FOOD SECURITY, MATERNAL KNOWLEDGE, AND CHILD NUTRITION: BIBLIOMETRIC INSIGHTS INTO GLOBAL AND REGIONAL RESEARCH TRENDS (2015–2025)

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ABSTRACT

This study aims to analyze the scientific development and global research trends regarding the interrelationship among food security, maternal knowledge, and child nutrition during the period 2015–2025. The background of this research is grounded in the persistent high prevalence of stunting and child malnutrition across various countries, making food security and maternal nutrition literacy critical focuses in sustainable development. This study employs a bibliometric approach, with data obtained using the Publish or Perish software based on Crossref, complemented by institutional repositories and official reports from WHO, FAO, and UNICEF. A total of 100 of the most relevant publications were analyzed using VOSviewer through co-occurrence mapping, network visualization, overlay visualization, and density visualization. The analysis revealed four main clusters: (1) child malnutrition and health determinants, (2) household food security and nutrition, (3) maternal knowledge and feeding practices, and (4) contextual and temporal factors. The findings indicate that child nutrition issues—particularly stunting—have become the focal point of global research closely associated with household food security and maternal knowledge. Publication trends increased during the COVID-19 pandemic, with a strong emphasis on the socioeconomic impacts on child nutrition. Nevertheless, existing studies remain dominated by observational research, with limited longitudinal analyses and geographical diversity. This study concludes that a more integrative and interdisciplinary approach is required to strengthen the scientific evidence supporting the development of sustainable nutrition and food security policies.

Keywords: Food Security, Maternal Knowledge, Child Nutrition, Bibliometric Analysis, Stunting.

INTRODUCTION

At the global scale, the effort to achieve food security and eradicate malnutrition remains far from complete. According to The State of Food Security and Nutrition in the World 2024 report, between

713 and 757 million people experienced hunger in 2023, and the world is still not on a consistent trajectory toward achieving Sustainable Development Goal (SDG) 2, which targets the elimination of hunger and all forms of malnutrition (FAO, 2024). The report also emphasizes that high food inflation has significantly weakened household purchasing power and hindered access to nutritious and high-quality diets (Tahreem et al., 2024).

In the context of low- and middle-income countries, economic pressures, limited market infrastructure, and the vulnerability of food systems exacerbate the burden on families in meeting the nutritional needs of household members, particularly children. In this regard, maternal nutrition knowledge plays a crucial role as a bridge between food availability (food security) and child feeding practices. Mothers with better nutrition literacy tend to select healthier foods, implement improved feeding frequency and quality, and respond more appropriately to their children's nutritional needs (Puspitasari et al., 2025). A study conducted in Iran demonstrated that maternal nutrition literacy was significantly associated with a reduced risk of childhood obesity in households experiencing food insecurity (Hashemzadeh et al., 2025). Meanwhile, research in Pakistan (Tahreem et al., 2024) found that maternal nutrition literacy was related to feeding practices, although its direct association with nutritional status indicators (such as stunting and wasting) was not always significant after controlling for confounding variables (Maerescu et al., 2025).

On the other hand, meta-analyses and systematic reviews reinforce that maternal education and knowledge have positive effects on child nutritional status. For instance, Prasetyo, Permatasari, and Susanti (2023), in their systematic review, found that maternal nutrition education influences child nutritional status through improvements in mothers' knowledge, attitudes, and skills ($p < 0.001$) (Prasetyo et al., 2023). Similarly, previous studies on maternal health literacy have also shown that women with higher health literacy are more capable of implementing appropriate child feeding practices (Johri et al., 2016).

Although the literature on food security, maternal nutrition literacy, and child nutrition has grown rapidly, studies that integrate these three domains within a single bibliometric analysis remain very limited. Many bibliometric studies have focused on only one domain—for example, bibliometric research on food security without directly linking it to child nutrition, or bibliometric analyses in the field of child nutrition without considering the role of maternal nutrition literacy. Consequently, a comprehensive cross-domain mapping that reveals thematic patterns, shared keyword vocabularies, and research collaboration networks between the domains of food and child nutrition is still lacking.

Building upon this background, the present study proposes an integrated bibliometric approach to map how global and regional research connects *household food security, maternal nutrition knowledge*, and *child nutritional status* during the period 2015–2025. Through co-occurrence techniques and network, overlay, and density visualizations using VOSviewer, as well as the integration of policy data

and updated metadata (e.g., *The State of Food Security and Nutrition in the World — SOFI* report), this study aims to identify thematic clusters, topic evolution, and research collaboration patterns across countries and institutions. It is expected that the resulting mapping will not only provide a comprehensive overview of the literature but also contribute to more holistic and adaptive research and policy implications addressing challenges related to food security, nutrition literacy, and child nutrition amid economic pressures and the transformation of global food systems.

LITERATURE REVIEW

According to Saparinto and Hidayati (2006), food safety is the condition or effort required to prevent food from potential biological, chemical, and physical contamination that can disrupt, harm, and endanger human health. Food safety is the assurance that food will not cause harm to consumers when prepared and/or consumed (Herdiana, 2018).

According to Law Number 18 of 2012, Article 3, Food Safety is the condition and effort required to prevent food from potential biological, chemical, and other contamination that can disrupt, harm, and endanger human health and is not related to religion, beliefs, and culture, so it is safe for consumption. Food production is the activity or process of producing, preparing, processing, making, preserving, packaging, repackaging, and/or changing the form of food. Food provision is realized to meet the food needs and consumption of communities, households, and individuals in a sustainable manner (Zazili, 2019).

