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Review Article

Global trends and publication on secretome in dermatology practice: A bibliometrics analysis from 2003 to 2023

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Abstract

Introduction The secretome, also known as conditioned medium, is a collection of proteins and other molecules secreted by Mesenchymal stem cells (MSCs). It has been increasingly studied for its potential applications in dermatology practice. However, there has been limited bibliometric analysis to understand the global trends in this field. The objective of this study is to analyze the global trends and publication activity related to secretome in dermatology practice through bibliometrics analysis.

Methods A systematic search was performed using the Web of Science Core Collection database to identify relevant publications on secretome in dermatology practice from 2003 to 2023. Statistical analyses were performed using Excel and VOSviewer software. Various bibliometric indicators were analyzed to evaluate the publication trends, research topics, and collaboration networks.

Results A total of 304 articles with H-index 45 and 20,74 citations per paper related to secretome in dermatology practice were identified. The annual publication output showed an upward trend, with a peak in 2022. The United States (57) had the highest number of publications, followed by China (37) and Germany (37). The most common research topics were wound healing, skin regenerative & rejuvenation, inflammatory skin diseases, skin cancer and hair growth. For promising hotspots, "exosomes and regenerative medicine" showed the highest, followed by "senescence", "photoaging", and "wound repair".

Conclusion Our bibliometric analysis demonstrates that secretome research in dermatology practice has been an increasingly studied field with potential applications in the development of novel therapeutics for skin disorders. Collaboration among researchers and countries is crucial for advancing secretome research in dermatology practice.

Key words
Secretome; Bibliometrics; Publication trends; Research topics.

Introduction

Secretome, a complex mixture of biologically active molecules, has emerged as a crucial area of interest in dermatology practice.[1] It comprises a diverse range of proteins, lipids, nucleic acids, and extracellular vesicles that play essential roles in cell signalling, tissue repair, immune regulation, and intercellular communication

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within the skin microenvironment.[2,3] The secretome's multifaceted functions make it an intriguing and promising area for dermatological research and therapeutic interventions.[4]

Over the past two decades, there has been a growing interest in exploring the secretome's role in dermatology, leading to an increase in scientific publications on this topic.[5] Understanding the global trends and publication patterns related to secretome in dermatology practice is essential for identifying key research areas and emerging developments in the field.[6,7] However, a comprehensive understanding of the global trends and publication patterns surrounding secretome in dermatology practice remains limited. A bibliometric analysis is a valuable approach to address this gap by systematically examining the publication output, collaborations, and impact of secretome-related research in the dermatology field.[8,9]

The objective of this study is to conduct a bibliometric analysis of secretome-related research in dermatology from 2003 to 2023. This study utilized the Vancouver citation style to examine a wide range of scientific publications retrieved from prominent databases, including Web of Science. By employing bibliometric techniques, it aimed to identify key contributors, influential institutions, and high-impact journals that have contributed to the advancement of secretome research in dermatology.

Furthermore, the geographical distribution of publications was analyzed to assess regional research productivity and identify potential knowledge hubs. Co-citation and co-authorship networks were constructed to reveal collaborations and research clusters that have shaped the field's development.[9]

The findings of this bibliometric analysis will provide valuable insights into the current state of secretome research in dermatology, highlighting emerging trends and areas for further investigation. By understanding the global landscape of secretome research, this study aims to facilitate the identification of promising research directions and foster collaboration among researchers in the dermatology community.

Methods

Data Source The data for this bibliometrics study was collected from the Web of Science Core Collection database, a comprehensive and widely used academic citation index. This database was selected due to its extensive coverage of scientific literature across various disciplines, including dermatology and secretome research. The use of Web of Science ensures access to high-quality and peer-reviewed publications, providing a reliable basis for our bibliometric analysis.

A systematic search was conducted to identify relevant publications on secretome in dermatology practice published between 2003 and 2023. The search strings were formulated using a combination of query "MSC-CM" OR "Conditined-Medium" OR "Secretomes" OR "SECRETOME" AND "Dermatology" OR "Skin" AND "Effect" OR "Practice" OR "Clinical". The search was limited to publications in the English language to maintain consistency in data analysis.

Data Collection The initial search resulted in a broad set of articles related to secretome in dermatology practice. To ensure the inclusion of relevant publications, a two-step screening process was conducted. In the first step, titles and abstracts were reviewed to eliminate irrelevant articles. Subsequently, the full-texts of the remaining articles were assessed to identify those meeting the inclusion criteria.

The inclusion criteria were as follows:

- Publications related to secretome in the context of dermatology practice.
- Articles published between 2003 and 2023.
- Articles available in the English language.

