A Comprehensive Study on the Scientific Landscape of Linear Regression

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ABSTRACT

This study presents a bibliometric analysis of research trends in linear regression using data retrieved from the Scopus database. The search query included the keywords linear and regression in the title, abstract, or keywords, and filtered results to final-stage journal articles written in English, categorized under the exact keyword Article, affiliated with institutions in the United Kingdom, and published between 2022 and 2025. The analysis, conducted using VOS viewer and Scopus visualization tools, reveals fluctuations in publication counts, with a notable decline in 2025. Leading journals such as PLOS ONE, BMJ Open, and International Journal of Environmental Research and Public Health contribute significantly to the field. At the same time, University College London (UCL) and the University of Oxford emerge as the most influential institutions. Co-authorship and co-citation analyses indicate strong collaborative networks, particularly in medical and epidemiological research. Additionally, funding bodies like the National Institute for Health and Care Research (NIHR) and UK Research and Innovation play crucial roles in supporting these studies. Despite the widespread applications of linear regression across various disciplines, gaps remain in its methodological advancements, particularly in handling high-dimensional data, non- linearity, and real-time decision-making applications. This study highlights the need for future research to explore more adaptive and robust regression models that integrate machine learning techniques and dynamic real-world scenarios.

1. Introduction

Linear regression is one of the most fundamental and widely used statistical methods in various scientific disciplines, ranging from economics and engineering to social sciences and healthcare. As a predictive modeling technique, it provides a simple yet powerful approach for understanding relationships between dependent and independent variables. Despite its simplicity, linear regression continues to be a critical area of research, particularly in exploring its limitations and potential improvements. In recent years, there has been an increasing interest in enhancing its applicability by integrating it with advanced computational methods such as machine learning and deep learning.

This bibliometric study analyzes research trends in linear regression, focusing on publication patterns, key contributors, and emerging research themes [1].

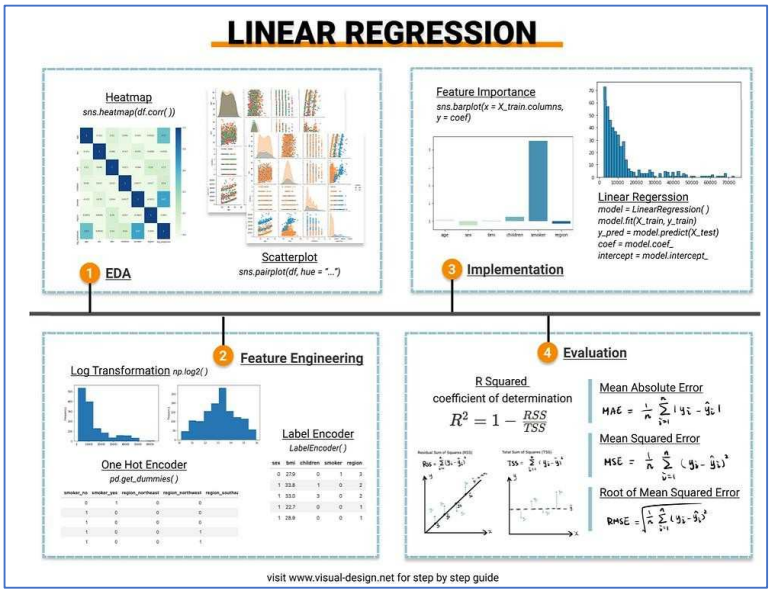

Figure 1. Linear Regression Concept [2]

Bibliometric analysis provides valuable insights into the evolution of a research field by mapping publication trends, co-authorship networks, and citation patterns. By examining academic outputs, it becomes possible to identify influential authors, leading institutions, and funding agencies that drive research in the domain. Previous bibliometric studies have explored various statistical and machine learning methods, yet a comprehensive analysis focusing solely on linear regression has been relatively scarce. Given the widespread use of linear regression in both theoretical and applied research, understanding its scholarly impact can help highlight future directions for innovation and interdisciplinary applications [3].

This study focuses explicitly on publications affiliated with institutions in the United Kingdom, a country with a strong academic and research presence in statistical methodologies and applied sciences. By analyzing research output from UK institutions, this study seeks to understand how linear regression is being developed and applied within different academic contexts. Additionally, the role of prominent journals, universities, and funding bodies will be examined to assess their contributions to the field. Such an analysis is crucial for identifying major players and collaborative networks that influence the evolution of linear regression research [4].

The dataset used in this study was retrieved from the Scopus database, applying search criteria that ensured the inclusion of only final-stage journal articles published between 2022 and 2025. The study examines key bibliometric indicators, including publication volume over time, author collaborations, citation patterns, and keyword co-occurrence. By employing Scopus visualization tools and the VOS viewer, this study provides a structured analysis of the research landscape in linear regression, highlighting dominant themes and potential research gaps [5].

A key objective of this study is to uncover emerging trends and challenges in linear regression research. While the method remains highly relevant, several open questions persist, particularly in handling complex datasets, addressing non-linearity, and improving its robustness in real-world applications. By analyzing academic output and identifying current research trajectories, this study aims to provide a foundation for future investigations that bridge theoretical advances with practical applications in data science, finance, healthcare, and beyond [6].

2. Methodology

To ensure a comprehensive and structured analysis of linear regression research, this study employs a bibliometric approach using data extracted from the Scopus database. Bibliometric analysis is a quantitative method that allows researchers to assess the impact of publications, track research trends, and visualize academic networks. The Scopus database was selected for its extensive coverage of peer-reviewed literature across multiple disciplines, making it a reliable source for large-scale research assessments. The study applies specific search criteria to filter relevant publications and uses visualization tools to analyze co-authorship, citation networks, and keyword relationships [7].

The dataset used in this study was obtained from the Scopus database by applying specific search criteria to ensure relevance and accuracy. The search query input was: TITLE-ABS-KEY (linear AND regression) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (EXACTKEYWORD, "Article")) AND (LIMIT-TO (AFFILCOUNTRY, "United Kingdom")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2023) OR LIMIT-TO (PUBYEAR, 2024)

OR LIMIT-TO (PUBYEAR, 2025). This query was designed to retrieve only final-stage journal articles written in English, published between 2022 and 2025, affiliated with institutions in the United Kingdom, and categorized under the exact keyword Article. These filtering parameters ensure that the dataset comprises high-quality, peer-reviewed academic publications, enabling a precise bibliometric analysis of research trends in linear regression [8].

After retrieving the dataset, bibliometric mapping and visualization were conducted using VOSviewer and Scopus analytics tools. VOSviewer was used to create co-authorship networks, keyword co-occurrence maps, and citation clustering, while Scopus analytics provided insights into publication trends, source distribution, and institutional affiliations. These tools enabled the identification of key authors, leading institutions, and major funding sources supporting research on linear regression. Furthermore, citation analysis helped determine the most influential papers and their impact within the broader academic community [9].