RESEARCH METHODS

This study employed a bibliometric approach to examine the scientific development concerning the interrelationship among *food security, maternal knowledge,* and *child nutrition* during the period 2015–2025. This approach enables a quantitative and visual analysis of publication trends, scientific collaborations, and thematic clusters within the fields of child nutrition and food security (Arghiroiu et al., 2025; Sweileh, 2020).

The primary data for this study were obtained using the Publish or Perish software with the *Crossref* database as the main search source, which is widely recognized for extracting scientific publication metadata and citation analysis (Harzing, 2019). *Crossref* was selected because it provides standardized and integrated metadata across academic publishers, allowing for a more comprehensive identification of publications compared to single databases such as Scopus or *Web of Science* (Öztürk et al., 2024). The dataset was further supplemented with additional sources from institutional repositories (theses and dissertations) and official reports from international organizations such as FAO, WHO, and UNICEF to broaden the coverage of both academic and policy-oriented literature. This approach aligns with methodological recommendations emphasizing the importance of combining formal publication sources and grey literature to enhance the validity and representativeness of bibliometric data (Du et al., 2024).

The search was conducted using main keywords that represent the three core research domains, namely nutrition knowledge, *household food security, stunting,*

under-five children, toddler malnutrition, maternal knowledge, and *food utilization*. The selection of these keywords was based on a preliminary literature review and the terminology used in FAO and WHO reports concerning global child nutrition status (FAO, 2024). From the search and screening results, a total of **100 of the most relevant publications** that met the inclusion criteria were obtained for further analysis using the bibliometric approach. Publications were manually classified according to year of publication, document type, number of citations, country of origin, research design, and publisher. The data were presented descriptively through visualizations such as bar charts, donut charts, and thematic maps to illustrate publication patterns (Zupic & Čater, 2014).

The bibliometric analysis was conducted using the VOSviewer software, which is widely used for mapping term networks and scientific collaborations. The analysis focused on the co-occurrence of terms derived from titles and abstracts using the full counting method (Waltman et al., 2010). The minimum occurrence threshold was set at seven, resulting in 31 relevant terms, of which 30 were included in the final mapping. The results were visualized in three main formats: network visualization, overlay visualization, and density visualization. The network visualization was used to illustrate the structural relationships among terms; the overlay visualization to trace temporal trends and topic evolution; and the density visualization to identify research areas with high intensity and potential research gaps. This multiple-approach design is consistent with recent practices in multidisciplinary bibliometric literature (Du et al., 2024; Kangalakova, 2025).

Data validity was ensured through manual inspection of metadata, removal of duplicates, and verification of keyword relevance, following current data validation practices in bibliometric research. Reliability was strengthened through comparison across visualizations, allowing for more stable interpretation of thematic clusters (Waltman et al., 2010).

As with other bibliometric studies, this research has limitations regarding database coverage. The use of *Crossref* as the primary source may not fully capture non-indexed publications and *grey literature* (Ng et al., 2023). To minimize this potential bias, data were complemented with academic repositories and global policy reports (FAO, 2024). This integrated approach ensures a more comprehensive representation of the global and regional research landscape in the fields of food security and child nutrition.

RESEARCH RESULTS

This section presents the results of the bibliometric analysis aimed at mapping the development of research on food security, maternal nutrition knowledge, and child nutrition at both global and regional levels. The analysis was conducted to identify publication trends, patterns of scientific collaboration, and emerging thematic focuses over the past decade. These findings serve as a foundation for understanding the trajectory of scientific development and the research contributions to nutrition and food security policy.

Publication Trends by Year (2015-2025)

The analysis revealed a significant increase in the number of publications addressing the interrelationship among *food security*, *maternal knowledge*, and *child nutrition* over the past decade. In the early period (2015–2017), scientific productivity remained low (3–6 publications per year), reflecting the limited global research focus on integrating household food security and child nutrition issues. A similar pattern was observed, indicating that *food security* research began to experience exponential growth after 2018, in line with the implementation of the *Sustainable Development Goals (SDGs)* (Ho & Lwesya, 2025).

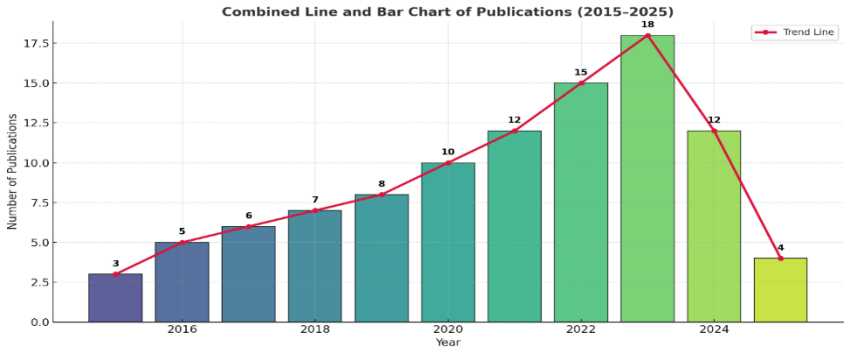

Figure 1. Publication Trends by Year

The results of the bibliometric analysis reveal a clear dynamic in the number of publications related to *food security*, maternal knowledge, and child nutrition during the period 2015–2025. In the early years (2015–2017), the number of publications remained low, ranging from three to six articles per year. This limited publication output can be interpreted as a reflection of the lack of systematic scientific attention to household food security and child nutrition issues, which at that time were mostly examined on a local scale and not yet integrated into the global agenda. The number of publications began to increase in 2018–2020 (seven to ten publications per year), coinciding with the growing global awareness of *SDG 2 (Zero Hunger)* and *SDG 3 (Good Health and Well-being)*. The most significant surge occurred between 2021 and 2023, peaking in 2023 with 18 publications. This period corresponds with the impact of the *COVID-19 pandemic*, which exacerbated household food insecurity and stimulated increased research on child nutrition and food crises (Kangalakova, 2025).

