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REVIEW ARTICLE

Exploring Global Food Insecurity and Obesity among Children Under Five Years: A Scoping Review

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ABSTRAK

Kenaikan berat badan berlebihan dan obesiti di kalangan kanak-kanak di bawah lima tahun telah menjadi isu kesihatan global yang ketara. Pertubuhan Kesihatan Sedunia melaporkan bahawa obesiti kanak-kanak meningkat daripada 4% pada tahun 1975 kepada 18% pada tahun 2016, yang melibatkan 38.2 juta kanak-kanak di bawah lima tahun menjelang 2019. Ketidaksamaan sosioekonomi, terutamanya ketidakjaminan makanan, menyumbang dengan ketara kepada isu kesihatan ini dengan menjejaskan kualiti pemakanan dan hasil kesihatan kanak-kanak. Kajian sorotan ini mengkaji hubungan antara ketidakjaminan makanan dan obesiti di kalangan kanak-kanak di bawah umur lima tahun di pelbagai rantau. Kajian ini mengikut garis panduan 'Preferred Reporting Items for Systematic Reviews and Meta-Analyses' (PRISMA) lanjutan kajian sorotan (PRISMA-Scr) di mana carian sistematik di PubMed, Scopus dan 'Web of Science' dilakukan untuk kajian yang diterbitkan antara Januari 2019 dan Januari 2024. Carian ini memfokuskan kepada kanak-kanak di bawah lima tahun, menilai keselamatan makanan di peringkat isi rumah dan mengkaji kaitannya dengan obesiti atau indeks jisim tubuh (BMI). Sebanyak 12 artikel yang telah disaring, menunjukkan perbezaan serantau yang besar dalam kadar ketidakjaminan makanan. Prevalens tertinggi ditemui di kalangan keluarga India Amerika di Amerika Syarikat (61%), diikuti oleh Jerash, Jordan (45.7%) dan Brazil (43.2%). Kebanyakan kajian menunjukkan hubungan yang kukuh antara ketidakjaminan makanan dan obesiti kanak-kanak. Walau bagaimanapun, laporan dari Ethiopia dan Iran tidak menunjukkan hubungan langsung, mungkin dipengaruhi oleh konteks tempatan. Kajian ini menyerlahkan hubungan kompleks antara ketidakjaminan makanan dan obesiti kanak-kanak, terutamanya dalam populasi yang kurang bernasib baik. Menangani isu ini memerlukan pendekatan pelbagai, termasuk campur tangan dasar, sokongan komuniti dan penyelidikan lanjut. Pembuat dasar perlu memberi tumpuan kepada peningkatan akses makanan, kemampuan dan pendidikan pemakanan.

Kata kunci: *Faktor sosioekonomi; ketidakjaminan makanan; obesiti kanak-kanak*

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ABSTRACT

The rise in overweight and obesity among children under five years has become a significant global health concern. The World Health Organization reports that childhood obesity increased from 4% in 1975 to 18% by 2016, affecting 38.2 million children under five years by 2019. Socioeconomic inequalities, particularly food insecurity, significantly contribute to these health issues by affecting children's dietary quality and outcomes. This scoping review examined the association between food insecurity and obesity in children under five years across different regions. This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA-Scr) extension for scoping reviews, systematically searching PubMed, Scopus, and Web of Science for studies published between January 2019 and January 2024. The search focused on children under five years, assessing household or child-level food security, and exploring associations with obesity or body mass index (BMI). Twelve articles were included, showing considerable regional differences in food insecurity rates. The highest prevalence was found among American Indian families in the US (61%), followed by Jerash, Jordan (45.7%) and Brazil (43.2%). Most studies indicated strong links between food insecurity and childhood obesity. However, reports from Ethiopia and Iran did not suggest direct relationships, underscoring the importance of local context. This review highlights the complex relationship between food insecurity and childhood obesity, especially in disadvantaged populations. Addressing this issue requires a multifaceted approach, including policy interventions, community support, and further research to understand contextual differences. Policymakers should focus on enhancing food access, affordability and nutritional education.

Keywords: Childhood obesity; food insecurity; socioeconomic factors

INTRODUCTION

The increased prevalence of childhood overweight and obesity worldwide has raised a concern and become one of the major public health problems that need serious attention. Data from World Health Organisation (WHO) report showed that the global prevalence of childhood overweight and obesity has increased significantly from 4% in 1975 to 18% in 2016. The pattern of the increment is similar in both boys and girls, where 18% of girls and 19% of boys were overweight. Meanwhile, for children under five years old, it is estimated that 38.2 million were overweight and obese in 2019, with the prevalence predominantly high in upper middle income and high income countries (WHO 2021).

