

Research Paper

Forensic Science Research on the Web of Science Database Over 22 Years: A Bibliometric Analysis



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ABSTRACT

Background: We reviewed the literature on forensic genetics from 1991 to 2022, emphasizing short tandem repeats. The objectives were to assess the caliber of research and draw attention to issues facing scientists and practitioners.

Methods: Except for China, a metrological study was performed on forensic literature from 1991 to 2022 using the Web of Science (WoS).

Results: The “journal of forensic sciences” had 380 papers that were the most read out of 2139 publications in the study. Also, “forensic science international: Genetics” had the most citations. Analysis with R software showed that 2001 was the peak publication year. “Journal of forensic sciences” and Budowle B were the most prolific. “Forensic science international: genetics” and Heller MJ received the most citations, and “forensic science”, “STRs”, and “DNA typing” were among the frequently used keywords.

Conclusion: The study could help scientists understand the trends of short tandem repeats based on forensic science research by highlighting the top ten research institutions, funding prospects, authors, and high-citation journals to anticipate future research directions.

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Introduction

Forensic genetics has undergone major changes since the late 1970s and early 1980s due to developments in DNA technology, judicial acceptance of DNA evidence, and public awareness campaigns [1]. While blood group antigens were initially used for suspect identification, standardized short tandem repeats (STRs) multiplexes are now widely used in forensic genetics globally [2]. Current advancements center on DNA analysis from crime scenes without database matching and using single-nucleotide polymorphisms (SNPs) to determine ancestry and observable traits [3]. Technological developments, such as massively parallel sequencing, provide more in-depth genetic information [4, 5]. Additionally, research has improved statistical methods for forensic genetic data analysis, including DNA mixtures. Mitochondrial DNA, SNPs, Y-chromosomal STRs, and STRs are essential techniques for identification [6-8].

Genetically engineered transgenic organisms frequently provide security problems. In high-profile cases, genetic genealogy, which traces ancestry and identifies relatives using genetic information, has drawn attention for its ability to solve cold cases and find missing people. New bioethical issues have arisen, such as utilizing biological specimens, data interpretation, and the legal admissibility of DNA evidence [4, 9, 10].

A bibliometric study examining forensic genetics literature from 1991 to 2022 focuses on STRs. The [Web of Science](#) (WoS) database is utilized to identify notable publishing companies, leading nations, trends, and influential writers. The study suggests future research areas and emphasizes contributions to advancing forensic genetics.

This study aims to conduct a bibliometric analysis of forensic genetics and stem cell research papers indexed in the [WoS database](#). We intend to find previous research contributions, upcoming research prospects, and possible collaborations. The [WoS database](#) was chosen because it offers a more thorough and precise evaluation of an author's scholarly influence than [PubMed](#). It also has a broader and more varied selection of STR-based forensic genetics sources [11-14].

Materials and Methods

Study search strategy

Utilizing the [WoS database](#), a bibliometric analysis was conducted focusing on “forensic” and “STR” through December 2022. It excluded non-English publications, certain document kinds, chemistry/engineering disciplines, particular fields, and non-scientific content, but it included original research, reviews, conference papers, and book chapters.

A total of 2139 papers underwent a thorough examination to identify duplicates, but none was discovered. Furthermore, all of these documents were utilized for data analysis ([Figure 1](#)). Journal articles that underwent peer review were chosen to ensure quality control [15]. The exclusion of China from the analysis was based on a prior detailed investigation [16]. The utilization of the STR technique is essential in the field of forensic DNA analysis to examine criminal incidents and determine the individuals involved [17]. Bibliometric analysis is a technique employed to assess the impact and advancement of a particular topic by reviewing data from published articles, such as authorship, citations, and keywords. Nevertheless, specific data cannot be utilized for this research due to limitations regarding its relevance, accessibility, or inherent characteristics [18, 19].

Data analysis

Using VOSviewer software, version 1.6.20, biblioshiny, and bibliometrics in R Studio, we examined [WoS](#) data, uncovered trends, and created bibliometric maps [11, 20-22].

Main information

[Table 1](#) presents the crucial bibliometric data on the STRs and forensic science acquired using the Biblioshiny tool. A total of 2139 documents, primarily original research articles, were gathered from 236 sources (2139), and 20.41 citations per piece are the average.

Results

Analyzing the rise in publications can help one understand trends and developments in a field. This analysis can offer insights into potential future research directions and assist in identifying solutions to solve new difficulties.

