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Dr. Alok Rawat
Ph.D., Guide, HOD, Community Health Nursing, Tantia University, Sri Ganga Nagar, Dibrugarh, Assam, India

Pooja
Ph.D., Scholar, Tantia University, Sri Ganga Nagar, Dibrugarh, Assam, India

Corresponding Author:
Dr. Alok Rawat
Ph.D., Guide, HOD, Community Health Nursing, Tantia University, Sri Ganga Nagar, Dibrugarh, Assam, India

Exploring the relationship between junk food consumption and health outcomes in school-aged children in India: A systematic review

Dr. Alok Rawat and Pooja

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Abstract
Adolescence marks a crucial period of rapid physical growth, accompanied by hormonal and emotional changes. Nutritional needs surge due to this growth spurt, alongside evolving food habits driven by increased independence and experimentation. Divided into early, middle, and late stages, adolescence shapes cognitive development and decision-making. Poor nutrition during this phase can impair cognitive abilities. Globally, junk food consumption is rising, especially among school children and adolescents, posing health risks due to their high sugar, fat, and salt content and lack of nutrients. The study encompasses experimental or interventional research, focusing on schools, and educational institutions. It seeks scientific papers in peer-reviewed journals, including original articles, systematic reviews, and government guidelines in English. Targeting school children aged 6-12 years and adolescents aged 13-17 years, interventions involve nutrition education, counseling, lifestyle modifications, and physical activity promotion, comparing against no intervention. Inclusion criteria involve literature focusing on school-based strategies related to nutrition, healthy eating, physical activity, and lifestyle. Exclusions include culinary activities, drugs, and studies on abnormal eating habits or disorders. Selection methods entail identifying relevant articles from databases and reference lists, yielding 8 related scientific papers. This review investigates the intricate link between junk food consumption and health outcomes in Indian school-aged children. With a surge in junk food intake among this demographic, concerns over its health impact have grown. The study aims to uncover how junk food affects children's health by analyzing dietary patterns, nutritional status, and chronic conditions prevalence. Findings reveal disparities in junk food consumption across age groups, socioeconomic classes, and urban-rural areas. The review stresses the need for balanced diets and awareness campaigns, especially in schools. It also highlights the adverse effects of frequent junk food consumption on oral health, adolescent obesity, and gender-based nutritional deficiencies. Urgent interventions, like lifestyle modifications and school screenings, are recommended to tackle hypertension's rising rates among adolescents.

Keywords: Adolescence, nutritional needs, physical growth, hormonal changes, emotional changes, food habits

Introduction
Adolescence is the only time following infancy when the rate of physical growth actually increases. This sudden growth spurt is associated with hormonal, cognitive, and emotional changes that make adolescence an especially vulnerable period of life. First, there is a greater demand for calories and nutrients due to the dramatic increase in physical growth and development over a relatively short period of time. Second, adolescence is a time of changing lifestyles and food habit-changes that affect both nutrient needs and intake. Third, adolescent drive for individuation means more opportunity to assert food choices and expand or narrow healthy options. Adolescence can be divided into three stages. Early adolescence (11-14 years of age) is characterized by the onset of puberty and increased cognitive development. Middle adolescence (15-17 years of age) is characterized by increased independence and experimentation. Late adolescence (18-21 years of age) is a time for making important personal and occupational decisions. Poor nutrition during any of these stages can have lasting consequences on an adolescent's cognitive development, resulting in decreased learning ability, poor concentration, and impaired school performance Eating junk food has become a trend. The children hate homemade healthy food. Junk food is injurious to health.

Eating Burger and Pizza increases cholesterol in human body. The fat in human body increases. The increase fat is dangerous for heart. Drinking soft drinks adds dangerous toxins in human body. It affects the bone, skin and kidney.