These health inequalities stem from socioeconomic disparities that impact not only the adult population but also younger children. One of the burdens of non-communicable diseases (NCDs) that requires attention, particularly among the young children is the emergence of the double burden of malnutrition, emphasising the increased prevalence of obesity in this age group (Campbell 2016). However, studies showed that children living in families with low incomes have two times greater risk to be affected by overweight and obesity than children living in higher income, and urban poor is significantly associated with childhood overweight and obesity (Reis et al. 2020; Titis et al. 2023).

The concept of food security encompasses various characteristics, which can be categorised into four main pillars. These pillars include the physical availability of food,

the economic and physical access to food, the usage of food, and the stability of these dimensions across time. Food insecurity is resulted when individuals failed to sustained the physical, social, and economic means to obtain a sufficient quantity of food that is both safe and nutritious, and that meets their specific dietary needs and preferences. This state of food insecurity disables individuals towards an active and healthy lifestyle (Sulaiman et al. 2021).

Food insecurity is characterised by constraints or uncertainty in the accessibility of nutritionally sufficient and safe food, as well as the capacity to acquire socially acceptable meals. The recognition of the importance of alleviating food insecurity is seen in its inclusion as a prominent objective under the second target of the Sustainable Development Goals (SDGs) for the year 2030 (Raheem et al. 2021).

On a global scale, it has been approximated that 41% of households that have children below the age of 15 years old encounter a significant level of food insecurity, categorised as either moderate or severe, while 19% of these households faced severe food insecurity. Furthermore, a significant proportion of households, which is 45%, indicated a lack of adequate financial resources to acquire food throughout the previous 12-month period (Pereira et al. 2021).

Children from low socioeconomic families are potentially exposed to unhealthy foods such as high fat, high sugar, high salt-energy dense and micronutrient-poor foods, which are types of food that are cheaper but poor in nutrient quality that will lead to childhood overweight and obesity (Martín-Rodríguez et al. 2022). In this scoping review, we examined the associations between food insecurity and obesity in children under five years old. The review summarised the overall evidence and discussed variations according to relevant demographics and the experience of food insecurity episodes. This review was necessary to understand the complex relationship between food insecurity and childhood obesity, inform public health interventions, and guide policy decisions aimed at addressing these important issues.

MATERIALS AND METHODS

This scoping review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews (PRISMA-ScR) guidelines (Tricco et al. 2018), as outlined in Figure 1. A thorough search was performed in PubMed, Scopus and Web of Science to identify studies examining the relationship between food insecurity and childhood obesity from a global perspective. The search strategy employed a combination of keywords and subject headings tailored to each database that was detailed in Table 1 and focused on the following concepts: (i) Population: children under five years old; (ii) Exposure: food insecurity status; and (iii) Outcome: prevalence of childhood obesity.

The search was restricted to English-language studies published from 2019 up to January 2024 to ensure the inclusion of the most recent and relevant research on the prevalence of food insecurity and obesity in children under five. This time frame was chosen to capture the latest trends and developments in the field, reflecting current societal, economic, and environmental factors affecting food insecurity and childhood obesity. References were extracted from the databases, and duplicates were eliminated using the Deduplicator tool from the Systematic Review Accelerator (Bond University, Institute for Evidence-Based Healthcare, Queensland, Australia) (Clark et al. 2020). The remaining references and their