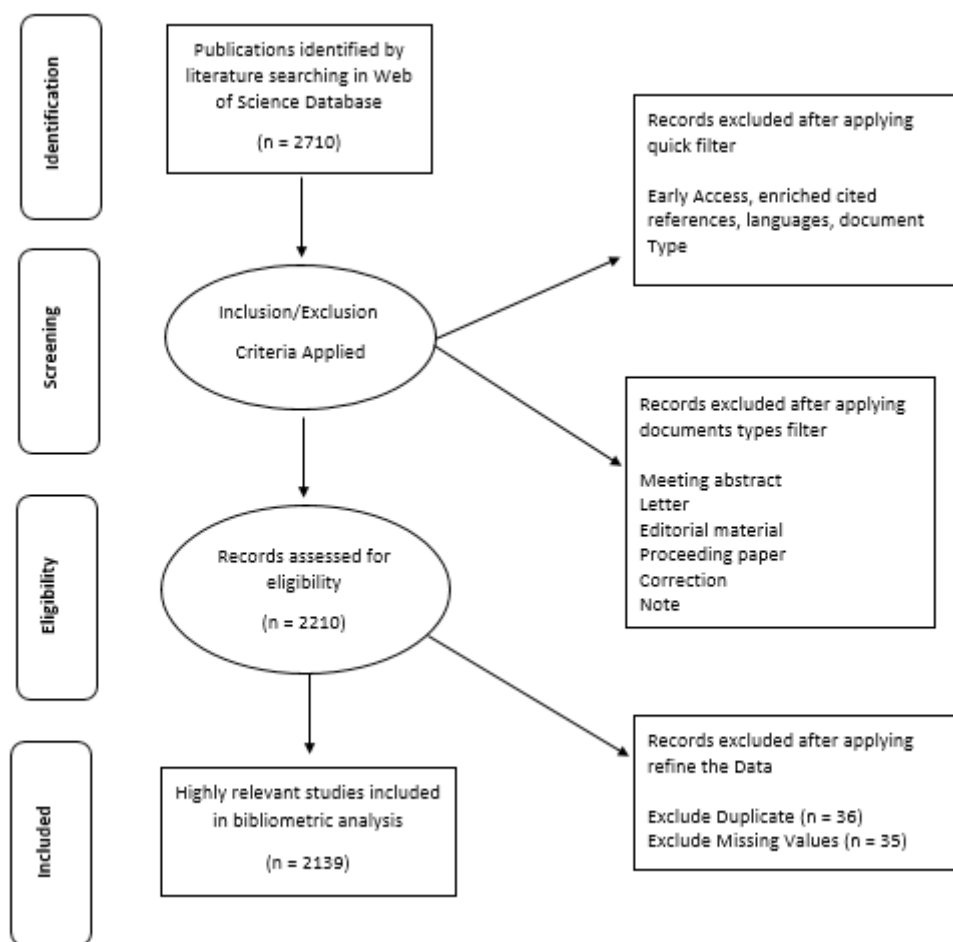

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Figure 1. Search method flowchart exhibiting 2139 publications between January 1991 and December 2022

Annual trend of publication growth

The number of forensic genetics articles has increased dramatically since 2000; it peaked in 2001 and will continue to rise sharply between 2020 and 2022. STRs were used in the greatest number of papers in 2001, indicating a rise in interest in forensic genetics that was particularly noticeable following that year (Figure 2).

Most productive and highly referenced journals

The Journal of Forensic Sciences is the most prestigious journal in forensic science, with the most papers published. *Forensic Science International: Genetics* and the *International Journal of Legal Medicine* are two highly regarded journals on the subject, trailing closely behind (Figure 3).

Proportion of articles contribution by authors and organizations

As seen in Figure 4a, the University of Porto ranked first with 75 documents in STR and forensic-based research, totaling 558 citations.

A total of 2139 research papers on forensic genetics and STRs were published by 6349 authors, with Budowle B. being the most productive author (Figure 5).

Most relevant countries by corresponding authors

According to Scimago Journal and Country Rank, the study considered authors' publishing output by nation, with the USA leading in publications and Germany, Japan, and Spain rating highly in scientific productivity across disciplines (Figure 6).

