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Article

Three Decades of School Meal Program Research: Bibliometric Insights for Governance and Sustainability of Indonesia's Free Nutritional Meal Initiative (MBG)

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Abstract

Three decades of research on school meal programs are synthesized through a bibliometric approach to inform the governance and sustainability of Indonesia's Free Nutritional Meal initiative (Makan Bergizi Gratis; MBG). By using Scopus-indexed publications (1994–2024) retrieved via Harzing's Publish or Perish, organized in Mendeley, and analyzed with VOSviewer, the study examines 120 publications with 1,334 citations, indicating a moderately mature and policy-relevant evidence base. The findings reveal a clear thematic progression from early emphasis on participation and policy design, to health and nutritional outcomes, and more recently to sustainability, operational efficiency, and technology-enabled monitoring. These evolving research priorities highlight the need for an integrated governance framework in MBG that combines national standards on nutrition, food safety, and procurement with context-specific implementation strategies. However, effective translation into practice requires addressing structural constraints, including regional disparities in infrastructure, limited cold-chain systems, and institutional coordination challenges. Positioned as a human capital intervention, MBG has the potential to contribute significantly to multiple Sustainable Development Goals, provided it is supported by adaptive governance, digital monitoring systems, and evidence-based policy integration.

Keywords: School meal programs; bibliometric mapping; Makan Bergizi Gratis (MBG); governance and sustainability

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I. Introduction

The Indonesian government's initiative to implement Free Nutritional Meal Initiative or Makan Bergizi Gratis (MBG) program reflects a strategic effort to address critical nutritional and educational challenges in the country. Indonesia faces a dual burden of malnutrition: stunting, anemia, and undernutrition in some areas, alongside growing obesity rates in others. According to (Rimbawan et al., 2023), school meal programs have proven effective in addressing anemia and improving nutritional knowledge and practices among Indonesian students, demonstrating the vital role of structured feeding initiatives.

Furthermore, malnutrition directly impacts cognitive development and educational attainment, creating a cycle of poverty that perpetuates inequality. This program aims to provide free nutritious meals to schoolchildren, aligning with the national agenda of improving educational outcomes and long-term economic productivity by ensuring students are well-nourished and ready to learn. Moreover, providing free nutritious meals aligns with global Sustainable Development Goals (SDGs), particularly those focusing on eradicating hunger and improving health.

Recent studies highlight significant gaps in dietary diversity and nutrient adequacy among Indonesian children, primarily due to economic disparities and limited access to balanced meals (Pranita et al., 2023). School meal programs like MBG serve as a reliable platform to deliver essential nutrients, especially in underserved regions. The MBG program is particularly relevant given Indonesia's ambitious goals to reduce stunting rates and improve health equity. Recent studies have highlighted the importance of addressing nutritional deficits among children to break the intergenerational cycle of poverty and poor health (Reyes et al., 2016). By integrating a free meal initiative within schools, MBG leverages the accessibility of educational institutions to serve as delivery mechanisms for essential nutrition, fostering a healthy and conducive learning environment. The program also serves as a critical safety net for underprivileged families, especially in rural and underdeveloped areas, where food insecurity remains prevalent.

Additionally, it promotes community engagement and local agricultural economies by sourcing ingredients locally, fostering economic growth alongside nutritional benefits. With effective implementation, MBG holds the potential to catalyze significant improvements in public health, education, and economic stability. As (Sekiyama et al., 2018) observed in past Indonesian school feeding program known as PROGAS pilot program, meal initiatives can significantly enhance students' dietary intake while promoting local food systems and agricultural development. This multidimensional impact underscores the potential of MBG to improve not only individual health but also community welfare and economic resilience.

Implementing MBG also holds the potential to address long-term societal issues such as educational disparities and productivity losses. Studies reveal a direct correlation between adequate nutrition and improved cognitive development and academic performance (Oddo et al., 2022). By ensuring that students receive well-balanced meals, MBG supports better learning outcomes and fosters a generation of healthier, more capable individuals. The program's focus on sustainability and inclusivity is crucial in mitigating persistent health inequalities, as emphasized by (Soma et al., 2024). As a cornerstone of Indonesia's human development agenda, MBG represents a transformative initiative for tackling malnutrition and supporting the nation's socio-economic progress.

To support the sustainability of the Makan Bergizi Gratis (MBG) program, academic research is essential to assess the extent to which school meal programs, particularly those similar to MBG, have been studied by scholars and researchers over the decades. Insights derived from various research findings can serve as valuable references for understanding best practices in the governance and management of such programs. For instance, (Gabriel et al., 2015) explored municipal management models of Brazil's National School Meal Program, providing critical insights into resource allocation, nutritional monitoring, and inter-sectoral collaboration. These insights enable policymakers and practitioners to adopt a more holistic approach, addressing not only nutritional outcomes but also broader impacts on education, public health, and community development. By grounding the MBG program in evidence-based research, its implementation can be refined to ensure it effectively addresses the diverse and interconnected challenges faced by Indonesia's education and health systems, thereby maximizing its long-term impact and sustainability.

II. Research Aim and Questions

This study aims to provide a comprehensive bibliometric analysis of research on school meal programs over the last three decades (1994-2024) to identify patterns, trends, and gaps in the existing literature. Such an analysis is critical as school meal programs play a pivotal role in improving nutritional outcomes and addressing educational disparities globally. By leveraging bibliometric tools, this study seeks to map the intellectual structure of this research field, highlight influential works, and understand the evolution of key themes. Bibliometric analysis not only provides insights into the volume of research and its geographic distribution but also underscores the thematic focus and collaborative networks, offering a meta-perspective on the field.