The decline in publications during 2024–2025 is likely attributable to *publication lag* and a research shift toward themes of climate change and food system transformation (Du et al., 2024). This temporal trend underscores the close correlation between global dynamics—such as the pandemic and food inflation pressures—and the rising scientific attention to child nutrition and household food security.

Table 1. Research Gap Based on Annual Publication Trends (2015–2025)

Period	Trend of Publications	Scientific Findings	Identified Research Gaps
2015–2017	Low (3–6/year)	Research still fragmented, mostly local case studies.	Limited global integration; lack of comparative studies across countries.
2018–2020	Gradual increase (7–10/year)	Growth linked to SDGs adoption; more focus on stunting and maternal knowledge.	Few longitudinal or intervention studies; evidence still dominated by cross-sectional designs.
2021–2023	Peak (12–18/year)	Surge of studies related to COVID-19 impact on food security and child nutrition.	Strong focus on pandemic-related shocks, but limited exploration of resilience strategies and post-crisis adaptation.
2024–2025	Decline (12 → 4/year)	Possible publication lag, shifting attention to climate change and food system issues.	Underrepresentation of fragile states and conflict-affected regions; limited continuity in multi-year data.

From this pattern, there are indications of several gaps that warrant attention. First, the dominance of short-term observational studies remains very high, while longitudinal and interventional research is still relatively limited. This condition results in an insufficient understanding of the causal relationships among maternal knowledge, *food security*, and child nutritional status. Second, publications are heavily concentrated in certain countries (e.g., Indonesia, Ethiopia, Nigeria, and Kenya), while other regions with high malnutrition prevalence (such as Sudan, Zambia, or several post-conflict countries) remain underrepresented. Third, research output after 2023 tends to decline, indicating a potential *research lag* or discontinuity in study progress. These gaps represent important opportunities for future research to expand geographical coverage, integrate longitudinal methods, and connect child nutrition issues with emerging dimensions such as sustainable food system resilience and climate change adaptation.

Publication Trends by Type

The analysis of publication types shows that the majority of the literature on *food security*, maternal knowledge, and child nutrition among under-five children was published in the form of journal articles, followed by theses/dissertations, official reports from international organizations, and conference proceedings. This proportion reflects that knowledge dissemination on this topic has been predominantly focused within formal academic forums, while still complemented by local research contributions from graduate students and global policy reports that provide practical context. The variation in publication types underscores the interconnection

among scientific evidence, academic inquiry, and policy recommendations, which together form the foundation for advancing food security and child nutrition initiatives.

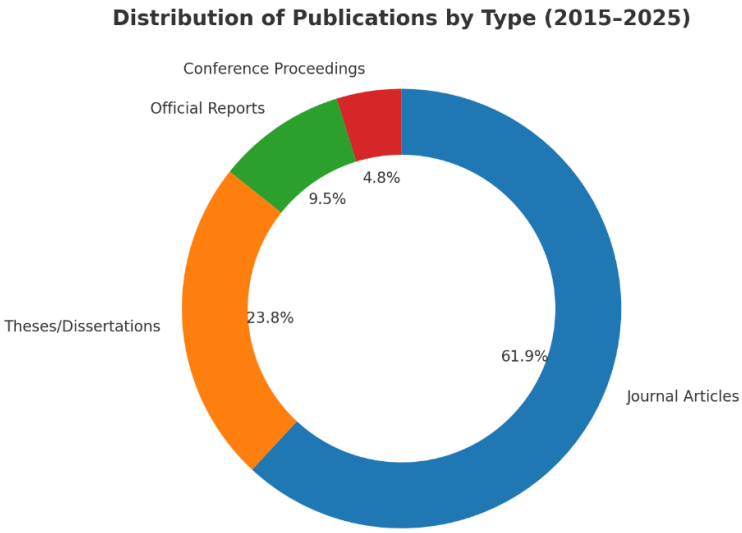

Figure 2. Publication Trends by Type

The results indicate that journal articles are the most dominant form of publication in studies on *food security*, maternal knowledge, and child nutrition during the period 2015–2025, accounting for approximately two-thirds of the total publications. This dominance can be interpreted as an indication that issues related to food security and child nutrition have become major concerns within formal academic forums that apply rigorous *peer-review* mechanisms, thereby ensuring higher data quality and credibility. On the other hand, theses and dissertations (representing about one-fourth of total publications) highlight the significant role of graduate student research, particularly in developing countries, in providing contextual data that are not always captured in international literature. Meanwhile, official reports from global organizations such as **WHO**, **FAO**, and **UNICEF**, although fewer in number, hold high significance as policy references and provide a broad conceptual framework. Conference proceedings, while contributing only a small proportion, remain relevant as they often contain the latest research that has not yet been published in journals.

This distribution pattern demonstrates that the primary channels of knowledge dissemination remain concentrated in journal articles; however, the supporting contributions from theses/dissertations and official reports remain crucial in enriching perspectives. Nevertheless, there are indications of discontinuities in the flow of knowledge dissemination, particularly because non-journal publications (such as dissertations and official reports) tend to receive limited global exposure. This condition may lead to constraints in the utilization of local data or policy insights that could otherwise strengthen global understanding. Therefore, although this publication-type distribution map reflects diversity, there is still room to broaden dissemination

channels so that research outcomes become more inclusive and capable of bridging academic evidence with practical needs in the field.