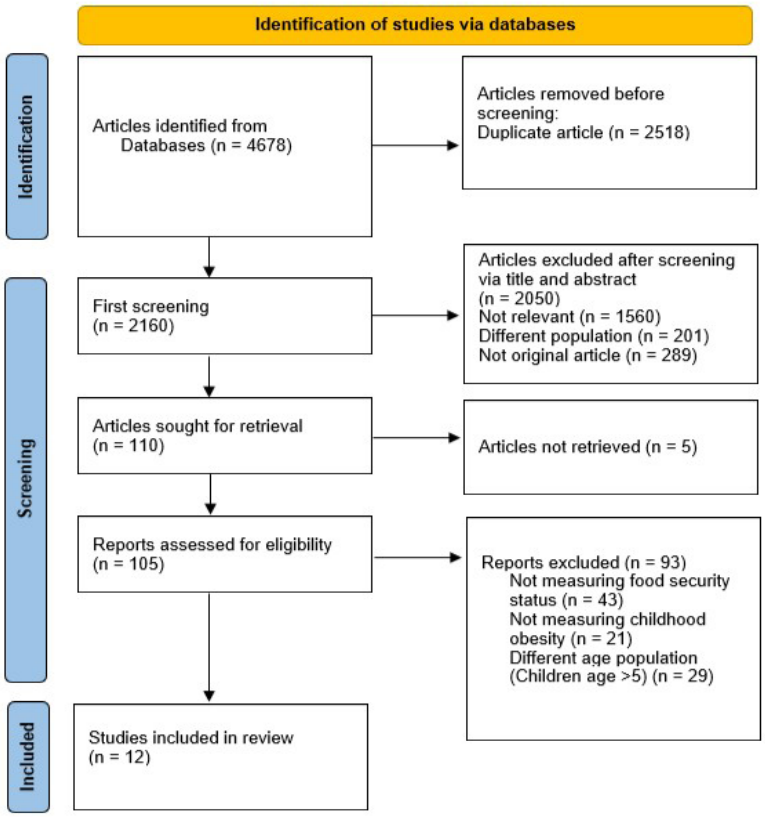

FIGURE 1: PRISMA flow chart

TABLE 1: Search string used for each database

Database	Search string
PubMed	((“Food insecurity” OR “food security” OR “Hunger” OR “Food scarcity” OR “Food deprivation” OR “Food insufficiency”) AND (“Children” OR “child” OR “kid*” OR “toddler*” OR “minor” OR “youngster*” OR “preschooler*” OR “paediatric”)) AND (“Obesity” OR “Overweight” OR “Adiposity” OR “Fatness”))
Scopus	TITLE-ABS-KEY (("Food insecurity" OR "food security" OR “Hunger” OR "Food scarcity" OR "Food deprivation" OR "Food insufficiency”) AND (“Children” OR “child” OR “kid*” OR “toddler*” OR “minor” OR “youngster*” OR “preschooler*” OR “paediatric”)) AND (“Obesity” OR “Overweight” OR “Adiposity” OR “Fatness”)
Web of science	ALL= ((“Food insecurity” OR “food security” OR “Hunger” OR “Food scarcity” OR “Food deprivation” OR “Food insufficiency”) AND (“Children” OR “child” OR “kid*” OR “toddler*” OR “minor” OR “youngster*” OR “preschooler*” OR “paediatric”)) AND (“Obesity” OR “Overweight” OR “Adiposity” OR “Fatness”))
The symbol * was used as truncation and wildcard function to increase the variability of selected keywords.	

abstracts were then imported into EndNote X (Clarivate Analytics, Philadelphia, PA, USA) for further screening.

The titles and abstracts were initially screened based on the following eligibility criteria: (i) original research articles; (ii) quantitative and mixed-method studies; (iii) focused on children under five years old; and (iv) examined the association between food security status and the nutritional status of children. This included studies that assessed food insecurity or insufficiency at the household or child level; compared outcomes by food security status; and examined obesity or body mass index (BMI) as the primary outcome of interest. Studies not related to childhood obesity, adiposity or overweight were excluded.

After eliminating duplicates, the remaining papers were rescreened by at least two reviewers. Any article that failed to pass title screening and did not meet the eligibility criteria was removed in the first stage. In the second phase of the review process, the abstracts of the remaining papers were examined, and any publications that did not meet the eligibility criteria were excluded. Finally, the full text of the articles was carefully reviewed to ensure eligibility and accessibility. Five articles identified during the screening phase could not be retrieved due to access restrictions, including limited database availability and subscription barriers. The process of study selection was summarised in the PRISMA flow chart (Figure 1).

Before commencing the data extraction process, the agreement of both reviewers on the review of the entire publication was necessary. Discussions were carried out to resolve any disputes that occurred. A standardised data extraction form using Microsoft Excel was used for each independent data extraction. The data extracted included the study design, population characteristics, exposure (food insecurity), outcome (childhood obesity) and relevant findings.