Data Analysis The collected data were organized and analyzed using Microsoft Excel. Various bibliometric indicators were employed to evaluate publication trends, research impact, and collaboration networks. Key bibliometric indicators included:

- Publication Count: The total number of articles related to secretome in dermatology practice.
- H-index: An index that reflects the impact of the publications and the number of citations received by each paper.
- Citation Count: The total number of citations received by all the identified articles.
- Year of publication: A graphical representation to examine the year-wise publication trends.
- Document type of research: the distribution of research output will categorize the publications into different types.
- Country distribution of research: This will provide insights into the global distribution of research output and the countries actively contributing to the field.
- Publishers of research: The publications' publishers will be identified and analyzed to determine the most prolific and influential publishers in the field.
- Top cited publication: These highly cited articles indicate the influential and impactful works in the domain.
- Occurrence/ keywords from VOSviewer: This analysis will generate a visualization of keyword clusters, providing an overview of the major research themes and topics within secretome research in dermatology practice.

In addition to the above indicators, VOSviewer software was utilized to visualize collaboration networks and identify research clusters based on co-occurence patterns. This network analysis provided insights into the collaborative relationships among researchers, institutions, and countries in the field of secretome research in dermatology practice. The bibliometric analysis provided a comprehensive overview of the global trends and publication activity related to secretome in dermatology practice, which would enable us to draw meaningful conclusions and implications for the field.

Results

From **Figure 1**, a total of 304 articles related to secretome in dermatology practice were identified. The cumulative H-index was found to be 45, indicating a substantial impact of secretome research in the field. The average citations per paper were 20.74, indicating significant interest and recognition from the scientific community.

Based on **Figure 2**, there is an observable upward trend in annual publication output, with a significant peak in 2022 (n=62; 20.3%), indicating a surge in interest in secretome research. The earliest record of secretome in dermatology practice was published in 2008 **(Table 1)**. **Figure 2** presents the growth of secretome publications in dermatology practice in two decade intervals. The United States (n=54; 17.7%) was the most prominent contributor, followed by Germany (n=37; 12.1%), China (n=37; 12.1%), and Austria (n=33; 10.8%). Other countries contributions are shown in **Table 1**.

Figure 1 Analysis of total publication and citation report.

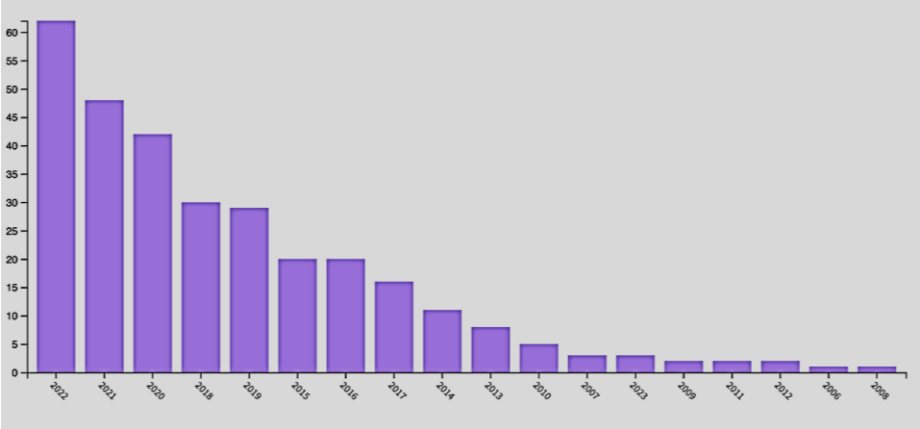

Figure 2 The publication of research.

Table 1 The characteristics study of bibliometric analysis.

No.	*Type of characteristic study*	*N (%age)*
1.	2022	62 (20.3%)
2.	2021	48 (15.7%)
3.	2020	42 (13.7%)
4.	2018	30 (9.8%)
5.	2019	29 (9.5%)
6.	2015	20 (6.5%)
7.	2016	20 (6.5%)
8.	2017	16 (5.2%)
9.	2014	11 (3.6%)
10.	2013	8 (2.6%)
11.	2010	5 (1.6%)
12.	2007	3 (0.9%)
13.	2023	3 (0.9%)
14.	2009	2 (0.6%)
15.	2011	2 (0.6%)
16.	2012	2 (0.6%)
17.	2006	1 (0.3%)
18.	2008	1 (0.3%)
The country distribution of research		
1.	USA	54 (17.7%)
2.	Germany	37 (12.1%)
3.	China	37 (12.1%)
4.	Austria	33 (10.8%)
5.	Switzerland	25 (8.2%)
6.	Italy	22 (7.2%)
7.	South korea	21 (6.9%)
8.	England	18 (5.9%)
9.	France	18 (5.9%)
10.	Canada	13 (4.2%)
11.	Spain	13 (4.2%)
12.	Japan	13 (4.2%)
The document type of research		
1.	Research article	252 (82.6%)
2.	Review article	37 (12.1%)
3.	Meeting abstract	12 (3.9%)
4.	Book chapters	3 (0.9%)
The publishers of research		
1.	Springer nature	57 (18.7%)
2.	Elsevier	52 (17.1%)
3.	Wiley	43 (14.1%)
4.	Mdpi	34 (11.1%)
5.	Frontiers media	27 (8.8%)
6.	Mary ann liebert	23 (7.5%)
7.	Public library science	20 (6.5%)
8.	Dove medical press	18 (5.9%)
9.	Hindawi publishing	16 (5.2%)
10.	Sage	14 (4.6%)