Publication Trends by Country/Region

The bibliometric analysis was also conducted to examine the distribution of publications based on the country or regional origin of the studies. The classification results indicate that most research on *food security*, maternal knowledge, and child nutrition originates from lower-middle-income countries, particularly in Asia and Africa. **Indonesia** ranks highest in terms of the number of publications, followed by **Ethiopia**, **Nigeria**, and **Kenya**. In addition, there is a significant contribution from regional and global publications issued by international organizations such as **WHO**, **FAO**, and **UNICEF**. This pattern demonstrates that issues related to child nutrition and food security are particularly prominent in countries still facing the dual burden of malnutrition and food instability, while international organizations play a vital role in providing conceptual and policy frameworks at the global level.

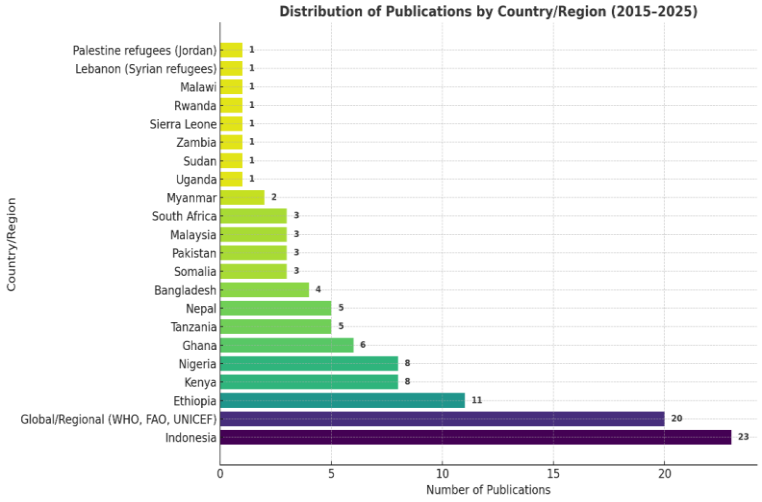

Figure 3. Publication Trends by Country

The publication distribution during the 2015–2025 period shows a clear dominance from **Indonesia** (23 publications), followed by global contributions from international organizations such as **WHO**, **FAO**, and **UNICEF** (20 publications). The large number of publications originating from Indonesia aligns with the country's high prevalence of *stunting* and its governmental priority on national programs for stunting reduction acceleration, which have driven an increase in research related to child nutrition and household *food security* (Hasan et al., 2025). These findings are also consistent with the **FAO** report in *The State of Food Security and Nutrition in the World (SOFI 2024)*, which identifies **Indonesia** as one of the countries with a strong commitment to evidence-based food and nutrition policies (FAO, 2024). In Sub-Saharan Africa, countries such as **Ethiopia** (11 publications), **Kenya** (8 publications), **Nigeria** (8 publications), and **Ghana** (6 publications) also stand out, consistent with the region's high burden of malnutrition. Additional contributions from **Nepal**,

Bangladesh, and **Somalia** indicate that research attention has also expanded to South Asia and other areas with high food insecurity.

However, the analysis also highlights the limited representation from other countries facing similar challenges. Nations such as **Sudan**, **Zambia**, **Rwanda**, **Malawi**, and **Uganda** produced only one publication over the decade, while research focusing on refugees in **Lebanon** and **Jordan** remains relatively scarce. This pattern suggests the presence of a geographical research gap, wherein post-conflict regions or low-income countries are still underrepresented in the scientific literature. This geographical imbalance reflects what Ijayense et al. (2025) refer to as *research concentration bias*—the tendency of global academic literature to focus on countries with more established research infrastructures and greater access to international funding (Ikudayisi & Adejumo, 2025). A similar condition was also identified by Wei et al. (2025) in studies of urban *food security*, where low-income nations often serve merely as research subjects without an equivalent capacity for scholarly publication (Frayne et al., 2022).

Thus, although the publication distribution demonstrates a focus on regions with the greatest nutritional burdens, research coverage still needs to be expanded more evenly to provide comprehensive and inclusive scientific evidence in support of both global policies and local interventions.

Publication Trends by Study Design

In addition to examining the variation in publication types and geographical distribution, it is also important to analyze the study designs used in research related to *food security*, maternal knowledge, and child nutrition. The classification results show that most articles employed a *cross-sectional* or observational approach, followed by *systematic reviews* and *scoping reviews*, case studies in specific regions, and intervention research with *quasi-experimental* designs. This variation in design reflects researchers' efforts to describe field conditions, synthesize existing evidence, and evaluate the effectiveness of interventions. However, the dominance of observational studies indicates a tendency to generate descriptive findings rather than strong causal evidence (Torres-Salinas et al., 2024)

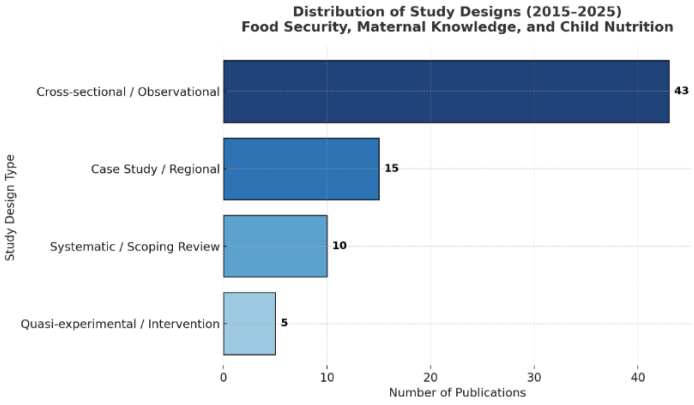

Figure 4. Publication Trends by Study Design

The distribution of study designs reveals that *cross-sectional* or observational studies have been the most dominant forms of research throughout the 2015–2025 period. This methodological preference is understandable, as such designs provide a rapid overview of the relationships among household *food security*, maternal knowledge, and child nutritional status. In addition, observational approaches are frequently employed in lower-middle-income countries, where resource constraints make such studies more feasible to conduct. Nevertheless, there has been a meaningful contribution from *systematic reviews* and *scoping reviews*, which have increased since 2020. The presence of regional case studies is also noteworthy, as they demonstrate how local factors—such as sociocultural conditions and food access—can influence the nutritional status of children under five. Meanwhile, intervention-based publications using *quasi-experimental* designs remain relatively scarce.

