Lifestyle Medicine

WILEY

Lifestyle Medicine Open Access

REVIEW OPEN ACCESS

A Scoping Review of School-Based Nutrition Interventions Conducted in Spain

Basil H. Aboul-Enein[1,2] | Nada Benajiba[3] | Stephen Gambescia[4] | Silvana Blanco[5] | Teresa Keller[6]

[1]College of Arts & Sciences Health & Society Program, University of Massachusetts Dartmouth, North Dartmouth, Massachusetts, USA | [2]Faculty of Public Health and Policy, London School of Hygiene & Tropical Medicine, London, UK | [3]Joint Research Unit in Nutrition and Food, RDC-Nutrition AFRA/IAEA, Ibn Tofail University-CNESTEN, Rabat, Kenitra, Morocco | [4]College of Nursing and Health Professions, Drexel University, Philadelphia, Pennsylvania, USA | [5]College of Professional Studies, Applied Nutrition Graduate Program, Northeastern University, Boston, Massachusetts, USA | [6]School of Nursing, New Mexico State University, Las Cruces, New Mexico, USA

Correspondence: Basil H. Aboul-Enein (baboulenein@umassd.edu; Basil.Aboul-Enein@lshtm.ac.uk)

Received: 11 January 2025 | **Revised:** 3 March 2025 | **Accepted:** 4 March 2025

Funding: The authors received no specific funding for this work.

Keywords: diet | nutrition intervention | schoolchildren | Spain

ABSTRACT

Background: The prevalence of childhood obesity is increasing in Europe, including Spain, leading to early onset chronic diseases. Two enduring risk factors in this phenomenon are unhealthy nutrition and lack of physical activity. The aim of this review is to examine and appraise the literature on the nature and extent (inputs, activities, outputs) of research conducted in school-based nutrition intervention programs in Spain and their effectiveness (outcomes and impact).

Methods: A review of published studies (2000–2024) using the PRISMA-ScR guidelines across 14 databases was conducted. Thirty-one studies met the inclusion criteria, involving a range of 28–2516 youth across many schools in various cities in Spain. Study designs ranged from randomized controlled trials to descriptive projects.

Results: Studies addressed a spectrum of dietary behaviors and knowledge aimed at promoting a healthy lifestyle overall, good nutrition, and adequate physical activity. Almost all studies produced positive changes in youths' nutrition behavior.

Conclusion: School nutrition intervention programs in Spain have shown significant promise in promoting healthier dietary behaviors and reducing obesity-related risks among children and adolescents. These programs improved adherence to the Mediterranean diet, increased fruit and vegetable intake, and better body mass index and body composition outcomes. To enhance impact and scalability, future efforts should focus on consistent methodologies and extended follow-up.

1 | Introduction

School health education plays a crucial role in equipping children with the knowledge and skills they need to maintain good health throughout their lives. One important aspect of this education is the food and nutrition programs offered at schools. These programs not only provide meals for children who might otherwise go hungry but also educate them about healthy eating habits [1]. School-based food programs are associated with other benefits that extend to families and communities. Programs that emphasize economic opportunities for local food suppliers and farmers. Parents and community members express satisfaction with well-developed school food programs [2].

Spain is classified as a high-income country by the World Bank [3], a category of countries with a high standard of living

supported by rich economic resources. The Spanish government has demonstrated a commitment to assuring quality food and nutrition programs in the country's schools [4]. There are national policies that govern standards set for school lunch programs [5, 6], guidelines for improving physical activity [7], and programs for educating teachers and families about the importance of school nutrition. Food and nutrition education programs in schools are expected to play a key role in shaping the dietary behaviors of schoolchildren and are well-regarded by Spanish citizens [8]. From promoting adherence to the Mediterranean diet to addressing challenges related to food waste and local food procurement, Spanish schools have embraced a holistic approach to promoting healthy lifestyles among their students [9–12]. Moreover, efforts to enhance school-based policies on physical activity and nutrition reflect a concerted push toward creating environments that support healthy living.

The effectiveness of school nutrition interventions, however, is not uniform across contexts and approaches. As evidenced by a diverse array of research findings, the outcomes of such interventions vary widely, with factors such as intervention design, implementation strategies, and the inclusion of parental involvement playing pivotal roles in determining success [13]. While progress in school nutrition in Spain is commendable, there is still much room for improvement. This scoping review aims to identify and appraise school-based nutrition interventions conducted within Spain's school settings, each with the overarching goal of positively influencing the health and eating habits of schoolchildren in Spain.

2 | Methods

2.1 | Selection Criteria

The Population, Intervention, Comparison, Outcomes, and Study (PICOS) design guidelines [14] were incorporated to develop the research question: "Do school age students in Spain (P) that are offered school-based nutrition interventions (I) have improved health and wellness parameters (O) compared with those that do not participate in school-based nutrition interventions(C)?" and subsequent inclusion and exclusion criteria (see Table 1). Peer-reviewed articles published in English or Spanish languages were included. Interventions reported outside traditional peer-reviewed articles as well as preschool settings were excluded from this review. The search was conducted in the Spring of 2024, and the results communicate literature published between 2000 and April 2024. In addition, reference lists of relevant studies were screened to identify publications from other studies that might be eligible for this review.

2.2 | Search Procedures

A scoping review of the literature was conducted using the methodical framework of Arksey and O'Malley [15], the PRISMA Extension for Scoping Reviews [16]. We began a comprehensive search using a combination strategy of medical subject heading keywords, terms, phrases, and Boolean operators (see the Supporting Information). The following 14 databases were searched: EBSCOHost; BIOSIS; CINAHL; ScienceDirect; ArticleFirst; Biomed Central; BioOne; ProQuest; SAGE Reference Online; Scopus; SpringerLink; PubMed; Taylor & Francis; and Wiley Online. The search strategies were adapted according to the indexing systems of each respective database (see the Supporting Information). The initial search yielded a total of $N = 5458$ articles. After removing duplicates and screening titles and abstracts for eligibility, the researchers identified 38 full-text articles, of which 31 met the inclusion criteria.

2.3 | Study Selection and Data Extraction

Two of the authors conducted the searches for relevant articles and one author utilized Rayyan QCRI software [17] to assist in the screening process. All retrieved articles were screened for relevance to the topic (see Figure 1). In addition, reference lists from retrieved articles were also hand-reviewed to identify any additional relevant publications. Titles and abstracts were screened for relevancy, and potentially relevant journal abstracts were reviewed by four of the authors. Potential articles for inclusion in this review were evaluated for relevance, merit, and inclusion/exclusion criteria (see Table 1). Articles accepted for inclusion were individually reviewed by each author. Additionally, the reference list of each included article was screened for potentially eligible articles. Once the list of selected studies was finalized, two of the authors extracted and cross-checked each study. One author updated the search, reviewed the articles, and wrote the first draft of the results and discussion sections of the review. Differences in opinion in data extracted were discussed to reach consensus and tabulated (Tables 2 and 3). Given that methodological quality assessment is not a prerequisite for scoping reviews, we did not appraise the included studies [18].

3 | Results

3.1 | The Characteristics of the Studies

The publications spanned from 2002 to 2020, with no studies published in 2003, 2005, 2007, 2019, and one in 2020. The highest number of publications occurred in 2013, with five studies. Research was conducted across various cities in Spain, with most studies taking place in the Autonomous Communities of Andalusia (eight studies) and Catalonia (three studies) (see Figure 2).

3.2 | Study Design

The studies included in this review employ a variety of research designs, categorized based on their methodology. Cluster-randomized trials were conducted by Mora et al. [33], Llargués et al. [29], Llauradó et al. [30], and Bibiloni et al. [20], while randomized controlled trials (RCTs) were used by Tarro et al. [48], Pablos et al. [36], Pastor et al. [38], and Te Velde et al. [49]. Pérez Solís et al. [42] employed a non-RCT methodology. Pérez López and Delgado Fernández [39, 40] utilized quasi-experimental designs. Several studies focused on longitudinal or intervention designs, including those by Llargués et al. [28], Martínez-García and Trescastro-López [32], García et al. [23], and Oliva Rodríguez et al. [35]. Cross-sectional and observational

TABLE 1 | PICOS criteria for inclusion and exclusion of studies.