To ensure data accuracy and reliability, all retrieved articles were manually reviewed to eliminate irrelevant entries or duplicates. Only articles that explicitly focused on linear regression as a primary methodological or applied component were retained. Metrics such as the total number of publications, citation count, author collaborations, and keyword frequency were extracted and analyzed. The study also examined funding acknowledgments to identify organizations that have played a critical role in advancing research in this domain [10].

The results of this bibliometric analysis provide a structured overview of the research landscape surrounding linear regression, offering insights into publication dynamics, collaborative networks, and emerging research topics. The findings can serve as a valuable reference for academics, policymakers, and funding agencies seeking to understand the trajectory of linear regression research and its future implications across various scientific fields [11].

3. Results and Discussion

The first analysis in this study examined the Output Visualization from Scopus, which provides a comprehensive overview of publication trends, key sources, and research distributions related to linear regression. This initial stage will focus on analyzing the annual publication trends to identify fluctuations in research activity over time, followed by an in-depth assessment of the most influential journals, authors, institutions, and countries contributing to this field. By leveraging Scopus visualization tools, this study aims to identify emerging patterns, dominant research themes, and potential gaps to guide future investigations. The insights derived from this analysis will serve as a foundation for subsequent bibliometric evaluations using VOSviewer, enabling a more detailed

exploration of co-authorship networks, citation relationships, and thematic clustering in linear regression research.

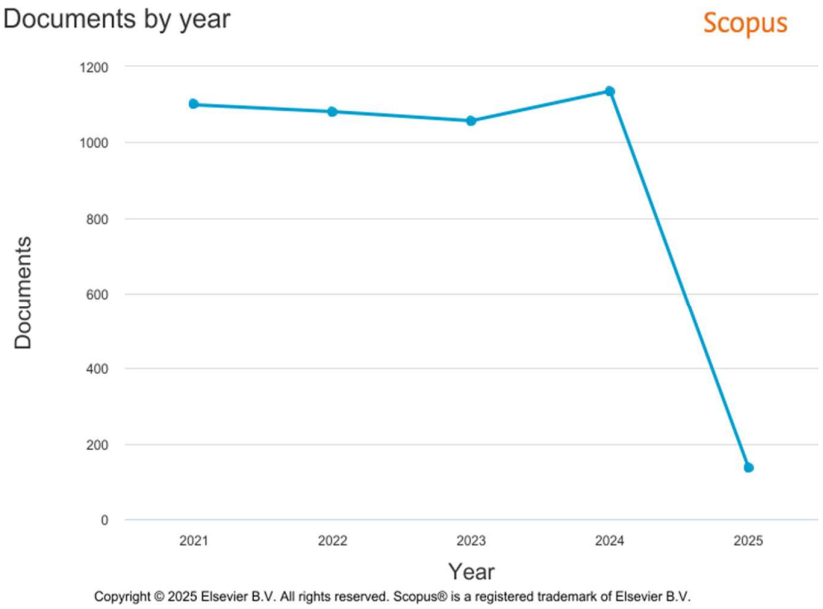

Figure 2. Scopus Visualization: Year Analysis

This graph shows the number of documents published per year based on Scopus data. From 2021 to 2024, the number of publications was relatively stable, with slight fluctuations around 1000-1200 documents per year. However, by 2025, the number of papers published will decline sharply, falling below 200. Delays in data recording could account for this sharp decline, as could changes in publishing policies or other external factors that affect the number of scientific publications [12], [13].

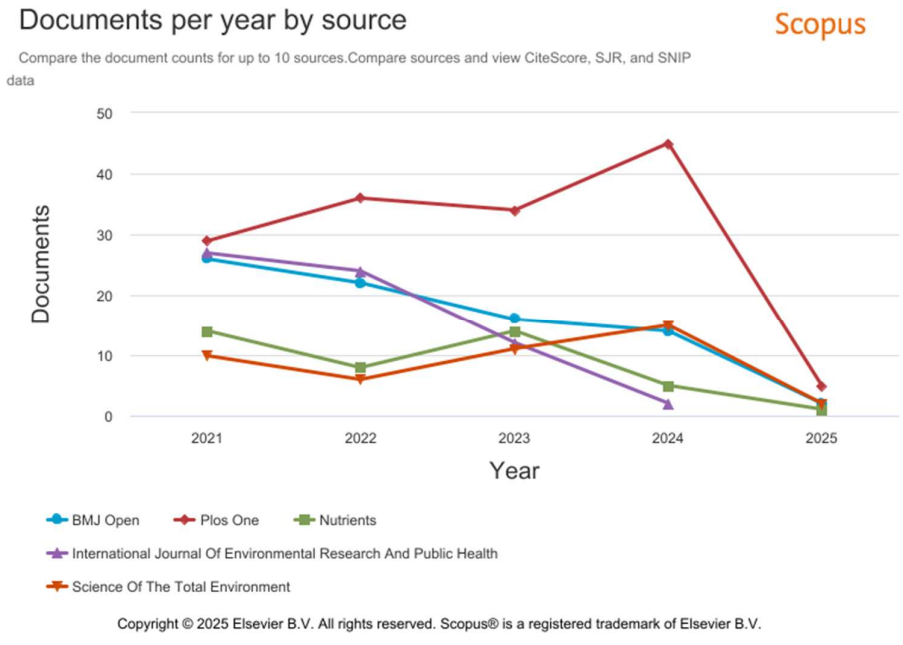

Figure 3. Scopus Visualization: Analyze-Source

The graph shows the annual trend in the number of documents from several academic sources indexed in Scopus, with significant fluctuations from 2021 to 2025. PLOS ONE has seen a steady

increase through 2024, followed by a sharp decline in 2025. In contrast, BMJ Open and the International Journal of Environmental Research and Public Health have experienced a gradual decline since 2021. Nutrients and Science of the Total Environment show a more stable pattern, with a slight increase in a few years, followed by a decrease again in 2025. This trend indicates that the number of publications in various journals can be influenced by external factors, including research trends, publication policies, and changes in research funding schemes [14], [15].