Junk food consumption (JFC) is increasing globally (Baraldi *et al*., 2018; Mandoura *et al*., 2017) [1, 2], and this trend is most alarming in low-and-middle-income countries (LMICs) (Baker & Friel, 2016; Saha *et al*., 2021) [3, 4]. JFC is particularly common among school children and adolescents [SCA] (Gupta *et al*., 2018; Moradi Latreyi *et al*., 2020; Sahoo *et al*., 2015; Silva *et al*., 2021; Upreti *et al*., 2020) [5, 6, 7, 8, 9]. Junk foods are energy-dense foods with high sugar, fat, and salt but low or no nutrients such as protein, fiber, vitamins, and minerals (Ashakiran & Deepthi, 2012; Datar & Nicosia, 2012; Kaushik *et al*., 2011) [10, 11, 12]. However, junk foods encompass a wide array of foods, including at least four categories: sweet foods, sweet beverages/sugary drinks, salty snacks, and fast foods. Sweet foods include biscuits, chocolates and candies, bakeries, sweets, etc. The sweet beverages include soda, cola, juicy, apple cider, beer, etc. The salty foods include noodles, cheese balls, potato chips, popcorn, papad, puffed rice, etc. The fast foods include *Samosa*, *Pakauda*, *Pizza*, *Chowmein*, *Mo:Mo*, hot dogs, burgers, sausage, French fries, etc. Junk foods contain high calories, refined salt, poly saturated fat, trans fat, monosodium glutamate (MSG), colours, artificial sweeteners, toppings, and some other additives (Arya & Mishra, 2013; Ashakiran & Deepthi, 2012; Kaushik *et al*., 2011) [13, 10, 12]. The terms such as 'junk food', 'ultra/processed food', 'hyper-palatable food', 'fast food', 'instant food', 'sugar-sweetened beverage', 'unhealthy snack food', and 'snack food' are often used interchangeably and so is the case in this paper.

Rational for review

Junk food consumption (JFC) is increasingly acknowledged as a significant public health issue, with research underscoring its adverse effects (Bohara *et al*., 2021; Vaida, 2013) [15, 14]. Evidence suggests that JFC is a primary contributor to preventable diet-related diseases and premature deaths. The global rise in premature deaths and illnesses from diet-related non-communicable diseases, including in Nepal, emphasizes the urgency of addressing this issue (Gupta *et al*., 2018; Neupane, 2014) [5, 16]. Individuals of all ages suffer from the negative health impacts of JFC, with school children and teenagers being notably vulnerable (Neupane, 2014) [16]. Recent trends indicate a shift in young people's dietary habits towards industrially processed foods, leading to increased JFC among school-age children and adolescents in Nepal (Bohara *et al*., 2021; Upreti *et al*., 2020) [15, 9]. Given that dietary habits formed during childhood and adolescence often persist into adulthood, intervention efforts targeting this demographic could yield significant long-term health benefits (Kelder *et al*., 1994) [17]. Schools play a crucial role in shaping children's behaviors, including dietary choices, making them ideal settings for promoting healthy eating habits and lifestyles (CDC, 2011; World Economic Forum, 2020) [18, 19]. Addressing these research gaps could enhance our understanding of the drivers and consequences of JFC, informing evidence-based strategies to promote healthier dietary behaviors and reduce the burden of preventable diet-related diseases.

Materials and Methods

This systematic review encompasses the analysis of 8 comprehensive articles. The review protocol includes various types of experimental or interventional research such as quasi-experimental studies, randomized controlled trials (RCTs), and cluster randomized controlled trials (C-RCTs), along with systematic reviews and review articles. The primary focus is on educational settings, particularly schools. The literature sought includes English-language scientific papers published in peer-reviewed journals, comprising original research, systematic reviews, and governmental guidelines or protocols. The study aims to encompass diverse geographical regions and target a population consisting of children aged 6–12 years and adolescents aged 13–17 years. Intervention strategies under consideration include nutrition education, diet counseling, lifestyle and behavior modifications, and promotion of physical activity. A specific emphasis is placed on comparing these interventions with a control group receiving no intervention.

Inclusion Criteria

The inclusion criteria for this systematic review encompass studies conducted exclusively in India and involving participants within the school-aged range, typically aged between 6 and 17 years. These studies must focus on examining the correlation between junk food consumption and various health outcomes among school-aged children. Additionally, eligible research must be published in peer-reviewed journals and available in the English language. Studies employing quantitative, qualitative, or mixed-methods research designs are considered for inclusion to ensure a comprehensive exploration of the topic.

