archiv euromedica 2026 | vol. 16 | num. 2 |

PUBLIC HEALTH

Cite as: Archiv EuroMedica. 2026. 16; 2. DOI [10.35630/2026/16/Iss.2.2](10.35630/2026/16/Iss.2.2)

Received 5 March 2026;
Accepted 18 April 2026;
Published 25 April 2026

THE ROLE OF NUTRITION EDUCATION IN PREVENTING CHILDHOOD OBESITY

Adrianna Purwin[1] ✉, Katarzyna Siwiec[1], Anna Kułach[1], Zofia Wcisło[2], Grzegorz Szmit[2], Weronika Basak[2], Maria Chmielewska[3], Łukasz Lamparski[4], Wiktoria Modrzejewska[4], Gabriela Krok[5]

[1] *Medical University of Warsaw, Poland*
[2] *Military Institute of Medicine, Warsaw, Poland*
[3] *Mazovian Brodnowski Hospital, Warsaw, Poland*
[4] *National Medical Institute of the Ministry of Interior and Administration, Warsaw, Poland*
[5] *Henryk Klimontowicz Hospital in Gorlice, Poland*

✉ ***adapurw@gmail.com***

ABSTRACT

BACKGROUND

Childhood obesity is a major public health problem with increasing prevalence and long-term health consequences. Although nutrition education is widely used to influence dietary behavior in children and adolescents, its independent effectiveness remains unclear due to heterogeneity of interventions and outcomes.

AIM

To evaluate the effectiveness of nutrition education in preventing overweight and obesity in children and adolescents, with differentiation between behavioral and clinical outcomes, and to identify factors modifying intervention effectiveness.

METHODS

A narrative review was conducted using PubMed, Google Scholar, and ResearchGate. The search covered studies published between 2013 and 2025, with one earlier key study included due to its relevance. The selection process involved screening titles and abstracts, followed by full text assessment according to predefined inclusion and exclusion criteria. Randomized controlled trials, controlled studies, and systematic reviews involving participants aged 5 to 18 years were included. Studies were required to report outcomes related to dietary behavior, nutrition knowledge, or anthropometric indicators. A total of 16 primary intervention studies were included in the analysis, along with relevant systematic reviews.

RESULTS

Nutrition education interventions consistently improve nutrition knowledge by approximately 10 to 25 percent and increase healthy food choices by 15 to 20 percent. In preschool children, interventions involving parents increase fruit and vegetable consumption by about 0.6 additional eating occasions per day and improve biochemical markers. Multi-level programmes reduce intake of unhealthy foods by 0.5 to 1.0 servings per day. School-based interventions, including gardening and cooking programmes, increase vegetable consumption by 0.5 to 0.8 servings per day and may lead to small reductions in BMI of about 0.2 to 0.4 units. However, effects on clinical outcomes remain inconsistent, and in many studies BMI changes are absent or limited. Greater effectiveness is observed in multi-component interventions that include parental involvement and environmental support.

CONCLUSIONS

Nutrition education improves dietary behavior and knowledge in children and adolescents, but its effect on clinical indicators of obesity is limited. The most consistent results are achieved in multi component programmes that integrate educational, family, and environmental components.

Keywords: childhood obesity, nutrition education, dietary behavior, prevention, children, adolescents, BMI, school-based interventions

INTRODUCTION

Childhood obesity is a major public health concern associated with an increased risk of metabolic, cardiovascular, and psychological disorders, as well as a high likelihood of persistence into adulthood [1,2]. Although its prevalence continues to rise globally, obesity is a multifactorial condition driven by complex interactions between behavioral, environmental, and social determinants, with dietary patterns representing a key modifiable factor [6,7,8].

In recent years, preventive strategies have increasingly focused on interventions targeting eating behaviors, among which nutrition education has emerged as a commonly implemented approach [9,10]. Nutrition education aims to improve knowledge, skills, and attitudes related to food choices, thereby influencing dietary behavior. However, despite widespread implementation in school, family, and community settings, the effectiveness of such interventions remains heterogeneous. Existing studies differ substantially in design, duration, outcome measures, and integration with environmental or behavioral components, which complicates the interpretation of results and limits comparability across studies [9,11,12,13].

Moreover, a significant proportion of the literature combines nutrition education with broader multi-component interventions, making it difficult to isolate its independent contribution to obesity prevention [10,14]. While some reviews report improvements in knowledge and short-term behavioral outcomes, evidence regarding sustained effects on anthropometric indicators such as BMI remains inconsistent [12,13,14]. In addition, the role of contextual factors, including parental involvement, age of participants, and delivery format, has not been systematically analyzed within a unified framework [15,16,17].

Given these limitations, there is a need for a focused synthesis of current evidence addressing the specific role of nutrition education within obesity prevention strategies. This includes evaluation of different educational approaches, identification of factors influencing effectiveness, and critical analysis of methodological constraints present in existing studies [18,19,20].

The aim of this narrative review is to examine the role of nutrition education in preventing childhood obesity by analyzing existing interventions, assessing their effectiveness, and identifying factors that influence outcomes, including age, family environment, and implementation context.

The following research questions were formulated:

1. Effectiveness of nutrition education with differentiation between behavioral and clinical outcomes.
2. Modifying factors of effectiveness, including programme type, age, and family involvement.
3. Limitations and barriers, including methodological constraints and environmental factors.

MATERIALS AND METHODS

PURPOSE OF THE STUDY

The purpose of this narrative review was to evaluate the role of nutrition education in the prevention of childhood overweight and obesity by synthesizing evidence from intervention studies conducted in children and adolescents. The review focused on both stand alone nutrition education programmes and multi component interventions in which education constituted a central element.

The analysis was structured to address the effectiveness of nutrition education with differentiation between behavioral outcomes such as dietary habits and knowledge, and clinical outcomes including anthropometric indicators. In addition, the review examined key factors modifying intervention effectiveness, including programme type, age of participants, and the role of family involvement. Particular attention was given to identifying methodological limitations and environmental barriers that may influence the implementation and outcomes of nutrition education interventions across different settings.

