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Trends and patterns in prostate cancer screening in primary care (2016-2025): a bibliometric study

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ABSTRACT

Aims: The aim of this study is to examine the scientific output, impact, and collaboration patterns of the literature on prostate cancer screening in primary care over the past decade using bibliometric methods.

Methods: The study was conducted on original English research articles published between 2016 and 2025 in journals indexed in the Science Citation Index Expanded within the Web of Science Core Collection database. Bibliometric analyses were carried out using Biblioshiny, the web-based interface of the Bibliometrix package running in the RStudio environment, and the VOSviewer software. Scientific output, citation performance, and keyword patterns were examined using Biblioshiny, while the network structures of co-authorship and co-citation relationships were visualized and evaluated with VOSviewer.

Results: A total of 266 original research articles were analyzed. These publications appeared in 139 journals and were produced by 2008 authors, with a mean of 8,87 authors per article and an international collaboration rate of 21,8%. Annual publication output showed a fluctuating pattern, reaching its peak in 2021. The average number of citations per article was 35,44. In the keyword analysis, "prostate cancer," "prostate-specific antigen," "primary care," and "screening" were the most frequently used terms. Co-authorship analysis revealed clear clustering among authors, with the presence of core research groups. In the country-level co-authorship network, the United States of America emerged as the most dominant hub, followed by England and Australia as other major contributors. Co-citation analysis indicated that the literature is mainly structured around large-scale screening trials and clinical guidelines.

Conclusion: This bibliometric analysis highlights the production, impact, and collaboration dynamics of the literature on prostate cancer screening in primary care, making the intellectual structure of the field visible and offering a guiding framework for future research.

Keywords: Prostatic neoplasms, early detection of cancer, mass screening, primary health care, bibliometrics

INTRODUCTION

Prostate cancer is a common disease among men, and survival improves markedly with early detection. The most widely used method for early detection is the prostate-specific antigen (PSA) test. However, the balance between the benefits of PSA-based screening and the risks of overdiagnosis and overtreatment remains controversial.[1] Screening decisions are most commonly made in primary care, as asymptomatic men usually first enter the health system through family physicians. However, some patients may initially present to emergency departments with suspicion of prostate cancer, which makes coordinated functioning between different levels of care essential for timely diagnosis and referral.

The use of PSA in primary care is known to vary between countries and according to different guidelines. In many settings, screening is performed opportunistically rather than through organized programs, which may negatively affect rates of early-stage diagnosis.[1] In addition, deficiencies in primary care physicians' knowledge and practices regarding prostate cancer screening have been reported.[2] Moreover, although risk-based and individualized approaches to screening are increasingly being recommended, the extent to which these models are reflected in primary care practice remains unclear. While some studies emphasize the benefits of screening, others highlight potential drawbacks such as overdiagnosis, patient anxiety, and increased burden on the healthcare system.[3-5] This situation makes it difficult to draw a comprehensive picture of how prostate cancer screening is positioned in primary care. Therefore, there is a need for a bibliometric evaluation that can identify general trends, areas of concentration, and gaps in the scientific output on prostate cancer screening in primary care.

The aim of this study is to examine the literature on prostate cancer screening in primary care using bibliometric methods and to provide a more systematic framework.

Based on original research published over the last ten years, publication volume, citation impact, leading authors and countries, collaboration patterns, and main research themes were analyzed, thereby presenting an up-to-date overview of scientific output in the field of prostate cancer screening in primary care.

METHODS

Ethics

As this study is a bibliometric analysis based on data extracted from the Web of Science Core Collection, it did not involve human participants, patient data, or animal experiments; therefore, ethics committee approval was not required.

Literature Search and Data Retrieval

This bibliometric study was conducted using the Web of Science (WoS) platform, which includes publications from many disciplines and provides detailed citation data. The WoS Core Collection database was selected as the data source, and the analysis was limited to publications between 2016 and 2025. Data were obtained through comprehensive searches performed in the WoS system using the "topic" (TS) field. The search strategy was constructed as follows: TS=(("prostate cancer" OR "prostatic cancer" OR "prostate carcinoma") AND ("screening" OR "early detection" OR "PSA" OR "prostate-specific antigen") AND ("primary care" OR "family medicine" OR "general practice" OR "family physician*" OR "general practitioner*")). Data download was carried out on January 15, 2026.