RESULTS

Characteristics of Included Studies

The initial search identified 4,678 records across three databases. After removing 2,518 duplicates, 2,160 records were screened. Of these, 2,055 articles were excluded for reasons such as irrelevance to the research question (n=1,560), different population focus (n=201), non-original articles (n=289), and inability to retrieve (n=5), leaving 105 articles for full-text review. Following further exclusions due to differing outcome measures, 12 studies were included in the final review. Generally, there have been a few studies in the past five years specifically addressing obesity among children under 5-years-old and its association with food insecurity. Of the 12 studies, the majority were conducted in the United State of America (USA) (n = 7). Other countries included Iran (n = 1), Brazil (n = 1), Ethiopia (n = 1), Jordan (n = 1), and the sub-Saharan African region (n=1), which included 10 countries in one study. Most of the studies employed a cross-sectional study design. Table 2 explained the characteristics of the included studies and Table 3 summarised the key attributes of the included studies.

Food Security Assesment

Regarding food security assessment tools, seven studies used national tools; such as the US Department of Agriculture Household Food Security Survey (five studies) (Adams et al. 2019; Benjamin-Neelon et al. 2020; Gipson-Jones et al. 2019; Martoccio et al. 2021; Treviño-Peña et al. 2020), the Brazilian Food Insecurity Scale (one study) (De Paiva Lourenção et al. 2021)

and the Iranian Household Food Insecurity Access Scale (one study) (Minaie et al. 2019).

The remaining five studies utilised other assessment tools including the Food and Agriculture Organisation's Food Insecurity Experience Scale, the Household Wealth Index, the Household Food Insecurity Access Scale, and early life exposure assessments by mothers (Abukishk et al. 2021; Alaba et al. 2023; Dinku et al. 2020; Gamba et al. 2021). This diverse methodological approach highlighted the varied contexts and metrics used to evaluate food security in relation to childhood obesity across different regions.

Prevalence of Food Insecurity

The results from this review revealed varying levels of food insecurity across different countries and populations. The highest prevalence was reported by a study from Adams et al. (2019) in the USA, where 61% of American Indian families with children aged 2-5 years old experienced food insecurity. Following closely, a study by Abukishk et al. (2021) found that 45.7% of households in Jerash, Jordan, were food insecure, significantly higher than the 26.5% in Souf District. Additionally, a study by De Paiva Lourenção et al. (2021)

TABLE 2: Characteristics of the included studies

No.	Author (Year)	Setting	Study design	Participants	Sample size
1	Abukishk et al. (2021)	Jordan	Cross-sectional	Children under 5 years old	367
2	Adams et al. (2019)	USA	Cross-sectional	2-5 years old children	450
3	Alaba et al. (2023)	Sub Saharan Africa	Cross-sectional	Children under 5 years old	55,285
4	Benjamin-Neelon et al. (2020)	USA	Cohort study	Infants	666
5	De Paiva Lourenção et al. (2021)	Brazil	Cross-sectional	Children aged 6 months to 5 years	581
6	Dinku et al. (2020)	Ethiopia	Cross-sectional	Children aged 6 months to 5 years	512
7	Gamba et al. (2021)	USA	Cohort	Children under 5 years old	243
8	Gipson-Jones et al. (2019)	USA	Cross-sectional	2-5 years old children	264
9	Martoccio et al. (2021)	USA	Cross-sectional	Preschool-age children	100
10	Minaie et al. (2019)	Iran	Cross-sectional	2-5 years old children	7,028
11	Tayie et al. (2021)	USA	Cross sectional	Children under 7 years old	4,121
12	Treviño-Peña et al. (2020)	USA	Cross-sectional	Preschooler	1,907

Footnote: USA: United States of America

TABLE 3: The key attributes of the included studies

No	Author (year)	Country	Food security assessment tool	Outcome assessed	Prevalence of food insecurity	Main findings of food insecurity and childhood obesity
1	Abukishk et al. (2021)	Jordan	Food and Agriculture Organization's Food Insecurity Experience Scale	Body mass index-for-age z-score +2SD. Overweight	Souf: 26.5% Jerash: 45.7% higher likelihood of severe food insecurity (cOR 2.33, CI: 1.4-3.87, p<0.001)	Jerash: 18.2% Souf: 7.1% (p=0.008) Crude OR (Jerash vs. Souf): 2.89 (CI: 1.26-6.63, p=0.012)
2	Adams et al. (2019)	USA	Food security from the US Department of Agriculture Household Food Security Survey	BMI for age	Households Affected: 61%.	Child Weight Classification: Obese: 22% Overweight: 18% Healthy Weight: 60% Findings: High rates of overweight and obesity (40%) were found among young American Indian children. Although household food insecurity was prevalent, its impact on child BMI remains unclear
3	Alaba et al. (2023)	Sub-Saharan African countries: Zimbabwe (2015), Malawi (2015), Burundi (2016), South Africa (2016), Guinea (2018), Mali (2018), Zambia (2018), Sierra Leone (2019), Senegal (2019), and Ethiopia (2019).	The household wealth index	Overweight Classification: Weight-for-height Z-score > +2 SD was classified as overweight.	NA	Overweight Prevalence: Highest: South Africa (13.8%) Lowest: Burundi (1.4%) Above Average (4.9%): Sierra Leone (5.0%), Zambia (5.4%), Guinea (6.0%), Zimbabwe (6.0%), South Africa (13.8%) Impact: Overweight disproportionately affected children from households in several countries, including Burundi, Ethiopia, Malawi, Mali, Senegal, Sierra Leone, Zambia, and Zimbabwe. Statistically significant concentration indices were found in Burundi, Mali, Senegal, and Zimbabwe (95% CI).