SEARCH STRATEGY:

The literature search was conducted using PubMed, Google Scholar, and ResearchGate with predefined keywords and Boolean operators.

The basic search string was:

(prevention [Title/Abstract] OR intervention [Title/Abstract]).

Search filters were applied to include only full texts of peer-reviewed articles published in English since 2013. One exception was made for a seminal systematic review published prior to this date, which was included due to its foundational relevance to the topic of school-based nutrition education interventions [21].

Studies were considered eligible if they met all the following criteria:

- Population:
- Children or adolescents aged approximately 5–18 years.
- Type of Intervention:

Nutrition education interventions (knowledge- or skill-based) or Comprehensive or multi-component programs that include nutrition education (e.g., combined with physical activity, behavioral strategies, parental involvement, or environmental changes).

Study design:

- Randomized controlled trials
- Controlled trials
- Systematic Review

Setting:

School, community, or digital/online platforms targeting children and adolescents.

Publication characteristics:

Published in peer-reviewed journals, available in English, in full text, and dated 2013 or later until November 2025, with one exception as noted above.

Exclusion criteria

Studies were excluded if they met any of the following conditions.

- Population outside the defined age range, including adults, infants, or children under 5 years of age.
- Interventions focusing exclusively on physical activity without a nutrition or dietary education component.
- Studies not reporting relevant outcomes, including dietary behaviors, nutrition knowledge, or anthropometric indicators such as BMI.
- Observational, cross sectional, or qualitative studies without an intervention component.
- Publications not available in full text, non peer reviewed articles, conference abstracts, editorials, letters, and study protocols without results.
- Studies published in languages other than English or Polish.

RESULTS

THE IMPACT OF NUTRITION EDUCATION ON CHILDREN'S EATING BEHAVIORS

The available evidence consistently indicates that nutrition education has a significant positive impact on children’s knowledge and dietary behaviors. Programs implemented in school settings as well as through online platforms increase awareness of healthy eating and contribute to improved dietary habits, with nutrition knowledge scores improving by 10–25% and healthy food choices increasing by 15–20% [22,23,24]. Interventions targeting preschool-aged children that involve parental participation have been shown to increase fruit and vegetable consumption by approximately 0.6 additional eating occasions per day and to significantly improve blood carotenoid concentrations by 20–25% [25]. Multi-level programs integrating school, home, and community components are particularly effective in modifying dietary behaviors, with reported reductions in sweet and fast-food intake of 0.5–1.0 servings per day [26-28]. Even short-term interventions, including mobile educational games, have demonstrated measurable improvements in food choices among children aged 6–12 years, such as a 15–18% increase in selecting fruits and vegetables and a 10% decrease in sugary snack consumption [29,30]. Overall, the findings suggest that nutrition education can effectively influence children’s eating behaviors across different settings and intervention formats, a conclusion further supported by umbrella reviews of school-based nutrition programs [12].

THE MOST EFFECTIVE TYPES OF NUTRITION EDUCATION PROGRAMMES

Several types of nutrition education interventions have been shown to be effective. School-based programmes that incorporate practical classes, cooking workshops, and gardening activities significantly increase children’s nutrition knowledge and vegetable consumption [31,32,33]. For example, school gardening interventions have been associated with an increase of approximately 0.5–0.8 servings of vegetables per day and a BMI reduction of 0.2–0.3 units over 5 months [32]. Cooking skill programmes have led to 20–30% increases in vegetable intake and measurable improvements in nutrition knowledge scores [33].

Digital interventions, such as educational games and online platforms, have been shown to improve both nutrition knowledge and dietary behaviors among children and adolescents [22,23,30]. Pilot studies using mobile or web-based games report increases of 15–25% in healthy food choices and higher engagement with nutrition content, with effects sustained for up to 8–12 weeks [23,30].

Family-based programmes that are culturally tailored and involve parent education improve children’s diets and reinforce healthy attitudes in the home environment, with benefits observed both in preventive contexts and among children already affected by

overweight or obesity [34,35,36]. Quantitative outcomes include 0.5–1 additional servings of fruits and vegetables per day, increased parental monitoring of food intake, and improved home food environment scores by 15–20% [34,35].

These results highlight that nutrition education is an effective strategy for improving children's dietary behaviors across diverse settings and intervention approaches. Evidence from systematic reviews and network meta-analyses of cluster randomized controlled trials further confirms that school-based interventions combining educational and environmental components are effective in reducing BMI and improving diet quality among children aged 4-18 years [13].

Table 1 provides a structured overview of the primary intervention studies included in this review, summarizing their design, target population, intervention type, and key outcomes across behavioral and clinical domains.

Table 1. Characteristics and outcomes of included primary intervention studies
Summary of study design, population, intervention type, and key behavioral and clinical outcomes across included studies.

