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Changes in Diet Quality and Mediterranean Diet Adherence After a School-Based Program Among Youth: The Delicious Project

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Abstract

Background: Enhancing diet quality and encouraging adherence to the Mediterranean diet in children and adolescents represents a major public health objective. School-based programs that integrate multiple components may be an effective approach to fostering healthier dietary behaviors, although their effectiveness across different settings and populations is still not fully established. **Objectives:** This study aimed to assess changes in diet quality and Mediterranean diet adherence following the implementation of a multicomponent school-based initiative within the EU-funded DELICIOUS project. **Methods:** An uncontrolled one-group pre–post quasi-experimental evaluation was conducted involving 667 children and adolescents from Italy, Spain, Portugal and Egypt. Diet quality was measured using the Youth Healthy Eating Index (Y-HEI), while adherence to the Mediterranean diet was assessed using the KIDMED score. Consumption of major food groups was collected through structured questionnaires. Changes in dietary indicators were analyzed before and after the program. The relationship between dietary scores and compliance

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with national dietary recommendations was also examined. **Results:** Following program implementation, the KIDMED, but not the Y-HEI, scores showed a significant improvement. Participants reported higher intake of fruits, vegetables, legumes, fish, nuts, and dairy products, along with reduced meat consumption. At the same time, pasta intake increased, whole-grain consumption decreased, and sweets' intake also rose. Overall, adherence to national dietary recommendations improved, although the results varied in the different school settings. Higher KIDMED and Y-HEI scores were, to different degrees, associated with a greater likelihood of meeting dietary guidelines. **Conclusions:** This multicomponent initiative was associated with a significant improvement in Mediterranean diet adherence among schoolchildren and adolescents, although no statistically significant overall improvement in diet quality was observed and dietary changes were mixed. Increased consumption of fruit, vegetables, legumes, fish, and nuts, together with reduced meat consumption, was accompanied by increased consumption of sweets and decreased consumption of whole grains. These findings suggest that such approaches may be associated with healthier eating patterns while also highlighting the importance of addressing specific components to achieve more balanced nutritional outcomes.

Keywords: Mediterranean diet; diet quality; school-based program; children; adolescents

1. Introduction

Childhood and adolescence represent critical periods for the establishment of dietary habits that can persist into adulthood and influence long-term health outcomes [1,2]. In recent decades, eating choices among young populations have shifted from traditional dietary models toward increased consumption of energy-dense and nutrient-poor foods and decreased intake of fruits, vegetables, and whole grains [3]. These trends have been suggested to contribute to the rising prevalence of childhood overweight and obesity and increase the risk of developing non-communicable diseases later in life [4]. Hence, improving diet quality during early life could be considered a valid public health strategy to establish healthy lifestyles and reduce the burden of non-communicable diseases in adulthood [5–7].

Efforts to improve dietary behaviors in children and adolescents have increasingly focused on school-based and community approaches [8]. Schools provide an optimal setting for initiatives aimed at improving dietary behaviors in children and adolescents, as they offer opportunities to reach large populations during a formative stage of life [9]. Nevertheless, strategies based solely on traditional nutrition education often show limited effectiveness in producing sustained dietary changes [10]. Dietary behaviors are influenced not only by knowledge but also by food preferences, practical skills, and the food environment [11]. Therefore, approaches that combine multiple educational and behavioral strategies may be more effective in promoting healthier eating habits [12]. Experiential and interactive approaches, such as food-related games, hands-on cooking activities, and practical food preparation, have been shown to enhance engagement, improve food literacy, and increase willingness to try healthier foods [13]. Integrating these strategies within school-based programs may therefore represent a promising approach to improving diet quality and promoting adherence to the traditional dietary models among children and adolescents.

The Mediterranean diet has been widely recognized as a healthy dietary pattern characterized by high consumption of plant-based foods, including fruits, vegetables, legumes, whole grains, nuts, and olive oil, moderate intake of fish and dairy products, and low consumption of red and processed meats [14]. This dietary model also represents the cultural heritage of the populations living in the Mediterranean area embracing socio-cultural aspects alongside environmental sustainability [15,16]. Adherence to the Mediterranean diet has

been associated with numerous health benefits in the adult population [17–19]. Evidence also suggests that adherence to this dietary pattern in childhood and adolescence may contribute to favorable health outcomes and support healthy growth and development [20–23]. However, despite its well-documented benefits, adherence to the Mediterranean diet has been declining among younger populations, even in countries traditionally associated with this dietary pattern [20,24].