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4	Benjamin-Neelon et al. (2020)	USA	18-item US Household Food Security Survey Module.	Infant BMI Z-Scores: · Overweight: BMI Z-score > 1 Skinfold Thickness: · Overall Fatness Proxy: Sum of subscapular and triceps skinfold thickness (SS + TR) · Central Fatness Proxy: Ratio of subscapular to triceps skinfold thickness (SS/TR	Household Food Security: High/Marginal: 66.4% Low/Very Low: 8.8%	Overweight Risk (Infants): Food-Secure Households: Decreased from 46.8% (3 months) to 33.1% (12 months) Food-Insecure Households: Increased from 53.2% (3 months) to 66.9% (12 months) Adjusted Outcomes (Very Low Food Security vs. High Food Security): BMI Z-scores: 0.18 (95% CI 0.01 to 0.35; p = 0.04) Subscapular Skinfold Z-scores: 0.31 (95% CI 0.04 to 0.59; p = 0.03) Odds of Overweight Risk: OR 1.55 (95% CI 1.14 to 2.10; p = 0.005)
5	De Paiva Lourenção et al. (2021)	Brazil	Brazilian Food Insecurity Scale (EBIA, in Portugis)	BMI-for-Age (BMI/A): Measured in Z-scores.	Food Security Status: Food Secure: 56.8% Food Insecure (Total): 43.2% Mild: 35.3% Moderate: 5.0% Severe: 2.9% Concern: 43.2% of the sample experienced food insecurity, with 5.0% at moderate and 2.9% at severe levels, raising concerns about hunger.	Children's Anthropometric Profiles: · Overweight: 22.7% · Obesity: 8.8% · High Weight: 8.3% · Short Stature: 23.6% Key Observations: · 95% of excess weight in disadvantaged socioeconomic classes was attributed to poor diet, with only 5% due to endogenous factors. · Cheaper foods, often high in calories and low in nutritional value, were a major determinant of excess weight.

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6	Dinku et al. (2020)	Ethiopia	Household Food Insecurity Access Scale (HFIAS)	BMI-for-age Z-score (BAZ).	Food Insecurity: Overall: 33.1% of children were in households experiencing any form of food insecurity. Female-Headed Households: 57.3% Male-Headed Households: 22.9% ($p < 0.0001$) Non-Educated Mothers: 76.3% Educated Mothers: 28.5% ($p < 0.0001$)	Children's Weight Status: Overweight or Obese: 42.2% Obese (BAZ score > 3): 27.9% Overweight (BAZ score between 2 and 3 SD): 15.2% Food insecurity and socio-economic status did not affect children's weight
7	Gamba et al. (2021)	USA	To assess early life exposure to food insecurity, mothers were asked when their children was age 1 and 2 to select yes/ no in response to the statement, "felt like not enough food to feed baby" in the past 12 months.	Height z-scores, Weight z-scores, and BMI z-scores. Obesity was defined as having a BMI>95th percentile based on age and sex.		Childhood obesity prevalence was 28% at age 3.5. Early life exposure to food insecurity (ELEFI) was associated with a 0.43 kg/m decrease in BMI from age 2 to 3.5, after adjusting for other factors. ELEFI was linked to a 0.92 kg/m increase in BMI among boys from age 3.5 to 5, but no significant BMI changes were observed in girls after adjusting for other factors.
8	Gipson-Jones et al. (2019)	USA	The food insecurity questions from the USDA Household Food Security Survey Module.	BMI for age Z score. Children who had BMIs at or above the 85th percentile were classified as overweight/obese.	42.1% of households experienced food insecurity.	23.3% of the children were classified as overweight or obese.