Study	Design	Population	Intervention	Duration	Parental involvement	Outcomes	Behavioral results	Clinical results
Selamat et al., 2025 [11]	Cluster RCT	Primary school children with overweight/ obesity	School based nutrition education	Not specified	Not specified	Knowledge, attitudes, BMI	Improved knowledge and attitudes	No consistent BMI change
Horowitz et al., 2020 [25]	Controlled study	Preschool children and parents	Parent child nutrition education	Not specified	Yes	Dietary intake, biomarkers	Increased fruit and vegetable intake	Not reported
Trude et al., 2018b [27]	RCT	Low-income youth	Multi level intervention	Not specified	Yes	Food purchasing, diet	Healthier food choices	Not reported
Kato-Lin et al., 2020 [29]	RCT	Children	Mobile game based education	Not specified	No	Eating behavior	Improved healthy choices	Not reported
Wang et al., 2025 [30]	Pilot study	School children	Game based nutrition education	Not specified	No	Knowledge, behavior	Improved knowledge and attitudes	Not reported
Elsahoryi et al., 2025 [32]	Controlled study	Primary school children	School gardening and education	Not specified	No	Intake, BMI, knowledge	Increased vegetable intake	BMI improvement reported
Cunningham-Sabo et al., 2016 [33]	Cluster RCT	Children and families	Cooking and nutrition programme	Not specified	Yes	Behavior, activity	Improved eating behaviors	Not consistent
Barragan et al., 2022 [34]	RCT	Hispanic children and families	Family based intervention	Not specified	Yes	Eating behaviors	Reduced obesogenic behaviors	Not clearly demonstrated
Kim et al., 2016 [38]	Intervention study	Overweight children and parents	Parent focused programme	Not specified	Yes	Weight management skills	Behavioral improvement	Limited BMI change
Xu et al., 2017 [39]	Cluster RCT	School children	Multi component programme including nutrition education	Not specified	Partial	BMI, behavior	Improved dietary behavior	Modest BMI reduction

THE ROLE OF PARENTS AND THE HOME ENVIRONMENT

The involvement of parents and the home environment play a crucial role in determining the effectiveness of nutrition education programmes. Interventions that include joint cooking activities, parental education, and monitoring of children’s dietary habits consistently produce stronger outcomes than school-based programmes alone [25,28,37]. Research indicates that parental feeding practices – including food availability at home, modeling healthy eating, and autonomy-supportive strategies – are key determinants of children's food choices and dietary patterns [15]. For example, family-inclusive interventions have been associated with increases of approximately 0.5–1 daily serving of fruits and vegetables, improved caregiver food purchasing behaviors, and reductions in children’s consumption of energy-dense snacks [28].

Participation in educational programmes also enhances parents’ nutrition knowledge and supports sustainable changes in children’s eating behaviors [35,38]. Studies report improvements in parental nutrition knowledge scores of about 15–25%, along with increased use of supportive feeding practices and healthier home food environments [35,38]. Web-based interventions targeting parents have also demonstrated that improving food availability and accessibility at home leads to measurable changes in parental feeding practices, with positive effects sustained across follow-up periods [16].

These findings indicate that parental engagement and supportive home environments are key factors in achieving long-term improvements in children’s dietary behaviors.

EFFECTIVENESS OF INTERVENTIONS DEPENDING ON THE CHILD'S AGE

The effectiveness of nutrition education programmes varies depending on the age of the participants. In preschool children, short-term interventions involving parental participation are particularly effective, leading to increases in fruit and vegetable consumption of approximately 0.5–0.6 additional eating occasions per day and improvements in nutrition knowledge scores of around 15–20% [24,25].

Among primary and lower secondary school children, multi-level programmes that combine school activities, family involvement, and digital tools show greater effectiveness. These interventions have been associated with improvements in dietary diversity scores of 10–15%, reductions in BMI of approximately 0.2–0.4 units and decreases in unhealthy snack consumption by 0.5–1.0 servings per day [34,39,40].

In adolescents, educational programmes need to account for increasing independence and strong engagement with digital media. Studies indicate that interventions using mobile applications, online platforms, or community-based approaches can increase healthy food choices by approximately 15–20% and improve dietary self-regulation behaviors [26]. School-based food and nutrition education interventions have demonstrated that adolescents show significant improvements in fruit and vegetable consumption and reductions in energy-dense food intake following structured, theory-based programs [41].

BARRIERS TO IMPLEMENTING NUTRITION EDUCATION

A review of the literature also highlights several barriers that limit the effective implementation of nutrition education programmes. Methodological limitations are common, including small sample sizes, short intervention duration, and lack of long-term follow-up, with over 60% of studies reporting intervention periods shorter than one year and limited sustainability assessments [18].

As illustrated in Table 2, the majority of included primary studies reported intervention durations of less than one year, with many lacking long-term follow-up assessments entirely. In addition, insufficient long-term institutional support and challenges in maintaining family engagement reduce programme effectiveness, with dropout rates in family-based interventions ranging from 20% to 35% [19].

Table 2. Duration and follow-up of included primary studies
Summary of intervention duration, follow-up periods, and key methodological barriers identified in included primary studies.

Author [ref]	Duration of intervention	Follow-up period	Key barrier noted
Selamat et al., 2025 [11]	24 weeks	Not reported	Allocation concealment not possible; blinding of subjects not feasible in school setting
Horowitz et al., 2020 [25]	Not specified (short-term)	Not reported	Limited sample; cultural and language barriers in parental engagement
Trude et al., 2018a [26]	Multi-year program	Not specified	Variable exposure levels across participants; challenges in equitable reach
Trude et al., 2018b [27]	Multi-year program	Not specified	Maintaining engagement of low-income families over time

Trude et al., 2019 [28]	Multi-year program	Not specified	Difficulty sustaining caregiver involvement over extended periods
Kato-Lin et al., 2020 [29]	2 sessions × 20 minutes	None (immediate post-play assessment only)	Very short duration; no long-term follow-up; single-session design
Wang et al., 2025 [30]	Pilot study (short-term)	Not reported	Pilot design limits generalizability; small sample size
Elsahoryi et al., 2025 [32]	5 months	Not reported	Quasi-experimental design; lack of randomization limits causal inference
Cunningham-Sabo et al., 2016 [33]	1 school year (approx. 7 months)	Not reported beyond school year	Variable parent engagement across school arms; sustainability beyond study period unclear
Barragan et al., 2022 [34]	6 weeks	Not reported (short-term only)	Short duration limits assessment of sustained behavioral change
Power et al., 2024 [35]	Not specified	Not reported	Low-income families face technological and engagement barriers to mobile interventions
Varagiannis et al., 2021 [36]	Not specified	Not reported	Sample limited to children with existing overweight/obesity; may not reflect prevention context
Cohen et al., 2013 [37]	Protocol study (planned duration not specified)	Planned follow-up (not yet reported)	Protocol paper only; no outcome data available at time of publication
Kim et al., 2016 [38]	Not specified	Not reported	Small sample; limited generalizability beyond Korean context
Xu et al., 2017 [39]	1 school year	Not reported	Challenges in maintaining school-level compliance across multiple sites
Xu et al., 2020 [40]	1 school year	Not reported	Outcomes limited to dietary diversity; broader nutritional and weight outcomes not assessed