Exclusion Criteria

Exclusion criteria for this systematic review entail studies conducted outside of India, as the focus is specifically on the context of India. Additionally, studies involving participants outside the defined school-aged range, falling below 6 years or above 17 years, are not included to maintain consistency in the target population. Studies that do not directly investigate the relationship between junk food consumption and health outcomes among school-aged children are excluded to ensure relevance to the research question. Non-peer-reviewed sources, including conference abstracts, books, or grey literature, are not considered due to their potential lack of rigorous review processes. Articles not available in English are excluded to maintain consistency in language comprehension. Furthermore, studies lacking in methodological rigor or containing insufficient data are excluded to uphold the quality and validity of the systematic review findings. The literature selection strategy is presented in Appendix 1. Figure 1 represents the search strategy in the form of a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart.

Prisma flowchart

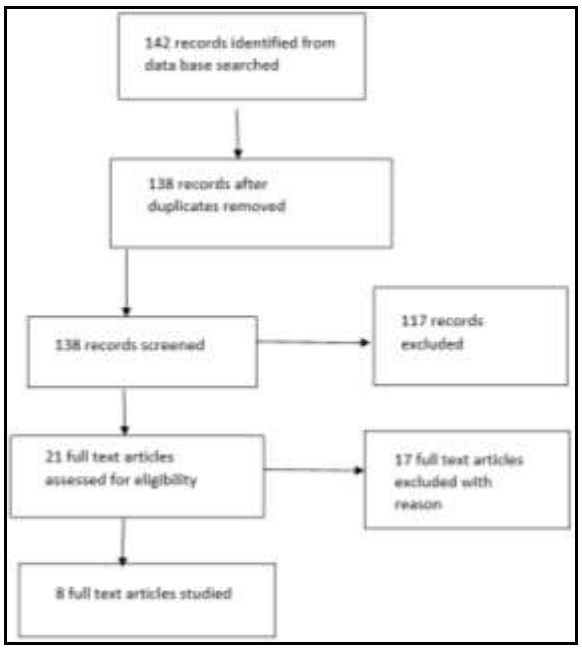

FIG 1: Conceptual framework and search strategy (PRISMA flow chart).