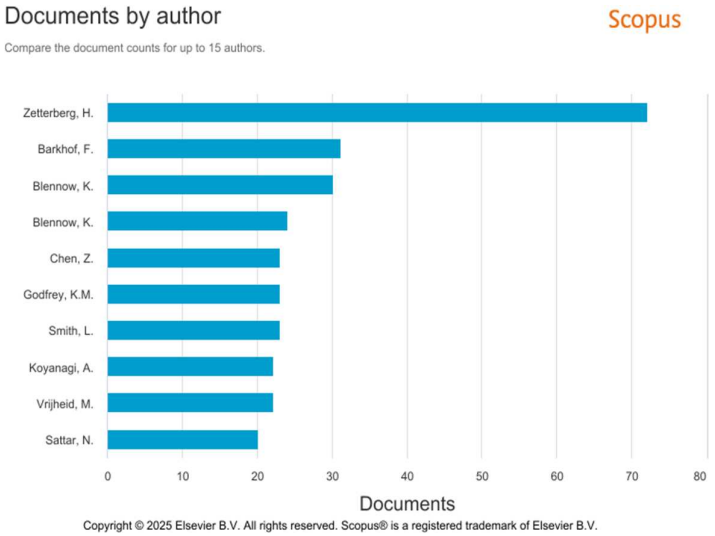

Figure 4. Scopus Visualization: Analyze-Author

Based on the visualization of the number of documents published by the author, Zetterberg, H. ranks first, with nearly 70 publications. Followed by Barkhof, F., and Blennow, K., with about 50 and 45 documents, respectively. Other authors, such as Chen, Z., Godfrey, K.M., and Smith, L. point to an almost equal number of publications, about 30 documents. Meanwhile, authors such as Koyanagi, A., Vrijheid, M., and Sattar, N. have contributed approximately 20-25 publications. This graph provides an overview of individual contributions to scientific publications, with Zetterberg, H. having a significant influence compared to other authors [16], [17].

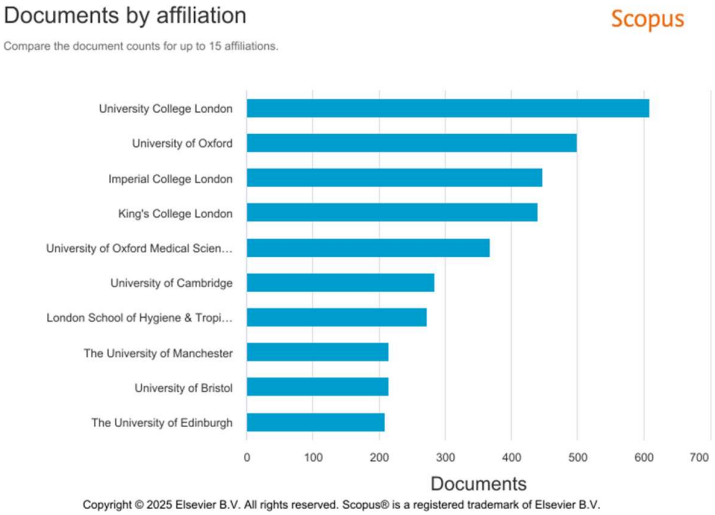

Figure 5. Scopus Visualization: Analyze-Affiliation

Based on a visualization of the number of documents published by affiliation, University College London (UCL) has the highest number of publications, with over 600, followed by the University of

Oxford with over 500. Imperial College London and King's College London are third and fourth, with about 400 documents each. Other affiliates, such as the University of Oxford Medical Sciences Division and the University of Cambridge, show significant contributions, with the number of documents approaching 300. Meanwhile, institutions such as the London School of Hygiene & Tropical Medicine, the University of Manchester, the University of Bristol, and the University of Edinburgh have contributed between 200 and 300 documents. This graph indicates the dominance of major UK universities in academic publications, with the primary focus on institutions with high research reputations [18], [19].

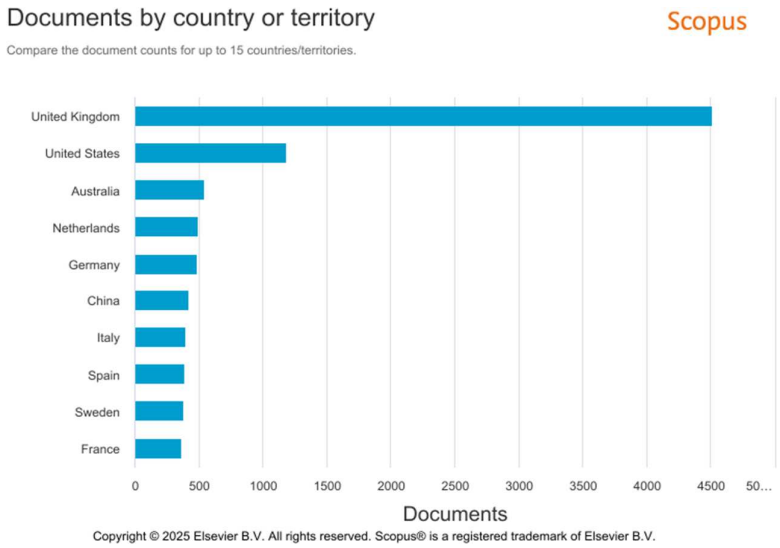

Figure 6. Scopus Visualization: Analyze-Country

This visual result shows the number of documents produced by different countries or regions, with an emphasis on comparing the number of documents that have been recorded. The graph shows that the United Kingdom has the highest number of documents, far surpassing the United States, which ranks second. Countries such as Australia, the Netherlands, and Germany exhibit substantial paperwork, although they remain well below the top two. Meanwhile, China, Italy, Spain, Sweden, and France exhibited lower document volumes, indicating variation in academic publication levels across these countries [20], [21].

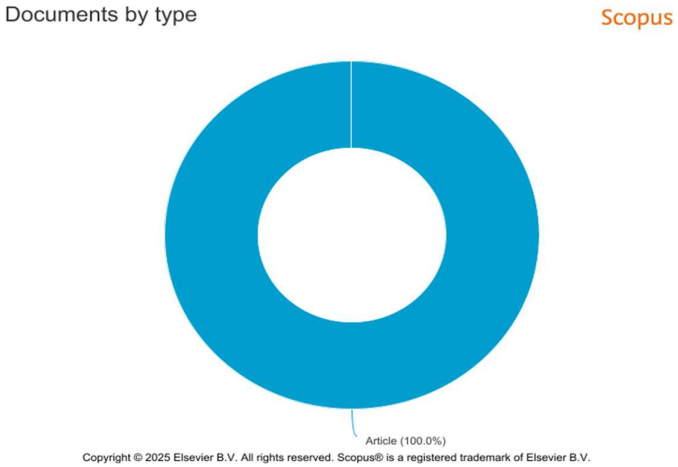

Figure 7. Scopus Visualization: Analyze-Doctype

These visual results indicate that 100% of the recorded documents are of the article type. The diagram clearly shows that articles are the primary publication type in the analyzed database. This indicates that research in this context is typically published as articles, reflecting a strong trend in academic

publishing. In the absence of other listed document types, it is essential to understand how this focus can affect the accessibility and dissemination of information within the scientific community [22], [23].