The inclusion criteria were defined as publication in journals indexed by WoS and covered by the Science Citation Index Expanded (SCIE), being written in English, having the characteristics of an original research article, and being retrieved using the defined search strategy. Articles directly related to the topic were manually selected. Publication types other than original research, such as case reports, case series, reviews, systematic reviews, and meta-analyses, were excluded from the study.

Data Analysis Tools

Microsoft Excel 2016 was used for organizing the obtained data and for the preliminary preparation stages.[6] For bibliometric analyses, Biblioshiny (version 4.1.3), the web-based interface of the Bibliometrix R package, was used; network and visual analyses were performed with the VOSviewer software (version 1.6.20).[7-9]

Data downloaded from WoS were transferred to the Biblioshiny environment, and before analysis, duplicate records and missing information were checked and necessary corrections were made. Using the Main Information module, basic bibliometric variables such as number of publications, number of journals, number of authors, collaboration structure, references, and citation indicators were planned to be calculated.

To examine publication output by year, the annual scientific production function in Biblioshiny was used. With this analysis, the number of studies published each year was determined and changes in publication volume over time were presented graphically.

The average article citation per year tool was used to evaluate the annual citation performance of the articles. At this stage, the mean number of citations per article for each publication year was calculated, and changes in citation trends over time were examined comparatively.

To identify the prominent concepts in the literature, a word cloud analysis was performed using Biblioshiny. In this analysis, author keywords were taken as the basis, and terms above a certain frequency threshold were selected and visualized according to their frequency of use. In this way, it was aimed to present a general outline of the conceptual structure of the research field.

Network and relationship analyses were carried out using the VOSviewer program. In the study, co-authorship and co-citation analyses were performed. In all analyses, the full counting approach was adopted as the counting method, and the association strength method was used to balance the strength of the links. In the layout algorithm, the random start value was set to 1000 and the maximum number of iterations was set to 1000. These settings were chosen to ensure that the most appropriate layout could be found by starting from different initial positions. In network structures, the units were defined as nodes, and the relationships between units were defined as links. To indicate the overall density of connections in the network, the Total Link Strength (TLS) value was used.

In the co-authorship analysis, two separate networks were created for authors and countries. In the author network, each node represented an author, and the node size indicated the author's weight within the network. Nodes were shown in different colors according to their clusters, and only the names of prominent authors were labeled. The lines between nodes represented collaborations between authors, and shorter and thicker lines were arranged to indicate stronger collaborations. In this analysis, the minimum number of documents for authors was set to 3, and the minimum number of citations was set to 0. Weighting was based on TLS.

In the country-based co-authorship analysis, each node represented a country, and the node size reflected the country's relative weight within the network. Countries were colored according to their clusters, and only the names of prominent countries were displayed. The lines between countries indicated collaboration, and line length was arranged to be inversely proportional to the strength of the relationship. For countries, the minimum number of documents was set to 1 and the minimum number of citations was set to 0, and total link strength was used for weighting. Weighting was based on TLS.

To examine the intellectual structure of the field, a co-citation analysis was performed. In this analysis, cited sources were taken as the unit of analysis, and sources that had received at least five citations were included. The analysis was carried out using VOSviewer, and the strength of the relationships between co-cited sources was weighted according to their citation counts.

RESULTS

Using the defined search strategy, a total of 918 publications focusing on prostate cancer screening in primary care were identified in the Web of Science database. After applying

the predefined inclusion and exclusion criteria, 266 original research articles suitable for bibliometric analysis were included in the study (**Figure 1**).

