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Bibliometric Analysis of Spatial Stunting Using VOSviewer

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Abstract: Stunting, or stunted growth, is a serious global public health problem. The aim of this research is to investigate the dynamics of co-occurrence, trends and saturation of keywords in spatial studies related to stunting using the literature review method. This research uses bibliometric analysis with the help of Web Lens.org, Openrefine, and VOSviewer for data collection and analysis. VOSviewer can display bibliometric mapping in three different visualizations, including network visualization, overlay visualization, and density visualization. The findings of this research reveal seven topic clusters related to the subject of this research, with network visualization results showing that research with the keywords 'spatial' and 'stunting' is still relatively limited. The overlay visualization results show that this research trend only emerged at the beginning of 2020 and has not yet reached saturation point. In conclusion, there is still a lot of room for further research in this area, making spatial stunting an interesting and potentially useful area for further exploration.

Keywords: Bibliometrics; Spatial; Stunting.

Introduction

Stunting, also known as growth retardation, is a severe global public health issue. It occurs when children experience impaired physical growth due to chronic malnutrition, primarily during the first 1,000 days of their lives, from pregnancy to the age of two. Stunting has long-term and profound consequences on the health, development, and productivity of children and the community (Renyoet, 2023). According to the World Health Organization (WHO), stunting affects more than 149 million children worldwide. Developing countries, especially in Africa and Asia, bear a higher burden of stunting (Kurniawati & Ardiansyah, 2022). With a focus on the second goal of the Sustainable Development Goals (SDGs), the World Health Organization (WHO) is committed to eradicating all forms of malnutrition by 2030, including achieving international targets set for 2025 to reduce the prevalence of stunting and wasting in young children (Yulianti, 2022; Franch-Pardo, 2020).

The spatial context adds a layer of complexity to the issue of stunting. Stunting tends to exhibit non-uniform distribution across various geographical regions, with specific areas being more vulnerable to stunting than others (Putra & Suariyani, 2021). Many factors, including environmental conditions, socioeconomic disparities, access to healthcare, and cultural practices, can influence this spatial variability (Wolff et al, 2017). As such, understanding the spatial dimension of stunting is critical for developing targeted interventions and policies.

Spatial analysis is a data collection method that plays a crucial role in environmental management and is an integral part of geographic disease management (France-pardo et al, 2020). It involves the examination and explanation of disease data in ways that consider geographical aspects, such as population distribution, environmental conditions, behaviors, social and economic factors, disease incidence, and the interactions between these variables. Each of these variables may act as a risk factors in the development of diseases (Kurniawati et al., 2020). In this context, stunting is not just a health concern but has significant spatial aspects. Stunting occurs unevenly across various geographical regions, with some areas being more vulnerable to stunting than others, influenced by various factors (Hailu et al, 2020). Remote sensing technology and

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Geographic Information Systems (GIS) are often employed to identify areas vulnerable to the disease. GIS is a system capable of processing, improving, updating, and rapidly analyzing data, especially spatial data (Khatimah, 2020). In the era of information technology, Geographic Information System (GIS) technology plays a vital role in spatial stunting analysis. GIS enables the efficient processing of spatial data and information visualization, facilitating better decision-making efforts to reduce stunting in various regions (Akpan et al, 2022; Aribowo, 2019). Therefore, spatial analysis of stunting with the aid of GIS is a highly relevant and vital approach to improving the well-being of children worldwide (Sendi, 2023).

Currently, there is a need for a more structured evaluation or assessment to support future research planning. Efforts to undertake further research can be carried out by applying bibliometric analysis to enhance a more structured research plan (Indratmoko et al, 2023). Bibliometrics is a literature study that evaluates research trends using indexed databases (Utami & Karlina, 2022). Its goal is to understand the development of science and describe the progress in a specific field of knowledge in more detail (De-Oliveira et al, 2019; Vatananan et al, 2019). This involves analyzing the publication timeframe and the number of cited articles, as well as visualizing existing maps and graphs in published articles (Afandi et al., 2022; Belussi, 2019).

This research plays a crucial role in supporting the understanding of spatial stunting. Through bibliometric analysis using VOSviewer, it aids in identifying relevant and significant research focuses related to the issue (Masykuri & Prayitno, 2023). Through collaboration mapping in research, the patterns of cooperation among researchers, institutions, and countries become evident, facilitating cross-border collaboration and knowledge exchange (Guo et al, 2019; Skute et al, 2019; Ferreira et al, 2022). Additionally, the research contributes to measuring the impact on scientific literature, providing insights into the development of knowledge about spatial stunting. The results of bibliometric analysis can guide the formulation of future research agendas by highlighting knowledge gaps, assisting researchers in directing their efforts effectively (Ren et al, 2020; Liu et al., 2021; He et al., 2023).