Parameter	Inclusion Criteria	Exclusion Criteria
Population	• School-aged students (i.e., at least 6 years old and above) who were examined in Spain within the school setting	• Students who were not of school age, such as preschool and college students, less than 6 years of age only, or more than 18 years old only • Students who were not studying in Spain • Students who were undergoing medical nutrition therapy-based diets
Intervention type	Any kind of school-based intervention that addresses nutrition-related aspects, including • Educational interventions • Environmental interventions • Multicomponential interventions	• Interventions that were not based on school facilities • Interventions that did not address nutrition-related outcomes
Comparators	Preintervention, baseline nutrition-related variables (i.e. anthropometric measures, biochemical parameters, nutrition-related knowledge, dietary habits, perceived hunger) of student groups who were • control: received no intervention. • received partial intervention, for example, educational intervention only versus multicomponential intervention	• N/A
Outcomes of interest	• changes in anthropometric outcomes, for example, BMI for age, height for age • changes in biochemical outcomes • changes in nutrition-related knowledge • changes in meeting the dietary macronutrient and/or micronutrient recommendations • changes in adherence to healthy dietary habits and avoidance of unhealthy ones • changes in risks of nutrition-related diseases, for example, obesity or iron-deficiency anemia • changes in short-term hunger	• Non-nutrition related outcomes
Language	English or Spanish	All other languages
Study type	• Experimental intervention studies with measured outcomes • Peer-reviewed original research articles • Original research conference publications • Protocol studies	Non-Peer-Reviewed articles • Non-numeric/categorical assessments or qualitative studies that did not involve an intervention • Commentaires • Narratives • Communications • Non-intervention based studies • White papers • Similar article types • Grey literature • Theses or dissertations

Abbreviations: BMI, body mass index; N/A, not applicable.

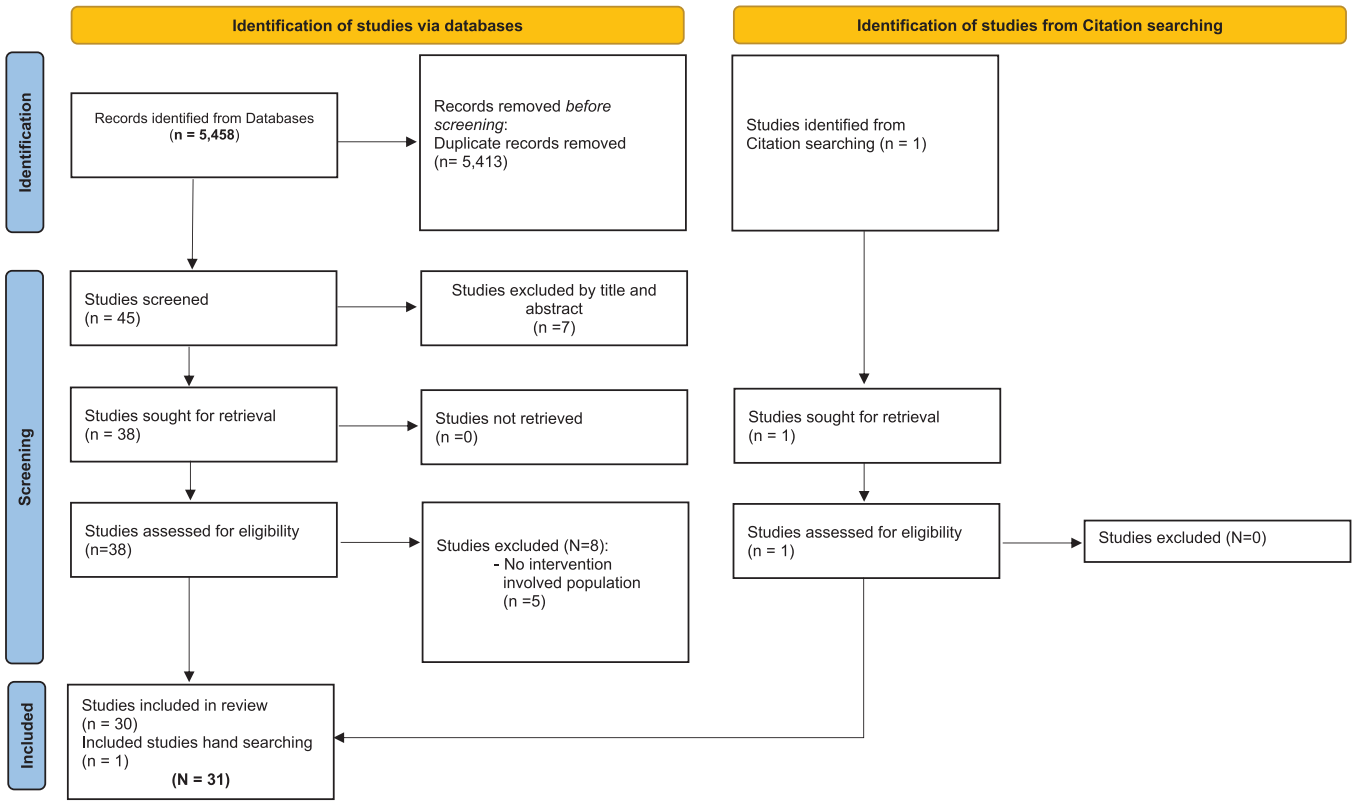

FIGURE 1 | Search flow diagram following PRISMA 2020 guidelines.

studies were employed by Rico-Sapena et al. [45], Pareja Sierra et al. [37], and González-Valero et al. [26], while pilot studies were conducted by Martínez-García and Trescastro-López [32], Rohlfs Domínguez et al. [47], Burguera et al. [21], and Muros et al. [34]. Pérez Rodrigo [41] presented an intervention protocol study that had not yet been implemented. Lastly, qualitative research was used by Lete and Perales Antón [27] and González-Jiménez et al. [25], and intervention studies were carried out by Escalé et al. [22] and Roberto and Carlos [46].

3.3 | Participants

In total, the reviewed studies cover a broad age range from 3 to 19 years old. Eight studies focused on children aged 3–6 years, including those by Mora et al. [33], González-Valero et al. [26], Bibiloni et al. [20], Rohlfs Domínguez et al. [47], and García et al. [23]. Seven studies targeted primary school-age children (7–11 years) and were conducted by Tarro et al. [48], Llauradó et al. [30], Allirot et al. [19], Te Velde et al. [49], Muros et al. [34], Pablos et al. [36], and Pérez Rodrigo et al. [41]. A large number of studies focused on adolescents, including Martínez-García and Trescastro-López [32], Rico-Sapena et al. [45], González-Jiménez et al. [24], Pareja Sierra et al. [35, 37], Pastor et al. [38], Restoy [44], Martínez et al. [31], Pérez López and Delgado Fernández [39], Oliva Rodríguez et al. [35], Burguera et al. [21], Roberto and Carlos [46], and Lete and Perales Antón [27]. The smallest sample size was reported by Martínez-García and Trescastro-López [32] with 28 participants aged 8–9 years. Martínez-García and Trescastro-López [32] conducted a pilot study with 28 students of the third Primary School in "La Serranica" in Aspe to promote their knowledge of food groups, their frequency of consumption, consumption of fruits and vegetables, and eating a healthy breakfast and lunch. The largest sample size was reported by Pareja Sierra et al. [37], with 2516 students 13 and 14 years from 79 schools distributed in the 17 autonomous regions in Spain exposed to the TAS program (Tu y Alicia por la Salud-Alice and you for Health) to promote healthy eating and physical activity through cooking and active leisure.

3.4 | External Review, Ethics in Research, Parental Informed Consent, and Privacy of Schoolchildren's Information

Authors of 10 publications reported that their study had an external review in accordance with ethical research, gaining parental consent when necessary, and keeping the privacy of the schoolchildren's information [21, 24, 29, 30, 34, 36, 38, 42, 47, 49]. External review entities in this regard were either university, hospital, government, or educational affiliated, and sometimes more than one type of entity reviewed their protocols. Authors of three publications mentioned that they observed the ethical standards proposed by the Committee on Research and Clinical Trials in the Declaration of Helsinki [50].

Authors of 21 publications did not report that an external review of their study was made. Making judgments of the need for an external review, especially when involving youth, which often needs parental consent, is beyond the scope of this review. We can offer some conjecture that the interventions were part and parcel of the conventional teaching/learning of nutrition education in

TABLE 2 | Study and intervention characteristics of reviewed studies promoting healthy nutrition in children, and both children and adolescent, and adolescents populations ($N = 31$).