The novelty of this study lies in its focus on bibliometric analysis specifically applied to school meal programs, which remains underexplored in the academic domain. Although bibliometric methodologies have been extensively used in other fields, the application to school meal programs offers unique value by uncovering insights into governance, policy implications, and nutritional impact. As emphasized by (Eustachio Colombo et al., 2020), systematic evaluations of school meal interventions are essential for advancing sustainable and nutritionally adequate programs. The findings of this study will contribute to building a robust evidence base, enabling policymakers to refine program design and implementation to achieve broader health and educational goals. The following questions have been formulated to fulfill the objectives of this study.

1. Which authors have contributed the most to the literature on school meal programs?
2. What are the key trends and thematic focus areas in research on school meal programs over the last three decades?
3. How can insights from bibliometric analysis inform the governance and sustainability of school meal programs?

III. Research Method

This study adopts a bibliometric approach to systematically examine the intellectual structure, thematic evolution, and policy relevance of research on school meal programs. Bibliographic data were retrieved from the Scopus database using Harzing's Publish or Perish (PoP) software in December 2024, covering publications from 1994 to 2024 with the search term "*school meal program*." The retrieved records were exported in RIS format, organized and curated in Mendeley Desktop, and subsequently analyzed using VOSviewer to generate bibliometric networks and thematic visualizations. A total of 120 Scopus-indexed publications were identified, and after screening for relevance and verifying metadata consistency, all records were retained for analysis. Descriptive bibliometric indicators derived from PoP were used to assess publication productivity and citation impact, while VOSviewer was employed to map co-authorship, co-citation, and keyword co-occurrence networks, enabling the identification of influential contributions, thematic clusters, and temporal shifts in research focus.

3.1 SCOPUS as the Primary Bibliographic Database

Scopus Indexed Journal database was selected as the sole bibliographic source due to its comprehensive multidisciplinary coverage across public health, nutrition, education, and policy studies—the principal domains underpinning research on school meal programs. Compared to more selective databases, Scopus offers broader journal inclusion, particularly for international and regional publications, while maintaining structured and high-quality citation metadata suitable for bibliometric analysis (Chadegani et al., 2013; Harzing & Alakangas, 2016). The adoption of a single-database approach also ensures consistency in metadata structure and avoids compatibility issues that may arise when integrating records from multiple sources in network-based analyses. This combination of coverage breadth, citation reliability, and data standardization makes Scopus an appropriate and methodologically robust choice for this study. Table 1 summarises the rationale for selecting Scopus compare to several commonly used alternatives.

Table 1. Comparison of Bibliographic Databases

Database	Advantages	Disadvantages
Scopus	Extensive multidisciplinary coverage, including social sciences, health, and education.	Limited coverage in humanities and niche disciplines compared to Web of Science.
	Comprehensive citation analysis tools with user-friendly navigation.	Requires a subscription, limiting access for smaller institutions.
	Better inclusion of non-English and regional journals compared to Web of Science.	
Web of Science	Established authority with longer historical coverage (dating back to 1900).	Smaller journal coverage compared to Scopus, especially for regional or non-English journals.

	High precision in citation analysis with selective journal indexing.	More suited for established disciplines, less coverage of emerging or interdisciplinary fields.
Google Scholar	Free access with broad coverage, including grey literature and conference proceedings.	Prone to duplicates and lacks detailed indexing and metadata accuracy.
	Includes a wide range of publication types not found in other databases.	Limited tools for advanced bibliometric analysis and network visualization.
Semantic Scholar	AI-powered insights for keyword extraction and semantic analysis.	Focuses on computer science and biomedical research, with limited coverage of other disciplines.
	Free and user-friendly for preliminary literature searches.	Less comprehensive than Scopus or Web of Science for multidisciplinary research.
Dimensions	Broad journal coverage with added data on grants, patents, and clinical trials.	Relatively new platform with fewer established tools compared to Scopus or Web of Science.
	Flexible and customizable search options for diverse research needs.	Lacks the depth of historical data provided by Web of Science.

Source*:* Author Analysis.

3.2 Data Retrieval from Scopus Using Harzing's Publish or Perish (PoP)

The bibliometric data were retrieved using Harzing's Publish or Perish (PoP) version 8.17.4863.9118 (Figure 1), a tool designed to extract citation metrics and bibliographic metadata from databases such as Scopus. The software enables efficient data collection through its user-friendly interface and supports export in standardized formats (e.g., .RIS), facilitating integration with reference management and analysis tools, including Mendeley and VOSviewer. In addition to data extraction, PoP automatically generates key citation indicators, such as total citations, h-index, and g-index, which are essential for assessing research impact and trends. Its compatibility with Scopus and its ability to streamline data retrieval and metric calculation make it a reliable instrument for bibliometric analysis, as demonstrated in prior studies (Samsudin et al., 2024). This approach ensures a consistent, systematic, and methodologically robust foundation for subsequent network visualization and thematic analysis.