Thus, research utilizing bibliometric analysis will visualize and map scientific articles related to spatial stunting, which can be discerned by observing the trends in published studies and the co-occurrence of keywords used by authors. The findings of this bibliometric analysis have the potential to provide valuable insights for researchers, policymakers, and healthcare organizations in their efforts to reduce the prevalence of stunting in children across various countries. By understanding the progress in research and trends related to the spatial aspects of stunting, we can identify weaknesses in existing literature and refer to further research in areas that require additional attention. Additionally, this analysis can facilitate the formation of more robust networks among researchers and organizations involved in stunting studies in various regions, enabling the exchange of knowledge and best practices in a collective effort to address this issue globally.

Method

This research was conducted using bibliometric analysis of literature that examined studies related to spatial stunting, employing VOSviewer. According to Liang & Liu, as cited in Kusumawati (2023), bibliometric analysis is an analytical approach to analyzing academic studies widely used in Library Information Science. The VOSViewer application is software that can generate visualizations and explore knowledge maps in bibliometric studies (Muhammad et al., 2022). explanation of the bibliometric analysis method can be seen in Figure 1.

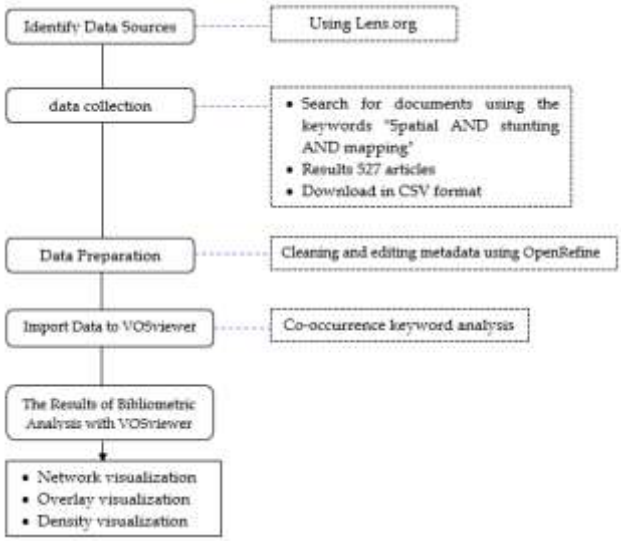

Figure 1. Research Methods

Result and Discussion

Publication by Year

Fluctuations have characterized the development of publications on spatial stunting in the last 20 years. This can be observed in Figure 2. The publication trend graph depicts a condition that is variable or fluctuating over time in response to the shifting research interests and focus on spatial stunting. Analyzing fluctuations in "Publication by Year" refers to the theory of the dynamics of science, which asserts that scientific trends

can vary in response to changes in social, economic, or policy environments. Increases and decreases in publications can be linked to these dynamics (Wamba et al, 2023).

In 2020, the graph saw a sharp decline, which is a consequence of the global preoccupation with COVID-19. When the issues related to COVID-19 were addressed, the research focus on spatial stunting regained momentum. This increase is a proactive response to mitigate the potential decline in the quality of human resources in the future, as the toddlers of today are the future productive members of society.

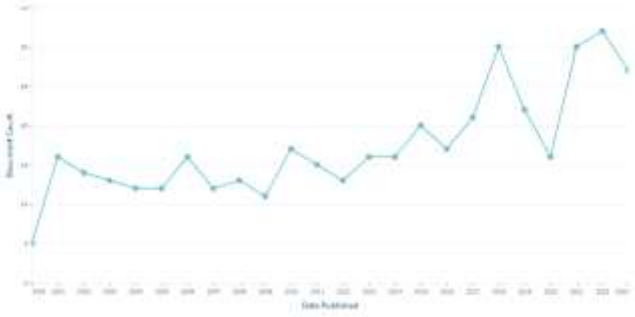

Figure 2. Annual publications by year range from the Lens.org database

Document by Affiliation

Organizing and analyzing documents through the lens of 'Document by Affiliation' is a method or classification that commonly involves research publications. In this scenario, 'affiliation' typically denotes the institutional or organizational connections of the authors contributing to the documents. The process involves grouping or classifying documents based on the affiliations of the authors, enabling the examination of trends, collaborations, and contributions linked to specific institutions or organizations in a particular field of study. This method offers valuable insights into the research environment and the interconnections among various entities within the academic or scientific community (Aria & Cuccurullo, 2017; Ertz & Leblanc-proulx, 2018).