Table 1. The bibliometric data based upon STR usage in forensic science

Bibliometric Data	Description	Values
Main information about the data	Timespan	1991:2022
	Sources (journals, books, etc.)	236
	Documents	2139
	Annual growth rate (%)	14.79
	Document average age	13.2
	Average citations per doc	20.41
	References	25322
Document contents	Keywords plus	2350
	Author's keywords	4006
Authors	Authors	6349
	Authors of single-authored docs	38
Authors' collaborations	Single-authored docs	46
	Co-authors per doc	5.55
	International co-authorships (%)	25.2
Document type	Article	2053
	Review	86

STRs: Short tandem repeats.

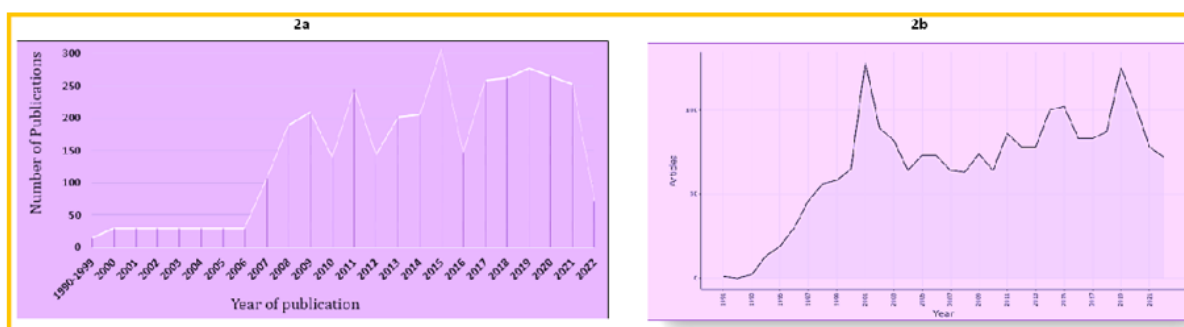
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Frequency distribution of scientific productivity

Lotka's law coefficients are determined through bibliometric analysis of STRs and forensic publications, explaining the distribution of author frequency and publication quantity in the studied topic (Figure 7).

Sources of publication with the highest local citations and influences

Forensic science international: Genetics is modeled after genetics. Citation counts and the impact of articles from top sites with strong local citation influence increased when they reference prestigious publications

International Journal of
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“STRs”, which were mentioned 382. A treemap shows the annual growth in the frequency of important phrases, with “forensic science”, “STRs”, and “DNA typing” showing the most development (Figure 8).

Three-field plot analysis

The Sankey plot analysis conducted with biblioshiny depicts the connections across countries, authors, and keywords in STR and forensic science research [33]. According to a Sankey plot analysis, research in forensic science and STR is led by the US, Germany, and Spain. Budowle and Gusmao are renowned writers, and “population genetics”, “PCR”, and “DNA typing” are the most frequently used keywords (Figure 9).

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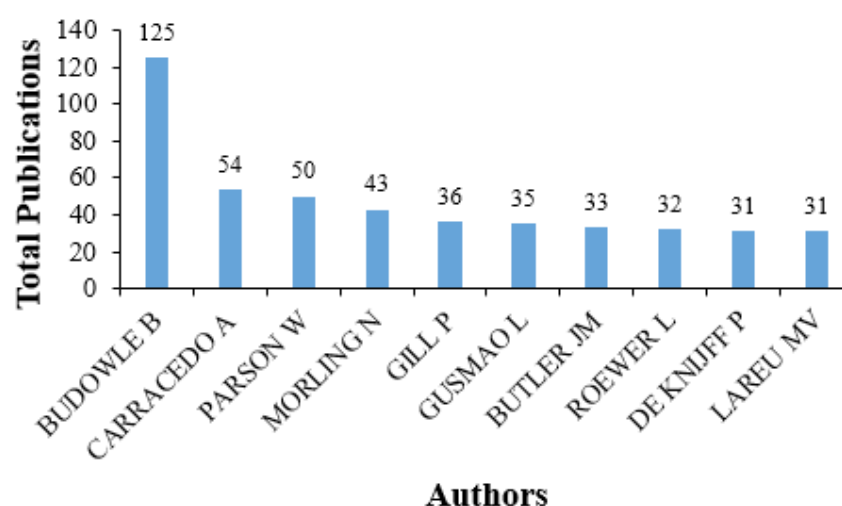


Figure 5. Most relevant authors with the number of publications

Keywords co-occurrences and author keywords dispersion analysis

A total of 4041 author keywords from 1991 to 2022 were examined in a forensic science investigation, emphasizing those that appeared at least 50 times. Essential concepts that biblioshiny found to be comparable to terms like “forensic genetics” and “massively parallel sequencing” include “population genetics”, “STRs”, “forensic science”, and “DNA typing” (Figure 10).