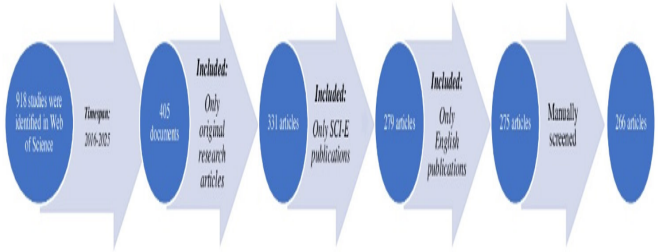

Figure 1. Flow diagram of the selection process

Figure 2 presents the main information data summarizing the basic bibliometric indicators of the publications included in the study. In the analysis covering the years 2016-2025, a total of 266 documents were obtained from 139 different sources. A total of 2008 authors contributed to these studies, and 5 of them produced single-authored publications. The international co-authorship rate was calculated as 21.8%, and the average number of authors per article was found to be 8.87. The annual growth rate of publications was 0.86%. The total number of references used in the analysis was 8226, and the average age of the documents was determined as 5.61 years. The average number of citations per article was 35.44. In addition, author keywords consisted of a total of 590 different terms.

Figure 2. Main information

Annual publication output by year is presented in **Table 1**. Overall, publication numbers showed a fluctuating pattern across the years, with a marked increase in 2021 and a gradual recovery trend in the following years (**Figure 3**).

Citation performance by publication year is summarized in **Table 1** and illustrated in **Figure 4**.

When the annual average number of citations per article was examined by year, the highest value was observed in 2016, and studies published in that year received an average of 16.60 citations per article per year. This was followed by 2019, in which the annual average citation rate was 14.08. In 2017 and 2018, annual citation averages were notably low, calculated as 1.34 and 2.30, respectively. In 2020 and 2021, annual average citation numbers were at similar levels (2.74 and 2.54, respectively), while in 2022 this value decreased to

Table 1. Citation performance of articles by year, showing mean total citations per article (MeanTCperArt), number of articles (n) and mean total citations per year (MeanTCperYear)

Year	MeanTCperArt	n	MeanTCperYear
2016	182.56	25	16.6
2017	13.41	29	1.34
2018	20.71	35	2.3
2019	112.63	19	14.08
2020	19.15	20	2.74
2021	15.23	43	2.54
2022	8.33	24	1.67
2023	7.24	21	1.81
2024	7.52	23	2.51
2025	1.7	27	0.85

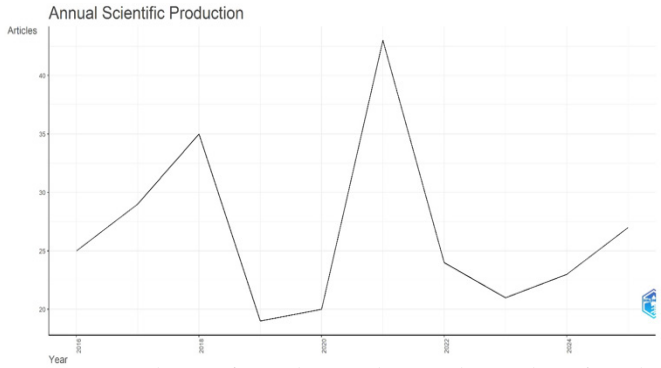

Figure 3. Annual scientific production showing the number of articles published each year between 2016 and 2025

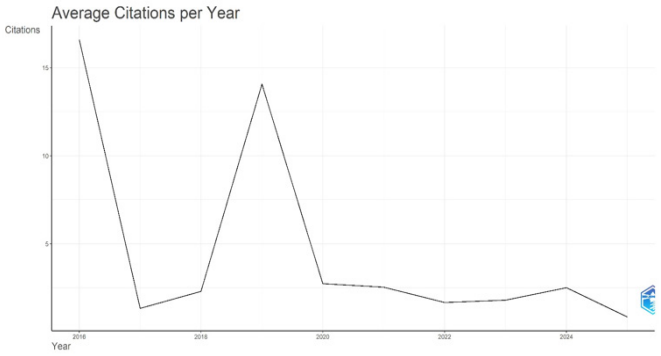

Figure 4. Distribution of average citations per year by publication year

a lower level of 1.67. A slight increase was observed in 2023 and 2024, with annual average citation values of 1.81 and 2.51, respectively. The lowest annual average citation value was identified in 2025, when articles published in that year received an average of 0.85 citations per article per year.