Author	Number of participants (age or grade)	City/region	Dietary behaviors/ knowledge addressed	Intervention duration	Follow-up period	Theoretical framework/ model	Delivered by
Allirot et al. [19]	137 (7–11 yo)	San Sebastian	Improving dietary habits through cooking	One workshop	Beginning, middle, and end of the workshop	N/R	RT
Bibiloni et al. [20]	1,199 (3–7 yo)	Barcelona	Improve diet quality and decrease overweight and obesity prevalence	2 months	2 years	N/R	E
Burguera et al. [21]	90 (11–14 yo)	Mallorca	Promotion of PA and healthy lifestyles	6 months	6 months	N/R	T, RT
Escalé et al. [22]	622 (3–12 yo)	Barcelona	Promotion of the Mediterranean diet and prevention and/or reversing of overweight and obesity	Three to five visits of dietitians/nutritionists	1 year	N/R	Dt, Nutr
García et al. [23]	501 (3–16 yo)	Murcia	Improvements in eating habits and PA	1 year	N/R	N/R	TTE
González-Jiménez et al. [24]	138 (14–19 yo)	Almeria	Adopting healthier eating and exercise habits and reduced sedentary activities	9 months	N/R	N/R	T
González-Jiménez et al. [25]	90 (15–17 yo)	Almeria	Adopting healthy eating and PA habits	9 months	N/R	N/R	T
González-Valero et al. [26]	79 (6–8 yo)	Granada	Adherence to the Mediterranean diet	2 months	1 month	N/R	RT
Lete and Perales Antón. [27]	2400 (third year of high school)	Basque Country	Improvements in dietary habits	9 months	N/R	N/R	RT
Llargués et al. [28]	394 (5–6 yo)	Granollers	Dietary and PA habits and BMI	2 school years	2 years	N/R	TTE
Llargues et al. [29]	397 (6 yo)	Barcelona	Promoting healthy eating habits and PA	6 years	4 years	N/R	TTE
Llauradó et al. [30]	690 (7–8 yo)	Terres de l'Ebre	Improve lifestyles, including diet and PA	3 years	22 months	N/R	E

(Continues)

TABLE 2 | (Continued)

Author	Number of participants (age or grade)	City/region	Dietary behaviors/ knowledge addressed	Intervention duration	Follow-up period	Theoretical framework/ model	Delivered by
Martínez et al. [31]	372 (12–16 yo)	Valencia	Improvements in dietary habits	6 months	N/R	N/R	RT
Martínez-García and Trescastro-López [32]	28 (8–9 yo) Third-grade primary school students	Alicante	Knowledge about food groups and their frequency of consumption, consumption of fruits and vegetables and a healthy breakfast Development of a healthy lunch	1 month	2 years	the Hanlon method for prioritizing health problems	Dt, Nutr, T
Mora et al. [33]	509 (6 yo)	Catalonia	Cooking to improve dietary habits	2 years	2, 4, and 6 yrs	N/R	TTE
Muros et al. [34]	54 (10–11 yo)	Granada	Thirteen sessions of vigorous short-duration PA combined with sessions of nutritional education	7 weeks	N/R	N/R	RT
Oliva Rodríguez et al. [35]	107 (9–15 yo)	Seville	Educational program on healthy lifestyles provided by a health professional	6 months	2 months	N/R	E
Pablos et al. [36]	158 (fifth to sixth grade)	Eastern Region (Valencian Community)	Improving diet and health	8 months	N/R	N/R	RT, TTE
Pareja Sierra et al. [37]	2,516 (13–14 yo)	17 different Communities in Spain	Promoting healthy eating and PA through cooking and active leisure	6 months	N/R	N/R	TTE
Pastor et al. [38]	263 (12–16 yo)	Granada	Eating habits and metabolic syndrome components	1 year	N/R	N/R	E
Pérez López and Delgado Fernández [39]	48 (12–16 yo)	Cartagena	Changes in the consumption of fruit and vegetables	3 months	N/R	N/R	T, RT

(Continues)

TABLE 2 | (Continued)

Author	Number of participants (age or grade)	City/region	Dietary behaviors/ knowledge addressed	Intervention duration	Follow-up period	Theoretical framework/ model	Delivered by
Pérez López and Fernández [40]	128 Students in the fourth (and last) year of compulsory secondary school	Granada	Promoting healthy dietary habits and PA	Own commitments that students accepted voluntarily for the sake of their own personal health by applying the "Ten Commandments for Good Health"	6 months	NAOS Strategy (Spanish strategy for nutrition, physical activity and prevention of obesity)	Joint team (student—teacher—parent)
Pérez Rodrigo et al. [41]	Protocol study (not yet implemented) (10–13 yo)	Bilbao	Part of the School-based education strategies to promote fruit and vegetable consumption: The Pro Children Project.	Protocol study (not yet implemented)	N/R	The Attitude, Social Influence, and Self-Efficacy model	T, family and community
Pérez Solís et al. [42]	382 (first to fifth grade)	Aviles	Effectiveness of reducing BMI	Two consecutive academic years	2 years	N/R	T, E
Puig et al. [43]	1537 children and young people enrolled in preschool, primary, and secondary school	Llucmajor	School-based nutritional program	2 years	N/R	N/R	N/R
Restoy [44]	150 (13–14 yo)	Cartagena	Consumption of fruit and vegetables	1 year	N/R	N/R	E, T
Rico-Sapena et al. [45]	111 (9–12 yo)	Alicante	Effects on school feeding habits	2 years	N/R	N/R	T
Roberto and Carlos [46]	241 (13–14 yo)	Zaragoza	Nutrition education to improve the quality of breakfast meal	N/R	N/R	N/R	N/R
Rohlfs Domínguez et al. [47]	152 (4–6 yo)	Granada	Effect of increasing vegetable consumption	2 weeks	N/R	Self-determination theory	T, R
Tarro et al. [48]	1,939 (7–8 yo)	Reus	Promoting a healthy lifestyle, including dietary and PA	28 months	N/R	N/R	TTE
Te Velde et al. [49]	1,472 (10–11 yo)	Bilbao	Improving fruit and vegetable availability at schools and home	2 years	1 year	Behavior-change theory	T

Abbreviations: BMI, body mass index; CG, control group; E, experts; Dt, dietitian; IG, intervention group; NA, not applicable or assessed; N/R, not reported in the study; Nutr., nutritionists; PA, physical activity; RT, research team; SS, school staff; T, teachers; TTE, teachers trained by experts; yo, years old.

TABLE 3 | Study design, overall study quality, and overall intervention effectiveness on anthropometrics and dietary behavior of reviewed studies promoting healthy nutrition in children ($N = 31$).

Author	Study design	Study effect on anthropometrics	Study effect on dietary knowledge and/or behavior	Study effect on other assessed health attitudes, behaviors, outcomes
Allirot et al. [19]	Experimental study	N/R	Increased willingness to taste unfamiliar foods in the intervention group ($p = 0.011$) Increased liking in IG for a whole afternoon snack ($p = 0.034$), for two of three unfamiliar foods and one of three familiar foods ($p < 0.05$)	N/R
Bibiloni et al. [20]	Longitudinal intervention study	N/R	70% adherence to a Mediterranean diet	Increase in consumption of one fruit or fruit juice/day (from 83.7% to 90.6%; $p =$ 0.014), a second fruit or fruit juice (from 32% to 72%; $p <$ 0,001), one vegetable/day (from 69.9% to 79.6%; $p =$ 0,006) and more than one vegetable/day (from 22.6% to 50.5%; $p < 0.001$)
Burguera et al. [21]	Pilot study	Beneficial changes in % muscle mass (+3.4%)	N/R	Beneficial change in systolic blood pressure (−7.7 mmHg) Improvement of 0.5 s in speed
Escalé et al. [22]	Intervention	Reduction in the Z-score of BMI	No decrease in the Kidmed score	N/R
García et al. [23]	Interventional, longitudinal, prospective study	N/R	Decrease in intake of industrial bakery and pastry products ($p < 0.000$); lunchtime snacks ($p < 0.000$); mid-day snack of industrial baked goods, soft drinks	Decrease in time spent watching TV ($p <$ 0.005)
González-Jiménez et al. [24]	Descriptive analyses	Significant decline in BMI measures ($p < 0.000$) after the intervention	Significant improvement in healthy eating habits (p < 0.000)	Increase in physical activity ($p = 0.006$) and significant reduction in sedentary leisure activities ($p < 0.000$)
González-Jiménez et al. [25]	Qualitative study	Differences in BMI measures obtained before and after intervention ($p < 0.000$)	N/R	Significant differences in the Krece Plus test ($p < 0.000$) and practice of PA ($p =$ 0.006) Significant reduction ($p < 0.000$) in hours spent watching TV for both male and female
González-Valero et al. [26]	Descriptive, preexperimental	Reduction of 3.8% in BMI after intervention	Posttest showed 79.7% followed optimal Mediterranean diet compared to the pretest only 59.5%	N/R
Lete and Perales Antón [27]	Qualitative study	N/R	36% had improvement in the quality of their diet 85% knew the balanced Mediterranean dietary pattern	N/R