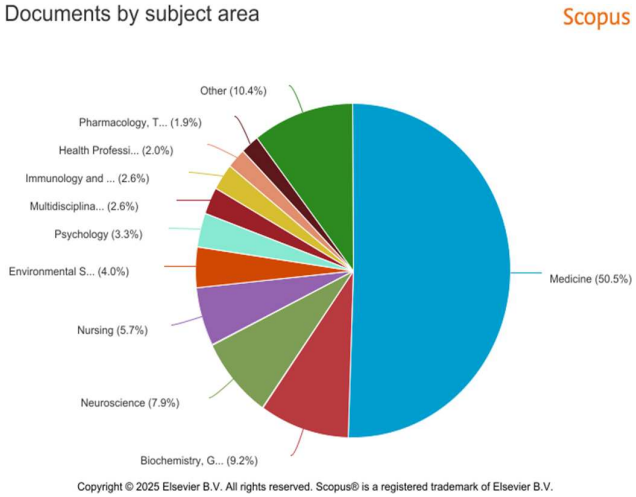

Figure 8. Scopus Visualization: Analyze-Subject

These visual results show the distribution of documents by subject area, with the Medicine category accounting for 50.5%. This field extends beyond other categories, making it a significant focus of the published analysis. After that, Biochemistry recorded 9.2%, followed by Neuroscience (7.9%) and Nursing (5.7%). Other categories, such as Environmental Science (4.0%) and Psychology (3.3%) showed smaller contributions. With Others accounting for 10.4% of the total documents, these results reflect a strong trend in medical research compared to other fields of science [24], [25].

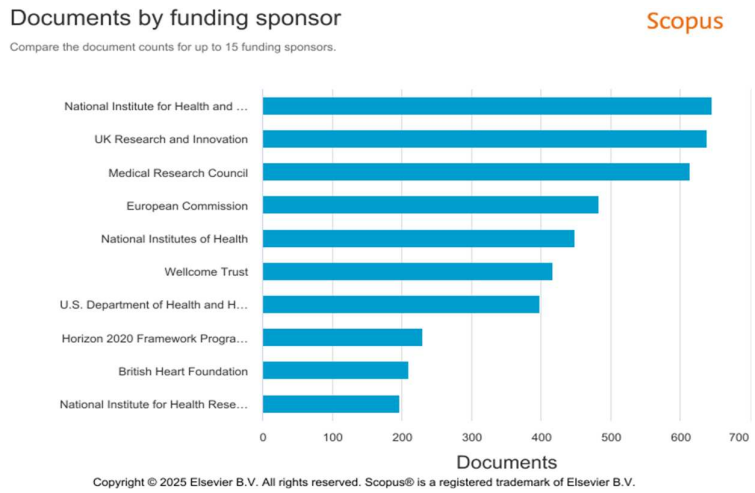

Figure 9. Scopus Visualization: Analyze-Funding Sponsor

These visual results show the number of documents supported by various funding sponsors, with the National Institute for Health and Care Research (NIHR) leading the list, with nearly 600 documents. Behind it, the UK Research and Innovation and the Medical Research Council also show significant contributions, each with more than 400 documents. Other sponsors, such as the European Commission and the National Institutes of Health, also make significant contributions, but they remain well below the top three sponsors. Given the total number of documents recorded for each sponsor, this graph reflects the critical role of various funding agencies in supporting research and publications in the health and related sciences [26], [27].

The following study is based on the Output Visualization from VOSviewer, which provides an in-depth bibliometric analysis of research trends related to linear regression. Using VOSviewer, this study examines key aspects, including co-authorship networks, citation relationships, keyword co-occurrence, and bibliographic coupling. These visualizations help identify influential authors, major institutions, and dominant research themes within the field. The analysis also highlights collaborative patterns and knowledge dissemination across different academic and industrial sectors. By interpreting these findings, this study aims to identify emerging trends, research gaps, and potential areas for future exploration in the application and development of linear regression methodologies

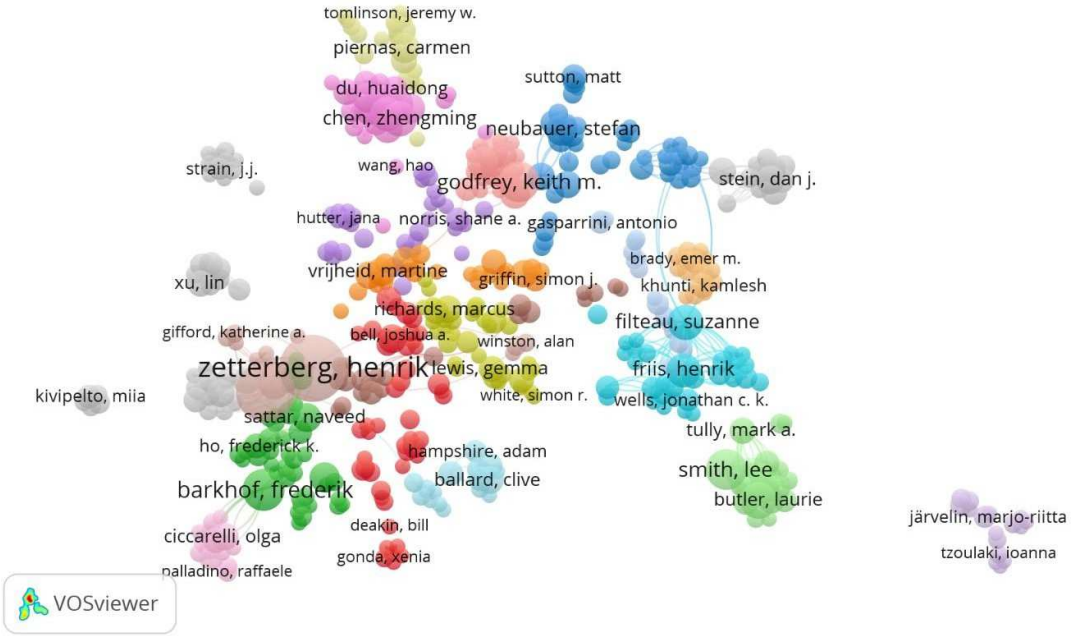

Figure 10. VOSviewer Visualization: Co-Authorship by Author

The visualization produced by VOSviewer shows a map of the author's collaboration network in a particular research field. Each dot (node) represents an author, and the size of the node reflects the number of publications. The varying colors indicate distinct collaboration clusters, suggesting the presence of groups of authors who often collaborate on research. For example, the red cluster appears to reflect a focus on health research, with authors such as Henrik Zetterberg and Frederiek Barkhof showing close collaboration. The connecting lines between nodes indicate interactions and collaborations among authors, illustrating the network of knowledge and research trends within the field. This visualization facilitates the identification of research leaders and significant patterns of author collaboration [28], [29].