The top 10 affiliations with the most publications in spatial stunting-related research can be observed. The affiliation occupying the first position with the most publications in this research is the Chinese Academy of Science, with 12 published articles. It is followed by the Agricultural Research Service, which has published 9 related articles. Other affiliations, such as Cornell University, Harvard University, and the Hebrew University of Jerusalem, each published 6 articles. Occupying the 6th to 10th positions in the top 10 affiliations with the most scientific publications related to spatial stunting are the Centre National De La Recherche Scientifique, Columbia University, Commonwealth Scientific and Industrial Research Organisation, Indian Institute of Remote Sensing, and Ohio State University, each with 5 published articles.

As seen in Figure 3, the increasing intensity of red indicates a higher number of articles published by a particular affiliation and vice versa. Research on spatial stunting is crucial as stunting represents a chronic nutritional issue that impacts the growth and development of children. Stunting can lead to long-term consequences on health, education, and future productivity worldwide.

Figure 3. Top 10 affiliates related to the topic

Document by author

Documents by Author refers to the method or category of organizing and analyzing documents, especially in research publications, with a focus on the authors. In this context, the emphasis is on individual authors and their contributions to the document. By grouping or categorizing documents based on their authors, an analysis of trends, collaborations, and the overall impact of specific researchers in a particular field of study can be conducted. This approach provides insights into individual contributions and relationships among different authors within the academic or scientific community (Bellusi et al, 2019; Mokhtari er al, 2020; Donthu et al, 2021).

Spatial bibliometric studies on stunting are essential tools for assessing research contributions and advancing further understanding and addressing the serious issue of stunting on a global, regional, and local level. In the context of spatial bibliometrics on stunting, the authors' contributions refer to the quantity and types of documents they have produced. This includes journal articles, books, conference papers, and more. These contributions reflect the level of authors' involvement in stunting research. Citations measure the influence of research and the authors' contributions to the scholarly literature. The number of citations indicates the extent to which the authors' research has been noticed, reviewed, and used by other researchers in the field. This can be seen in Table 1

Here is a brief overview of the authors and their contributions regarding the number of documents and citations in the scholarly literature. Amit Kumar has produced four documents and has been cited 37 times in scholarly literature. Other authors such as Damaris K Kinyoki, Aaron Osgood-Zimmerman, Partha Sarathi Roy, Lydia Leonardo, and Ricardo J Soares Magalhães have each produced three documents related to spatial

stunting with varying citation counts. Their contributions reflect their roles in understanding the issue of stunting.

Through spatial bibliometric analysis, we can assess the extent to which research enriches our understanding of stunting, identify weaknesses in the literature, and guide future research. In spatial bibliometric studies on stunting, understanding the authors' contributions and citation analysis is crucial for assessing the impact of research, identifying researchers playing critical roles in the field and guiding further research. It can also assist in determining potential collaborations among these authors to enhance the understanding and effective management of stunting.

Table 1. Top 10 authors with the most publications related to the topic

Author	Documents	Citation
Amit Kumar	4	37
Damaris K Kinyoki	3	260
Aaron Osgood-Zimmerman	3	241
Partha Sarathi Roy	3	60
Lydia Leonardo	3	20
Ricardo J Soares Magalhães	3	20
Jaacov katan	3	0
Ali H Mokdad	2	194
Alfred Ngwira	2	14
Andrea L Araujo Navas	2	7

Co-occurrence of keywords

VOSviewer visualization generates three types of data maps: network visualization, overlay visualization, and density visualization. In network and overlay data maps, there are elements such as nodes and edges (Kirby, 2023). Nodes are depicted as circles and represent keywords that frequently appear in many articles within the database. Typically, these nodes are formed from articles and abstracts accessible through VOSViewer. On the other hand, edges depict the relationships between these nodes. The closer the distance between nodes connected by an edge, the stronger the connection between those keywords (Zhao et al, 2019; Meng et al, 2020). This means that these keywords are often used together in journal publications (Ariwibowo, 2019). Keywords are marked with circles of different colors (Wang et al, 2018). The size of these circles illustrates the level of the positive relationship between the keywords and their occurrence in titles and abstracts (Mulyawati & Ramadhan, 2021). In other words, the more often the keywords appear in titles and abstracts, the larger the circle size and the font used to display these keywords (Alifariki, 2022). Besides examining the size of the appearing keywords, in network visualization, the relationships or connections between commonly known research topics, referred to as links, can be observed. Links themselves have a strength represented as a value. The higher significant the value, the stronger or higher the level of their connection (Shah et al, 2020; Guleria & Kaur, 2021). However, in its visualization, VOSviewer does not indicate the extent of the strength of the relationships but only shows the thickness of the lines and the number of connections between research topics (Rahman et al., 2023).