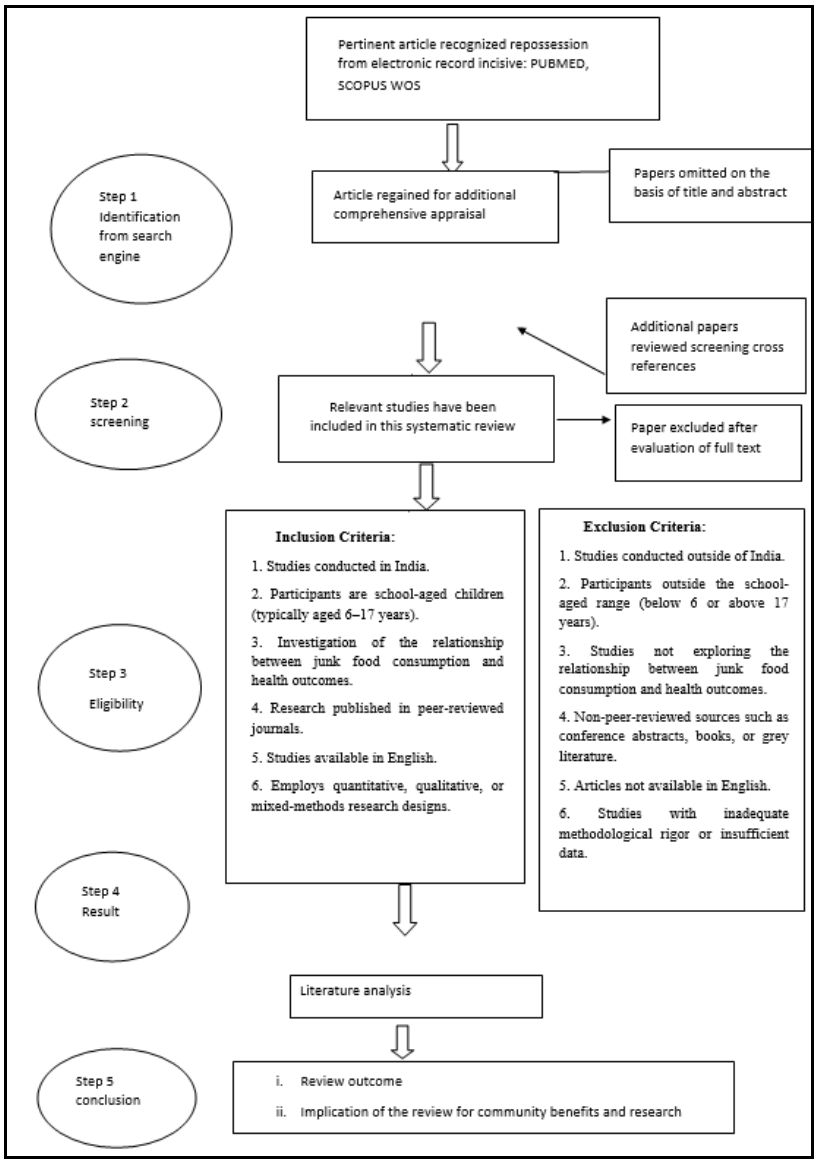

Fig 2: Conceptual framework of the methodology.

Table 1: Main findings, Methodology and methods

Author/s Year	Sample/setting/sampling technique	Methodology and methods	Main findings
1. Fathima A, *et al.* 2024 [3-4]	Study involved children (5-12 years) and adolescents (13-18 years) from rural (Chinnakanganangkuppam) and urban (Ariyankuppam) areas. Sample size: 360, using cluster sampling.	A cross-sectional study interviewed children or adults with a semi-structured questionnaire after parental consent. Sampling involved rural and urban clusters.	In 144 children (5-12 years), junk food prevalence was 40%; in 90 adolescents (13-18 years), it was 25%. Chocolate (38.88%) was common in 173 children; chips (38.02%) in 73 adolescents. Higher consumption occurred daily or <3 times/week compared to weekly or more. Age 5-8 had 2.73 times more consumption than 13-18 (P=0.001). Unemployed mothers consumed 2.35 times more than employed (P=0.002). Urban areas had 2.41 times higher consumption than rural (P=0.001).
2. Fathima A, *et al.* 2024 [34]	360 children under the age of 5-12 years and adolescents aged 13-18 who dwell in the rural and urban field practicing region with the help of cluster sampling technique	A community-based, cross-sectional study was conducted. Data were collected with the help of quasi-structured questionnaire	The most common junk food eaten by 173 children was chocolate (38.88%) and in 73 adolescents, it was chips (38.02%). The most common fast food eaten by the 60 children (85.72%) and 18 adolescents (78.27%) was samosa. The most common instant food eaten by 10 children (71.42%) and 52 adolescents (96.29%) was noodles. The most common street food for 71 children (51.83%) and 37 adolescents (74%) was golgappaa/pani puri.
3. Athavale P, *et al.* 2020	Three NGO staff utilized word-of-mouth to recruit a convenience sample of mothers/caregivers of children aged 6 months to 6 years in five urban slum communities.	This study employed mixed methods for data collection: 1. Nutrition and Oral Health Survey: Administered by trained NGO staff and university volunteers, consisting of 50 questions adapted from WHO's oral health survey, focusing on maternal and child nutrition and oral health. 2. Dental Screening Exams: Conducted by licensed Indian dentists, who visually assessed dental conditions following WHO guidelines. 3. Anthropometric measures: Children's weight and height were measured by community health workers and volunteers, adhering to WHO standards, using digital scales and stadiometers.	Eighty percent of children lived 5 min from a junk-food store, over 50% consumed junk-food and sugary tea daily, 50% experienced ECC, 19% had severe deep tooth decay, 27% experienced mouth pain, and 56% experienced chronic and/or acute malnutrition. In children ages 3–6, each additional tooth with deep decay was associated with increased odds of undernutrition (Odds Ratio [OR] 1.10, Confidence Interval [CI] 1.02–1.21). Focus groups identified the junk-food environment, busy family life, and limited dental care as contributors to ECC.
4. Grace GA, *et al.* 2021 [6]	The necessary sample size was determined as 110 obese adolescents (cases) and 110 non-obese adolescents (controls). From the 16 Higher Secondary Schools, two were randomly chosen. Cases and controls were selected based on BMI for age and sex, with age-based group matching for controls.	This school-based case-control study was carried out in Chrompet, which is an urban residential area in Tambaram Taluk of Kancheepuram district, Tamil Nadu. Data collected via structured questionnaire included sociodemographics, family obesity history, physical activity, dietary intake, parent info, sibling info, meal habits, and TV behavior.	About 52.7% of children belonged to the age group 13–15 years. Adequate fruits intake was reported by 42.7% of obese adolescents and 60% of nonobese adolescents. Adequate intake of vegetables was noted in 20.9% of cases and 24.5% of controls. The risk factors which were found to be statistically associated with adolescent obesity were increased fast food intake, sweets consumption, inadequate fruit intake, and the liberty given by the parents in purchasing snacks..
5. Khan AS, *et al.* 2022 [20]	A sample size of 200 was determined for adolescents aged 10-18 years, with a 95% confidence interval and 5% precision, assuming a 14.5% prevalence of iron deficiency anemia.	It was a single centre cross-sectional, clinical observational study done in Department of pediatrics and Medicine, Assam Medical college and Hospital, Dibrugarh, Assam. Adolescents from OPD and IPD were randomly selected after counseling and obtaining consent. Detailed clinical examination included general and systemic assessments. Laboratory criteria included hemoglobin levels, mean corpuscular volume, and serum ferritin. Ethical clearance and parental consent were obtained. Data collection and analysis followed.	Among 200 adolescents, the prevalence of anemia is 51%. Within anemic adolescents, 34.3% have iron deficiency anemia (IDA), while others have non-IDA anemia. IDA rates differ between males (16.5%) and females (18.8%), with higher rates in females aged 14-18. Junk food consumption correlates with higher IDA prevalence. Adolescents with low BMI exhibit a 60% IDA rate, overweight individuals 14.2%, and those with normal BMI 7%. IDA prevalence is higher in lower socioeconomic classes.
6. Fadnis VP, *et al.* 2020 [8]	A total 507 students belonging to the age group of 10-17 years were examined.	It was An observational/cross-sectional study. Data collection done by Anthropometric measurements were taken to calculate Body Mass Index (BMI) and Blood pressure was measured by using mercury sphygmomanometer. Gender, age and height were considered for determining hypertension.	Amongst the 507 children, prevalence of pre-hypertension was 15.4% and that of hypertension was 10.85%. The increased frequency of intake of junk and/or salty food has shown to have a strong corelation with hypertension. Nearly 6 (23.07%) out of the 26 people who had junk food more than 6 times a week were shown to have hypertension as compared to the 12 (5.21%) out of the 230 people who had junk food less than 2 times in a week