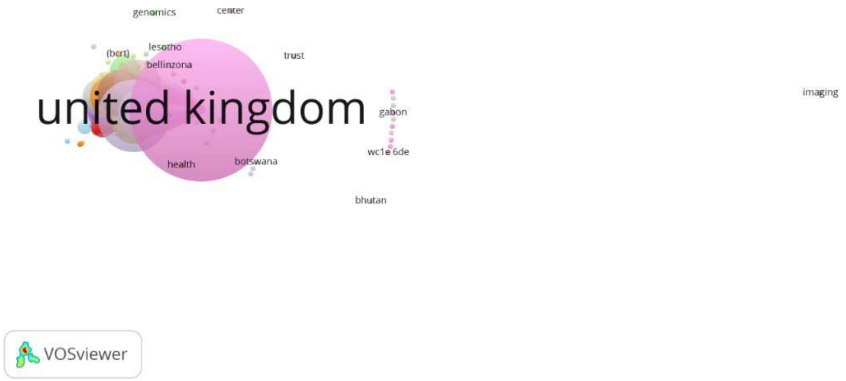

Figure 11. VOSviewer Visualization: Co-Authorship by Countries

The results of this visualization present a keyword network map indicating a central theme in health and genomics research, with "United Kingdom" as the primary focal point, reflecting significant influence and contributions in this field. The large size of the node for the "United Kingdom" indicates its high frequency in the literature, reflecting its central role in international health research. Around these nodes, other keywords, such as "health," "genomics," and "trust," indicate linkages to various research and collaboration topics. The distinct color clusters represent related research areas, such as global health and the development of genomic technologies, and indicate collaboration with other countries, including Botswana, Gabon, and Bhutan, which signifies cross-border knowledge exchange and study of health issues. This visualization provides clear insight into the network of collaborations and research themes developing in the international arena [30], [31].

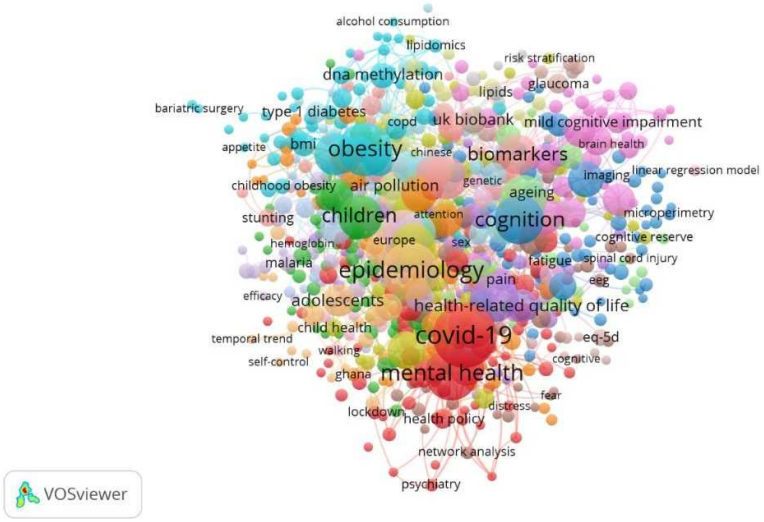

Figure 12. VOSviewer Visualization: Co Occurrence by Author Keywords

This image depicts a keyword network map generated with VOSviewer, which analyzes relationships among terms in scientific datasets, such as journal publications or research articles. Each point or node in this map represents a keyword, and the connecting line indicates the linkage or frequency of co-occurrence in the study. The size of each node reflects the frequency of the word in the dataset; larger nodes, such as "covid-19," "mental health," "epidemiology," "obesity," "cognition," and "biomarkers," indicate the dominance of the term in the analyzed study. Different colors indicate groups or clusters of topics that are closely related, such as the red group that seems to focus on mental health, health policy, and the pandemic, the green group that deals with children, adolescents, and social factors, the blue group that includes cognitive aspects and biomarkers, and the yellow group that deals with the environment and other health factors, such as air pollution and risk stratification. These visualizations are particularly useful for understanding emerging research trends, helping researchers identify linkages among topics, and for further exploring relevant or underexplored research areas [32], [33].

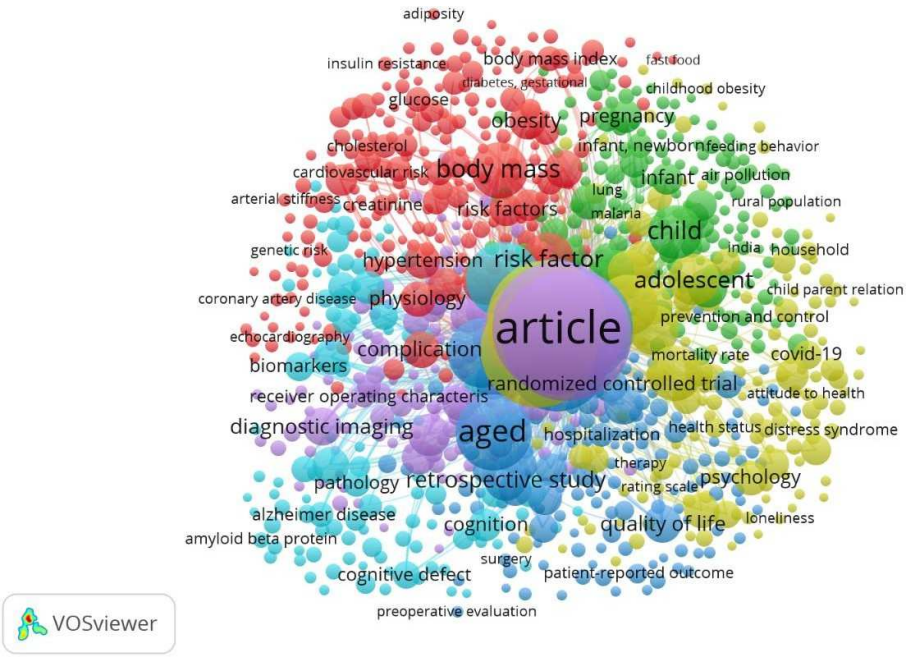

Figure 13. VOSviewer Visualization: Co Occurrence by Index Keywords

This image is a keyword network map generated using VOSviewer software, which is commonly used in bibliometric analysis to identify relationships between terms in research datasets. In this visualization, each dot or node represents a keyword that appears in a scientific publication, while a connecting line indicates the degree of interconnectedness based on the frequency of occurrence together. The size of the node reflects how often the term appears, with key keywords such as "article," "body mass," "adolescent," "aged," "quality of life," and "diagnostic imaging" having larger sizes, signaling dominance in the analyzed study. Different colors indicate clusters or groups of closely related topics, such as red clusters that appear to focus on health risk factors, obesity, blood pressure, and body mass index; green clusters related to children, adolescents, and environmental factors; blue clusters associated with diagnostic imaging, pathology, and neurodegenerative diseases; and yellow clusters that include aspects of psychology, quality of life, and social impact, including the COVID-19 pandemic. These visualizations help in understanding emerging research patterns, identifying key trends in healthcare, and exploring interconnections between topics in the scientific literature [34], [35].