The average total number of citations per article also varied by year. The highest value was observed in 2016, followed by 2019. In the subsequent years, the average total citations per article were markedly lower. Overall, studies published in the earlier years were found to have higher values in terms of both annual and total citations.

In the word cloud and frequency table, the most frequently used term was "prostate cancer," appearing 93 times (**Table 2, Figure 5**). This was followed by "prostate-specific antigen" (37 occurences), "primary care" (34 occurences), and "screening"

(33 occurences). In the visualization, the term "prostate cancer" is clearly displayed in a larger size compared with the other words.

Table 2. Most frequently used keywords and their number of occurrences

Terms	Frequency
Prostate cancer	93
Prostate-specific antigen	37
Primary care	34
Screening	33
Cancer screening	29
Cancer	19
Prostatic neoplasms	15
Early detection of cancer	14
PSA	13
Oncology	10
Primary health care	10

PSA: Prostate-specific antigen

Figure 5. Word cloud showing the most frequently used keywords in studies on prostate cancer screening in primary care, with word size reflecting the number of occurrences

The network map created to demonstrate scientific collaboration among authors is presented in **Figure 6**. Within the scope of the analysis, a total of 76 authors with a minimum of 3 publications and a minimum citation threshold of 0 were identified. Co-authorship analysis was conducted based on these 76 authors. In weighting institutional relationships, the TLS metric was used. The total number of clusters was 16, with 197 links and a TLS of 548. In this analysis, the authors with the highest TLS and citations were Ahmet Hashim U, Burak Paula, Day Emily, Fiorentino Francesca, Gammon Martin, Klimowska Nassar Natalia, Padhani Anwar R, Price Derek, Sokhi Heminder, Tam Henry, and Winkler Mathias, and all of these authors had 3 articles, 129 citations, and 30 TLS. The authors with the highest number of publications were Pollack Craig E (6 articles, 108 citations (cit), 16 TLS) and Roobol Monique J (6 articles, 26 cit, 4 TLS).

The network map created to demonstrate scientific collaboration among countries is presented in **Figure 7**. Within the scope of the analysis, a total of 44 countries with at least 1 publication and a minimum citation threshold of 0 were evaluated. The analysis was conducted on 37 countries that were interconnected among these 44 countries. The TLS metric was used to weight the relationships between countries. In the generated network structure, the total

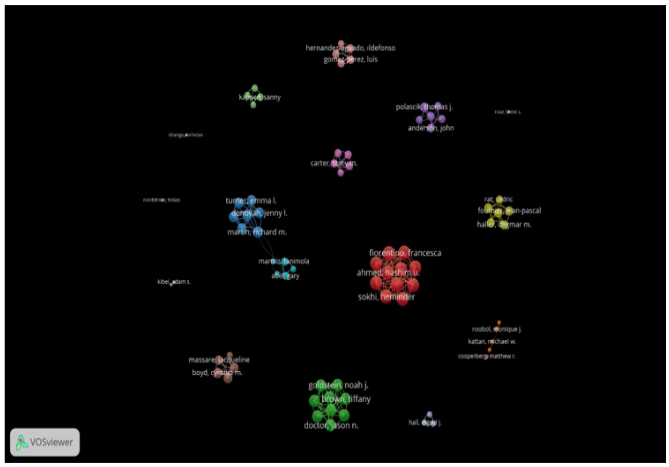

Figure 6. Network visualization of author co-authorship in prostate cancer screening research in primary care

number of clusters was 9, the number of links was 93, and TLS was 137. The countries with the highest number of publications and the highest citation counts were United States of America (124 articles, 5550 cit, 37 TLS), England (50 articles, 1248 cit, 34 TLS), and Australia (22 articles, 350 cit, 14 TLS), respectively. The countries with the highest TLS values were United States of America, England, Spain (12 articles, 178 cit, 17 TLS), and the Netherlands (13 articles, 86 cit, 17 TLS), respectively.