The dominance of observational studies and the limited number of intervention-based studies indicate that existing literature has primarily focused on mapping phenomena rather than testing causal relationships or evaluating the effectiveness of nutrition intervention strategies directly. As a result, the available scientific evidence tends to be strong in describing situations but remains limited in providing recommendations grounded in long-term program evaluation. As highlighted by Contreras et al. (2025), future *food security* research should integrate *systems-based intervention models* to assess the long-term socioeconomic impacts of nutrition and household food security policies (Contreras et al., 2025).

In other words, while research in this field has successfully identified factors associated with food security and child nutrition, there remains a pressing need for more studies that evaluate the actual impacts of interventions designed to sustainably improve these conditions (Wang et al., 2021).

Main Publisher and Journal Trends

In addition to annual distribution, publication types, and study designs, it is also important to examine the publishing channels utilized. The analysis shows that most publications related to *food security*, maternal knowledge, and child nutrition were disseminated through reputable international journals, particularly those managed by major publishers such as Springer, MDPI, PLOS, Wiley, and Elsevier. In addition, there are contributions from other publishers such as Taylor & Francis, SAGE, BMJ, Cambridge, and Oxford Academic, although their proportions are relatively smaller. This pattern indicates that issues of food security and child nutrition have not only attracted attention at the local research level but have also been recognized as significant themes within global publication forums that are indexed and possess broad scientific impact.

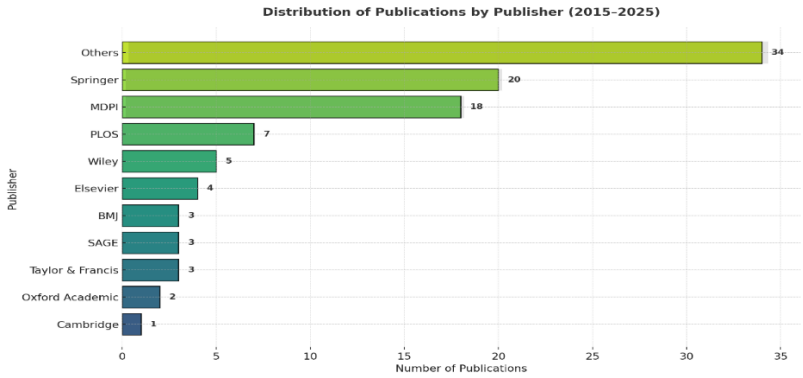

Figure 5. Publication Trends by Publisher

The publication distribution shows that the majority of research on *food security*, maternal knowledge, and child nutrition has been published in international journals managed by major academic publishers. **Springer** ranks first, contributing approximately 20 publications, followed by **MDPI** with 18 publications, while **PLOS**, **Wiley**, and **Elsevier** each account for a smaller number of articles.

The presence of these major publishers reflects the growing global recognition of child nutrition and food security as relevant, multidisciplinary, and important fields within the context of sustainable development. Moreover, several specialized journals—such as *Maternal & Child Nutrition* and *Public Health Nutrition*—provide dedicated platforms for studies linking social factors, maternal knowledge, and child nutritional status, thereby reinforcing the academic legitimacy of this topic within the domains of public health and nutritional sciences.

However, despite the dominance of reputable publishers, the distribution of publications also reveals a degree of imbalance. The number of articles published by other publishers, including **Taylor & Francis**, **SAGE**, **BMJ**, **Cambridge**, and **Oxford Academic**, remains relatively small, while publications from local or university-based journals tend to be less frequently indexed internationally. This indicates that although much of the literature is concentrated within high-visibility global channels, context-specific research at the local level has not yet gained equivalent publication opportunities.

As a result, the available scientific evidence still largely represents global and regional perspectives, whereas locally grounded insights often appear only in institutional reports or theses with limited reach. In other words, while the existing literature provides a strong foundation in global forums, it has not yet fully captured the diversity of local perspectives that are essential for designing more adaptive and sustainable nutrition interventions.

Analisis Kata Kunci (*Keyword Co-occurrence*)

As an essential component of the bibliometric analysis, *keyword co-occurrence* mapping was employed to identify the main emerging themes in the literature concerning *food security*, maternal knowledge, and child nutrition. Using the *VOSviewer* software, a total of 636 terms were identified from the titles and abstracts of the publications. After applying a

minimum occurrence threshold of seven, only 31 terms met the inclusion criteria, of which 30 were selected based on the highest levels of relevance.