(Continues)

TABLE 3 | (Continued)

Author	Study design	Study effect on anthropometrics	Study effect on dietary knowledge and/or behavior	Study effect on other assessed health attitudes, behaviors, outcomes
Llargués et al. [28]	Experimental, longitudinal	Greater increase in BMI in CG ($p \leq 0.001$) A decrease of 3.6% in the prevalence of obesity in IG	N/R	N/R
Llargues et al. [29]	Cluster-randomised study	Decrease in prevalence of overweight and obesity (1.4% and 3.7%, respectively)	N/R	N/R
Llauradó et al. [30]	Cluster randomized control trial	Obesity prevalence and BMI values were similar in IG and CG	N/R	15% increase of boys in IG who performed ≥4 after-school PA h/week ($p = 0.027$) 16.6% more boys in IG watched ≤two TV h/day ($p = 0.009$), compared to CG
Martínez et al. [31]	Interventional study	Decrease in BMI after intervention ($p < 0.001$)	47.4% improvement in diet quality based ($p < 0.001$) Significant increase in breakfast consumption along with having dairy for breakfast and a decrease in consumption of industrial pastries	N/R
Martínez-García and Trescastro-López [32]	Pilot study	N/R	Increased knowledge in healthy eating in 70% of students in IG, with a decrease after 2 years, except for recognizing a healthy breakfast (89%) 18% increase in fruit consumption and a decrease in consumption of pastries and commercial juices	N/R
Mora et al. [33]	Cluster-randomised prospective study with two parallel arms	BMI in the treatment group was reduced by 1.13 kg/m^2 after intervention	N/R	N/R
Muros et al. [34]	Intervention	A decrease in the body fat percentage in IG	N/R	Decrease of total cholesterol, cholesterol linked to low-density lipoproteins and blood pressure, together with an increase in cholesterol linked to high-density lipoproteins, and an improvement in the maximum oxygen uptake and dietary intake profile in the IG compared with the CG ($p < 0.05$)
Oliva Rodríguez et al. [35]	Longitudinal analytical pilot study	N/R	Statistically significant increased knowledge regarding feeding and healthy lifestyles in the IG compared to CG	N/R

(Continues)

TABLE 3 | (Continued)

Author	Study design	Study effect on anthropometrics	Study effect on dietary knowledge and/or behavior	Study effect on other assessed health attitudes, behaviors, outcomes
Pablos et al. [36]	Randomized control trial	N/R	Significant improvements ($p < 0.05$) after the intervention in triglycerides, blood glucose, and maximal oxygen consumption Significant improvements in breakfast habits and quality of diet	N/R
Pareja Sierra et al. [37]	Cross-sectional study	N/R	Increase in weekly consumption of fruit and vegetables and reduction in weekly consumption of foods for occasional consumption, such as fried foods, pastries, snacks, or soft drinks	N/R
Pastor et al. [38]	Randomized control trial	Decrease in prevalence of overweight and obesity ($p < 0.001$) BMI significantly decreased in normal weight, overweight, and obesity groups ($p = 0.001$ and $p = 0.02$, respectively)	N/R	Reduction in prevalence of metabolic syndrome from 32.2 to 19.7% ($p < 0.001$)
Pérez López and Delgado Fernández [39]	Quasi-experimental design	N/R	A significant increase ($p \leq 0.001$) in breakfast Consumption and fruit intake ($p \leq 0.001$) Adequate hydration ("Water") ($p < 0.01$) reduction in consumption of soft drinks ($p < 0.05$)	N/R
Pérez López and Fernández [40]	Quasi-experimental (pretest, posttest, retest)	N/R	Significant improvement ($p \leq 0.001$) in habits related to breakfast and fruit, water drinking, reduced soft drinks, and pastry consumption, increased physical activity, and dental hygiene	A high degree of students ($n = 128$) commitment to good health
Pérez Rodrigo et al. [41]	Intervention (this is a protocol study, not yet implemented)	N/R	Significantly increased consumption of nuts, fruits, and vegetables ($p < 0.001$) Increased number of students who incorporate bread or cereals in the breakfast meal ($p < 0.001$). The feminine pattern improves more than the masculine ($p < 0.001$) Significant increase in the percentage of optimal Mediterranean diet ($p < 0.001$)	N/R

(Continues)

TABLE 3 | (Continued)

Author	Study design	Study effect on anthropometrics	Study effect on dietary knowledge and/or behavior	Study effect on other assessed health attitudes, behaviors, outcomes
Pérez Solís et al. [42]	Non-RTC	Decreased BMI z-score in IG from 1.14 to 1.02 ($p = 0.017$) compared to CG	Improved diet quality score from 7.33 to 7.71 points ($p = 0.045$) Following an optimal diet increased from 42.6% to 52.3% ($p = 0.021$)	N/R
Puig et al. [43]	Intervention	N/R	Significant increase in the consumption ($p < 0{,}001$) of nuts and second fruits and vegetables A significant increase in the number students who have breakfast and those who incorporate to it bread or cereals A significant increase in the percentage of optimal Mediterranean diet ($p < 0.001$) and 29.6% of the students refer to having modified their habits from the interventions	N/R
Restoy [44]	Prospective study	N/R	Increase consumption of salad and vegetables ($p = 0.011$) and fruit ($p = 0.02$) A significant increase in students who ate fruit at least once a day ($p < 0.0001$)	N/R
Rico-Sapena et al. [45]	Cross-sectional and comparative descriptive observational study	N/R	Greater adherence to following Mediterranean diet in the IG (87% compared to 39% CG) The percentage of students in IG with optimal diet (65%) was higher than those who needed to improve their diet (34%) compared to CG (43% and 51%, respectively) 65% increase in optimal diet after intervention	IG showed a higher percentage of affirmative answers in the Kidmed test
Roberto and Carlos [46]	Intervention	N/R	Increased percentage of schoolchildren in IG who eat a good quality breakfast from 23.0% to 32.6% Deceased percentage of schoolchildren in CG who eat a good quality breakfast from 12.0% to 8.3%. In the IG, the quality of the breakfast has improved (significantly at 10%), while in the CG the quality of the breakfast has worsened (significantly at 10%)	N/R
Rohlfs Domínguez et al. [47]	Experimental design	N/R	Provision of choice showed an increase in vegetable consumption	N/R

(Continues)

TABLE 3 | (Continued)

Author	Study design	Study effect on anthropometrics	Study effect on dietary knowledge and/or behavior	Study effect on other assessed health attitudes, behaviors, outcomes
Tarro et al. [48]	RCT	Effective reduction of −0.24 units in the change of BMI z-score compared to CG A decrease in obesity prevalence in boys −2.36% in IG and increased by 2.03% in the CG; the difference was 4.39% ($p = 0.01$)	N/R	IG increased PA >5 h/week than CG ($p = 0.02$)
Te Velde et al. [49]	Group-randomised trial	N/R	IG reported a 57 g/day higher intake of fruit and vegetables compared to CG ($p < 0.05$)	N/R

Abbreviation: BMI, body mass index; CG, control group, IG, intervention group; PA, physical activity; N/R, not reported in the study; RCT, randomized controlled trial.

the schools. Additionally, if an external review was warranted, it would likely be a concern of reviewers and editors in the peer review process for the respective journal

3.5 | Dietary Behaviors/Knowledge Addressed and Effects of Interventions

The studies included in this review addressed a broad spectrum of dietary behaviors and knowledge aimed at promoting healthy nutrition behaviors among children and adolescents. Most of the studies focused on improving overall healthy lifestyles by incorporating dietary habits and/or physical activity [20, 21, 23, 24, 25, 27, 29, 30, 31, 34–36, 40, 45, 48]. Three studies specifically focused on cooking to improve dietary habits [19, 33, 37], while González-Valero et al. [26] emphasized adherence to the Mediterranean diet. Four studies examined the effectiveness of reducing body mass index (BMI) [20, 22, 28, 42]. Five studies aimed at increasing fruit and vegetable consumption [39, 41, 44, 47, 49]. Martínez-García and Trescastro-López [32] focused on enhancing knowledge about food groups and their consumption practices, while Pastor et al. [38] investigated eating habits and their relationship to metabolic syndrome components. Lastly, Roberto and Carlos [46] concentrated on nutrition education to improve the quality of breakfast meals.