In this study, a search was conducted using the keywords 'Spatial AND Stunting AND Mapping' accessed in September 2023 through Lens, resulting in 527 documents. After analysis, the journal articles produced were divided into 7 clusters: red, dark blue, green, purple, yellow, light blue, and orange, indicating relationships between research topics, as illustrated in Figure 4.

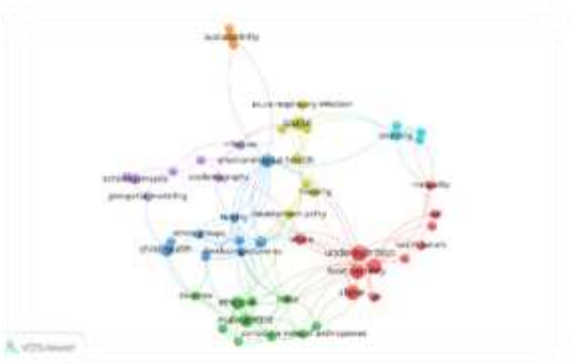

Figure 4. Network Visualization on the Keyword Spatial Stunting

Cluster 1 is highlighted in red and consists of 9 keywords (undernutrition, food security, China, Africa, health beliefs, CIAF, inequality, and fish). Therefore, the relationship among the keywords in Cluster 1 revolves around issues related to food, nutrition, food security, and public health globally, specifically focusing on China and Africa as exemplary regions with significant impacts in this context. Cultural beliefs and inequality also play essential roles in comprehending and addressing these issues, while programs like CIAF aim to enhance food security worldwide. Cluster 2, marked in green, encompasses 5 keywords (malnutrition, Ethiopia, policy, diarrhea, and the composite index of anthropometry). These keywords are primarily found in research discussing all closely interrelated elements within the context of malnutrition in Ethiopia and the efforts undertaken to combat it.

Cluster 3, in dark blue, comprises 5 keywords (environmental health, child health, developing countries, ethnic groups, and fertility). The relationship between these keywords describes environmental health, child health, developing countries, ethnic

groups, and fertility, all interconnected in the context of environmental impacts on human health, especially in children, across various cultural and geographical settings. Cluster 4 in yellow features 4 keywords (spatial, acute respiratory infection, development policy, and mapping). The keyword relationships in Cluster 4 focus on understanding the spatial dimension as a critical factor in formulating effective development policies for disease control. Cluster 5, colored purple, comprises 4 keywords (schistosomiasis, infection, geospatial modeling, and biodemography). These keywords represent research on geospatial modeling and biodemography knowledge in disease infections. Cluster 6, in light blue, contains the keyword 'stunting,' and Cluster 7, in orange, contains the keyword 'sustainability.' As depicted in Figure 4, Cluster 1 is the largest, meaning it is the most extensively researched topic and thus more interconnected with other research topics in different clusters. In contrast, Cluster 7 is the smallest, indicating the slightest association with other topics and, therefore, the least researched.

In the network visualization analysis, some keywords belong to the top ten primary keywords based on the number of occurrences (occurrences) and the total strength of the relationships between keywords (total link strength). Occurrences indicate how many articles appear when these keywords are used, making them central information topics and discussion material in related journals (Zubaidah & Ninglasari, 2020). This information is presented in Table 2. The keyword 'undernutrition' or malnutrition has the highest number of co-occurrences (6) and the highest total link strength (10). In this research, the keyword 'spatial' ranks eighth in co-occurrences (4) and has a total link strength of 1. The keyword 'stunting' is outside the top ten. Based on the analysis in Figure 4 and Table 2, it is evident that research on the keywords 'spatial' and 'stunting' is still relatively scarce.