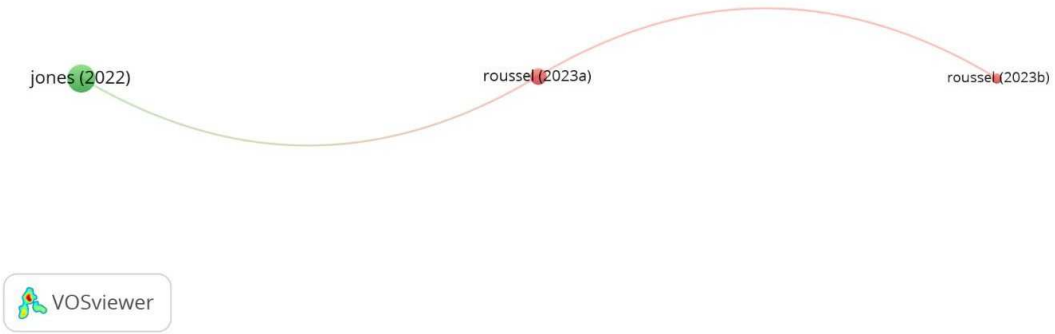

Figure 14. VOSviewer Visualization: Citation by Document

The result of this visualization displays a network of citations between three relevant publications, where "Jones (2022)" is connected to two other works by "Roussel (2023a)" and "Roussel (2023b)". The larger nodes on the "Jones" publication suggest that the work may have had more influence in

its field, while Roussel's two publications have citation proximity that shows a significant linkage in the same topic. The lines connecting these nodes reflect the interactions and streams of knowledge between research, describing how one publication can influence and collaborate with other works in the development of science. This visualization provides a clear insight into the literature network and how authors contribute to each other in building a deeper understanding of the research theme being discussed [36], [37].

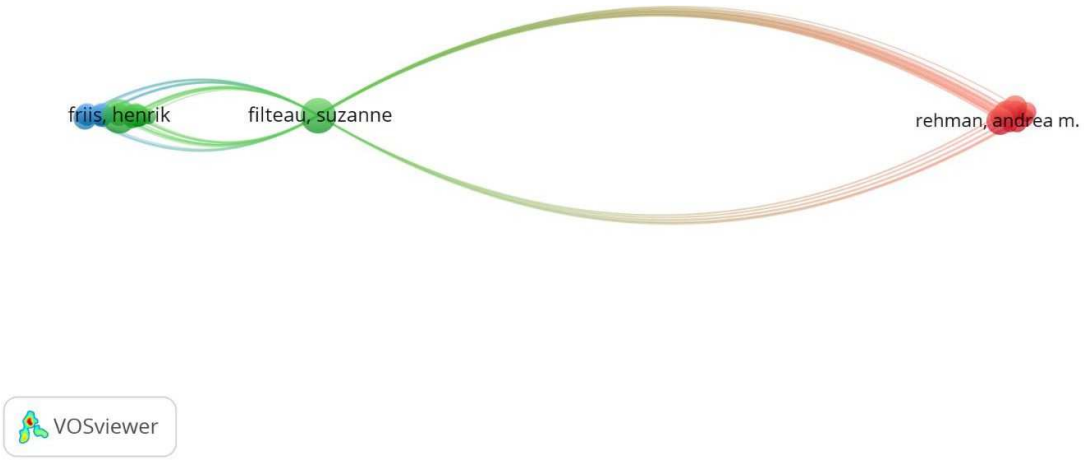

Figure 15. VOSviewer Visualization: Citation by Author

The results of this visualization show a network of collaboration between three authors: Henrik Friis, Suzanne Filteau, and Andrea M. Rehman. The larger nodes in the authors' names reflect the level of contribution and impact of their research in the field being studied, while the lines connecting them indicate the existence of interactions and collaborations between the works they produce. The color and thickness of the lines indicate the intensity of the collaboration, with a stronger relationship seen between Friis and Filteau, as well as Rehman having a great influence in the context of this network. This visualization provides insight into how researchers are interconnected and share knowledge in the development of science in related fields [38], [39].

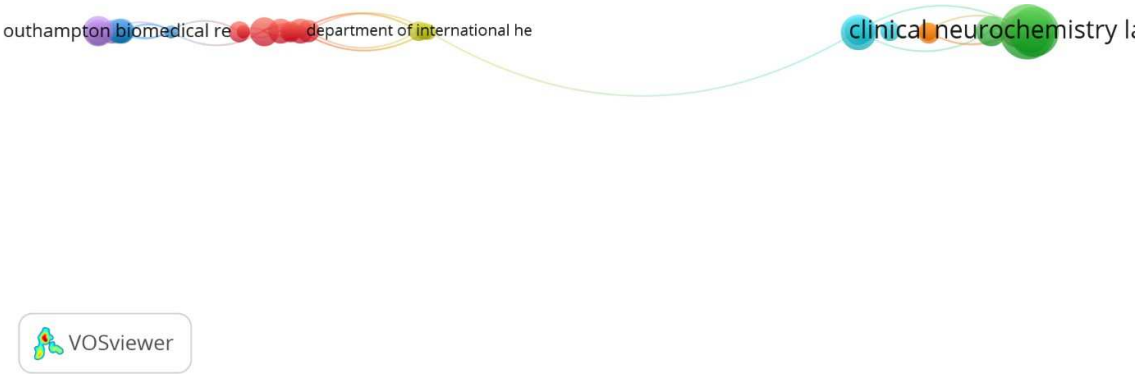

Figure 16. VOSviewer Visualization: Citation by Organizations

The results of this visualization showcase a network of relationships between various institutions and concepts focusing on the fields of biomedical research and clinical neurochemistry. The connected nodes, such as "Southampton Biomedical Research" and "Clinical Neurochemistry," show the linkages between research conducted in the health and biomedical fields, with the lines connecting them reflecting the flow of information and collaboration between institutions. The varying node sizes indicate the level of influence and contribution of each institution within the scope of the study.