The studies reviewed explored the impact of interventions on various dietary knowledge, behaviors, and health outcomes, with positive improvements observed in several areas. In general, there was a significant increase in adherence to the Mediterranean diet, as reported by González-Valero et al. [26] and Puig et al. [43]. Improvements in diet quality were indicated by Pérez Solís et al. [42], Martínez-García and Trescastro-López [32], and Pérez López and Delgado Fernández [39]. Additionally, Oliva Rodríguez et al. [35] demonstrated a significant increase in knowledge regarding healthy feeding and lifestyles.

The majority of studies focused on dietary behavior and food consumption. Several studies reported increased fruit and vegetable consumption [32, 37, 38, 44, 43, 47]. Along with these improvements, there was a significant decrease in unhealthy dietary habits, such as reduced consumption of pastries and commercial juices, and a decrease in the intake of fried foods, pastries, and soft drinks [23, 32, 37]. Allirot et al. [19] also noted an increased willingness to try unfamiliar foods and a greater liking for healthy snacks. Furthermore, Pablos et al. [36], Puig et al. [43], and Pérez López and Delgado Fernández [39] reported improvements in breakfast consumption habits.

3.6 | Duration

The interventions in the reviewed studies varied significantly in duration. Some studies had relatively short intervention periods, such as Rohlfs Domínguez et al. [47] with 2 weeks, González-Valero et al. [26], and Bibiloni et al. [20] with 2 months, and Pérez López and Delgado Fernández [39] with 3 months. Several studies ($n = 4$) had interventions lasting 6 months [21, 31, 35, 37], while others ($n = 3$) extended for 1 year [23, 38, 44], 2 years [33, 49], or 2 school years [28, 42]. The longest intervention periods were those

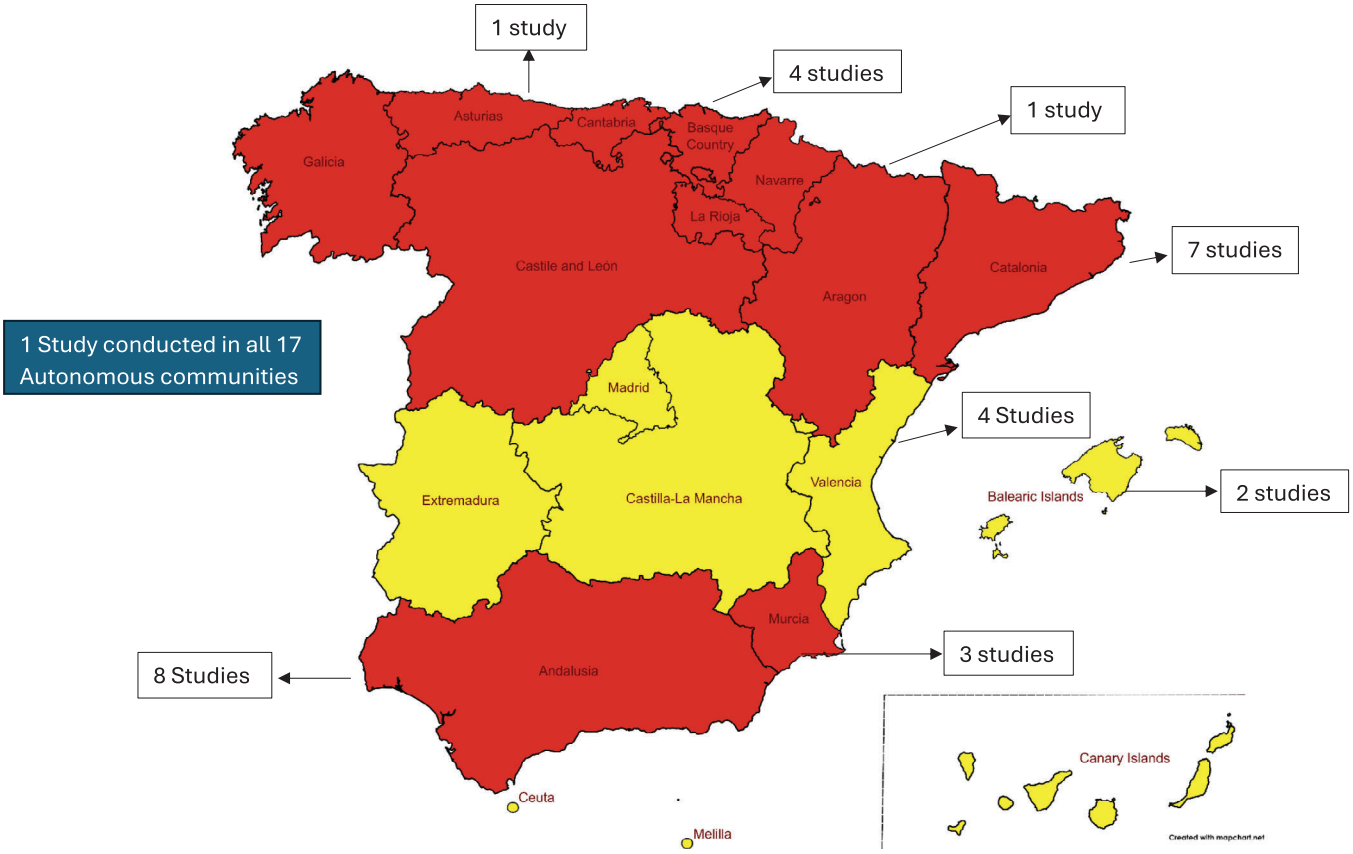

FIGURE 2 | Regional distribution of school-based nutrition intervention studies in Spain (by autonomous communities).

of Llauradó et al. [30], with a 3-year study, and Llargués et al. [29], whose intervention spanned 6 years.

3.7 | Framework/Model

A small number of studies (n = 5) included in this review employed theoretical frameworks or models for their interventions. Specifically, Martínez-García and Trescastro-López [32] applied the Hanlon method for prioritizing health problems, while Rohlfs Domínguez et al. [47] used self-determination theory. Te Velde et al. [49] incorporated behavior-change theory, and Pérez López and Fernández [40] based their intervention on the Strategy for Nutrition, Physical Activity and Prevention of Obesity (NAOS), a Spanish approach designed to promote nutrition, physical activity, and obesity prevention. Additionally, Pérez Rodrigo et al. [41] utilized the attitude, social influence, and self-efficacy model.

3.8 | Follow-up

A variety of follow-up periods were specified in about half of the studies (n = 15) included in the review. The shortest follow-up periods were 1 month [26] and 2 months [35]. Other studies (n = 3) reported follow-ups lasting 6 months [21, 22, 40]. Longer follow-up periods included 1 year [49] and 2 years [20]. Llargués et al. [29] had a follow-up period of 4 years, while Llauradó et al. [30] followed participants for 22 months. Mora et al. [33] conducted follow-ups at 2, 4, and 6 years. Additionally, some studies, such as Pérez Solís et al. [42], did not specify a consistent follow-up duration, and others such as Allirot et al. [19] conducted follow-ups at specific points at the beginning, middle, and end of the workshop.

3.9 | Delivery of the Interventions

The delivery of the interventions in the reviewed studies involved various personnel. Several studies [28, 29, 33, 42] utilized teachers for the intervention implementation. Some of these also included experts or nutritionists, as seen in Martínez-García and Trescastro-López [32], while Rohlfs Domínguez et al. [47] involved researchers in the delivery. Other studies [19, 24, 26, 36] relied on research teams for intervention delivery. Llauradó et al. [30] and Bibiloni et al. [20] were delivered solely by experts, while Pérez López and Fernández [40] involved a joint team consisting of students, teachers, and parents. Tarro et al. [48] used students from two universities to act as health promotion agents in delivering nutrition education programs in primary schools.