7. Kirti K, *et al*., 2023 [7]	The CNNS employed a multi-stage sampling approach to choose a representative sample of households and individuals aged 0–19 years across 30 states.	The research methodology utilized data from the "Comprehensive National Nutrition Survey (CNNS) (2016-18)," a collaborative effort between the Ministry of Health and Family Welfare, Government of India, UNICEF, and the Population Council. The CNNS conducted a nationwide survey of children and adolescents, employing a multi-stage sampling approach to select households and individuals. In rural settings, this entailed selecting primary sampling units (PSUs) and households, while in urban areas, it involved sampling urban wards and census enumeration blocks (CEBs).	Researchers studied 12,318 teenagers, dividing them into five groups based on their eating habits. One group tended to eat unhealthy food and had more obesity and health issues. Another group ate mostly plant-based but lacked some nutrients and had obesity and diabetes. Another group preferred convenient food, lacking essential nutrients and facing health issues. The last group followed a Western diet, also facing health problems and nutrient deficiencies.
8. Begum RF, *et al*. 2023 [10]	200 adolescent girls	Cross-sectional study. A cross-sectional study examined the intake of several types of junk food in 200 girls with and without menstrual abnormalities by investigating their menstrual patterns, anthropometric measures, and eating frequency	It found that junk food consumption was substantially related to menstrual difficulties. Junk food slows down the body's metabolism and reduces the calories it burns, making it challenging to maintain a healthy weight. Junk food indirectly affects androgen levels through IR. Elevated insulin levels cause the decline of sex hormone-binding globulin (SHBG), a regulatory protein that suppresses the activity of androgens in females and causes hyperandrogenism when cytokines cause IR. There is a correlation between the current young society and junk food which lead to obesity and its complications.

