University* and *Foot & Ankle International* and their leading position in the field of PF. There is no doubt that authors

interested in PF should pay more attention to *La Trobe University* and *Foot & Ankle International*.

Co-authorship research is an important part of bibliometrics and the level of research collaboration is an index to evaluate the current research status. The network map revealed that the centrality and density value of this study was not high. The collaboration between countries, institutions, journals and authors were relatively weak. Therefore, it is urgent to promote the international academic communication between authors, countries and institutions. Furthermore, forming an academic community is beneficial to the development of research in the future.

Studies Focused on PF

Under normal circumstances, doctors can differentiate causes of plantar fasciitis during the patient history and physical examination. To diagnose objectively, MRI is the only imaging method that can precisely visualize lesions of the plantar fasciitis, whether they be musculoaponeurositides, enthesopathies or tears, and whether they be acute or chronic, with or without complications at present. By its direct visualization of the lesion, MRI enables an accurate assessment of the injury to be made and thereby better orients the therapeutic strategy. Currently, the clinical efficacy of treatment for PF is controversial. The relationship between individual patient's characteristics and its potential predictive value on outcomes has not been studied. In addition, there is no scoring system to determine the severity of PF and no prognostic model in choosing between conservative or surgical treatment [17-19].

A large number of doctors only pay attention to patients' symptoms and signs. However, "bio-psycho-social medical model" has now attract public's attention, it leads us to pay more attention to patients' psychology health and social adaptability. It is essential to improve patients' quality of life. Through the assessment of quality of life, physicians will have more understanding of the patients' physical, psychological and social functions, carry out effective psychological guidance, so that they can truly achieve the purpose of treating diseases, reducing trauma, recovering functions and improving the quality of life [20,21].

Strengths and Limitations

As far as we know, our study is the first to use bibliometric analysis and visualization tool to analyze the quality and quantity of researches in the field of PF. We organized a systematic literature search in the WOS to ensure the objectivity and comprehensiveness of the research, for the WOS could offer powerful data from various aspects with a high and powerful recognition. Apart from these advantages, this study also has some limitations. First, bibliometric analyses only contain the published literature in WOS database, the unpublished and non-English articles were not included. Second, bibliometric data changes quickly, the delay of the indexation may lead to difference in the results. Third, all citations were handled in the same way whether it was cited for its positive contribution or for its negative impact or poor quality. In addition, authors may tend to cite papers from the journals in which they hoped to publish their research.

Conclusions

This study provides a basic worldwide overview of research publications and relative research interest on PF. In general, the

research of PF has a stable progress in recent years. USA is the country with the highest productivity both in quality and quantity. China, Germany, UK and Australia also contributes a lot. In this field, *La Trobe University* is the largest contributor and *Foot & Ankle International* is the best journal. Growth factor, wave therapy, corticosteroid, foot function index and physical therapy are the research hotspots in the recent years. However, the distribution of research is imbalanced on a world scale. The collaboration between countries, institutions, journals and authors is relatively weak.

References

1. Thomas JL, Christensen JC, Kravitz SR, Mendicino RW, Schubert JM, Vanore JV, et al. The diagnosis and treatment of heel pain: a clinical practice guideline-revision 2010. *J Foot Ankle Surg.* 2010; 49: S1–S19.
2. Tu P, Bytowski JR. Diagnosis of heel pain. *Am Fam Physician.* 2011; 84: 909–916.
3. Lemont H, Ammirati KM, Usen N. Plantar fasciitis: a degenerative process (fasciosis) without inflammation. *J Am Podiatr Med Assoc.* 2003; 93: 234–237.
4. Wearing SC, Smeathers JE, Urry SR, Henning EW, Hills AP. The pathomechanics of plantar fasciitis. *Sports Med.* 2006; 36: 585–611.
5. Cole C, Seto C, Gazewood J. Plantar fasciitis: evidence-based review of diagnosis and therapy. *Am Fam Physician.* 2005; 72: 2237–2242.
6. Maier M, Steinborn M, Schmitz C, Stabler A, Kohler S, Pfahler M, et al. Extracorporeal shock wave application for chronic plantar fasciitis associated with heel spurs: prediction of outcome by magnetic resonance imaging. *J Rheumatol.* 2000; 27: 2455–2462.
7. Ergul S, Ardahan M, Temel AB, Yildirim BO. Bibliometric review of references of nursing research papers during the decade 1994-2003 in Turkey. *Int Nurs Rev.* 2010; 57: 49-55.
8. Zhang TS, Qin HL, Wang T, Li HT, Li H, Xia SH, et al. Global publication trends and research hotspots of nonalcoholic fatty liver disease: a bibliometric analysis and systematic review. *Springerplus.* 2015; 4: 776.
9. Yin M, Xu C, Ma J, Ye J, Mo W. A Bibliometric Analysis and Visualization of Current Research Trends in the Treatment of Cervical Spondylotic Myelopathy. *Global spine journal.* 2021; 11: 988-998.
10. Sun J, Wang MH, Ho YS. A historical review and bibliometric analysis of research on estuary pollution. *Mar Pollut Bull.* 2012; 64: 13-21.
11. Boyce R, Rosch R, Finlayson A, Handuleh D, Walhad SA, Whitwell S, et al. Use of a bibliometric literature review to assess medical research capacity in post-conflict and developing countries: Somaliland 1991-2013. *Trop Med Int Health.* 2015; 20:1507-1515.
12. Chen C, Hu Z, Liu S, Tseng H. Emerging trends in regenerative medicine: a scientometric analysis in CiteSpace. *Expert Opin Biol Ther.* 2012; 12: 593-608.
13. Fajardo-Ortiz D, Duran L, Moreno L, Ochoa H, Castano VM. Mapping knowledge translation and innovation processes in Cancer Drug Development: the case of liposomal doxorubicin. *J Transl Med.* 2014; 12: 227.
14. van Eck NJ, Waltman L. Software survey: VOS viewer, a computer program for bibliometric mapping. *Scientometrics.* 2010; 84: 523-38.
15. Allen L, Jones C, Dolby K, Lynn D, Walport M. Looking for landmarks: the role of expert review and bibliometric analysis in evaluating scientific publication outputs. *PLoS One.* 2009; 4: e5910.
16. Liu YH, Wang SQ, Xue JH, Liu Y, Chen JY, Li GF, et al. Hundred top-cited articles focusing on acute kidney injury: a bibliometric analysis. *BMJ Open.* 2016; 6: e011630.
17. Lin GX, Kotheeranurak V, Mahatthanatrakul A, Ruetten S, Yeung A, Lee SH, et al. Worldwide research productivity in the field of full-endoscopic spine surgery: a bibliometric study. *Eur Spine J.* 2020; 29: 153–160.
18. Tu P, Bytowski JR. Diagnosis of heel pain. *American Family Physician.* 2011; 84: 909-916.
19. Roger B, Grenier P. MRI of plantar fasciitis. *European Radiology.* 1997; 7: 1430-1435.
20. Yin MC, Yan YJ, Tong ZY, Xu CQ, Qiao JJ, Zhou XN, et al. Development and Validation of a Novel Scoring System for Severity of Plantar Fasciitis. *Orthopaedic Surgery,* 2020; 12: 1882-1889.
21. Jacobs WC, Rubinstein SM, Willems PC, Moojen WA, Pellise F, Oner CF, et al. The evidence on surgical interventions for low back disorders, an overview of systematic reviews. *Eur Spine J.* 2013; 22:1936-49.
22. Forsth P, Michaelsson K, Sanden B. Does fusion improve the outcome after involving 5390 patients. *Bone Joint J.* 2013; 95-B: 960-5.