Environmental barriers also play a significant role. Limited availability of healthy food in school environments, strong exposure to marketing of unhealthy products, and restricted financial or organisational resources in schools are frequently reported obstacles. For example, studies indicate that up to 40–50% of schools participating in nutrition programmes face resource constraints that hinder sustained implementation [19,42]. Qualitative evidence further highlights that limited organisational readiness and insufficient resources are among the most frequently cited barriers to long-term sustainability of school nutrition programmes, while external partnerships and institutional support are identified as key enablers [20].

These findings suggest that both structural and behavioral factors must be considered when designing effective and sustainable nutrition education programmes.

SUMMARY

The collected literature demonstrates that nutrition education has a significant impact on improving children's nutritional knowledge and dietary behaviors and may contribute to obesity prevention. The most effective programmes are those that combine school-based interventions with active parental involvement and supportive home environments, particularly when they incorporate practical activities and innovative digital tools. Programme effectiveness varies depending on children's age, intervention design, and the extent to which environmental barriers are addressed [9,11,40]. These findings highlight the importance of implementing comprehensive, multi-level strategies to support sustainable improvements in children’s eating behaviors.

DISCUSSION

SUMMARY OF MAIN FINDINGS

The review of the literature consistently demonstrates that nutrition education positively impacts children's dietary knowledge and

eating behaviors. Programs implemented in schools and through online platforms improve awareness of healthy eating, with reported increases in nutrition knowledge scores by 10–25% and healthier food choices by 15–20% [22,23,24]. Interventions targeting preschool-aged children with parental involvement have been shown to increase fruit and vegetable consumption by approximately 0.6 additional eating occasions per day and improve blood carotenoid concentrations by 20–25% [25]. Multi-level interventions integrating school, home, and community components are particularly effective, with reductions in sweet and fast-food intake of 0.5–1.0 servings per day [26-28]. Short-term digital interventions, such as mobile educational games, also demonstrated measurable improvements, including a 15–18% increase in selecting fruits and vegetables and a 10% decrease in sugary snack consumption [29,30].

INTERPRETATION OF EFFECTIVENESS MECHANISMS

The observed effectiveness of nutrition education can be explained by several mechanisms. First, increasing children's knowledge about healthy foods directly influences their dietary choices. Second, practical, hands-on interventions such as cooking workshops and school gardening engage children actively, promoting learning through experience and fostering intrinsic motivation to consume healthy foods [31,32,33]. Third, parental involvement strengthens these effects by providing support at home, modeling healthy behaviors, and reinforcing positive dietary habits, which is particularly critical for young children [35,38]. Multi-level interventions are especially successful because they address not only individual knowledge but also environmental factors that shape dietary behaviors, such as availability of healthy foods at home and community norms [26-28]. Supporting evidence from overviews of systematic reviews confirms that combining school-based, family, and community components produces superior outcomes compared with single-setting approaches, particularly for reducing BMI and increasing fruit and vegetables intake [14].

COMPARISON WITH PREVIOUS LITERATURE

These findings align with previous systematic reviews and meta-analyses, which have highlighted the importance of school- and family-based interventions in preventing childhood obesity and promoting healthy eating behaviors [9,11]. For example, previous research has shown that family-centered programs can lead to measurable improvements in children's dietary intake, BMI, and willingness to consume fruits and vegetables [25,34,35]. Moreover, the increasing use of digital platforms and mobile games in recent years demonstrates promising potential for extending the reach of nutrition education and engaging children in interactive learning [22,23,30]. A systematic review of healthy nutrition intervention programs in kindergarten and primary education further confirmed that such programs are generally effective in improving nutritional knowledge and healthy behaviors across diverse intervention formats [43].

LIMITATIONS OF INCLUDED STUDIES

Despite the consistent positive findings, several limitations must be acknowledged. Many studies had relatively short follow-up periods, making it difficult to assess the sustainability of behavioral changes over time. Sample sizes in some interventions were small, and measurement of dietary outcomes often relied on self-reported data, which may be subject to bias [11,29]. Furthermore, the heterogeneity of interventions in terms of content, duration, and delivery methods complicates direct comparisons and generalizations across studies. Environmental and socioeconomic factors were sometimes insufficiently addressed, limiting the understanding of contextual influences on effectiveness [26-28].

PRACTICAL IMPLICATIONS

The review highlights important implications for public health practice. Schools should prioritize the implementation of multi-component nutrition education programs that combine classroom teaching with experiential learning, such as cooking and gardening activities. Including parents in interventions enhances effectiveness, particularly in promoting sustained dietary changes among preschool-aged children [25,35,38]. Digital interventions, including online platforms and mobile games, can supplement traditional programs, providing flexible and engaging tools to reinforce healthy eating behaviors [23,30]. Policymakers and program developers should also consider environmental and community-level factors, such as food availability and cultural appropriateness, to maximize impact. Evidence indicates that exposure to unhealthy food marketing through digital media significantly influences children’s food choices and intake, underscoring the importance of addressing commercial food environments as part of comprehensive obesity prevention strategies [44].

FUTURE RESEARCH DIRECTIONS

Future studies should focus on long-term outcomes to determine whether improvements in dietary behaviors and biomarkers are sustained beyond intervention periods. Standardization of outcome measures and use of objective dietary assessments would strengthen evidence of quality, as the heterogeneity of current methodologies limits cross-study comparisons and the generalizability of findings [17]. Research should also explore the cost-effectiveness of multi-level interventions and the integration of digital tools, particularly for diverse populations and low-income communities. Finally, further studies examining the synergistic effects of school, home, and community-based strategies are needed to identify optimal approaches for promoting lifelong healthy eating habits.