Discussion

Several studies shed light on the pervasive impact of junk food on various health aspects, particularly among children and adolescents. Fathima *et al*. (2024) [3-4] revealed high junk food prevalence, notably in urban areas, influencing metabolic and hormonal manifestations. Urban residency and maternal employment significantly influenced consumption rates, highlighting environmental and social determinants. Similarly, Bohara *et al*. (2021) [15] found high junk food consumption among Nepalese adolescents, with social settings playing a crucial role. A community-based study in Puducherry (Dec 2020-Oct 2022) unveiled common junk food items like chocolate, chips, samosa, and noodles among children and adolescents, indicating a widespread dietary pattern. Emphasized gender differences in junk food consumption, with girls more inclined towards it, citing taste and convenience as primary motivators. Athavale *et al*. (2020) [5] highlighted the alarming prevalence of junk food consumption among low-income communities in Mumbai, linking it to Early Childhood Caries (ECC) and malnutrition. Grace *et al*. (2021) [6] corroborated the association between junk food consumption and obesity among adolescents, stressing the need for dietary interventions.

Study in Egypt revealed concerning rates of oral health issues and overweight/obesity among children, indicating the multifaceted impact of dietary habits. Explored the association between junk food consumption and anemia prevalence, emphasizing the need for targeted nutritional interventions. Fadnis *et al*. (2020) [8] underscored the link between junk food intake and hypertension among adolescents, with factors like family history and obesity exacerbating risks. Kirti *et al*. (2023) [7] employed data analytics to identify dietary patterns among adolescents, revealing associations with obesity and metabolic conditions. Begum *et al*. (2023) [10] elucidated the detrimental effects of junk food on hormonal disorders like PCOS, emphasizing the importance of dietary modifications in disease management.

These studies collectively highlight the pervasive influence of junk food on various health outcomes, underscoring the urgent need for targeted interventions and policy measures to promote healthier dietary habits among children and adolescents.

Bias Assessment

The study "Exploring the Relationship Between Junk Food Consumption and Health Outcomes in School-Aged Children in India: A Systematic Review" undergoes comprehensive bias assessment. Selection bias might occur if the sampled studies fail to represent the diverse demographics of Indian school-aged children, potentially skewing findings. Publication bias could overestimate the link between junk food and health outcomes if studies with significant results are disproportionately published. Language bias might arise if the review excludes non-English studies, limiting the inclusivity and applicability of findings. Reporting bias could distort the overall assessment if studies selectively report outcomes related to junk food consumption. Funding bias is a concern if the review receives funding from entities with vested interests, potentially influencing interpretations. Methodological bias may arise from inadequate search strategies or inclusion criteria, impacting the review's reliability. Confounding bias is a challenge in accounting for variables like socioeconomic status, which independently influence junk food consumption and health outcomes. Addressing these biases is crucial for accurately interpreting the review's findings and ensuring the validity of conclusions regarding junk food's impact on health outcomes in Indian school-aged children.

Limitations of the study

The study "Exploring the Relationship Between Junk Food Consumption and Health Outcomes in School-Aged Children in India: A Systematic Review" faces several limitations. Firstly, the reliability and validity of findings depend heavily on the quality of the included studies, which may vary in methodology and data collection techniques.

Secondly, the generalizability of the findings may be limited due to regional variations in dietary habits, cultural factors, and socioeconomic status across India. Moreover, temporal factors pose a challenge as the review may not capture recent developments or changes in junk food consumption patterns and health outcomes among school-aged children. Additionally, reliance on published studies introduces the risk of publication bias, potentially skewing the assessment of the relationship between junk food consumption and health outcomes. Language bias is another concern, as limiting the review to English publications may overlook relevant research in other languages. Furthermore, the heterogeneity of included studies in terms of design, population, and outcome measures may hinder the synthesis of findings and the strength of evidence. The review may also inadequately address confounding factors such as socioeconomic status and parental influences, which could independently impact both junk food consumption and health outcomes. Lastly, bias within the individual studies included in the review, such as selection bias or reporting bias, could influence the overall conclusions. Acknowledging and addressing these limitations is crucial for ensuring the reliability and validity of the systematic review's conclusions regarding the relationship between junk food consumption and health outcomes in school-aged children in India.

Conclusion

In conclusion, this review underscores the urgent need for comprehensive public health interventions to address the rising prevalence of junk food consumption and its associated health outcomes among school-aged children in India. Such interventions should encompass education, policy measures, and community-based programs aimed at promoting healthier dietary habits and preventing diet-related diseases from early childhood through adolescence.

Conflict of Interest

Not available

Financial Support

Not available

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