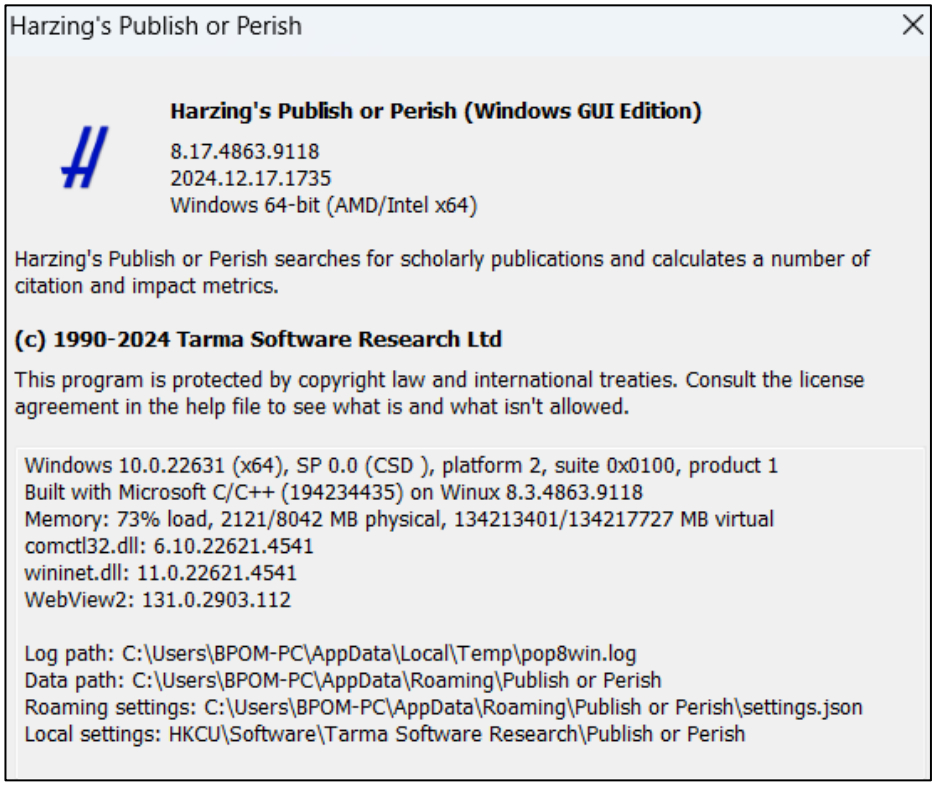

Figure 1. Harzing's Publish or Perish (PoP) Software Version

Source*:* Author Documentation

3.3 Mendeley Desktop for Bibliographic Management

Mendeley Desktop (version 1.19.8), as illustrated in Figure 2, was employed as the primary reference management tool to organize and manage bibliographic data in this study. The software supports the import of metadata, including abstracts, in formats such as .RIS and .BibTeX, ensuring compatibility with data retrieval tools like Harzing's Publish or Perish and facilitating seamless integration with VOSviewer for subsequent analysis. It also enables efficient citation management through automatic referencing and bibliography generation across various styles, while offering functionalities such as PDF annotation, metadata extraction, and structured file organization. These features enhance accuracy, consistency, and efficiency in handling large bibliometric datasets. Its reliability and widespread academic adoption are supported by evidence indicating improved accuracy and productivity in scholarly writing (Simarmata et al., 2021), as well as comparative advantages in metadata management over alternative tools such as Zotero and EndNote (Zhang, 2012).

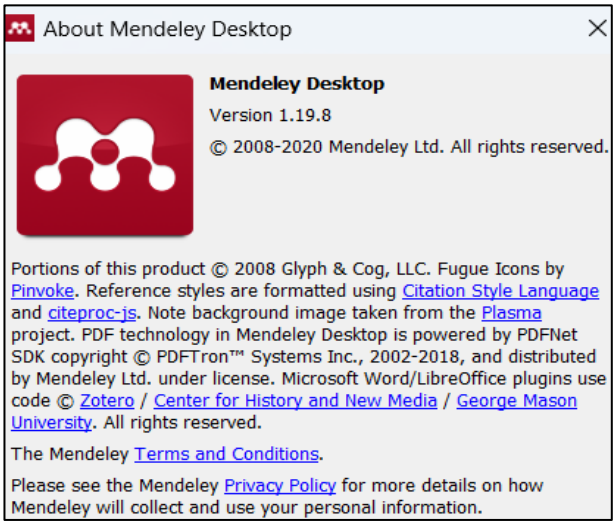

Figure 2. Mendeley Desktop Software Version

Source: Author Documentation

3.4 Utilization of VOSviewer for Bibliometric Analysis

VOSviewer (version 1.6.20) was employed to analyze and visualize bibliometric data derived from Scopus-indexed publications on school meal programs, enabling the mapping of co-authorship, co-citation, and keyword co-occurrence networks. The software supports large datasets and facilitates the identification of thematic clusters and intellectual structures based on abstract-level metadata, thereby informing the study's key findings. Its selection is supported by its established effectiveness in bibliometric research, particularly in producing clear and precise visualizations of complex scholarly networks (van Eck & Waltman, 2010), as well as its user-friendly interface and compatibility with standard bibliometric data formats (Al Husaeni & Nandiyanto, 2021).

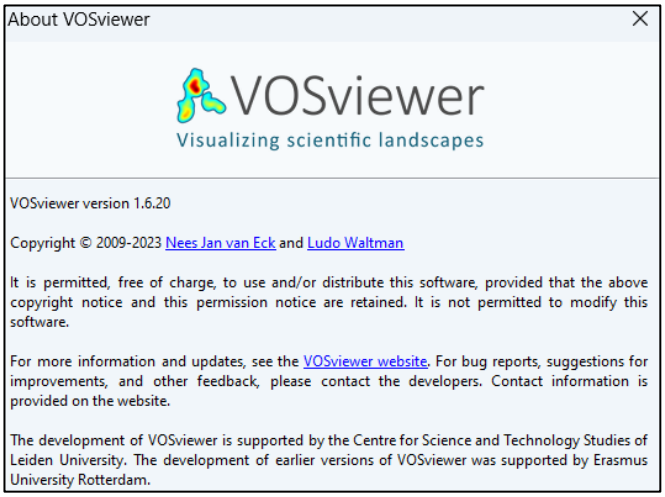

Figure 3. VOSviewer application version

Source: Author Documentation

3.5 Explanation of PRISMA Framework

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework provides a structured and transparent approach for identifying, screening, and synthesizing research, thereby enhancing the rigor and reproducibility of systematic analyses across disciplines, including bibliometric studies (Page et al., 2021). In this study, a modified PRISMA framework (Table 2) was applied to align with the bibliometric design, integrating Harzing's Publish or Perish, Mendeley Desktop, and VOSviewer to support data extraction, organization, and visualization. Scopus was utilized as the primary data source due to its extensive multidisciplinary coverage and high-quality indexed publications (Chadegani et al., 2013). This approach ensures a systematic identification of research trends, thematic developments, and knowledge gaps in the school meal program literature.