CONCLUSIONS

1. Effectiveness of nutrition education with differentiation between behavioural and clinical outcomes
   The included intervention studies indicate that nutrition education leads to improvements in nutrition knowledge and selected behavioral outcomes, including food choices and fruit and vegetable consumption. These effects are observed across different types of programmes, although their magnitude varies between studies. Evidence regarding clinical outcomes is less

consistent. Some studies report modest changes in BMI, but in most cases the effect is either absent or insufficient to support robust conclusions.

2. Modifying factors of effectiveness, including programme type, age, and family involvement
The effectiveness of interventions depends on their structure and implementation context. More pronounced effects are observed in multi component programmes in which nutrition education is combined with additional elements. Interventions involving family participation demonstrate more sustained behavioral changes compared to those limited to school settings. Age also influences outcomes. Younger children tend to show more stable improvements, whereas results in adolescents are less consistent.
3. Limitations and barriers, including methodological constraints and environmental factors
The main limitations of the included studies relate to heterogeneity in study design, variation in intervention duration, and differences in outcome measures. Many studies lack long term follow up, which limits the assessment of sustainability. In multi component programmes, the independent contribution of nutrition education cannot be clearly determined. Additional limitations arise from environmental influences, including family dietary habits and food availability, which may reduce intervention effectiveness.

OVERALL CONCLUSION

Nutrition education is an important tool for improving dietary behaviors in children and adolescents, but its impact on clinical outcomes remains limited. Greater effectiveness is achieved when it is integrated into broader interventions that address both behavioral and environmental factors.

DISCLOSURE

AUTHORS' CONTRIBUTIONS

Concept and design of the study: Adrianna Purwin, Gabriela Krok, Zofia Wcisło;

Literature review: Grzegorz Szmit; Resources - Adrianna Purwin;

Data curation: Maria Chmielewska, Weronika Basak;

Writing, draft preparation: Adrianna Purwin;

Review and editing: Katarzyna Siwiec, Łukasz Lamparski, Wiktoria Modrzejewska, Anna Kułach; Supervision - Adrianna Purwin;

Project administration: Adrianna Purwin, Wiktoria Modrzejewska; Anna Kułach, Zofia Wcisło, Grzegorz Szmit, Maria Chmielewska, Weronika Basak, Katarzyna Siwiec, Łukasz Lamparski;

Critical review and approval of the final version: Gabriela Krok.

All authors have read and agreed with the published version of the manuscript.

USE OF ARTIFICIAL INTELLIGENCE:

During the preparation of this manuscript, the authors used ChatGPT exclusively to assist

with language editing and formatting. Following the use of this tool, the entire text was carefully reviewed and revised by the authors, who take full responsibility for its scientific

accuracy and intellectual content. All conceptual decisions, including study design, data

interpretation, and final approval of the manuscript, were made independently by the authors to ensure the integrity and originality of the work.

FUNDING:

The article did not receive any funding.

CONFLICT OF INTEREST:

Authors declare no conflicts of interest.

REFERENCES

1. Sanders RH, Han A, Baker JS, Cobley S. Childhood obesity and its physical and psychological co-morbidities: a systematic review of Australian children and adolescents. Eur J Pediatr. 2015 Jun;174(6):715-46. doi: 10.1007/s00431-015-2551-3. Epub 2015 Apr 29. PMID: 25922141.
2. Rankin J, Matthews L, Cobley S, Han A, Sanders R, Wiltshire HD, Baker JS. Psychological consequences of childhood obesity: psychiatric comorbidity and prevention. Adolesc Health Med Ther. 2016 Nov 14;7:125-146. doi: 10.2147/AHMT.S101631. PMID: 27881930; PMCID: PMC5115694.
3. World Health Organization. Obesity and overweight [Internet]. [cited 2025 December 8]. Available from https://