Table 2. Top 10 Research Keywords

Keyword	Occurrences	Total Link Strength
undernutrition	6	10
food security	5	10
China	5	5
India	5	5
environmental health	4	4
Ethiopia	4	3
malnutrition	4	2
spatial	4	1
Africa	3	4
geographic factors	3	4

Looking at the trend of research publication over the years related to this study, often referred to as novelty, in this analysis, novelty level refers to the year when the research was conducted and the period or period during which the spatial stunting-related research was conducted. This is evident from the color differentiation in each study. The darker the color in the overlay visualization, the older the study, and the brighter the color in the overlay visualization, which means the study is more recent (Komedi, 2022). The colors used are blue, green, and yellow. If the visualized color approaches yellow, it indicates that a new study has been conducted (McAllister et al, 2022; Ullah et al, 2023).

Based on Figure 5, it is evident that research related to spatial stunting has been conducted from 2000 to 2022. Research on spatial stunting began in early 2020. In the preceding years, the focus was on developing countries, and then it shifted to environmental health and subsequently to malnutrition, leading to the recent research on spatial stunting.

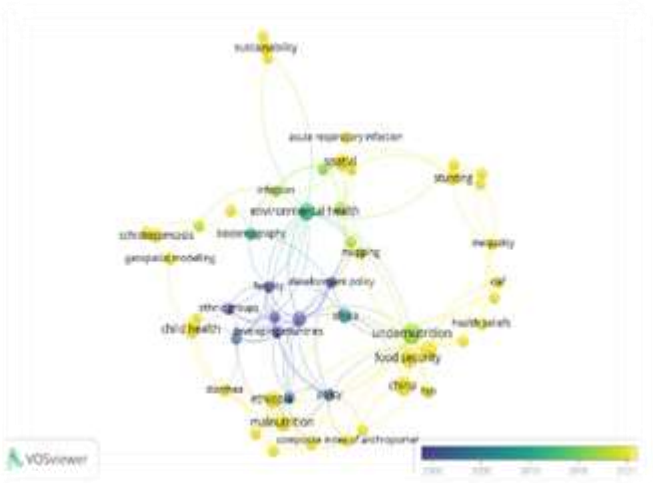

Figure 5. Overlay Visualization of the Keyword 'Spatial Stunting

Figure 5 illustrates the depth of research, indicating that the brighter the color, the more research has been conducted. In the density visualization mapping, the colors used are blue, green, and yellow. If the visualized color approaches yellow, it indicates that the topic appears more frequently (Netek et al, 2018; Schloss et al, 2018). The level of popularity is indicated by the frequent appearance of keywords and marked by the yellow-colored areas. Research with less yellow indicates topics that are less explored and have potential for further research (Yao et al, 2020; Alnajem et al, 2021). In Figure 6, it is evident that the keywords with the enormous loops and bright colors marked with solid yellow are 'undernutrition' and 'food security.' Research on spatial stunting still offers ample opportunities for further exploration, as these keywords are rarely used or researched.

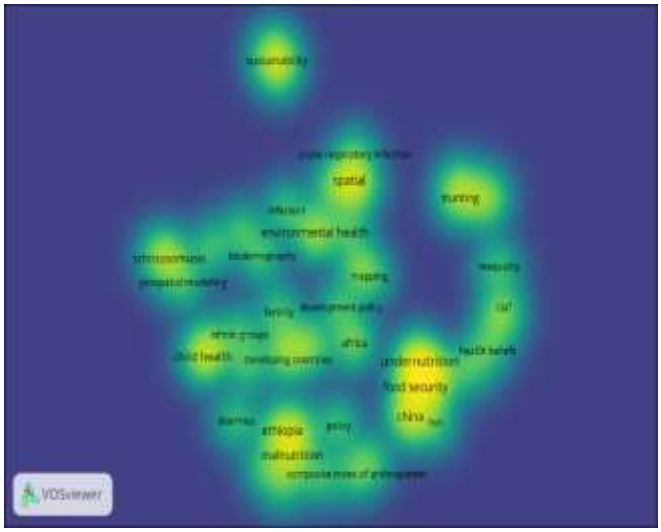

Figure 6. Density Visualization of Spatial Stunting Keywords

Conclusion

Based on bibliometric analysis using VOSviewer, it is evident that research on the keywords 'spatial' and 'stunting' is still limited in the literature. The publication time trend indicates that studies on spatial stunting only started emerging in early 2020. The relatively subdued color in the visualization suggests that this topic requires further exploration. This implies a significant potential for additional research in this domain, making spatial stunting an intriguing and potentially fruitful area for exploration.

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Author Contributions

Conseptualization, original draft preparation, results discussion, methodology, analysis, conclusions, M.M.F.; review and editing, I.U, N.S, E.Y,. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

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