Table 2. Modified PRISMA Framework for Bibliometric Analysis

PRISMA Step	Description	Tools Used
Identification	Relevant articles were identified using keywords related to "school meal programs" in Scopus.	Scopus, Harzing's Publish or Perish
Screening	Titles and abstracts were screened for relevance based on inclusion and exclusion criteria.	Mendeley Desktop
Eligibility	Full texts of eligible articles were assessed to ensure alignment with the research objectives.	Mendeley Desktop, n = 120 paper
Inclusion	Final selection of articles was imported into VOSviewer for bibliometric analysis and visualization.	VOSviewer

Source*:* Author Analysis.

IV. Result and Discussion

The bibliometric data generated from the Scopus database by using PoP software as shown in Figure 4, employed the keyword "School Meal Program," covering the research period from 1994 to 2024, reveals a robust scholarly interest in the topic over three decades. There are 120 academic papers have been published, accumulating 1,334 citations, with an average of 44.47 citations per year and 11.12 citations per paper. The h-index (19) indicates that 19 publications have been cited at least 19 times, demonstrating the field's moderate yet impactful influence within academia. Additionally, the g-index (33) reflects the cumulative impact of the most-cited publications, while the e-index (23.79) highlights excess citations beyond those required for the h-index, further illustrating the depth of scholarly attention on seminal studies. These metrics collectively emphasize the increasing recognition of research on school meal programs in addressing critical issues related to child nutrition,

education, and public health. The dataset in Table 3 reveals significant trends in authorship patterns, with an Authors per Paper ratio of 0.98, indicating a predominance of small author teams or single-author studies. The AWCR (212.28) and AW_index (14.57) further underscore the substantial contributions of individual researchers to this field.

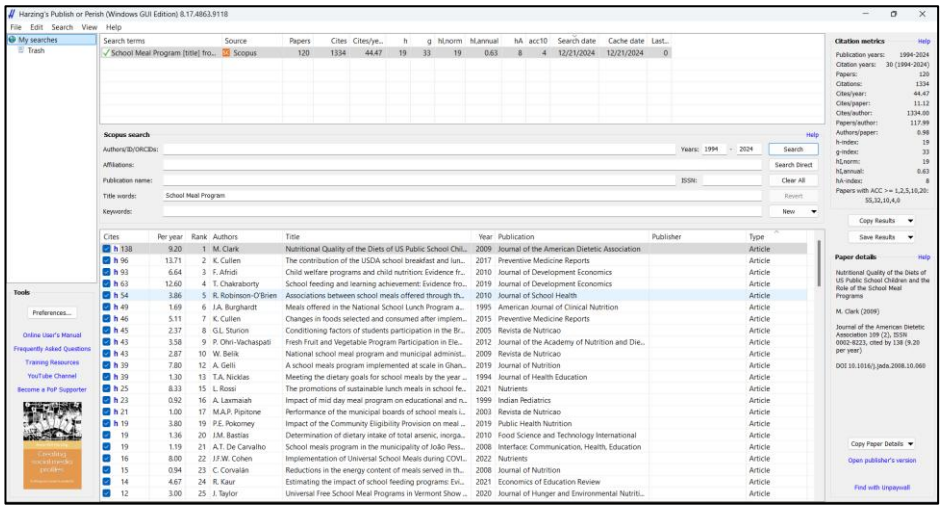

Figure 4. Generating Metadata using Harzing's Publish or Perish (PoP)

Source*:* Author Analysis

However, the limited collaboration reflected in these metrics suggests opportunities for fostering interdisciplinary partnerships to expand the research scope. Normalized indices, such as the hI_norm (19) and hI_annual (0.63), show consistent scholarly influence over time, emphasizing the sustained relevance of the research. The metrics also highlight the impact of "star papers," with a significant share of citations (e.g., acc1: 55, acc2: 32) concentrated in a small subset of highly influential publications, driving advancements in the field.

Over 30 years, research activity has steadily grown, with notable peaks corresponding to global events and policy shifts. The presence of 4 star papers—highly influential studies with exceptional citation performance—demonstrates the role of seminal works in shaping the trajectory of the field. Temporal metrics, such as h_coverage (69.5) and g_coverage (82.9), further illustrate how the most-cited studies continue to drive academic discussions. These findings underscore the importance of "School Meal Program" research in addressing global nutritional challenges while pointing to untapped opportunities for collaboration and innovation to enhance the field's interdisciplinary impact.

The bar chart in Figure 5. illustrates the annual distribution of publications indexed in the Scopus database for the keyword "School Meal Program" from 1994 to 2024. The data shows a fluctuating trend in publication output over the years. Between 1994 and 2008, the number of publications remained relatively low and sporadic, with no consistent upward trend. A gradual increase in research activity is evident from 2009 onwards, with a notable rise in publications between 2016 and 2021, where the annual output consistently exceeded 10 publications. The peak of publication activity occurred during 2019 and 2021, with the highest number of publications in a single year. Following this peak, the number of

publications stabilizes slightly, showing consistent yet slightly declining outputs in 2022, 2023, and 2024. This distribution reflects an overall increase in academic attention to the topic over the past three decades.