3.10 | Study Effect on Anthropometry

About half of the studies (n = 14) included in this review investigated the effect of interventions on the BMI of students. The majority of studies examining the effects of anthropometric measures such as BMI and body fat percentages show positive

outcomes, particularly in terms of reductions in BMI or BMI *z*-scores. These positive effects were observed in studies by Mora et al. [33], González-Valero et al. [26], Pérez Solís et al. [42], Tarro et al. [48], González-Jiménez et al. [24, 25], Pastor et al. [38], Martínez et al. [31], Escalé et al. [22], and Burguera et al. [21]. Additionally, the prevalence of overweight and/or obesity was reduced in three studies [29, 38, 48]. Burguera et al. [21] also found beneficial changes in muscle mass percentage (+3.4%), and Muros et al. [34] observed a decrease in body fat percentage in the intervention group. However, the study by Llauradó et al. [30] found no significant difference in obesity prevalence or BMI between the intervention and control groups.

3.11 | Study Effect on Dietary Knowledge and/or Behavior

The interventions evaluated across various studies ($n = 12$) showed diverse effects on additional health attitudes, behaviors, and outcomes, aligning with healthier lifestyle changes. Four studies [23–25, 30, 48] reported significant increases in physical activity and/or a significant reduction in time spent watching TV in the intervention group (IG). Pastor et al. [38] observed a significant reduction in the prevalence of metabolic syndrome, from 32.2% to 19.7% ($p < 0.001$). Burguera et al. [21] found beneficial changes in systolic blood pressure (−7.7 mmHg) and an improvement in reaction speed. Muros et al. [34] reported decreases in total cholesterol, blood pressure, and low-density lipoproteins, while high-density lipoproteins and maximum oxygen uptake improved in the IG compared to the control group.

4 | Discussion

This scoping review looked at a robust period (about a quarter century) to understand the nature and extent (inputs, activities, outputs) and successes and challenges (outcomes and impact) of contemporary nutrition education programs in Spain. Dietary habits begin at a young age, and food consumption practices at home traditionally have had the most effect. However, the lengthy "face time" that children and adolescents have in school with teachers and other adults makes the school site an optimal place for knowledge acquisition and behavior adoption or change to healthy eating and physical activity. The government at all levels in Spain is committed to assuring quality food and nutrition programs in schools [4]. While there are national policies that govern standards for school lunch programs [5, 6], variances exist between what students will eat and what students will bring into school [51]. Thus, it should be no surprise to see many of the studies undertaken have a "home and school" approach.

When working toward creating healthy habits or changing bad habits the descriptor "comprehensive approach" is a mainstay recommendation, such as smoking and alcohol avoidance, unsafe sex, and violence prevention. Researchers recognize that developing a healthy lifestyle at any age should involve both good nutrition and significant and sustained physical activity. Both actions, or lack thereof, contribute significantly to the rise in overweight and obesity among youth in developed countries. This serves as a motivating factor to continue research in the four fundamental questions for any educational intervention: (1) What do the learners need to know?, (2) How do I teach it?, (3) How do I know they learned something?, and (4) What difference did the program make? It is impressive that 14 studies involved anthropomorphic measures to answer the latter question, and all but one of the 14 [30] saw positive improvements in one or several anthropomorphic outcomes: BMI, body fat percentage, muscle mass, and weight reduction. Taking such measurements are delicate steps for researchers in a protocol involving young people and their parents; therefore, researchers investing time and effort in such projects is appreciated.

Programs related to influencing dietary knowledge and food consumption among youth accentuate the positive with emphasis on thinking about and trying healthy foods, rather than emphasizing what not to eat, such as sugary, fatty, and salty food and drink. No program had a significant emphasis on snaking, which most often contains the triple-threat substances mentioned above. In fact, few programs used the traditional messaging of "a balanced meal." Interventions chose to unbundle the message to specific foods such as fruits and vegetables or the Mediterranean diet. Such programs found creative ways to educate, demonstrate, and have students practice healthy food consumption via, free food distribution, cookbooks, and at-home activities involving parents.

Several types of instructors have been used in the projects reviewed. While subject matter experts, such as nutritionists, physical education teachers, and health educators have their value and place in "healthy schools" efforts, training the classroom teachers to impart health-enhancing messages has high value in getting to reach more students in the multiplying effect of using a pyramid approach of train the trainers who then train the more generalist teachers and allows for economy of effort for all involved. Thus, thought should be given to recruiting and organizing educators with expertise in curriculum, instruction, assessment, and maintenance in delivering healthy school initiatives.

Surprisingly, there is little work done in this area of inquiry to assess and counteract peer influences and ubiquitous food advertisements' influence, especially those targeting the very young. Furthermore, children and youth healthy lifestyle programs would do well to include recognizing misinformation and the morass of "bad behaviors" permeating social media today. This should motivate researchers and schools to include more community-wide programs using coalition building, media advocacy, and social marketing strategies.

Study designs in the area of food consumption and physical activity are challenging, given there is limited use of direct observation. Researchers need to rely on self-reporting of student behavior (questionnaires or diaries) or parental reports, which are known to be less accurate by over-reporting the "good" or expected behavior and under-reporting unhealthy behavior [52]. By far most interventions in this review use a health education/promotion approach. Researchers could consider using more theory-based designs such as the transtheoretical model of health behavior [53] or the social cognitive theory [54], especially since there were few well-established or "branded" nutrition education curricula or programs seen in this review. Several projects gave a name or acronym to their interventions; thus, it would make sense to replicate these using health education and

health communication theories to validate success and how they can be adapted to other sites or types of students.

4.1 | Limitations

There are added challenges to a range of planned steps, including implementation and follow-up, in research protocols involving youth. Additionally, there is a need to keep parents informed, as they are sometimes part of the interventions. The oversight of teachers and administrators in the schools, along with the time constraints imposed by daily and school calendar schedules for interacting with participants, further complicates the process. These variables can significantly affect participant selection and participation as well as adherence to the fidelity of an intervention. Historically, using self-reported survey questionnaires and diaries to measure students' eating and physical activity behaviors has presented limitations in accuracy. Most people, including youth, tend to underreport unhealthy behaviors and overreport healthy ones [55].

Data validation and quality of the studies are beyond the scope of this review.

5 | Conclusion

Research done to measure the success and challenges (outcomes and impact) of contemporary nutrition education and general healthy lifestyle programs conducted in schools (primary and secondary) in Spain has produced useful results. Almost all studies showed positive improvements in students gaining knowledge on healthful dietary habits and why it is important to consume a nutrient-dense diet. A meaningful amount of work has been done to show improvements in anthropomorphic measures after students participate in healthy lifestyle activities, such as BMI, body fat percentage, muscle mass, and weight reduction. The health education interventions were focused, such promoting particular types of food, versus the broader approach of what is considered a healthy meal. Future studies should consider using more theory-driven interventions such as the transtheoretical model of health behavior or the social cognitive theory in behavior within the Spanish cultural and dietary context. School-based lifestyle programs should include recognizing the morass of misinformation permeating social media today. More community-wide interventions using social media, social marketing, and contemporary health communication strategies within the school context are areas to warrant further study.

Acknowledgments

The authors have nothing to report.

Ethics Statement

Given the nature of this scoping review, no ethical oversight was found to be necessary for this review and, therefore, no institutional review board was acquired.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that supports the findings of this study are available in the Supporting Information of this article.

References

1. N. Omidvar, A. Doustmohammadian, E. Shakibazadeh, C. C. T. Clark, M. S. Kasaii, and M. Hajigholam-Saryazdi, "Effects of School-Based Interventions on Food and Nutrition Literacy (FNLIT) in Primary-School-Age Children: A Systematic Review," *British Journal of Nutrition* 129, no. 12 (2023): 2102–2121, https://doi.org/10.1017/s0007114522002811.

2. Global Child Nutrition Foundation. "School Meal Programs Around The World: Global Report Based on the 2021 Global Survey of School Meal Programs." Accessed June 3, 2024. https://gcnf.org/global-reports/.

3. World Bank. "Spain." Accessed July 29, 2024. https://data.worldbank.org/country/spain.

4. P. Gallego, I. Galán, M. José Medrano, P. Ramos, F. Rivera, and C. Moreno, "Recent Changes in School-based Policies on Physical Activity and Nutrition in Spain," *European Journal of Public Health* 24, no. 6 (2014): 899–904, https://doi.org/10.1093/eurpub/cku022.