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9	Martoccio et al. (2021)	USA	The US Household Food Security Survey Module	Children were classified as overweight or obese if their BMI was at or above the 85th percentile for their age and sex.		There was a significant correlation between socioeconomic risk and child BMI z-score (r = 0.20, p = 0.05). Child BMI z-score: Mean = 0.39, SD = 1.11, Range = 2.06 to 4.07.
10	Minaie et al. (2019)	Iran	Iranian Household Food Insecurity Access Scale (HFIAS).	BMI for age (BAZ).	28.9% of total children were food insecure.	Food-insecure children generally had lower anthropometric indices compared to food-secure children, indicating poorer nutritional status.
11	Tayie et al. (2021)	USA	Child food security survey module of the US Census Bureau's Current Population Survey.	Overweight was defined as a Z-score +2 SD, whereas severe overweight (obesity) was defined as Z-score +-3SD. A BMI-for-age value greater than the 95th percentile was categorised as obese (severe overweight).	Among the 4,121 children who met the inclusion criteria: 65.3% were in the food secure category, 13.7% were in the marginal food security category, 21.0% were in the food-insecure category.	The prevalence of overweight/obesity was significantly higher among children in the marginal food security (7.8%, p = 0.001) and food insecure (7.9%, p = 0.001) categories compared to the food secure category (5.8%). Within the marginal food security category, children aged 2–3 years had significantly greater body weight (p = 0.001), height (p = 0.028), and BMI (p = 0.001) compared to their food-secure counterparts.
12	Treviño-Peña et al. (2020)	USA (Texas Mexico)	The US Department of Agriculture (USDA), Expanded Food and Nutrition Education Program.'	BMI for age	57% of the children were living in poverty. Nearly half of the parents/ guardians reported running out of food sometimes, most of the time, or always before the end of the month.	The prevalence of obesity was 19.2% in boys and 16.8% in girls. The height and weight percentiles indicated that the children were shorter than 52% and heavier than 57% of US children of the same age.

Footnote: FAO: Food and Agriculture Organization; USDA: United States Department of Agriculture; HFIAS: Household Food Insecurity Access Scale; cOR: Crude Odds Ratio; CI: Confidence Interval; OR: Odds Ratio; NA: Not Applicable. USA: United States of America; BMI: Body Mass Index; SD: Standard Deviation; ELEFI: Early life exposure to food insecurity

reported that 43.2% of Brazilian families with children aged 6 months to 5 years old faced food insecurity, with 35.3% experiencing mild, 5.0% moderate and 2.9% severe levels. Furthermore, a study by Gipson-Jones et al. (2019) reported that 42.1% of households with 2- to 5-year-old children in West Tennessee, USA, were food insecure.

On the other hand, moderate food insecurity was reported by Dinku et al. (2020), which found that 33.1% of households in Ethiopia with mother-child pairs (children aged 6-59 months old) experienced food insecurity, with a higher prevalence in female-headed households (57.3%) and those with non-educated mothers (76.3%). Additionally, a study by Minaie et al. (2019) found that 28.9% of children aged 2-5 years old in Iran were food insecure. Another study by Tayie et al. (2021) noted that among 4,121 children in the USA, 13.7% were marginally food secure, and 21.0% were food insecure.

A few studies also reported a lower prevalence of food insecurity. A study by Benjamin-Neelon et al. (2020) reported that in the south-eastern USA, 66.4% of households with infants had a high or marginal food security, while 8.8% had a low or very low food security. Lastly, a study by Treviño-Peña et al. (2020) highlighted that 57% of households with preschoolers in Texas and Mexico were living in poverty, with nearly half of parents/guardians frequently running out of food before the end of the month. These findings emphasised the critical and widespread issue of food insecurity, with significant variability based on geographical location, household head gender, and parental education levels.

Food Insecurity and Childhood Obesity

The majority of the studies reviewed found a significant association between food insecurity and higher prevalence of childhood overweight and obesity (Abukishk et al. 2021; Adams et al. 2019; Benjamin-Neelon et al. 2020; De Paiva Lourenção et al. 2021; Gipson-Jones et al. 2019; Tayie et al. 2021). For instance, a study by Adams et al. (2019) reported that 61% of American Indian families with children aged 2-5 years old in the USA experienced food insecurity, with 22% of the children were classified as obese. Similarly, a study by Abukishk et al. (2021) found that 45.7% of households in Jerash, Jordan, were food insecure, which was associated with a higher prevalence of overweight among children compared to Souf District.