The bibliometric analysis of publications on school meal programs also identifies the most influential studies indexed in the Scopus database between 1994 and 2024 as shown in Table 4. Among these, the article by (Clark & Fox, 2009), titled "Nutritional Quality of the Diets of US Public School Children and the Role of School Meal Programs", emerges as the most referenced study with 138 citations. This study underscores the critical role of school meal programs in shaping dietary behaviors and improving the nutritional quality of meals consumed by children in the United States, positioning it as a foundational reference in the field.

Table 3. Result of Data Crawling by Harzing's Publish or Perish (PoP)

Query	School Meal Program [title] from 1994 to 2024
Source	Scopus
Papers	120
Citations	1334
Years	30
Cites_Year	44.47
Cites_Paper	11.12
Cites_Author	1334
Papers_Author	117.99
Authors_Paper	0.98
h_index	19
g_index	33
hc_index	15
hI_index	19
hI_norm	19
AWCR	212.28
AW_index	14.57
AWCRpA	212.28
e_index	23.79
hm_index	19
QueryDate	12/21/2024 17:27
Cites_Author_Year	44.46
hI_annual	0.63
h_coverage	69.5
g_coverage	82.9
star_count	4
year_first	1994
year_last	2024
ECC	1334
acc1	55
acc2	32
acc5	10
acc20	0
hA	8

Source*:* Author Analysis

Similarly, (Cullen & Chen, 2017) publication focuses on the health outcomes associated with the USDA school meal programs, accumulating 96 citations and showcasing its relevance to contemporary nutritional policies. Meanwhile, (Afridi, 2010) work provides a different perspective, offering evidence from India on how school meal programs address malnutrition and enhance child welfare in low-resource settings. These studies form the

cornerstone of scholarly discussions on the role of school meal programs in addressing food security, nutritional disparities, and educational outcomes.

Further insights from the analysis reveal that high-impact studies, such as (Chakraborty & Jayaraman, 2019) research on the connection between school feeding and learning achievement, emphasize the broader educational benefits of these programs in developing countries. The sustained annual citation rates of these articles highlight their ongoing relevance and the global scope of the discourse on school meal programs.

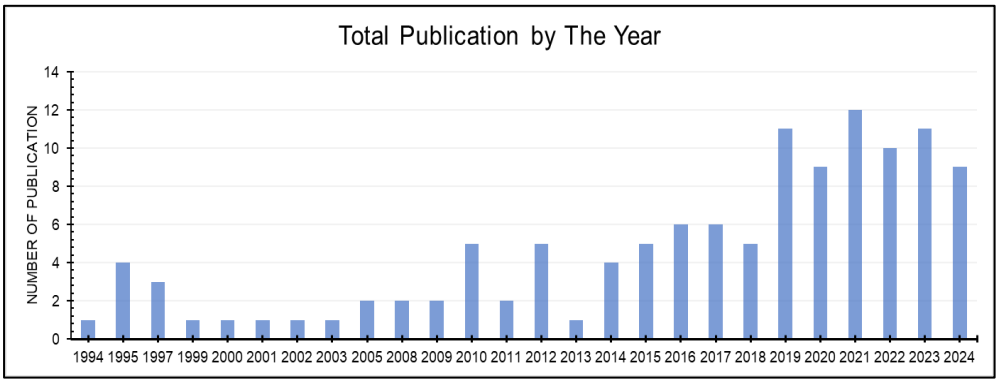

Figure 5. Distribution of publications from 1994 to 2024

Source*:* Author Analysis

Most of these impactful studies are published in rigorous journals, such as Journal of the American Dietetic Association, Preventive Medicine Reports, and Journal of Development Economics, reflecting their scholarly value and contribution to the evidence base. The collective findings reinforce that the most referenced studies serve as critical resources for policymakers and researchers aiming to optimize school meal initiatives and integrate them with public health and education strategies.

Table 4. Top-Cited Publications on School Meal Programs in Scopus Database (1994–2024)

Rank	Title	Author(s)	Year	Journal	Citations	Cites/Year
1	Nutritional Quality of the Diets of US Public School Children	(Clark & Fox, 2009)	2009	Journal of the American Dietetic Assoc.	138	9.2
2	The Contribution of the USDA School Breakfast	(Cullen & Chen, 2017)	2017	Preventive Medicine Reports	96	13.71

Rank	Title	Author(s)	Year	Journal	Citations	Cites/Year
	and Lunch Program					
3	Child Welfare Programs and Child Nutrition: Evidence from India	(Afridi, 2010)	2010	Journal of Development Economics	93	6.64
4	School Feeding and Learning Achievement: Evidence from Developing Countries	(Chakraborty & Jayaraman, 2019)	2019	Journal of Development Economics	63	12.6
5	Associations Between School Meals and Dietary Habits	(Robinson-O'Brien et al., 2010)	2010	Journal of School Health	54	3.86

Source*:* Author Analysis

Following data retrieval using Harzing's Publish or Perish (PoP), abstracts of the selected publications were systematically extracted and organized using Mendeley Desktop (Figure 6), ensuring structured management of bibliographic metadata and textual content to support subsequent analysis.