5. E. M. Trescastro-López, "Public Nutrition Policies and Their Influence on School Feeding: The Spanish Experience in the Twentieth Century," *Social History of Medicine* 34, no. 4 (2021): 1256–1276, https://doi.org/10.1093/shm/hkaa100.

6. M. Á. San José González, L. C. Blesa Baviera, and J. M. Moreno-Villares, "Comedores Preescolares y Escolares. Guías, Recomendaciones y Normativa en España," *Anales de pediatria (Barcelona)* 95, no. 1 (2021): 55.e1–55.e9, https://doi.org/10.1016/j.anpedi.2021.01.010.

7. E. Pardos-Mainer, B. Gou-Forcada, L. Sagarra-Romero, S. Calero Morales, and R. R. Fernández Concepción, "Obesidad, Intervención Escolar, Actividad Física y Estilos de Vida Saludable en niños españoles," *La Revista Cubana de Salud Pública* 47, no. 2 (2021): e1096.

8. C. Cavero Esponera, S. Fernández Sánchez-Escalonilla, and M. Royo-Bordonada, "Public Opinion on Food Policies to Combat Obesity in Spain," *International Journal of Environmental Research and Public Health* 19, no. 14 (2022), https://doi.org/10.3390/ijerph19148561.

9. World Health Organization. "WHO Director-General's remarks at Food Systems Summit – 24 July 2023." Accessed July 20, 2024. https://www.who.int/director-general/speeches/detail/who-director-general-s-remarks-at-food-systems-summit-24-july-2023.

10. R. Fernández-Iglesias, S. Álvarez-Pereira, A. Tardón, B. Fernández-García, and E. Iglesias-Gutiérrez, "Adherence to the Mediterranean Diet in a School Population in the Principality of Asturias (Spain): Relationship With Physical Activity and Body Weight," *Nutrients* 13, no. 5 (2021): 1507, https://doi.org/10.3390/nu13051507.

11. I. Egaña Txurruka, S. Valcárcel Alonso, N. Macazaga Perea, C. Oria Eraso, and G. García-Baquero Moneo, "Evaluation of Food Intake Through Residual Analysis in 90 Basque School Canteens," *Gaceta Sanitaria* 37 (2023): 102256, https://doi.org/10.1016/j.gaceta.2022.102256.

12. B. Derqui, V. Fernandez, and T. Fayos, "Towards More Sustainable Food Systems. Addressing Food Waste at School Canteens," *Appetite* 129 (2018): 1–11, https://doi.org/10.1016/j.appet.2018.06.022.

13. E. Abderbwih, M. R. Mahanani, A. Deckert, et al., "The Impact of School-Based Nutrition Interventions on Parents and Other Family Members: A Systematic Literature Review," *Nutrients* 14, no. 12 (2022): 2399, https://doi.org/10.3390/nu14122399.

14. J. P. T. Higgins, J. Thomas, J. Chandler, et al., *Cochrane Handbook for Systematic Reviews of Interventions*. (John Wiley & Sons, 2019).

15. H. Arksey and L. O'Malley, "Scoping Studies: Towards a Methodological Framework," *International Journal of Social Research Methodology* 8, no. 1 (2005): 19–32, https://doi.org/10.1080/1364557032000119616.

16. A. C. Tricco, E. Lillie, W. Zarin, et al., "PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation," *Annals of Internal Medicine* 169, no. 7 (2018): 467–473, https://doi.org/10.7326/m18-0850.

17. M. Ouzzani, H. Hammady, Z. Fedorowicz, and A. Elmagarmid, "Rayyan-a Web and Mobile App for Systematic Reviews," *Systematic Reviews* 5, no. 1 (2016): 210, https://doi.org/10.1186/s13643-016-0384-4.

18. M. D. J. Peters, C. Godfrey, P. McInerney, Z. Munn, A. C. Tricco, and H Khalil. "Chapter 11: Scoping Reviews (2020 version)." In "*JBI Manual for Evidence Synthesis*", ed. E Aromataris and Z Munn. (JBI, 2020), 407–452.

19. X. Allirot, N. da Quinta, K. Chokupermal, and E. Urdaneta, "Involving Children in Cooking Activities: A Potential Strategy for Directing Food Choices Toward Novel Foods Containing Vegetables," *Appetite* 103 (2016): 275–285, https://doi.org/10.1016/j.appet.2016.04.031.

20. M.dM. Bibiloni, J. Fernández-Blanco, N. Pujol-Plana, et al., "Mejora de la calidad de la dieta y del Estado Nutricional en Población Infantil Mediante un Programa Innovador de Educación Nutricional: INFADIMED," *Gaceta Sanitaria* 31, no. 6 (2017): 472–477, https://doi.org/10.1016/j.gaceta.2016.10.013.

21. B. Burguera, A. Colom, E. Piñero, et al., "ACTYBOSS: Activity, Behavioral Therapy in Young Subjects—After-school Intervention Pilot Project on Obesity Prevention," *Obesity Facts* 4, no. 5 (2011): 400–406, https://doi.org/10.1159/000333436.

22. M. T. Escalé, D. M. Chicano, N. E. Castillo, et al., "Educación Nutricional en Niños en Edad Escolar a Través del Programa Nutriplato," *Nutricion Hospitalaria* 37, no. Spe. 2 (2020): 47–51, doi:10.20960/nh.03357.

23. M. P. E. García, M. D. V. García, V. B. Curiel, and J. C. L. Lacoma, "Hábitos de Alimentación y de Actividad Física. Un Año de Intervención en la Escuela. Estudio piloto," *Acta Pediatrica Espanola* 67, no. 1 (2009): 21–25.

24. E. González-Jiménez, G. R. Cañadas, R. Fernández-Castillo, and G. A. Cañadas-De la Fuente, "Analysis of the Life-style and Dietary Habits of a Population of Adolescents," *Nutricion Hospitalaria* 28, no. 6 (2013): 1937–1942.

25. E. González-Jiménez, G. R. Cañadas, A. Lastra-Caro, and G. A. Cañadas-De la Fuente, "Efectividad de una Intervención Educativa sobre Nutrición y Actividad Física en una Población de Adolescentes: Prevención de Factores de Riesgos Endocrino-metabólicos y Cardiovasculares," *Aquichan* 14, no. 4 (2014): 549–559, https://doi.org/10.5294/aqui.2014.14.4.9.

26. G. González-Valero, F. Zurita-Ortega, P. Puertas-Molero, R. Chacón-Cuberos, T. E. Garcés, and M. C. Sánchez, "Educación para la Salud: Implementación del Programa "Sportfruits" en Escolares de Granada," *SPORT TK-Revista EuroAmericana de Ciencias del Deporte* 6, no. 2 (2017): 137–146, https://doi.org/10.6018/300491.

27. A. I. Lete and A. Perales Antón, "Evaluación del programa de intervención dietética (escolares de 3o ESO) [Dietary Assessment Program Evaluation (Third-Year Secondary School Students)]," *Nutricion Hospitalaria* 17, no. 6 (2002): 296–301. Evaluación del programa de intervención dietética (escolares de 3o ESO).

28. E. Llargués, A. Recasens, R. Franco, et al., "Medium-Term Evaluation of an Educational Intervention on Dietary and Physical Exercise Habits in Schoolchildren: The Avall 2 Study," *Endocrinología y Nutrición* 59, no. 5 (2012): 288–295, https://doi.org/10.1016/j.endoen.2012.06.004.

29. E. Llargués, M. A. Recasens, J. M. Manresa, et al., "Four-Year Outcomes of an Educational Intervention in Healthy Habits in Schoolchildren: The AVALL 3 Trial," *European Journal of Public Health* 27, no. 1 (2017): 42–47, https://doi.org/10.1093/eurpub/ckw199.

30. E. Llauradó, L. Tarro, D. Moriña, R. Queral, M. Giralt, and R. Solà, "EdAl-2 (Educació en Alimentació) Programme: Reproducibility of a Cluster Randomised, Interventional, Primary-School-Based Study to Induce Healthier Lifestyle Activities in Children," *BMJ Open* 4, no. 11 (2014): e005496, https://doi.org/10.1136/bmjopen-2014-005496.