Besides that, a study by De Paiva Lourenção et al. (2021) reported that 43.2% of Brazilian families faced food insecurity, with a remarkable occurrence of overweight and obesity among children. In addition, a study by Gipson-Jones et al. (2019) found that 42.1% of households in West Tennessee, USA, were food insecure, with nearly a quarter of the children were classified as overweight or obese. On top of that, a study by Benjamin-Neelon et al. (2020) noted that infants from food-insecure households in the southeastern USA showed an increase in overweight prevalence, and a study by Tayie et al. (2021) highlighted that food insecurity was associated with a higher prevalence of overweight and obesity among children in the USA.

However, a study from Ethiopia (Dinku et al. 2020) did not find an association between food insecurity and child anthropometric indicators such as overweight or obesity, despite a moderate prevalence of food insecurity (33.1%) among households with mother-child pairs. Additionally, a study from Iran (Minaie et al. 2019) highlighted poor nutritional status among food-insecure children but did not directly link food insecurity to overweight or obesity.

Overall, the evidence suggested that food insecurity was frequently associated with higher rates of childhood obesity, particularly in disadvantaged populations. However, there were exceptions, such as the studies from Ethiopia and Iran, which did not find a direct link between food insecurity and overweight or obesity, indicating that the relationship may be influenced by contextual factors.

DISCUSSION

This scoping review explored the prevalence of food insecurity and its association with childhood obesity among children under 5-years-old across various global contexts. The review revealed a significant variation in food insecurity levels and highlighted a consistent association between food insecurity and higher rates of childhood obesity in many of the studies. However, notable exceptions were also identified, suggesting that the relationship between food insecurity and obesity may be influenced by local contextual factors such as cultural dietary practices, local food environments, and socioeconomic conditions, in which they play a crucial role in shaping the impact of food insecurity on childhood weight status (Dinku et al. 2020; Minaie et al. 2019).

In the studies reviewed, the prevalence of food insecurity varied significantly across different regions and populations. High prevalence rates were observed in regions such as North America (e.g., American Indian families in the USA) (Adams et al. 2019), the Middle East (e.g., households in Jerash, Jordan) (Abukishk et al. 2021), and South America (e.g., Brazilian families) (De Paiva Lourenção et al. 2021), with reported levels ranging from 42% to 61%. Conversely, moderate levels of food insecurity were reported in regions like sub-Saharan Africa (Dinku et al. 2020) and parts of the Middle East (Minaie et al. 2019), with prevalence rates ranging from 21% to 33%. The variations in food insecurity levels across different studies can be attributed to several factors. In regions with high poverty rates, economic instability, and limited access to resources, food insecurity tends to be higher. For example, American Indian families in the USA and households in Jerash, Jordan, faced significant economic challenges, leading to higher food insecurity. In more economically stable regions or where social safety nets are stronger, food insecurity levels are generally lower. For example, in the south-eastern USA, despite having some pockets of food insecurity, it shows higher overall food security due to better economic conditions and access to assistance programs.

In some cultures, dietary practices and food distribution within households may exacerbate food insecurity. For instance, in Ethiopia, the higher prevalence of food insecurity among female-headed households may reflect cultural norms of the disadvantaged women in resource allocation. In addition, lower levels of education among parents, particularly mothers, can lead to a higher food insecurity. Studies have highlighted those non-educated mothers in Ethiopia report significantly higher rates of food insecurity (Dinku et al. 2020). In addition, regions prone to environmental challenges such as drought, poor soil quality, or lack of access to clean water may experience higher food insecurity. This is seen in the study from Ethiopia, where environmental factors contribute to food scarcity.

The majority of the studies found a significant association between food insecurity and higher prevalence of childhood overweight and obesity. This association can be explained by several factors. From the aspect of nutritional quality and dietary patterns of the children, food-insecure households may prioritise calorie-dense, nutrient-poor foods

that are cheaper and more filling but contribute to weight gain and poor health outcomes to the children. This phenomenon, known as the "food insecurity-obesity paradox," suggests that limited resources of food will lead to reliance on unhealthy food options that promote obesity (Dhurandhar 2016).