The majority of the research articles (n=252; 82.6%) constituted the document type, followed by review articles (n=37; 12.1%), meeting abstracts (n=12; 3.9%), and book chapters (n=3; 0.9%) **(Table 1)**. Springer Nature (n=57; 18.7%) emerged as the primary publisher of research, followed by Elsevier (n=52; 17.1%), Wiley (n=43; 14.1%), and MDPI (n=34; 11.1%) **(Table 1)**.

Top 5 cited articles **Table 2** displays the top 5 highly cited articles across various time periods. Notably, the most cited article from 2003 to 2023 focused on the potential of secretome in accelerating skin wound healing in 2010, garnering 329 citations. Subsequently, the amniotic-derived secretome's role in wound healing was discussed in 2014, amassing 116 citations. In 2010, an article highlighting adipose-derived secretome's capacity to stimulate hair growth garnered 110 citations. Furthermore, in 2015, an investigation into

umbilical cord-derived secretome and its enhanced paracrine induction of wound healing received significant attention with 2018 citations. Lastly, in 2018, an article exploring secretome to reduce wound healing attracted 104 citations. The prevailing theme among these top cited articles was the analysis of secretome's potential in promoting and curing wound healing.

A total of 304 documents addressed the topic of secretome in dermatology practice. **Figure 3** illustrates a visualization map presenting the occurrence of terms within these documents.

The map comprises six distinct clusters, denoted by different colors (red, green, blue, orange, purple, and brown). Each cluster signifies terms that were frequently mentioned together in the analyzed literature.

The first cluster (red) included terms such as "skin inflammation", "psoriasis", "atopic dermatitis", and "cellular senescence". In the second cluster (green), terms such as "hair growth", "hair follicle regeneration", "growth", and "melanogenesis" were commonly associated. The third cluster (blue) consisted of terms like "cancer", "carcinoma", "photoaging", "endothelial growth factor", and "anti-aging." In the fourth cluster (orange), terms such as "skin regeneration", "repair", "scar formation", and "chronic wound" were frequently mentioned together. The fifth cluster (purple) comprised terms like "skin rejuvenation", "wound repair", "quantitative proteomic", and "dermaroller". Lastly, the sixth cluster (brown) included terms such as "regenerative medicine", "drug delivery", "vitiligo", and "bone-marrow cells". These clusters of terms reveal the common themes and research areas discussed in relation to secretome in dermatology practice across the analyzed literature.

Discussion

The overall representation of the scholarly literature has been examined in this study. This study used advanced bibliometric techniques to create hierarchies based on the country with the highest number of publications and used patterns in the citation network of articles to produce these representations.

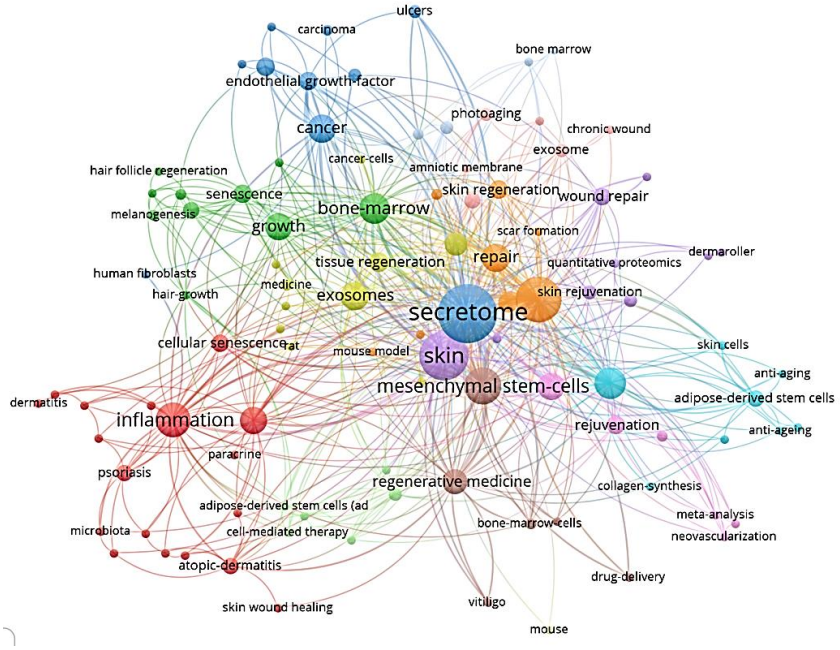

Figure 3 Network visualization map of co-occurrence research.