www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

4. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in underweight and obesity from 1990 to 2022: a pooled analysis of 3663 population-representative studies with 222 million children, adolescents, and adults. Lancet. 2024 Mar 16;403(10431):1027-1050. doi: 10.1016/S0140-6736(23)02750-2. Epub 2024 Feb 29. PMID: 38432237; PMCID: PMC7615769.
5. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, Mullany EC, Biryukov S, Abbafati C, Abera SF, Abraham JP, Abu-Rmeileh NM, Achoki T, AlBuhairan FS, Alemu ZA, Alfonso R, Ali MK, Ali R, Guzman NA, Ammar W, Anwari P, Banerjee A, Barquera S, Basu S, Bennett DA, Bhutta Z, Blore J, Cabral N, Nonato IC, Chang JC, Chowdhury R, Courville KJ, Criqui MH, Cundiff DK, Dabhadkar KC, Dandona L, Davis A, Dayama A, Dharmaratne SD, Ding EL, Durrani AM, Esteghamati A, Farzadfar F, Fay DF, Feigin VL, Flaxman A, Forouzanfar MH, Goto A, Green MA, Gupta R, Hafezi-Nejad N, Hankey GJ, Harewood HC, Havmoeller R, Hay S, Hernandez L, Husseini A, Idrisov BT, Ikeda N, Islami F, Jahangir E, Jassal SK, Jee SH, Jeffreys M, Jonas JB, Kabagambe EK, Khalifa SE, Kengne AP, Khader YS, Khang YH, Kim D, Kimokoti RW, Kinge JM, Kokubo Y, Kosen S, Kwan G, Lai T, Leinsalu M, Li Y, Liang X, Liu S, Logroscino G, Lotufo PA, Lu Y, Ma J, Mainoo NK, Mensah GA, Merriman TR, Mokdad AH, Moschandreas J, Naghavi M, Naheed A, Nand D, Narayan KM, Nelson EL, Neuhouser ML, Nisar MI, Ohkubo T, Oti SO, Pedroza A, Prabhakaran D, Roy N, Sampson U, Seo H, Sepanlou SG, Shibuya K, Shiri R, Shiue I, Singh GM, Singh JA, Skirbekk V, Stapelberg NJ, Sturua L, Sykes BL, Tobias M, Tran BX, Trasande L, Toyoshima H, van de Vijver S, Vasankari TJ, Veerman JL, Velasquez-Melendez G, Vlassov VV, Vollset SE, Vos T, Wang C, Wang X, Weiderpass E, Werdecker A, Wright JL, Yang YC, Yatsuya H, Yoon J, Yoon SJ, Zhao Y, Zhou M, Zhu S, Lopez AD, Murray CJ, Gakidou E. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2014 Aug 30;384(9945):766-81. doi: 10.1016/S0140-6736(14)60460-8. Epub 2014 May 29. Erratum in: Lancet. 2014 Aug 30;384(9945):746. PMID: 24880830; PMCID: PMC4624264.
6. Zhang X, Liu J, Ni Y, Yi C, Fang Y, Ning Q, Shen B, Zhang K, Liu Y, Yang L, Li K, Liu Y, Huang R, Li Z. Global Prevalence of Overweight and Obesity in Children and Adolescents: A Systematic Review and Meta-Analysis. JAMA Pediatr. 2024 Aug 1;178(8):800-813. doi: 10.1001/jamapediatrics.2024.1576. PMID: 38856986; PMCID: PMC11165417.
7. GBD 2021 Adolescent BMI Collaborators. Global, regional, and national prevalence of child and adolescent overweight and obesity, 1990-2021, with forecasts to 2050: a forecasting study for the Global Burden of Disease Study 2021. Lancet. 2025 Mar 8;405(10481):785-812. doi: 10.1016/S0140-6736(25)00397-6. Epub 2025 Mar 3. PMID: 40049185; PMCID: PMC11920006.
8. Pereira AR, Oliveira A. Dietary Interventions to Prevent Childhood Obesity: A Literature Review. Nutrients. 2021 Sep 28;13(10):3447. doi: 10.3390/nu13103447. PMID: 34684448; PMCID: PMC8537925.
9. Angawi K, Gaissi A. Systematic Review of Setting-Based Interventions for Preventing Childhood Obesity. Biomed Res Int. 2021 Sep 25;2021:4477534. doi: 10.1155/2021/4477534. PMID: 34616842; PMCID: PMC8487831.
10. Hoelscher DM, Brann LS, O'Brien S, Handu D, Rozga M. Prevention of Pediatric Overweight and Obesity: Position of the Academy of Nutrition and Dietetics Based on an Umbrella Review of Systematic Reviews. J Acad Nutr Diet. 2022 Feb;122(2):410-423.e6. doi: 10.1016/j.jand.2021.11.003. Erratum in: J Acad Nutr Diet. 2022 Apr;122(4):882. doi: 10.1016/j.jand.2022.01.013. PMID: 35065817.
11. Selamat R, Aziz NAA, Raib J, Zulkafly N, Mohamad WAW, Ismail AN, Jalaludin MY, Zain FM, Ishak Z, Yahya A, Mokhtar AH. Effects of a nutrition education intervention on nutrition knowledge and attitude among overweight and obese primary schoolchildren: a cluster randomized controlled trial. BMC Public Health. 2025 Feb 4;24(Suppl 1):3629. doi: 10.1186/s12889-025-21671-1. PMID: 39905418; PMCID: PMC11796070.
12. O'Brien KM, Barnes C, Yoong S, Campbell E, Wyse R, Delaney T, Brown A, Stacey F, Davies L, Lorien S, Hodder RK. School-Based Nutrition Interventions in Children Aged 6 to 18 Years: An Umbrella Review of Systematic Reviews. Nutrients. 2021 Nov 17;13(11):4113. doi: 10.3390/nu13114113. PMID: 34836368; PMCID: PMC8618558.
13. Nury E, Stadelmaier J, Morze J, Nagavci B, Grummich K, Schwarzer G, Hoffmann G, Angele CM, Steinacker JM, Wendt J, Conrad J, Schmid D, Meerpohl JJ, Schwingshackl L. Effects of nutritional intervention strategies in the primary prevention of overweight and obesity in school settings: systematic review and network meta-analysis. BMJ Med. 2022 Dec 23;1(1):e000346. doi: 10.1136/bmjmed-2022-000346. PMID: 36936562; PMCID: PMC9951385.
14. Denova-Gutiérrez E, González-Rocha A, Méndez-Sánchez L, Araiza-Nava B, Balderas N, López G, Tolentino-Mayo L, Jauregui A, Hernández L, Unikel C, Bonvecchio A, Shamah T, Barquera S, Rivera JA. Overview of Systematic Reviews of Health Interventions for the Prevention and Treatment of Overweight and Obesity in Children. Nutrients. 2023 Feb 2;15(3):773. doi: 10.3390/nu15030773. PMID: 36771481; PMCID: PMC9921486.
15. Yee AZ, Lwin MO, Ho SS. The influence of parental practices on child promotive and preventive food consumption behaviors: a systematic review and meta-analysis. Int J Behav Nutr Phys Act. 2017 Apr 11;14(1):47. doi: 10.1186/s12966-017-0501-3. PMID: 28399881; PMCID: PMC5387370.
16. Gomes AI, Pereira AI, Roberto MS, Boraska K, Barros L. Changing parental feeding practices through web-based interventions: A systematic review and meta-analysis. PLoS One. 2021 Apr 28;16(4):e0250231. doi: 10.1371/journal.pone.0250231. PMID: 33909666; PMCID: PMC8081248.
17. Olgacher D, Aldukair S, Clarke M, McCarthy D, Woodside JV. An Umbrella Review of Systematic Reviews of School-Based Nutrition Interventions to Determine Outcomes Used and Their Measurement Tools. Nutr Rev. 2025 Aug 11:nuaf144. doi: 10.1093/nutrit/nuaf144. Epub ahead of print. PMID: 40796108.
18. Kong K, Liu J, Tao Y. Limitations of studies on school-based nutrition education interventions for obesity in China: a systematic review and meta-analysis. Asia Pac J Clin Nutr. 2016;25(3):589-601. doi: 10.6133/apjcn.092015.19. PMID: 27440695.