Discussion

This study does a bibliometric analysis of research on forensic science and STRs from 1991 to 2022, utilizing the [WoS database](#). The data indicate a significant level of teamwork since a single individual created just 46% of the documents. Notable authors such as Budowle, Carracedo and Parson have consistently produced scholarly works, particularly after 2001. The analysis identifies the United States and Germany as the primary contributors,

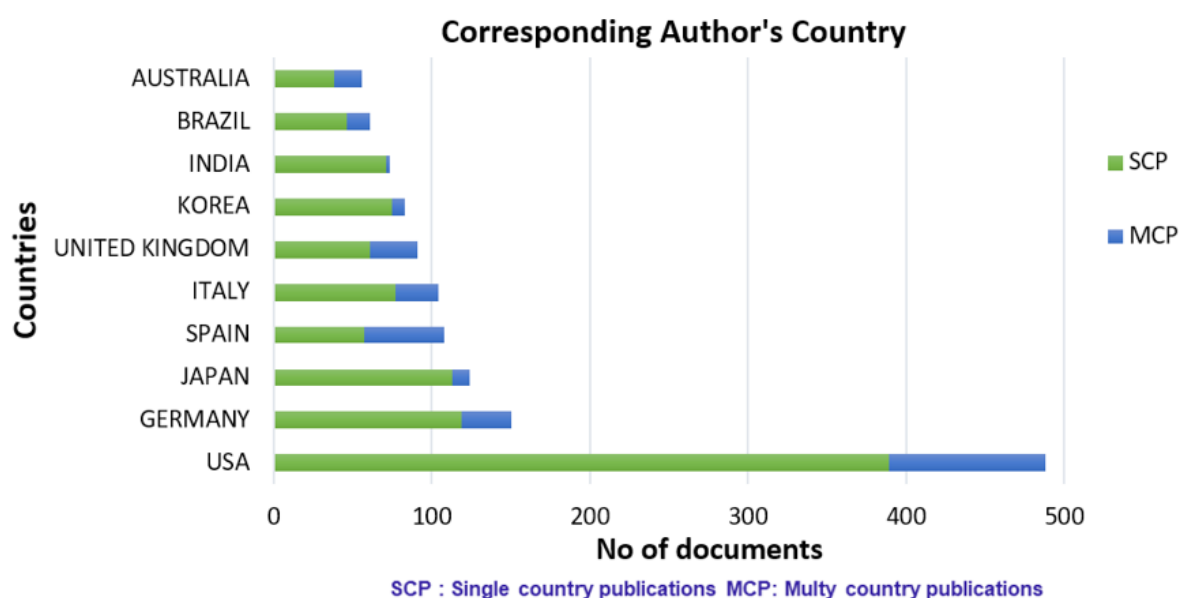
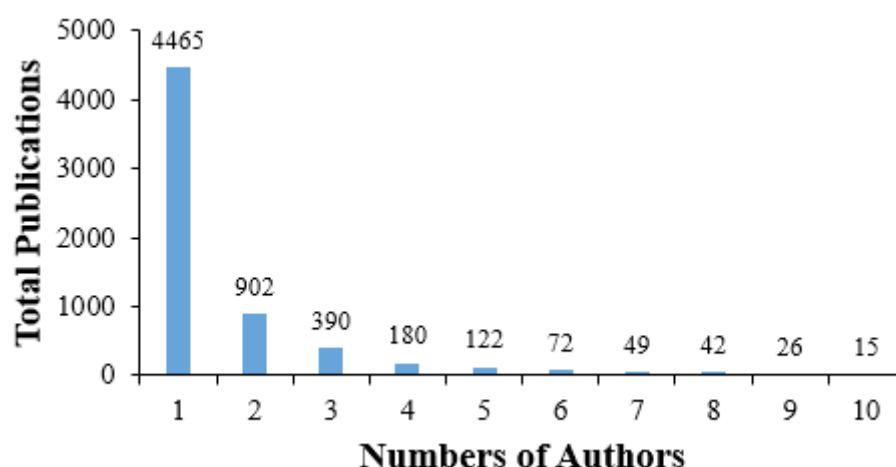


Figure 6. Inter- and intra-collaboration among countries

SCP indicates single-country publications, and MCP refers to multi-country contributions for publication. The selection of countries was made in the corresponding author's country.