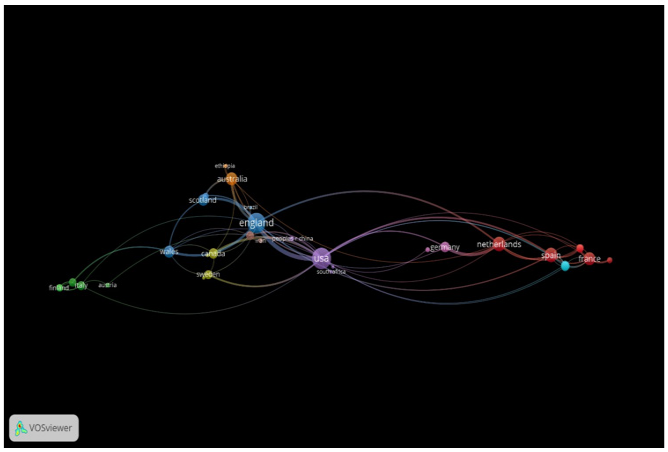

Figure 7. Network visualization of country co-authorship in prostate cancer screening research in primary care

To examine the intellectual structure of studies on prostate cancer screening in primary care and the network of relationships among co-cited publications, a co-citation analysis was performed (**Figure 8**). A minimum threshold of 3 citations was applied for cited sources. According to this criterion, 147 of the total 8213 references were included in the analysis. All of these 147 references were found to be interconnected, and the analysis was conducted based on this group. The weighting of links was based on the number of citations received by the references. As a result of the analysis, 6 clusters were formed, with a total of 3234 links and 5851 TLS calculated. The five documents with the highest citations and also the highest TLS, ranked according to citation counts, were as follows: Moyer VA, 2012, Ann Intern Med, v157, p120, doi:10.7326/0003-4819-157-2-201207170-00459 (53 cit, 439 TLS); Schröder FH, 2014, Lancet, v384, p2027, doi:10.1016/S0140-6736(14)60525-0 (43 cit, 386 TLS); Carter HB, 2013,

J Urology, v190, p419, doi:10.1016/j.juro.2013.04.119 (42 cit, 303 TLS); Andriole GL, 2009, New Engl J Med, v360, p1310, doi:10.1056/NEJMoa0810696 (36 cit, 365 TLS); and Schröder FH, 2009, New Engl J Med, v360, p1320, doi:10.1056/NEJMoa0810084 (35 cit, 328 TLS).[10-14]

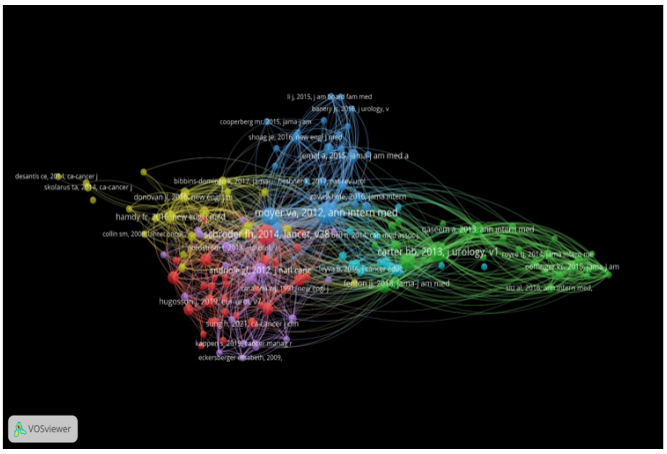

Figure 8. Co-citation network map presenting the intellectual framework of studies on prostate cancer screening in primary care

DISCUSSION

This bibliometric analysis presents a current overview of the field by summarizing the production, impact, and collaboration patterns of the literature on prostate cancer screening in primary care during the 2016-2025 period. The study reveals the development of the literature focusing on prostate cancer screening in primary care and highlights the importance of first points of contact in the early detection process. The inclusion of 266 original research articles, selected from 918 records identified through the Web of Science search using predefined criteria, suggests that the topic has a broad publication base in the primary care context but is concentrated into a more limited core when focusing on original research.