This visualization provides a clear picture of how various institutions interact and collaborate in order to advance science in the field of clinical and health [35], [36].

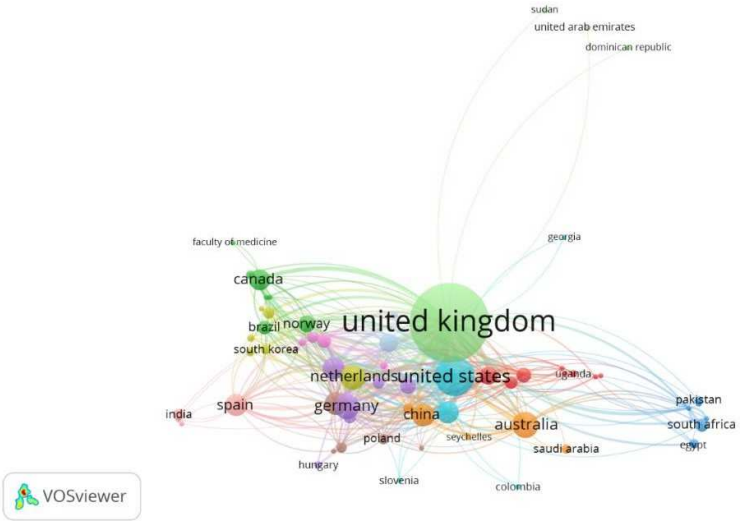

Figure 17. VOSviewer Visualization: Citation by Countries

The results of this visualization show an international collaborative network in research centered in the United Kingdom, which serves as the main node in the network. Other countries such as Australia, Canada, and Germany appear to have strong connections, reflecting active relationships in cross- country research. The lines connecting these nodes indicate a significant flow of scientific collaborations and publications, with different colors indicating different disciplines or research themes. This visualization illustrates how global research interacts with each other, as well as the important role played by various countries in shaping the international research landscape [37], [38].

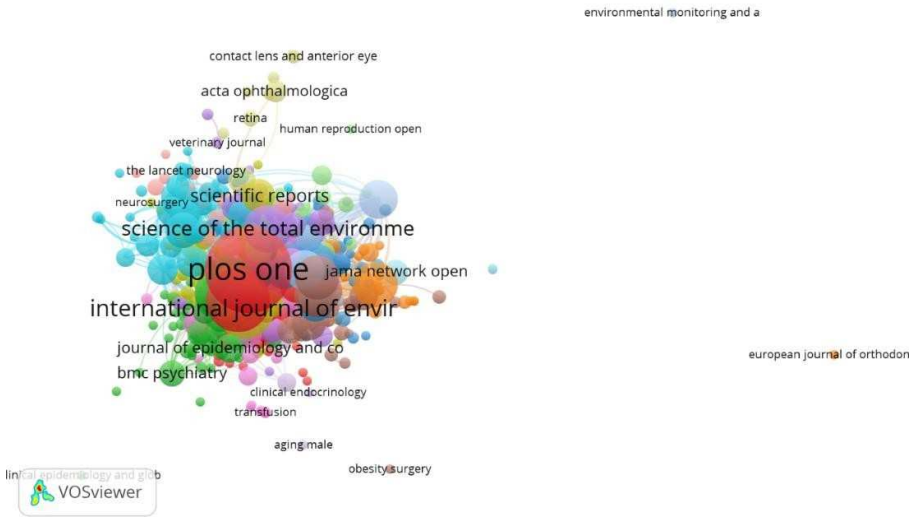

Figure 18. VOSviewer Visualization: Bilbliographoc Coupling by Sources

This visualization is a bibliometric map that shows citation relationships between sources or journals using VOSviewer. Each node (circle) represents a journal, with a size that reflects the number of citations or associations in the network. The journals "PLOS ONE" and "International Journal of Environment" appear to be the largest nodes, indicating that they both have a high number of citations and a central role in scientific networks. Different colors indicate clusters of journals that have similar

topics or thematic relationships, for example in the fields of epidemiology, environment, medicine, or other health sciences. The connecting lines between journals show a relationship of citations, where journals that are more cited together tend to form a tighter group. In addition, there are some more isolated journals, such as the "European Journal of Orthodontics" and "Environmental Monitoring and A," which show more limited citations than the main clusters. This visualization helps in understanding citation patterns between journals and identifying influential sources in a research field [44], [45].

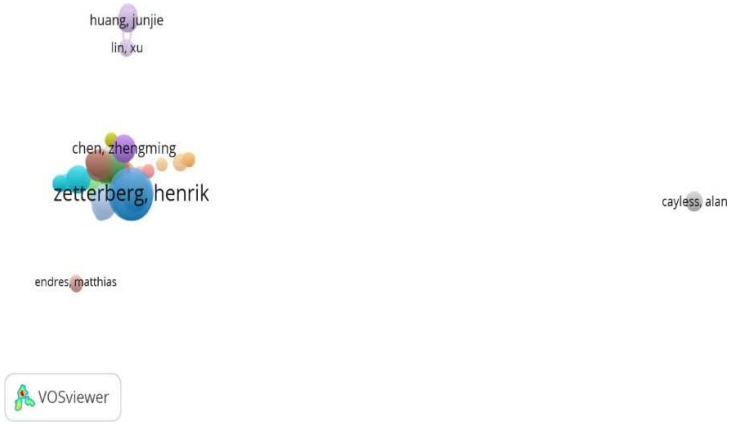

Figure 19. VOSviewer Visualization: Bilbliographoc Coupling by Authors

This visualization shows a bibliometric map of citation relationships between authors based on data analyzed using VOSviewer. In this graph, the authors' names are represented as nodes (circles), with a size that reflects the number of citations received by each author. "Zetterberg, Henrik" appears to be the author with the highest number of citations and has many connections with other writers, such as "Chen, Zhengming". This indicates that Zetterberg's work has a great influence in this academic network. On the other hand, there are authors such as "Cayless, Alan" and "Huang, Junjie" who are more isolated, suggesting that they have more limited citation relationships compared to the main clusters. This map helps in understanding citation relationships between authors, identifying academic collaborations, as well as uncovering who has a major influence in a particular research field [45], [46].

Figure 20. VOSviewer Visualization: Bibliographic Coupling by Organizations

The visual results show a network diagram depicting the relationship between several departments in the health and clinical sciences. The most prominent central point is "clinical neurochemistry of the laboratory," which indicates a central role in research and collaboration. Around this point, there are other departments such as the "department of global health" and the "department of pediatrics',"

which show a multi-disciplinary linkage. The size and color of the dots reflect the level of engagement or relevance of each department in this network, which can provide deeper insights into interdepartmental collaboration in time research [47], [48].