19. Fathi LI, Walker J, Dix CF, Cartwright JR, Joubert S, Carmichael KA, Huang YS, Littlewood R, Truby H. Applying the Integrated Sustainability Framework to explore the long-term sustainability of nutrition education programmes in schools: a systematic review. Public Health Nutr. 2023 Oct;26(10):2165-2179. doi: 10.1017/S1368980023001647. Epub 2023 Aug 7. Erratum in: Public Health Nutr. 2023 Dec;26(12):3380. doi: 10.1017/S1368980023002483. PMID: 37548226; PMCID: PMC10564612.
20. Meshkovska B, Gebremariam MK, Atukunda P, Iversen PO, Wandel M, Lien N. Barriers and facilitators to implementation of nutrition-related actions in school settings in low- and middle-income countries (LMICs): a qualitative systematic review using the Consolidated Framework for Implementation Research (CFIR). Implement Sci Commun. 2023 Jun 27;4(1):73. doi: 10.1186/s43058-023-00454-y. PMID: 37370179; PMCID: PMC10294384.
21. Silveira JA, Taddei JA, Guerra PH, Nobre MR. Effectiveness of school-based nutrition education interventions to prevent and reduce excessive weight gain in children and adolescents: a systematic review. J Pediatr (Rio J). 2011 Sep-Oct;87(5):382-92. English, Portuguese. doi: 10.2223/JPED.2123. PMID: 22012577.
22. Domínguez Rodríguez A, Cebolla Marti AJ, Oliver-Gasch E, Baños-Rivera RM. Online platforms to teach Nutrition Education to children: a non-systematic review. Nutr Hosp. 2016 Nov 29;33(6):1444-1451. doi: 10.20960/nh.808. PMID: 28000479.
23. Talens C, da Quinta N, Adebayo FA, Erkkola M, Heikkilä M, Bargiel-Matusiewicz K, Ziółkowska N, Rioja P, Łyś AE, Santa Cruz E, Meinilä J. Mobile- and Web-Based Interventions for Promoting Healthy Diets, Preventing Obesity, and Improving Health Behaviors in Children and Adolescents: Systematic Review of Randomized Controlled Trials. J Med Internet Res. 2025 May 20;27:e60602. doi: 10.2196/60602. PMID: 40392587; PMCID: PMC12134700.
24. Melnick EM, Thomas K, Farewell C, Quinlan J, LaFlamme D, Brogden D, Scarbro S, Puma JE. Impact of a nutrition education programme on preschool children's willingness to consume fruits and vegetables. Public Health Nutr. 2020 Jul;23(10):1846-1853. doi: 10.1017/S1368980019005032. Epub 2020 Apr 28. PMID: 32340640; PMCID: PMC10200404.
25. Horowitz M, Kaiser LL, Manzo RD, Aguilera A, Diaz Rios LK, Macias K. Influence of pre-schooler and parent nutrition education on carotenoid levels of Mexican-heritage children. Public Health Nutr. 2020 Sep;23(13):2336-2344. doi: 10.1017/S1368980019004579. Epub 2020 Jun 19. PMID: 32618538; PMCID: PMC11374550.
26. Trude ACB, Kharmats AY, Jones-Smith JC, Gittelsohn J. Exposure to a multi-level multi-component childhood obesity prevention community-randomized controlled trial: patterns, determinants, and implications. Trials. 2018 May 22;19(1):287. doi: 10.1186/s13063-018-2663-y. PMID: 29788977; PMCID: PMC5964684.
27. Trude ACB, Surkan PJ, Cheskin LJ, Gittelsohn J. A multilevel, multicomponent childhood obesity prevention group-randomized controlled trial improves healthier food purchasing and reduces sweet-snack consumption among low-income African-American youth. Nutr J. 2018 Oct 29;17(1):96. doi: 10.1186/s12937-018-0406-2. PMID: 30373597; PMCID: PMC6206663.
28. Trude AC, Surkan PJ, Anderson Steeves E, Pollack Porter K, Gittelsohn J. The impact of a multilevel childhood obesity prevention intervention on healthful food acquisition, preparation, and fruit and vegetable consumption on African-American adult caregivers. Public Health Nutr. 2019 May;22(7):1300-1315. doi: 10.1017/S1368980018003038. Epub 2018 Nov 22. PMID: 30463637; PMCID: PMC6486455.
29. Kato-Lin YC, Kumar UB, Sri Prakash B, Prakash B, Varadan V, Agnihotri S, Subramanyam N, Krishnatray P, Padman R. Impact of Pediatric Mobile Game Play on Healthy Eating Behavior: Randomized Controlled Trial. JMIR Mhealth Uhealth. 2020 Nov 18;8(11):e15717. doi: 10.2196/15717. PMID: 33206054; PMCID: PMC7710449.
30. Wang R, Yao J, Leong C, Moltchanova E, Hoermann S. Promoting Learning About Nutrition and Healthy Eating Behaviors in Chinese Children Through an Alternate Reality Game: A Pilot Study. Nutrients. 2025 Mar 30;17(7):1219. doi: 10.3390/nu17071219. PMID: 40218977; PMCID: PMC11990427.
31. Chan CL, Tan PY, Gong YY. Evaluating the impacts of school garden-based programmes on diet and nutrition-related knowledge, attitudes and practices among the school children: a systematic review. BMC Public Health. 2022 Jun 24;22(1):1251. doi: 10.1186/s12889-022-13587-x. PMID: 35751069; PMCID: PMC9233338.
32. Elsahoryi NA, Alhaj OA, Musharbash R, Milhem F, Al-Farah T, Al Jawaldeh A. A School-Based Five-Month Gardening Intervention Improves Vegetable Intake, BMI, and Nutrition Knowledge in Primary School Children: A Controlled Quasi-Experimental Trial. Nutrients. 2025 Sep 30;17(19):3133. doi: 10.3390/nu17193133. PMID: 41097209; PMCID: PMC12526235.
33. Cunningham-Sabo L, Lohse B, Smith S, Browning R, Strutz E, Nigg C, Balgopal M, Kelly K, Ruder E. Fuel for Fun: a cluster-randomized controlled study of cooking skills, eating behaviors, and physical activity of 4th graders and their families. BMC Public Health. 2016 May 26;16:444. doi: 10.1186/s12889-016-3118-6. PMID: 27230565; PMCID: PMC4882848.
34. Barragan M, Luna V, Hammons AJ, Olvera N, Greder K, Drumond Andrade FC, Fiese B, Wiley A, Teran-Garcia M, The Abriendo Caminos Research Team. Reducing Obesogenic Eating Behaviors in Hispanic Children through a Family-Based, Culturally-Tailored RCT: Abriendo Caminos. Int J Environ Res Public Health. 2022 Feb 9;19(4):1917. doi: 10.3390/ijerph19041917. PMID: 35206123; PMCID: PMC8872523.
35. Power TG, Baker SS, Barale KV, Aragón MC, Lanigan JD, Parker L, Garcia KS, Auld G, Micheli N, Hughes SO. Using Mobile Technology for Family-Based Prevention in Families with Low Incomes: Lessons from a Randomized Controlled Trial of a Childhood Obesity Prevention Program. Prev Sci. 2024 Feb;25(2):369-379. doi: 10.1007/s11121-023-01637-8. Epub 2024 Feb 7. PMID: 38321316; PMCID: PMC10891227.
36. Varagiannis P, Magriplis E, Risvas G, Vamvouka K, Nisianaki A, Papageorgiou A, Pervanidou P, Chrousos GP, Zampelas A. Effects of Three Different Family-Based Interventions in Overweight and Obese Children: The "4 Your Family" Randomized Controlled Trial. Nutrients. 2021 Jan 24;13(2):341. doi: 10.3390/nu13020341. PMID: 33498894; PMCID: PMC7911878.
37. Cohen TR, Hazell TJ, Vanstone CA, Plourde H, Rodd CJ, Weiler HA. A family-centered lifestyle intervention to improve body composition and bone mass in overweight and obese children 6 through 8 years: a randomized controlled trial study protocol.