In this context, approaches that combine educational strategies, environmental modifications, and family or community involvement may provide a promising framework for improving diet quality and promoting adherence to the Mediterranean diet among young populations [25]. Previous studies have shown that promoting adherence to the Mediterranean diet may also provide health benefits in younger generations [26]. However, modifying dietary choices in favour of traditional healthy dietary patterns is hard to achieve, especially among children and adolescents. Therefore, the aim of the present study was to evaluate the results of a multicomponent school program designed to improve diet quality and increase adherence to the Mediterranean diet among school children and adolescents living in four Mediterranean countries.

2. Materials and Methods

2.1. Study Design and Population

The DELICIOUS (UnDErstanding consumer food choices & promotion of healthy and sustainable Mediterranean Diet and LIfestyle in Children and adolescents through behavIOUral change actionS) project was a quasi-experimental school-based program with a longitudinal multi-country sample evaluation (one-group pre-test–post-test) starting January 2025 at baseline (T0) and after 6 months (T1) [27]. The project involved children and adolescents aged 6 to 17 years in four Mediterranean countries (Italy, Spain, Portugal, and Egypt) and it aimed to improve diet quality, adherence to the Mediterranean diet and an active lifestyle, as well as weight loss in a group of participants (not included in the present study). Participants were recruited among the school partners of the project (one school per country). Based on previous studies with similar aims [28,29], a non-probabilistic target sample of at least 150 participants for each country was set. Participants were enrolled on a voluntary basis, with the school used as a single center sample unit. Students were considered for inclusion in the study sample if they met a basic inclusion criterion, such as the ability to participate in the program activities. All students were enrolled in this study, leading to the recruitment of a total of 738 participants. After follow-up, 42 students were excluded because they either missed a significant number of the planned activities ($n = 26$) or it was impossible to pair the pre–post information ($n = 16$). After exclusion of additional 29 participants due to unreliable questionnaire responses (i.e., all answers consisted of the first option), the final sample retained was of 667 participants. All processes were carried out in accordance with the Declaration of Helsinki (1989) established by the World Medical Association. The participants' parents signed an informed consent form before the commencement of this research.

2.2. Program Description

Educational activities were implemented using an age-specific and culturally adapted approach across participating countries. The intervention was tailored to national contexts and the developmental needs of two age groups (6–12 and 13–17 years) while also extending educational activities to participants' families. The educational component comprised both formal and non-formal strategies. For children aged 6–12 years, nutrition and sustainability concepts based on the Mediterranean dietary pattern were incorporated into existing primary school curricula whenever permitted by each country's educational policies. In schools

where curricular integration was not approved, the educational materials were delivered through non-formal educational activities. For adolescents aged 13–17 years, additional educational resources focusing on the Mediterranean Diet were developed, together with supporting materials for teachers and educational staff. The non-formal education component consisted of a comprehensive set of Mediterranean Diet-based educational resources specifically developed according to consumer behaviour analyses and local market assessments conducted in each participating country. Activities targeted children and adolescents aged 6–17 years, their families or caregivers, and school personnel, with the objective of promoting long-term adherence to healthy and sustainable dietary habits. Educational materials addressed nutrition, sustainability, and practical aspects of Mediterranean dietary practices. As part of the experiential activities, healthy snack products were developed using minimally processed ingredients, including locally available dried fruits, cereals, and nuts [30,31]. A physical activity program was also implemented by following a structured exercise plan delivered over six weeks during the pilot phase and six months during the main study [32,33]. Participants attended three supervised sessions per week, each lasting approximately 40–45 min. The program included a variety of activities designed to improve cardiorespiratory endurance, muscular strength, speed, coordination, and overall physical fitness through exercises such as running, jumping, and strength training.

2.3. Data Collection

Questionnaire administration was conducted in classroom settings during school hours by trained educators following a standardized administration protocol. Participants completed the questionnaires in their usual school environment under supervised conditions. Educators remained available throughout the administration to provide clarification and support in understanding questionnaire items, while avoiding any influence on participants' responses. This support was provided when needed, particularly for younger children. No age-specific administration procedures were applied, and the same standardized protocol was used across all age groups. Adequate time was provided to ensure that all participants could complete the questionnaires without time pressure. Data on age, sex, and country of living was recorded.