Table 2 Top 5 cited articles.

No.	*Authors* *Title*	*Publication*	*Source*	*Citation*
1.	Walter, M. N. M *et al*. Mesenchymal stem cell-conditioned medium accelerates skin wound healing: An in vitro study of fibroblast and keratinocyte scratch assays	2010	Experimental Cell Research	329
2.	Jun, Eun Kyoung *et al*. Hypoxic Conditioned Medium from Human Amniotic Fluid-Derived Mesenchymal Stem Cells Accelerates Skin Wound Healing through TGF-beta/SMAD2 and PI 3K/Akt Pathways	2014	International Journal of Molecular Sciences	116
3.	Park, Byung-Soon *et al*. Hair growth stimulated by conditioned medium of adipose-derived stem cells is enhanced by hypoxia: evidence of increased growth factor secretion	2010	Biomedical Research-Tokyo	110
4.	Santos, Jorge M *et al*. Three-dimensional spheroid cell culture of umbilical cord tissue-derived mesenchymal stromal cells leads to enhanced paracrine induction of wound healing	2015	Stem Cell Research & Therapy	108
5.	Park, Se-Ra *et al*. Stem Cell Secretome and Its Effect on Cellular Mechanisms Relevant to Wound Healing	2018	Molecular Therapy	104

These findings were consistent with the study conducted by Zhao *et al*. (2018) regarding umbilical cord mesenchymal stem cells (UC-MSC), which showed that China with 558 papers, South Korea with 160 papers, and the United States with 136 papers are the top 3 most productive countries in generating study with a primary focus on UC-MSC.[10] Similar to that study, in this study, the United States and China are included in the top 3 most productive countries, along with Germany. This study found that 2008 was recorded as the first known publication regarding the usage of the secretome in dermatology; these findings align with Zhao *et al*. (2018), which concluded that the growth of global publications on UC-MSC started to grow exponentially in 2008.[10]

Among all the topics discussed, papers discussing wound healing using secretome as an intervention are the most researched and cited. This finding is similar to the study conducted by Manriquez *et al*. (2015), which concluded in their paper of published systematic review and meta-analysis bibliometrics, wound healing is one of the most prominent topics researched, placed seventh after psoriasis, skin infection, nonmelanoma skin cancer, and melanoma. These findings further strengthen the trend of wound healing studies in dermatology.[11]

Other highly discussed topics found in this study include skin regenerative and rejuvenation, inflammatory skin diseases, skin cancer and hair growth, similar to the study by Seivright *et al*. (2021) which also found that cutaneous oncology placed second highest number of journal articles published bibliometric analysis in four high impact dermatology journal.[12] However, the division of the categories is quite broad, including medical dermatology and papulosquamous dermatoses. This wide categorization may cause bias in the result because of the disproportionate allocation and grouping. Skin inflammation is also gaining traction nowadays, as the study by Liu *et al*.

(2023) showed an almost two-fold increase in the amount of publication on research about the relationship between skin regeneration and inflammation from 2021 to its peak year of 2022- a finding similar to this study.[13]

Overall this study's findings strengthen the views on the increasing trend and upward trajectory of dermatology journal publications regarding wound healing, skin regenerative and rejuvenation, inflammatory skin diseases, skin cancer and hair growth. This study also serves as a pioneer in studying the trend in global secretome usage in dermatology.

Limitation One limitation of the study is the potential for incomplete data retrieval from the selected databases, which may result in the exclusion of relevant publications on secretome in Dermatology Practice. Additionally, the analysis is limited to English-language publications, possibly leading to language bias and missing valuable research published in other languages

Conclusion

In conclusion, this bibliometrics study provides valuable insights into the global trends and publication analysis of secretome in dermatology practice from 2003 to 2023. The analysis demonstrated a significant increase in research interest, as evidenced by the upward trend in annual publication output and a notable peak in 2022. Moreover, key research topics, including wound healing, skin regenerative and rejuvenation, inflammatory skin diseases, skin cancer, and hair growth signify potential areas for future research and therapeutic interventions. This bibliometric analysis sheds light on the evolving field of secretome in dermatology practice and its potential for driving innovative and impactful research in the years to come.

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