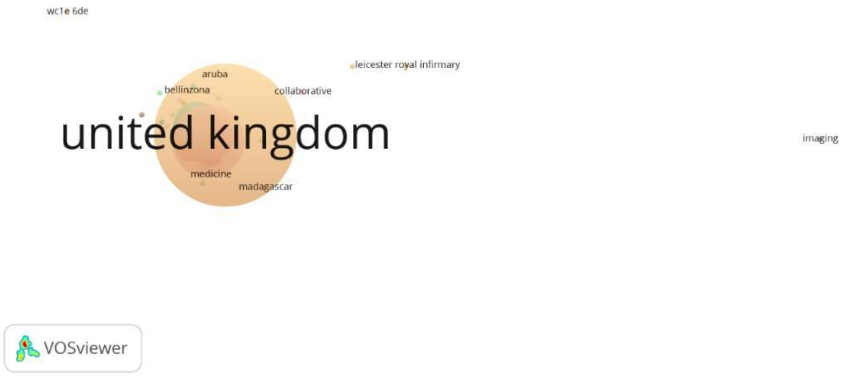

Figure 21. VOSviewer Visualization: Bibliographic Coupling by Countries

The results of this visual show a network map that connects various concepts and institutions related to health research, with the focus on the "United Kingdom" as the center. The largest point signifies the significance or wide scope of research in this context. Around the United Kingdom, there are terms such as "Leicester Royal Infirmary," "collaborative," "medicine," and "imagining," suggesting that the research involves collaboration between institutions and disciplines. Some other terms such as "aruba" and "Madagascar" indicate the existence of cross-country connections, which can indicate global research efforts as well as the exchange of medical information and data. This graph provides an overview of the power of collaborative networks in the field of health sciences [49], [50].

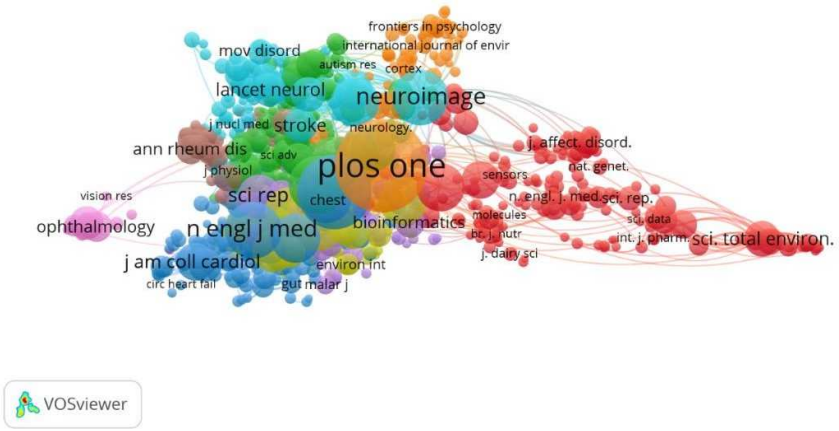

Figure 22. VOSviewer Visualization: co-citation by Cited Sources

This visualization shows a network of co-citations from cited sources, generated using VOSviewer. PLOS One is the most prominent (large-sized) journal, indicating that it has many citations along with other sources. Some color clusters indicate different research areas, such as “neuroimage” for neuroscience (yellow green), “n engl j med” for medicine (blue), and “sci total environ” for environmental science (red). The relationship between nodes (lines) indicates how often two journals are cited together; strong connections within the same field are observed [51], [52].

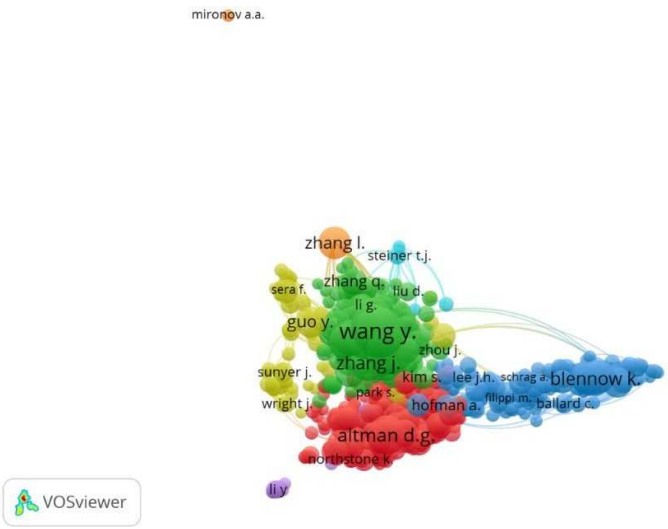

Figure 23. VOSviewer Visualization: Co - Citation by Authors

This visualization shows a co-citation analysis by author, which illustrates the relationship of shared citations between various researchers. The nodes (circles) represent the authors, while the lines connecting them indicate how often they are cited together in the scientific literature. The size of the node indicates the number of citations received, while the color of the cluster indicates the group of researchers working in an interrelated field of research. It can be seen that "Wang Y." and "Blenno K." have a strong association with many other authors, indicating that they are often cited in the context of the same research. Meanwhile, "Mironov A.A." appears to be isolated, suggesting that this researcher has a different or specific citation pattern than others [53], [54].

4. Conclusion

This bibliometric study provides a comprehensive overview of the research landscape on linear regression, focusing on publications affiliated with UK institutions from 2022 to 2025. The findings indicate that publication trends have remained relatively stable from 2022 to 2024, with a sharp decline in 2025, possibly due to changes in publication policies or indexing delays. The dominance of PLOS ONE, BMJ Open, and other high-impact journals underscores the interdisciplinary nature of linear regression applications, with significant contributions from medical, environmental, and social sciences. Collaboration patterns reveal key authors such as Zetterberg H. and Barkhof F. leading the field, supported by strong institutional backing from UCL and the University of Oxford. Moreover, funding sources like NIHR and UK Research and Innovation play a critical role in shaping research trajectories. At the same time, linear regression remains a fundamental statistical method; open challenges persist, particularly in adapting it to complex and high-dimensional datasets. The integration of machine learning approaches, the handling of non-linearity in data, and the development of real-time adaptive regression models are areas requiring further exploration. Additionally, the bibliometric analysis suggests a potential shift in research focus, urging future studies to investigate the evolving role of linear regression in modern data science and its intersection with advanced computational methods. Addressing these challenges could lead to more robust and scalable regression techniques, expanding their applicability in emerging fields such as artificial intelligence, bioinformatics, and financial analytics.

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