31. M. I. Martínez, M. D. Hernández, M. Ojeda, R. Mena, A. Alegre, and J. L. Alfonso, "Desarrollo de un Programa de Educación Nutricional y Valoración del Cambio de Hábitos Alimentarios Saludables en una Población de estudiantes de Enseñanza Secundaria Obligatoria," *Nutricion Hospitalaria* 24, no. 4 (2009): 504–510.

32. A. Martínez-García and E. M. Trescastro-López, "Actividades de Educación Alimentaria y Nutricional en Escolares de 3o de Primaria en el Colegio Público "La Serranica" de Aspe (Alicante): Experiencia piloto," *Revista Española de Nutrición Humana y Dietética* 20, no. 2 (2016): 97–103, https://doi.org/10.14306/renhyd.20.2.192.

33. T. Mora, E. Llargués, and A. Recasens, "Does Health Education Affect BMI? Evidence From a School-based Randomised-control Trial," *Economics and Human Biology* 17 (2015): 190–201, https://doi.org/10.1016/j.ehb.2014.11.001.

34. J. J. Muros, M. Zabala, M. J. Oliveras-López, F. A. Ocaña-Lara, and H. López-García de la Serrana, "Results of a 7-Week School-Based Physical Activity and Nutrition Pilot Program on Health-Related Parameters in Primary School Children in Southern Spain," *Pediatric Exercise Science* 25, no. 2 (2013): 248–261, https://doi.org/10.1123/pes.25.2.248.

35. R. Oliva Rodríguez, M. Tous Romero, B. Gil Barcenilla, G. Longo Abril, J. L. Pereira Cunill, and P. P. García Luna, "Impacto de una intervención educativa breve a escolares sobre nutrición y hábitos saludables impartida por un profesional sanitario." [Impact of a Brief Educational Intervention About Nutrition and Healthy Lifestyles to School Students Given by a Healthcare Provider], *Nutricion Hospitalaria* 28, no. 5 (2013): 1567–1573, https://doi.org/10.3305/nh.2013.28.5.6746.

36. A. Pablos, V. Nebot, V. Vañó-Vicent, D. Ceca, and L. Elvira, "Effectiveness of a School-Based Program Focusing on Diet and Health Habits Taught Through Physical Exercise," *Applied Physiology, Nutrition and Metabolism* 43, no. 4 (2018): 331–337, https://doi.org/10.1139/apnm-2017-0348.

37. S. L. Pareja Sierra, E. Roura Carvajal, R. Milà-Villarroel, and A. Adot Caballero, "Estudio y Promoción de Hábitos Alimentarios Saludables y de Actividad Física entre los Adolescentes Españoles: Programa TAS (tú y Alicia por la salud)," *Nutricion Hospitalaria* 35, no. spe 4 (2018): 121–129, https://doi.org/10.20960/nh.2137.

38. M. M. C. Pastor, M. D. Serrano Pardo, M. L. Fernández Soto, J. D. Luna Del Castillo, and F. Escobar-Jiménez, "Impact of a 'School-Based' Nutrition Intervention on Anthropometric Parameters and the Metabolic Syndrome in Spanish Adolescents," *Annals of Nutrition & Metabolism* 61, no. 4 (2012): 281–288, https://doi.org/10.1159/000341495.

39. I. J. Pérez López and M. Delgado Fernández, "Un Juego de Cartas durante los Recreos Escolares Mejora los Hábitos Alimentarios en Adolescentes," *Nutricion Hospitalaria* 27, no. 6 (2012): 2055–2065, https://doi.org/10.3305/nh.2012.27.6.6071.

40. I. J. Pérez López and M. D. Fernández, "Mejora de Hábitos Saludables en Adolescentes desde la Educación Física escolar," *Revista de Educación* 360 (2013): 314–337, https://doi.org/10.4438/1988-592X-RE-2011-360-113.

41. C. Pérez Rodrigo, J. Aranceta, H. Brug, M. Wind, C. Hildonen, and K. P. Klepp, "Estrategias Educativas para la Promoción del Consumo de Frutas y Verduras en el Medio Escolar: Proyecto Pro Children," *Archivos Latinoamericanos De Nutricion* 54, no. Suppl 1 (2004): 14–19.

42. D. Pérez Solís, J. J. Díaz Martín, F. Álvarez Caro, I. Suárez Tomás, E. Suárez Menéndez, and I. Riaño Galán, "Efectividad de una Intervención Escolar contra la Obesidad," *Anales de pediatria (Barcelona)* 83, no. 1 (2015): 19–25, https://doi.org/10.1016/j.anpedi.2014.08.010.

43. M. S. Puig, M. Moñino, M. Colomer, N. Martí, and E. Muñoz, "Modificación de los Hábitos Alimentarios en Escolares del término Municipal de Llucmajor tras Dos Años de Intervenciones Educativas (2002-2005)," *La Revista Española de Nutrición Comunitaria* 12, no. 1 (2006): 14–22.

44. J. L. S. Restoy, "Cambios en el consumo de fruta y verdura en estudiantes de 2.° de ESO Después de Seguir un Programa de Educación Nutricional," *Nutrición Clínica y Dietética Hospitalaria* 32, no. 1 (2012): 26–34.

45. N. Rico-Sapena, M. E. Galiana-Sanchez, J. Bernabeu-Mestre, E. M. Trescastro-López, and J. M. Vasallo, "Efectos de un Programa Alternativo de Promoción de la Alimentación Saludable en comedor escolar," *Revista Ciência & Saúde Coletiva* 24, no. 11 (2019): 4071–4082, https://doi.org/10.1590/1413-812320182411.02482018.

46. H. L. Roberto and F. B. J. Carlos, "Influencia de un Programa de Educación Nutricional en la Modificación del Desayuno en un Grupo de Adolescentes," *Nutrición Clínica y Dietética Hospitalaria* 30, no. 2 (2010): 26–32.

47. P. Rohlfs Domínguez, F. Gámiz, M. Gil, et al., "Providing Choice Increases Children's Vegetable Intake," *Food Quality and Preference* 30, no. 2 (2013): 108–113, https://doi.org/10.1016/j.foodqual.2013.05.006.

48. L. Tarro, E. Llauradó, R. Albaladejo, et al., "A Primary-School-Based Study to Reduce the Prevalence of Childhood Obesity–The EdAl (Educació en Alimentació) Study: A Randomized Controlled Trial," *Trials* 15 (2014): 58, https://doi.org/10.1186/1745-6215-15-58.

49. S. J. Te Velde, J. Brug, M. Wind, et al., "Effects of a Comprehensive Fruit- and Vegetable-Promoting School-Based Intervention in Three European Countries: The Pro Children Study," *British Journal of Nutrition* 99, no. 4 (2008): 893–903, https://doi.org/10.1017/s000711450782513x.

50. World Medical Association. "Declaration of Helsinki: Medical Research Involving Human Participants." Accessed March 2, 2025. https://www.wma.net/what-we-do/medical-ethics/declaration-of-helsinki/.

51. A. Garrido-Fernández, F. M. García-Padilla, J. L. Sánchez-Ramos, J. Gómez-Salgado, G. H. Travé-González, and E. Sosa-Cordobés, "Food Consumed by High School Students During the School Day," *Nutrients* 12, no. 2 (2020): 485.

52. M. N. Ravelli and D. A. Schoeller, "Traditional Self-Reported Dietary Instruments Are Prone to Inaccuracies and New Approaches Are Needed," *Frontiers in Nutrition* 7 (2020): 90, https://doi.org/10.3389/fnut.2020.00090.

53. J. Nakabayashi, G. R.-i Melo, and N. Toral, "Transtheoretical Model-Based Nutritional Interventions in Adolescents: A Systematic Review," *BMC Public Health [Electronic Resource]* 20, no. 1 (2020): 1543, https://doi.org/10.1186/s12889-020-09643-z.

54. M. Bagherniya, A. Taghipour, M. Sharma, et al., "Obesity Intervention Programs Among Adolescents Using Social Cognitive Theory: A Systematic Literature Review," *Health Education Research* 33, no. 1 (2018): 26–39, https://doi.org/10.1093/her/cyx079.

55. S. Bel-Serrat, C. Julián-Almárcegui, M. González-Gross, et al., "Correlates of Dietary Energy Misreporting Among European Adolescents: The Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) Study," *British Journal of Nutrition* 115, no. 8 (2016): 1439–1452, https://doi.org/10.1017/s0007114516000283.

Supporting Information

Additional supporting information can be found online in the Supporting Information section.