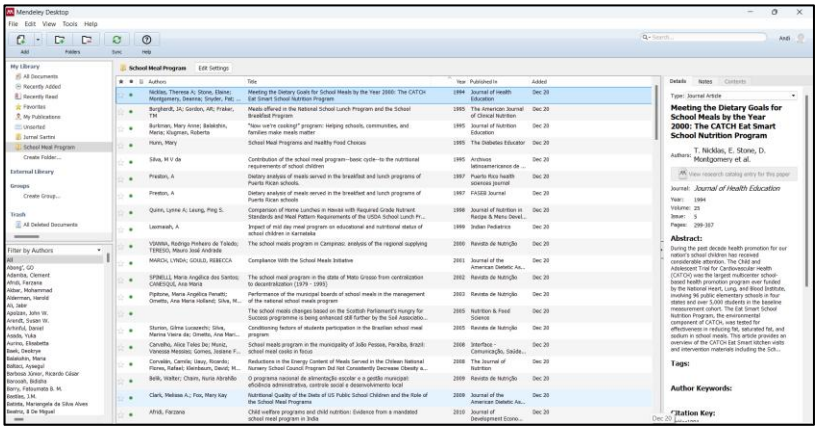

Figure 6. Extracting Abstract using Mendeley for Desktop

Source*:* Author Analysis

The extracted abstracts were subsequently transformed into a network visualization using VOSviewer software, enabling the identification of thematic clusters and research trends. This visual representation highlights the key subjects analyzed by researchers over the past 30 years, providing a comprehensive overview of the intellectual structure and focus areas within the field of school meal programs. The network map at Figure 7 serves as a critical tool to uncover the evolution of research priorities, collaborative networks, and emerging themes, contributing valuable insights to the academic discourse on this topic.

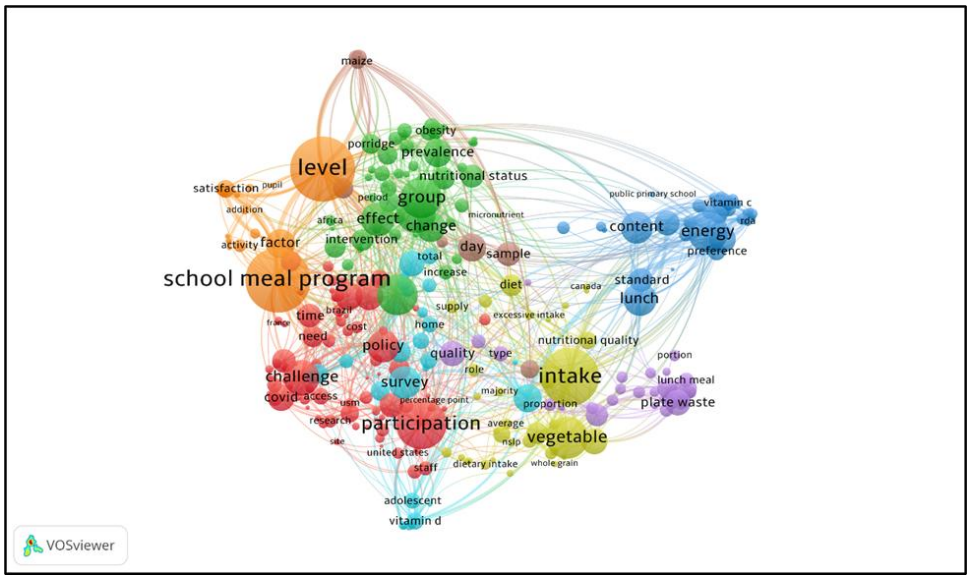

Figure 7. Network Visualization of Research Themes on School Meal Programs Based on Scopus Database (1994–2024)

Source*:* Author Analysis

The network visualization and cluster-based analysis highlight significant trends in research on school meal programs from 1994 to 2024. As the Table 5 shown the central cluster (orange) represents the foundational focus on the implementation and evaluation of school meal programs, emphasizing participation, activity levels, and satisfaction. These themes underline the programs' critical role in improving dietary behaviors and educational outcomes. The table complements this by showcasing intervention-based research as a central pillar, indicating sustained academic interest in measuring program effectiveness and accessibility.

Table 5. Elaboration of the Identified Clusters in the Network Map

Claster	Color	Keywords	Key trend and Research Thematic
1	Orange	School meal program, level, activity	This cluster examines the implementation and

Claster	Color	Keywords	Key trend and Research Thematic
		factor, satisfaction, intervention	evaluation of school meal programs, focusing on participation levels and satisfaction.
2	Red	Challenge, policy, COVID, time, cost, access	Highlights operational and policy challenges, such as cost management, accessibility, and external disruptions like the COVID-19 pandemic.
3	Green	Group, effect, nutritional status, change, prevalence, obesity, micronutrient	Investigates the impact of school meal programs on nutritional status, focusing on obesity and micronutrient deficiencies.
4	Blue	Energy, content, standard, lunch, preference, vitamin C	Analyzes energy content, nutrient standards, and preferences in school meal programs, emphasizing nutritional adequacy.
5	Yellow	Intake, vegetable, proportion, dietary intake, quality	Explores dietary intake patterns, emphasizing vegetable consumption and the overall nutritional quality of school meals.
6	Purple	Plate waste, lunch meal, portion	Focuses on food waste in school meal programs, with emphasis on portion sizes and waste management strategies.
7	Light Blue	Adolescents, home, supply, staff, survey	Examines the role of adolescents, staff, and households in determining the effectiveness of school meal programs.
8	Brown	Maize, porridge, Africa, period	Explores region-specific studies, particularly in Africa, focusing on cultural relevance and staple food inclusion like maize.