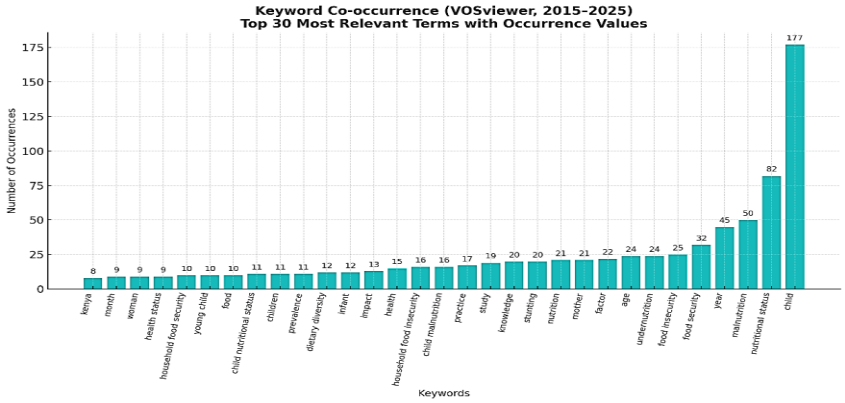

Figure 6. *Keyword Co-occurrence* Using VOSviewer

This analysis produced several thematic clusters, including *household food security*, *maternal knowledge*, *stunting and child undernutrition*, and *resilience and food utilization*. These clusters indicate the overall direction of research development and illustrate the strong interrelationships among variables that collectively explain child nutrition conditions and household *food security*.

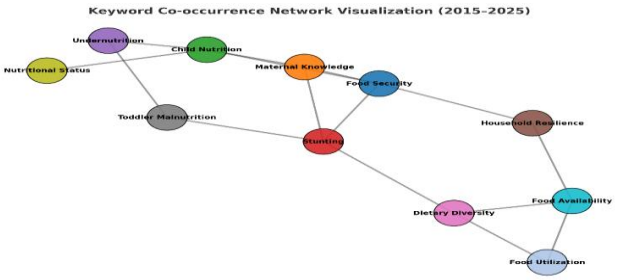

Figure 7. *Keyword Co-occurrence Network Visualization*

Figure 6. Keyword Co-occurrence Network Visualization (2015–2025) illustrates the thematic relationships among frequently occurring terms in studies related to *food security*, maternal knowledge, and child nutrition. The term *stunting* serves as the central node in the network, showing strong associations with *maternal knowledge*, *food security*, *dietary diversity*, and *toddler malnutrition*, signifying its role as the main connecting theme between nutritional factors, maternal behavior, and household food conditions. The connections among *nutritional status*, *undernutrition*, and *child nutrition* emphasize the research focus on child health aspects, while the links between *food availability* and *household resilience* reflect the dimensions of access and food utilization.

Overall, the map demonstrates an integration between biological and socio-economic aspects within child nutrition studies, revealing opportunities for future research on the interconnections between

household food security and child feeding practices. These results are consistent with the findings of Hashemzadeh et al. (2025), who reported that maternal nutrition literacy is significantly associated with both obesity and child malnutrition risks, depending on the level of family *food security* (Hashemzadeh et al., 2025).

Table 2. Quantitative Analysis Based on Frequency (*Occurrences*)

Frequency Category	Value Range	Example Keywords	Interpretation
Very High	>100	*child* (177)	The term "child" represents the most dominant central node, indicating that research over the past decade has been highly focused on under-five children as the primary population in the context of nutrition and *food security*.
High	50–99	*nutritional status* (82), *malnutrition* (50)	Both terms occupy the second most prominent position, signifying that child nutritional status and malnutrition are key variables frequently examined as both risk factors and research outcomes.
Moderate	20–49	*undernutrition* (24), *year* (45), *food security* (32), *factor* (22)	These keywords often appear in contextual and methodological discussions, such as "year" reflecting temporal dimensions or "factor" indicating analytical approaches to nutritional determinants.
Low	<20	*household food security* (10), *mother* (21), *practice* (17), *stunting* (20)	Although less frequent, these terms are conceptually important, representing specific variables related to household-based and maternal knowledge research contexts.

The analysis based on the *relevance score* values reveals a variation in the degree of association between terms and the main research theme, ranging from 0.25 to 2.48. Terms with the highest relevance (≥1.5), such as *child* (2.48), *household food security* (2.19), *young child* (1.91), *infant* (1.46), and *dietary diversity* (1.45),

demonstrate a strong relationship with the core focus of the study on early childhood nutrition and household food security. Meanwhile, terms with moderate relevance (1.0–1.5), including *household food insecurity* (1.37), *woman* (1.29), *health status* (1.26), and *undernutrition* (1.21), reflect supporting dimensions that highlight the role of maternal health and food instability as indirect determinants of child nutritional status.

In contrast, terms with lower relevance (<1.0)—such as *food security* (0.25), *knowledge* (0.43), *year* (0.61), and *practice* (0.66)—represent keywords with broader contextual use that are not exclusive to the main theme. Nevertheless, these terms remain important in enriching the multidimensional analysis, particularly in explaining temporal, behavioral, and policy-related aspects that influence the interrelationship between maternal knowledge, food security, and child nutrition (Maerescu et al., 2025).

Network Visualization Analysis

Network Visualization Analysis is used in bibliometric research to illustrate the interrelationships among keywords that form the conceptual structure of a particular field of study (Rahman T, 2025). Through this mapping process, thematic relationships and clustering patterns among topics can be visually represented as an interconnected network. Each *node* represents a keyword, while the connecting lines indicate the strength of association between concepts. Different colors denote thematic clusters that are generated automatically, providing a comprehensive overview of the direction and dynamics of research related to *food security*, *maternal knowledge*, and *child nutrition*.