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emphasizing the substantial impact of journals such as “The Journal of Forensic Sciences” and “Forensic Sciences International: Genetics”. Although there is a strong emphasis on STRs, there is also a clear presence of other techniques and transdisciplinary research. This study is one of the initial worldwide evaluations of bibliometrics in this subject, focusing on the swift distribution of open-access research.

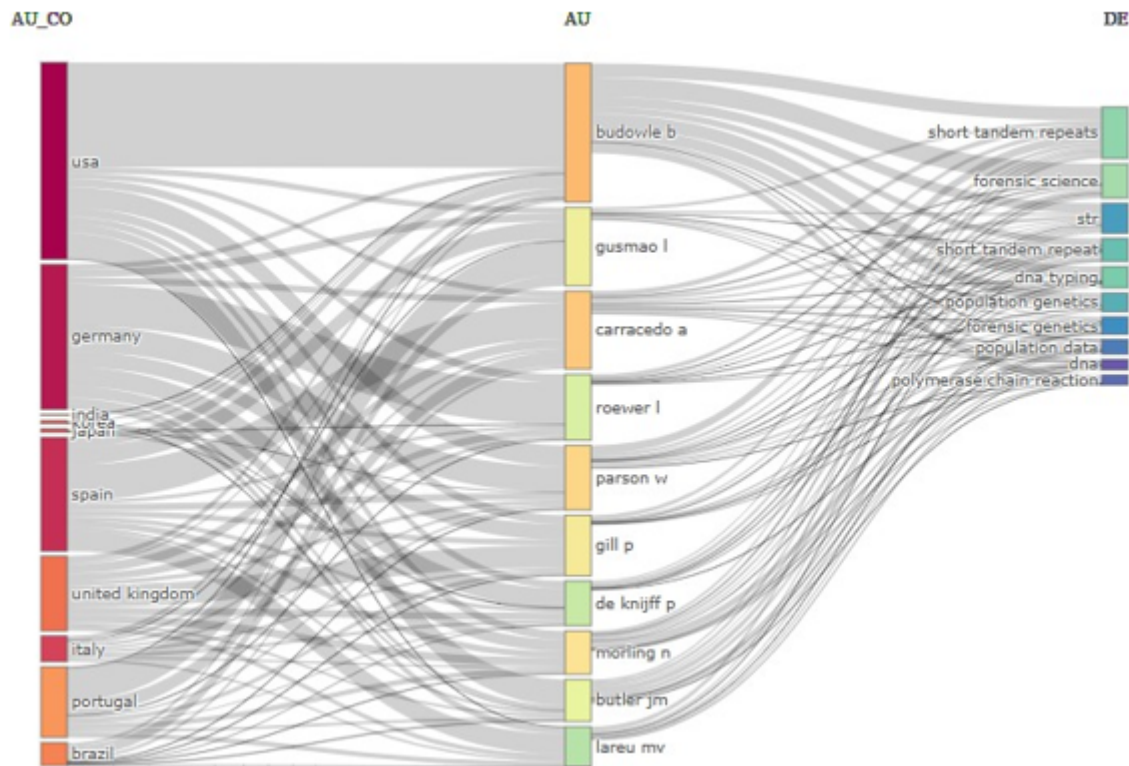
Conclusion

This study investigated the worldwide scientific production in forensic science by analyzing data from the WoS. The specific focus of the study was on STRs and prominent experts in this field. Implementing open-access regulations and rapid technological progress have expedited data sharing and expanded knowledge. STR typing, next-generation sequencing, and SNPs are essen-

Table 2. Source of publication, citations, impact factor, country name, and author citations

Journal	No. of Publications	Total Citations	Impact Factor	Publisher	Country	Author	Citation
Journal of Forensic Sciences	380	6994	1.8	Wiley Online Library	USA	Budowle	1234
Forensic Science International-genetics	363	8214	4.8	Elsevier	Ireland	Butler	1037
International Journal of Legal Medicine	288	6616	2.6	Springer	Germany	Gill	950
Forensic Science International	278	6433	1.99	Elsevier	Ireland	Kayser	617
Legal Medicine	62	430	0.4	Elsevier	Netherlands	Roewer	596
Electrophoresis	58	1294	3.5	Wiley VCH Verlag	Germany	Szibor	593
Croatian Medical Journal	53	1290	1.6	Medicinska Naklada	Croatia	Parson	586
Forensic Science International Genetics Supplement Series	40	41	0.5	Elsevier	Ireland	Schneider	559
American Journal of Forensic Medicine and Pathology	24	216	1.1	Lippincott Williams & Wilkins	USA	Morling	553
Annals of Human Biology	21	72	1.2	Taylor & Francis	UK	Carracedo	536