Source*:* Author Analysis

Peripheral clusters add depth by addressing policy challenges, nutritional outcomes, and emerging themes such as sustainability and cultural adaptation. The red cluster underscores systemic barriers, with keywords like "COVID" and "cost" reflecting the

increasing attention to external disruptions and economic constraints. For example, reforms such as the Healthy, Hunger-Free Kids Act have significantly enhanced dietary quality while addressing logistical issues (Chandran et al., 2023). The green cluster, focusing on nutritional impacts, highlights the role of school meals in mitigating obesity and micronutrient deficiencies, aligning with global health goals (Gopaldas, 2005).

Emerging research themes, represented in clusters such as purple (food waste) and brown (regional studies), illustrate the expanding scope of school meal program research. Waste reduction strategies, as seen in studies linking portion control to vegetable consumption, highlight the field's growing focus on sustainability (Schwartz et al., 2015). Similarly, the brown cluster emphasizes the importance of culturally tailored interventions, with African studies on maize-based school meals demonstrating the value of local adaptations. Together, these insights reveal a research field that has transitioned from foundational evaluations to addressing specific challenges and opportunities in policy, nutrition, and sustainability. This evolution underscores the need for interdisciplinary and context-sensitive approaches to advance global school meal initiatives.

Furthermore, the overlay visualization map as shown in Figure 8 reveals the chronological evolution of research themes in school meal programs from 1994 to 2024, with color coding highlighting shifts in focus over time. In the early period (1994–2005), represented by blue tones, research primarily centered on foundational aspects of school meal programs, such as participation, policy development, and programmatic impact. Keywords like "policy," "participation," and "satisfaction" reflect the establishment of school meal programs as critical interventions for child nutrition and education. This phase provided essential frameworks for understanding the systemic role of these programs in addressing malnutrition and promoting educational equity.

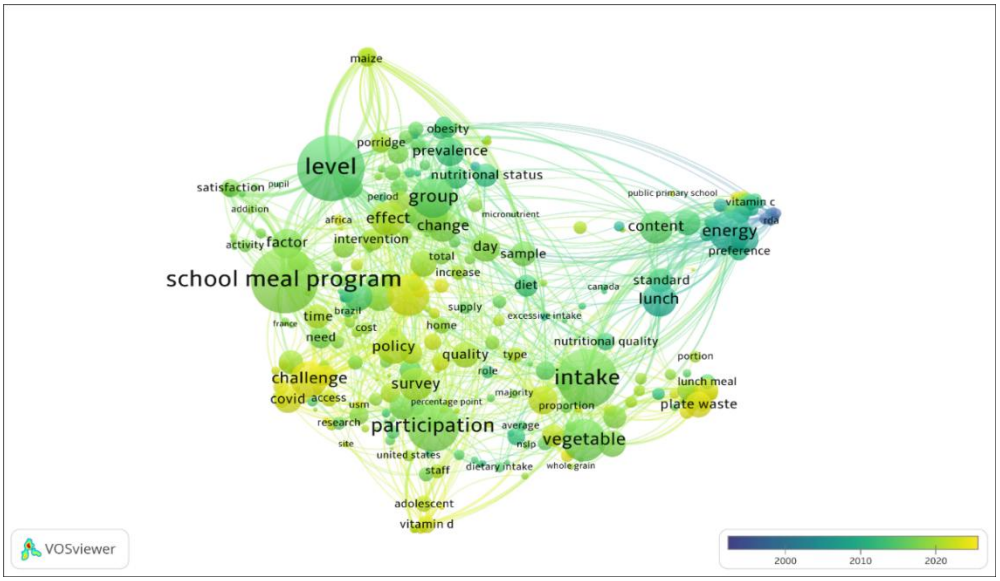

Figure 8. Development of Research Themes in School Meal Programs (1994–2024)

Source*:* Author Analysis

The period from 2005 to 2015, indicated by green hues, marks a transition towards investigating the specific health and nutritional outcomes of school meal programs. During this time, keywords like "nutritional status," "obesity," and "micronutrient" gained prominence, highlighting efforts to address global nutritional disparities. Research during this phase focused on evaluating program effectiveness in combating conditions such as childhood obesity and micronutrient deficiencies, particularly in low- and middle-income countries. Additionally, regional studies, evident from keywords like "Africa" and "adolescent," emerged, emphasizing the importance of demographic and cultural factors in shaping program outcomes.

The most recent phase (2016–2024), represented by yellow tones, reflects a growing focus on sustainability, dietary diversity, and operational efficiency. Emerging themes include "plate waste," "vegetable," and "proportion," underscoring efforts to reduce food waste while improving dietary quality. Concurrently, there has been a notable shift toward integrating broader dietary considerations, such as nutrient-specific interventions (e.g., "vitamin C") and improving the overall content of school meals. These developments demonstrate an evolution toward refining the impact of school meal programs through sustainable practices, enhanced nutritional standards, and evidence-based program optimizations.

Table 6. Review of Research Themes in School Meal Programs on Period 1994–2024

Time Period	Color (Overlay Visualization)	Key Themes	Insights	Gaps and Future Directions
1994–2005	Blue	Participation, policy, satisfaction	Early research focused on foundational aspects, such as establishing school meal programs as critical interventions for child nutrition and education.	Limited exploration of regional disparities and culturally tailored program designs.
2005–2015	Green	Nutritional status, obesity, micronutrients	Research shifted towards evaluating specific nutritional outcomes, with an emphasis on mitigating childhood obesity and addressing micronutrient deficiencies.	Insufficient focus on operational challenges (e.g., cost and logistics) and the intersection of health and educational goals.

Time Period	Color (Overlay Visualization)	Key Themes	Insights	Gaps and Future Directions
2016–2024	Yellow	Sustainability, plate waste, dietary diversity	Recent studies have emphasized improving program sustainability through reduced food waste, optimizing portion sizes, and enhancing dietary quality (e.g., vegetables).	Lack of integration of advanced technologies, such as AI and digital tools, for program delivery and real-time monitoring.