This paradoxical situation where food insecurity coexists with obesity, can be attributed to several underlying dynamics, for example the high cost of healthy foods whereby the fresh fruits, vegetables, lean proteins, and whole grains are often more expensive and less accessible in low-income neighbourhoods. This financial barrier pushes families towards cheaper, processed foods high in sugars, fats, and salts, which contribute to weight gain and poor health outcomes (Hunter-Adams et al. 2019). Secondly, the high calorie-dense foods provide more energy per unit of cost compared to nutrient-dense foods. Therefore, families facing food insecurity might opt for foods that can stretch their budget further, often at the expense of nutritional quality. This reliance on inexpensive, high-calorie foods can lead to excessive calorie intake and weight gain (Wu et al. 2019).

While the association between food insecurity and childhood obesity was evident in many studies, exceptions like the study by Minaie et al. (2019) that highlighted poor nutritional status among food-insecure children but did not directly link food insecurity to overweight or obesity. This suggests that while food insecurity leads to poor nutrition, it does not necessarily result in obesity in all contexts. Factors such as the quality of available food, feeding practices, and access to healthcare play a crucial role. In Iran, traditional diets and cultural practices may influence nutritional outcomes differently compared to Western contexts.

The differences in findings underscore the complexity of the relationship between food insecurity and childhood obesity. Study by Pryor and Dietz (2022) suggest that while food insecurity is a risk factor for poor nutritional outcomes, its impact on obesity may be mediated by additional factors such as local dietary patterns, physical activity levels and healthcare access. Understanding these differences is essential for developing targeted interventions that consider the unique needs of different populations.

The findings of this review have significant implications for policymakers and practitioners. The association between food insecurity and childhood obesity suggests the need for targeted interventions in populations with a high prevalence of food insecurity. Policymakers should prioritise programs that address both food security and nutritional quality to mitigate the dual burden of malnutrition and obesity. Community-based initiatives that improve access to healthy foods, provide nutritional education, and support economic stability are crucial.

Future research should explore the underlying mechanisms linking food insecurity to childhood obesity. Longitudinal studies are needed to establish causality and understand the temporal relationship between food insecurity and obesity. Research should also consider the role of contextual factors, such as cultural dietary practices, social support systems, and local food environments, in shaping the relationship between food insecurity and childhood obesity.

Moreover, it is important to conduct research in diverse geographic and cultural contexts to gain a comprehensive understanding of the global impact of food insecurity on childhood obesity. Studies should also utilise standardised and validated food security assessment tools to ensure comparability of results across different regions.

Strength and Limitation

This scoping review demonstrates several key strengths that enhance the understanding of the relationship between food insecurity and childhood obesity. By including studies from global perspective and utilising various food security assessment tools, the review provides a broad and robust perspective on the issue. The focus on children under five years old addresses a critical developmental period, offering insights into early childhood growth and health impacts. Highlighting the importance of contextual factors such as cultural dietary practices, local food environments, and socioeconomic conditions, the review underscores the need for tailored interventions. The findings guide policy development and community support programs while identifying gaps for future research, emphasising the need for more longitudinal studies and diverse settings to develop effective strategies for addressing this public health issue.

This scoping review has several limitations that may influence the interpretation and generalisability of the findings. First, potential biases in study selection and the heterogeneity of assessment tools used across the included studies may affect the consistency and comparability of the results. Additionally, the cross-sectional nature of most studies limits the ability to infer causality between food insecurity and childhood obesity, as temporal relationships cannot be established.

Second, this review focused on studies published within the last five years to ensure the findings reflect current trends and policies. However, this decision may exclude earlier studies that could provide valuable historical insights. As a result, the limited temporal scope may restrict the global applicability of the findings, particularly for regions with less recent research on food insecurity and childhood obesity. Future reviews would benefit from adopting a broader time frame to capture long-term trends and changes in this relationship.

Third, the comprehensiveness of the data is constrained by the limited representation of certain regions, particularly the Far East and Southeast Asia, which were not included in this review. This gap likely stems from the search strategy employed, which may not have captured relevant studies from these areas. Expanding geographic coverage in future reviews could provide a more balanced understanding of the global landscape of food insecurity and childhood obesity.

CONCLUSION

The review identifies a statistically significant relationship between food insecurity and childhood obesity, particularly among disadvantaged populations. Studies from countries like the USA, Jordan and Brazil consistently show that food insecurity is linked to higher rates of childhood obesity, due to factors such as high consumption of calorie-dense foods, stress-induced eating, and cyclical food availability. Addressing this issue calls for policy approaches to improve food security and affordability, community support, and healthcare provider initiatives. Further research, especially through longitudinal studies, is necessary to better understand this complex relationship.

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