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Figure 9. The three-field plot analysis showing keywords (right), authors (center), and nations (left)

The lines and boxes illustrate the relationship between the three variables. The height of the rectangles and the thickness of the connecting lines indicate the strength of the relationship between variables.

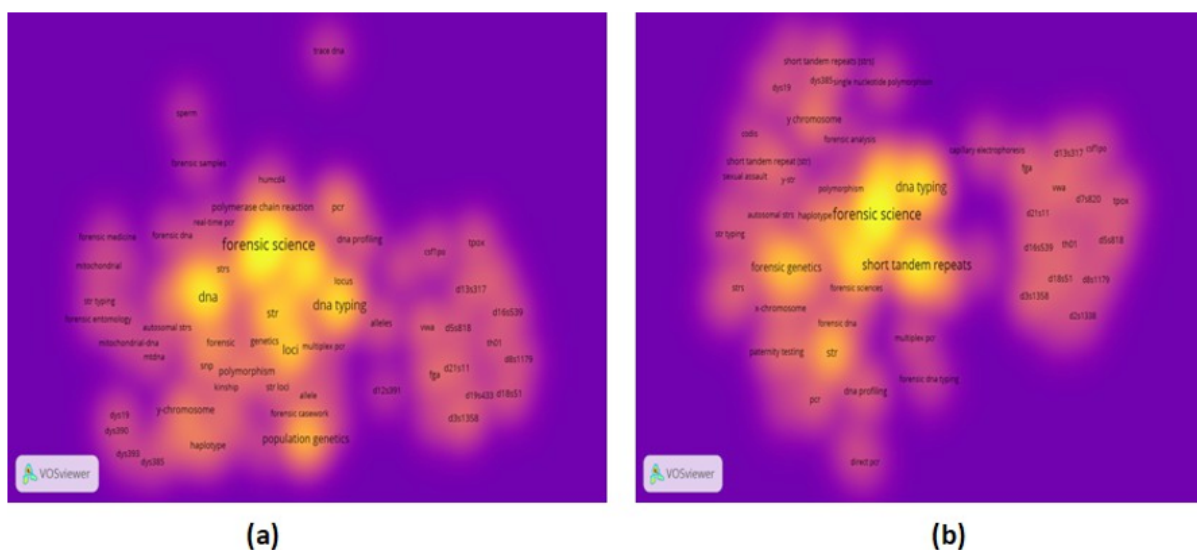


Figure 10. Trends in the co-occurrence of keywords in research related to forensic science

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tial methodologies. Since 2001, there has been a significant increase in publications in forensic genetics, with the United States, Germany, Japan, and Spain taking the lead in research. Notable periodicals in the field include the Journal of Forensic Sciences and Forensic Science International: Genetics. Future research should investigate cutting-edge machine learning methods and create extensive visualization tools for bibliometric analysis.

Limitations

The investigation used the WoS database, devoid of some forensic genetics literature available on Google Scholar and PubMed. However, WoS has provided a variety of journals since 1995, growing through scholarly collaborations. Focusing on STR, InDels (insertion/deletion polymorphisms), SNPs (single-nucleotide polymorphism), and omics approaches, forensic genetics research is expanding rapidly to further scientific understanding and worldwide development. More research should look into more comprehensive keywords and sophisticated bibliometric methods.

Ethical Considerations

Compliance with ethical guidelines

There were no ethical considerations to be considered in this research.

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Authors' contributions

Conceptualization and supervision: Hafiz Muhammad Zeeshan and Furkan Yousaf; Methodology: Rakhi Issrani; Investigation: Faqeeha Javed; Writing – original draft: Hafiz Muhammad Zeeshan and Furkan Yousaf; Writing – review & editing: Muhammad Nadeem Baig; Data collection: Rakhi Issrani and Faqeeha Javed; Data analysis: Hafiz Muhammad Zeeshan, and Furkan Yousaf.

Conflict of interest

The authors declared no conflict of interest.

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