Source*:* Author Analysis

As detailed in Table 6, the analysis of school meal programs research over the past 30 years underscores their thematic issue. However, from a policy perspective, the bibliometric evolution identified in this study has direct implications for the design and governance of Indonesia's Free Nutritional Meal initiative (MBG). Early research in this field concentrated on participation and policy design, indicating that programme effectiveness is strongly determined by clear institutional mandates, transparent governance structures, and standardized operational procedures. Subsequent studies shifted attention toward nutritional status, micronutrient intake, and educational outcomes, suggesting that MBG should be assessed not only in terms of coverage but also through measurable improvements in dietary diversity, reduction of anemia prevalence, school attendance, and learning readiness. More recent contributions emphasize sustainability, food waste management, and dietary quality, indicating that MBG should be framed as an integrated food-system intervention aligned with SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 12 (Responsible Consumption and Production), and SDG 17 (Partnerships for the Goals).

The existing evidence indicates that adapting international best practices to the MBG context is likely to encounter significant implementation constraints. Variations in infrastructure, procurement capacity, storage systems, and local food availability may result in uneven program performance across regions. Additional challenges include limited cold-chain logistics, fragmented cross-sector coordination, inadequate nutrition monitoring systems, fiscal constraints, and potential low acceptance of meals when menus do not align with local dietary preferences. These considerations suggest that MBG should not be implemented through a uniform national model. Instead, it requires a framework that combines nationally defined nutritional and governance standards with context-specific menu adaptation, phased institutional capacity strengthening, digital monitoring of procurement and food waste, and integrated evaluation of both health and educational outcomes. Future studies should therefore assess whether MBG contributes to sustained improvements in nutritional status, school participation, cognitive outcomes, and social mobility, particularly in disadvantaged settings.

V. Conclusion and Recommendatio

This study has provided a comprehensive bibliometric analysis of research on school meal programs, synthesizing contributions from prominent authors, key thematic trends, and insights for governance and sustainability. The bibliometric review revealed that scholars such as (Cullen & Chen, 2017) and (Clark & Fox, 2009) have significantly shaped the discourse on school meal programs, contributing extensively to themes such as dietary quality, policy implementation, and programmatic challenges. Their work has been instrumental in advancing understanding of how school meal programs address nutritional and educational inequities, particularly through targeted interventions and evaluations. The central role of key contributors in shaping the research landscape and advancing policy-relevant academic discourse is thereby emphasized.

Over the last three decades, research on school meal programs has evolved through distinct thematic phases. Early studies focused on foundational aspects such as participation and policy development, highlighting the systemic importance of school meal programs in addressing malnutrition and improving educational outcomes. Mid-phase research expanded into specific health and nutritional impacts, including obesity prevention and micronutrient supplementation, as reflected in studies emphasizing nutritional adequacy and regional diversity. More recent work has pivoted towards sustainability, operational efficiency, and cultural relevance, with a heightened focus on themes such as food waste reduction, local agricultural integration, and nutritional diversity. This progression illustrates the field's responsiveness to global priorities, including the Sustainable Development Goals (SDGs), and its capacity to adapt to emerging societal needs.

. The bibliometric evidence indicates that effective governance of school meal programs is contingent upon the integration of policy design, nutritional outcomes, and sustainability considerations within a coherent implementation framework. In the context of Indonesia's Free Nutritional Meal (MBG) initiative, this necessitates a multi-level governance arrangement in which the central government defines minimum standards for nutrition, food safety, procurement, and performance reporting, while subnational authorities adapt implementation strategies to local agricultural conditions, infrastructure capacity, and student preferences. Such an approach enables greater policy coherence while ensuring responsiveness to Indonesia's geographical and socio-economic heterogeneity.

At the operational level, several strategic and practical recommendation can be identified. First, the phased implementation of MBG through pilot programs across diverse territorial contexts, e.g.: urban, peri-urban, rural, and remote areas which allow for context-sensitive evaluation using standardized indicators, including cost efficiency, dietary adequacy, food waste, attendance, and learning readiness. Second, the development of structured local procurement mechanisms linking schools with farmer groups, cooperatives, and small-medium enterprises would strengthen local food systems while enhancing freshness and cultural acceptability of meals. Third, the adoption of digital technologies for menu planning, inventory management, delivery verification, and monitoring of nutritional compliance and plate waste is essential to improve operational efficiency and transparency. Fourth, integrated evaluation frameworks involving both health and education sectors are required to assess outcomes such as anemia prevalence, cognitive performance, attendance, and classroom engagement, thereby positioning MBG as a human capital investment rather than solely a feeding intervention. Finally, future research should prioritize longitudinal and intergenerational analyses, particularly in disadvantaged regions, to assess the sustained

impacts of MBG in advancing key Sustainable Development Goals, including SDG 2, SDG 3, SDG 4, SDG 10, and SDG 12, through an equitable and evidence-based public policy framework.

Limitation

This study employs a robust methodology using Scopus as the primary bibliographic database and advanced tools like Harzing's Publish or Perish and VOSviewer for comprehensive bibliometric analysis. While Scopus provides a well-recognized and extensive dataset, future research could expand by incorporating other databases, such as Web of Science, to ensure even broader coverage. The focus on metadata and abstracts offers a strategic overview of research trends, yet further exploration of full-text analyses could deepen thematic insights and uncover context-specific findings. These considerations highlight opportunities for building on this study's strong foundation to advance knowledge and develop more nuanced strategies for sustainable school meal programs.

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