Annual production data show that publication numbers followed a fluctuating pattern rather than a steady linear increase, with a marked peak in 2021. These fluctuations can be associated with periods in which screening-related debates in primary care became more intense (e.g., PSA-based screening and decision-making approaches). The decline after the peak and the subsequent recovery trend suggest that the field has been reshaped not around a single line of debate, but through the interaction of decision-making processes in primary care and broader health system dynamics.

When citation performance is considered, the fact that studies published in earlier years have higher values in terms of both annual and total citations is an expected finding and reflects the "citation accumulation" effect. However, the clear prominence of the years 2016 and 2019 suggests that studies published in these periods had a stronger influence on shaping the discussion agenda of the field. The lower average citation values in more recent years may reflect not only lower impact but also the shorter citation window.

The keyword pattern clearly reveals the conceptual backbone of the field: the fact that "prostate cancer," "prostate-specific antigen," "primary care," and "screening" are the most frequently recurring terms indicates that the literature is shaped around the PSA axis and that the primary care context remains central. In addition, the high ranking of terms such as "cancer screening" and "early detection of cancer" suggests that studies focus not only on test performance, but also on how screening is positioned, under which conditions the value of "early detection" increases, and how this is managed in primary care.

Collaboration networks show that production and impact are concentrated in specific centers. At the country level, the clear leadership of the United States in terms of publications, citations, and link strength, together with the strong contributions of England and Australia, suggests that the scientific agenda in this field is largely driven by these ecosystems.[15-20] In addition, the presence of countries with high TLS values in the country network suggests that multicenter and multidisciplinary production has to some extent been established; however, it is difficult to say that the network as a whole is globally balanced. Similarly, the prominence of certain authors with high link strength in the author network reflects the role of specific teams in joint production and network building within the field.

Finally, the co-citation analysis shows that the intellectual core of the literature on prostate cancer screening in primary care is clustered around guideline/recommendation texts and large-scale screening studies. The fact that the most highly co-cited sources include the United States Preventive Services Task Force (USPSTF) recommendation, the European Randomised Study of Screening for Prostate Cancer (ERSPC) results, the American Urological Association (AUA) early detection guideline, and two large randomized studies (e.g., screening mortality results published in The New England Journal of Medicine (NEJM)) suggests that the field discusses the "evidence-practice" tension through these key texts.[10-14]

Limitations

The findings of this study have scope limitations because it is restricted to the WoS Core Collection and English-language original research; moreover, citation analyses are naturally affected by the time window, and the impact of recent publications may appear lower than it actually is.

CONCLUSION

The network and conceptual findings obtained show around which evidence clusters screening research in primary care is concentrated, suggesting that focusing on risk-based screening strategies, shared decision-making processes, and implementation studies may be a rational direction for future research. By making visible the developmental trajectory and intellectual focus of the literature on prostate cancer screening in primary care over the last 10 years, this study provides a guiding framework for more targeted research and practice-oriented screening strategies in the future.

ETHICAL DECLARATIONS

Ethics Committee Approval

As this study is a bibliometric analysis based on data extracted from the Web of Science Core Collection, it did not involve human participants, patient data, or animal experiments; therefore, ethics committee approval was not required.

Informed Consent

This bibliometric study used only publicly available data and did not involve human subjects or personal information; therefore, informed consent was not required.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

Author Contributions

Concept: ÇÖ, HKS; Design: ÇÖ, HKS; Supervision: ÇÖ, HKS; Resources: ÇÖ, HKS; Materials: ÇÖ, HKS; Data Collection and/or Processing: ÇÖ, HKS; Analysis and/or Interpretation: ÇÖ, HKS; Literature Review: ÇÖ, HKS; Writing – Original Draft: ÇÖ, HKS; Writing – Review & Editing: ÇÖ, HKS.

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