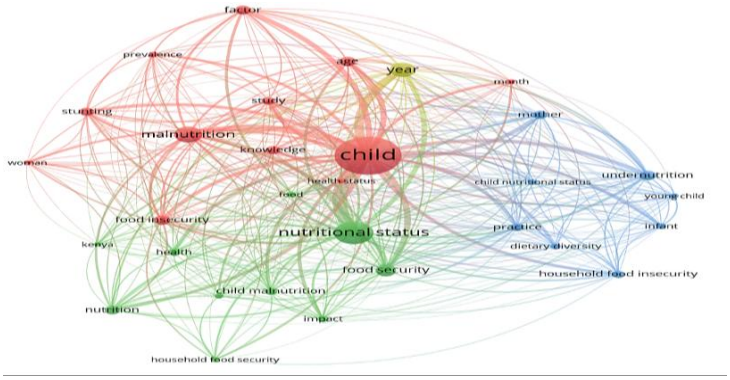

Figure 7. ***Network Visualization***

Table 2. Thematic Analysis Based on Four Main Clusters (According to the *Network Map*)

Cluster	Thematic Focus	Dominant Keywords	Implications
Child Malnutrition and Health Determinants	Highlights the relationship between child nutritional status and its	*child*, *malnutrition*, *factor*, *study*, *stunting*	Indicates the global research focus on the biological and social determinants of child nutrition.

	underlying determinants.		
Household Food Security and Nutrition	Examines household food availability, access, and stability.	*household food security*, *food insecurity*, *undernutrition*, *food security*	Reflects the economic and environmental dimensions of food security.
Maternal Knowledge and Feeding Practices	Emphasizes the role of mothers and feeding behaviors.	*mother*, *knowledge*, *practice*, *dietary diversity*	Highlights the importance of maternal nutrition literacy as a preventive factor against *stunting*.
Contextual and Temporal Factors	Addresses time, regional, and contextual aspects of research.	*year*, *kenya*, *impact*, *prevalence*	Suggests the geographical and longitudinal dimensions of global research.

The conceptual relationships among keywords form the main thematic structure of research on *food security*, *maternal knowledge*, and *child nutrition* during the 2015–2025 period. The mapping results generated using VOSviewer reveal four interrelated clusters that reflect the multidimensional focus of studies in the field of food security and child nutrition.

1. **The first cluster**, titled *Child Malnutrition and Health Determinants*, encompasses keywords such as *child*, *malnutrition*, *stunting*, *factor*, and *health*. The term *child* has the largest node size and the strongest connections to other keywords, indicating that issues related to child malnutrition and health remain the dominant focus in global research.
2. **The second cluster**, *Household Food Security and Nutritional Resilience*, consists of keywords including *food security*, *household food insecurity*, *nutritional status*, and *food utilization*. This cluster highlights the influence of household socio-economic and environmental conditions on food availability and child nutritional status (Madali-Kafes & Kafes, 2024).
3. **The third cluster**, *Maternal Knowledge and Feeding Practices*, emphasizes the behavioral and cognitive dimensions of maternal feeding practices, with strong associations among *maternal knowledge*, *practice*, *nutrition*, and *dietary diversity* (El Bilbeisi et al., 2022). This cluster indicates that maternal nutrition literacy plays a crucial role in promoting dietary diversity and achieving optimal child nutritional status.
4. **The fourth cluster**, *Contextual and Temporal Dimensions*, consists of keywords such as *year*, *impact*, *study*, and *Kenya*, which reflect the geographical and temporal variations of research contexts.

This network underscores that research on *food security* and *child nutrition* is complex and interrelated, where biological, social, economic, and behavioral factors form an integrated system that determines the direction and

dynamics of research in this field (Maheri et al., 2022).

Overlay Visualization Analysis (VOSviewer)

The *overlay visualization* using VOSviewer provides a dynamic representation of the temporal development of publications and the interconnections among research topics in the field of *food security*, *maternal knowledge*, and *child nutrition*. In this map, the color of each *node* represents the average publication year of the articles containing that keyword—ranging from purple for earlier years to yellow for more recent publications. The size of the *node* indicates the frequency of keyword occurrences, while the density and thickness of the connecting lines reflect the strength of conceptual relationships among topics. Thus, this map not only visualizes the thematic relationships between concepts but also illustrates the evolutionary trajectory of research over the past decade.

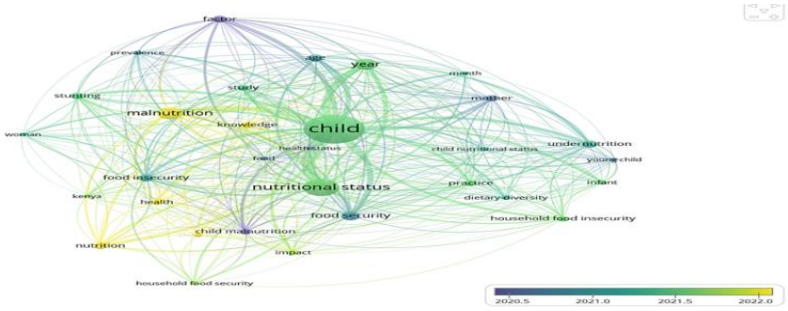

Figure 8. *Overlay Visualization (VOSviewer)*

The visualization results show that keywords such as *child*, *nutritional status*, and *food security* have remained central themes in research with high intensity from the early years up to the most recent period. The green color of these *nodes* indicates that these topics have consistently served as the main focus over the past several years, reflecting the sustained academic interest in issues of child nutrition and household food security. Conversely, several terms such as *nutrition*, *malnutrition*, and *food insecurity* appear in yellow, signifying an increasing research attention in the years approaching 2022. This pattern indicates a shift toward more contextual and multidimensional approaches in discussing child nutrition, incorporating social, behavioral, and household food security factors (Sirajuddin et al., 2021).