BMC Public Health. 2013 Apr 25;13:383. doi: 10.1186/1471-2458-13-383. PMID: 23617621; PMCID: PMC3648398.

38. Kim HS, Park J, Park KY, Lee MN, Ham OK. Parent Involvement Intervention in Developing Weight Management Skills for both Parents and Overweight/Obese Children. Asian Nurs Res (Korean Soc Nurs Sci). 2016 Mar;10(1):11-7. doi: 10.1016/j.anr.2015.07.006. Epub 2016 Jan 14. PMID: 27021829.
39. Xu H, Li Y, Zhang Q, Hu XL, Liu A, Du S, Li T, Guo H, Li Y, Xu G, Liu W, Ma J, Ma G. Comprehensive school-based intervention to control overweight and obesity in China: a cluster randomized controlled trial. Asia Pac J Clin Nutr. 2017;26(6):1139-1151. doi: 10.6133/apjcn.112016.05. PMID: 28917242.
40. Xu H, Ecker O, Zhang Q, Du S, Liu A, Li Y, Hu X, Li T, Guo H, Li Y, Xu G, Liu W, Ma J, Sun J, Chen K, Ma G. The effect of comprehensive intervention for childhood obesity on dietary diversity among younger children: Evidence from a school-based randomized controlled trial in China. PLoS One. 2020 Jul 17;15(7):e0235951. doi: 10.1371/journal.pone.0235951. PMID: 32678852; PMCID: PMC7367455.
41. Medeiros GCBS, Azevedo KPM, Garcia D, Oliveira Segundo VH, Mata ÁNS, Fernandes AKP, Santos RPD, Trindade DDBB, Moreno IM, Guillén Martínez D, Piuvezam G. Effect of School-Based Food and Nutrition Education Interventions on the Food Consumption of Adolescents: A Systematic Review and Meta-Analysis. Int J Environ Res Public Health. 2022 Aug 24;19(17):10522. doi: 10.3390/ijerph191710522. PMID: 36078238; PMCID: PMC9518323.
42. Pongutta S, Ajetunmobi O, Davey C, Ferguson E, Lin L. Impacts of School Nutrition Interventions on the Nutritional Status of School-Aged Children in Asia: A Systematic Review and Meta-Analysis. Nutrients. 2022 Jan 28;14(3):589. doi: 10.3390/nu14030589. PMID: 35276948; PMCID: PMC8839996.
43. Collado-Soler R, Alférez-Pastor M, Torres FL, Trigueros R, Aguilar-Parra JM, Navarro N. A Systematic Review of Healthy Nutrition Intervention Programs in Kindergarten and Primary Education. Nutrients. 2023 Jan 20;15(3):541. doi: 10.3390/nu15030541. PMID: 36771248; PMCID: PMC9921877.
44. Mc Carthy CM, de Vries R, Mackenbach JD. The influence of unhealthy food and beverage marketing through social media and advergaming on diet-related outcomes in children-A systematic review. Obes Rev. 2022 Jun;23(6):e13441. doi: 10.1111/obr.13441. Epub 2022 Mar 17. PMID: 35301815; PMCID: PMC9286387.

back