In addition, the bluish-colored *nodes*, such as *mother*, *young child*, and *dietary diversity*, indicate topics that were more frequently studied during the early phase of the analysis period (around 2020–2021). This pattern suggests that earlier studies tended to emphasize behavioral factors and consumption patterns, whereas more recent publications have begun to integrate *maternal knowledge*, socio-economic status, and household food security systems. Although research on the relationship between *food insecurity* and *child malnutrition* has shown a significant increase, a notable research gap remains regarding the longitudinal effects of household food security on child nutritional development over time, particularly

within high-risk and developing regions.

Overall, the results of the *Overlay Visualization* reaffirm that research on *food security*, *maternal knowledge*, and *child nutrition* continues to evolve with increasingly complex and interdisciplinary focuses. The color transitions on the map illustrate a clear shift in research trends—from descriptive approaches toward more analytical and policy-oriented perspectives that emphasize integration across domains. Accordingly, future studies have the potential to deepen understanding of the interconnections among socio-economic factors, nutritional behaviors, and household food security as the evidence base for decision-making in achieving sustainable improvements in child nutritional status.

Density Visualization Analysis (VOSviewer)

The *Density Visualization* generated through VOSviewer provides an overview of the intensity of occurrence and interconnection among keywords in scientific publications during the 2015–2025 period. In this map, colors represent the level of density or concentration of research topics, where red areas indicate keywords that appear most frequently and are strongly linked to other terms, while green and blue areas represent regions with relatively lower frequency and weaker associations (Rahman T, 2025).This approach allows researchers to identify the main research foci while simultaneously uncovering thematic areas that remain underexplored within the fields of *food security*, *maternal knowledge*, and *child nutrition*.

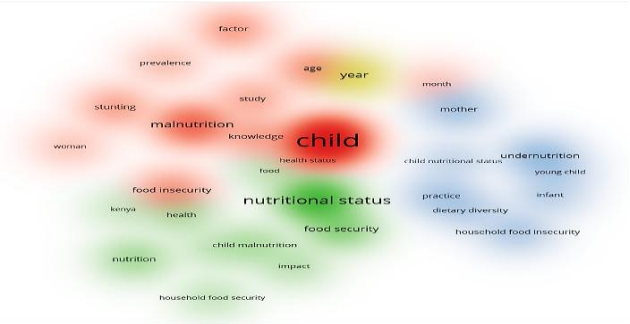

Figure 8. *Density Visualization* (VOSviewer)

DISCUSSION

The visualization results indicate that the keyword *"child"* occupies the central position with the highest density (highlighted in bright red), reflecting the dominant role of the child-related theme across the entire research map. This keyword is strongly associated with other terms such as *malnutrition*, *nutritional status*, and *health status*, forming the conceptual core of issues related to child nutrition and health. A cluster of terms such as *malnutrition*, *stunting*, and *factor* also appears in high-density areas, suggesting substantial scholarly attention to the biological and social determinants of malnutrition. Meanwhile, green-shaded areas representing keywords such as *food security*, *food insecurity*, and *nutrition* indicate important yet less intensively explored topics, implying that food security issues are often examined as supporting factors

rather than as the primary research focus (Maerescu et al., 2025).

On the other hand, blue-colored areas such as *mother*, *infant*, *young child*, *dietary diversity*, and *household food insecurity* display lower density levels. This indicates that research concerning the role of mothers, feeding practices, and household food security dynamics has received comparatively less scholarly attention than studies focusing on the clinical aspects of child nutrition. This pattern highlights a potential *research gap* that could be further developed, particularly regarding the long-term influence of maternal behavior, nutritional knowledge, and household consumption patterns on child nutritional status.

Overall, the results of this *Density Visualization* emphasize that research on child nutrition and food security remains predominantly centered on the direct analysis of children's conditions, whereas interdisciplinary studies—such as those examining the relationships among *maternal knowledge*, *household food security*, and *feeding practices* remain underexplored (Appoh & Krekling, 2005). Therefore, future research should be directed toward more integrative and context-specific approaches to provide a comprehensive understanding of the factors influencing *food security* and *child nutritional status* across diverse socio-economic contexts.

CONCLUSION

Based on the bibliometric analysis conducted over the 2015–2025 period, it can be concluded that research on *food security*, *maternal knowledge*, and *child nutrition* has developed rapidly, showing a growing tendency toward multidisciplinary integration across biological, social, and economic dimensions. Mapping using *VOSviewer* identified four main thematic clusters: *child malnutrition and health determinants*, *household food security and nutrition*, *maternal knowledge and feeding practices*, and *contextual and temporal factors*. These clusters illustrate that child nutrition issues cannot be separated from the context of household food security and maternal knowledge, both of which serve as key determinants in efforts to prevent malnutrition.

Publication trends revealed a significant increase during the COVID-19 pandemic period, when scientific attention was largely directed toward the socio-economic impacts on food security and child nutrition. However, a decline in publication productivity after 2023 suggests the presence of a *research lag* or a shift in research focus. Overall, research in this field remains dominated by observational designs, with high concentrations in developing countries such as Indonesia, Ethiopia, and Nigeria, while regions with severe food insecurity—including post-conflict countries—remain underrepresented.

The findings highlight several *research gaps* that warrant further investigation, including the limited number of longitudinal studies exploring causal relationships between maternal knowledge, food security, and child nutritional status; the scarcity of policy-based intervention research; and the lack of integration between nutritional behavior, socio-economic dimensions, and sustainable food security frameworks. Therefore, future research should prioritize more comprehensive, cross-sectoral, and context-specific approaches to

strengthen scientific understanding and support the formulation of effective policies aimed at improving food security and sustainably reducing stunting prevalence.

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