2.4. Dietary Intakes

Dietary intake was assessed using a structured dietary assessment questionnaire comprising a semi-structured 24-hour dietary recall and complementary food-frequency questions. The 24-hour section assessed foods consumed during the previous day using predefined food categories organized by meal occasion, with participants reporting the corresponding number of portions, units, or cups, as applicable, and with an additional response option for foods not listed. To evaluate usual dietary patterns, complementary questions focused on the daily or weekly frequency of consumption of key food groups using food-specific response categories. Food items were grouped as vegetables, fruit, cereals and whole grains, red/white and processed meat, legumes, fish, sweets, nuts, eggs, milk/yoghurt and other dairy products, oils and other dietary fats. The 24-hour recalls were predominantly used to estimate adequacy to country-specific dietary recommendations, while the food-frequency questions remarked the information to assess diet quality (see below).

2.5. Diet Quality and Adherence to the Mediterranean Diet

Diet quality was assessed through calculation of the Youth Healthy Eating Index (Y-HEI), a tool designed to measure diet quality in older children and adolescents [34]. This index assesses factors like fat, fiber, sodium, and added sugar intake, emphasizing food

choices rather than precise nutrient calculations, making it suitable for younger populations. The Y-HEI comprises 13 components, including intake of whole grains, fruits, vegetables, dairy, meat, snacks, sugary beverages, fried foods, butter and margarine, visible animal fats, and lifestyle habits such as eating breakfast and sharing meals with family. Scores range from 0 to 100, with higher scores reflecting better diet quality. In this study, data on multivitamin use and visible fat intake were excluded, reducing the maximum score to 90. As these components were not included, the resulting score represents an adapted version of the original Y-HEI and may limit direct comparability with studies using the complete index.

Adherence to the Mediterranean diet was assessed through the calculation of the KIDMED score [35], an index composed of 16 questions on a set of food items reflecting the alignment or misalignment with the Mediterranean dietary model. Items consistent with the Mediterranean Diet were assigned a score of +1, whereas unfavourable items a score of −1, for a maximum total possible score of 12 and higher total scores indicating greater adherence to the Mediterranean diet. The KIDMED score was analyzed as both a continuous variable and categorized with a score ≥7 deemed as high adherence to the Mediterranean Diet. Both the Y-HEI and KIDMED scores were calculated using the relevant items from the weekly food-frequency component.

2.6. Adequacy to Country-Specific National Dietary Recommendations

Food-based dietary recommendations were retrieved for each country based on available resources for Italy [36], Portugal [37,38], Spain [39,40], and Egypt [41]. Most guidelines provided recommendations on fruit and vegetables (altogether for Spain), specific on meat (Spain and Italy), meat and eggs (Egypt), protein sources (Portugal) as well as on olive oil (Italy), fats and oils (Portugal), or fats and sweets (Egypt). Other food groups subject to specific recommendations were cereals, legumes, fish and seafood, and dairy products. For each food group, compliance with country-specific dietary recommendations was determined using the relevant frequency-of-consumption item from the weekly food-frequency component and 24-hour recalls and the corresponding national recommendation threshold.

2.7. Statistical Analysis

Categorical variables were summarised using absolute frequencies and percentages, whereas the KIDMED and Y-HEI scores were reported as mean and standard deviation. Pre–post differences in the distributions of food consumption categories were assessed using Stuart–Maxwell test, initially in the overall sample and subsequently within each country. Mean KIDMED scores before and after the intervention were compared using paired-samples t-tests in the overall sample and separately in Portugal, Spain, Italy, and Egypt. Pre–post differences in Y-HEI scores were assessed using one-way repeated-measures analysis of variance (ANOVA) accounting for the paired nature of the data, both in the overall sample and separately within each country. Compliance with country-specific dietary recommendations was expressed as a dichotomous variable (compliant/non-compliant). Pre–post differences in guideline compliance were assessed using Stuart–Maxwell tests separately within each country and dietary recommendation.

The associations between KIDMED and Y-HEI scores and compliance with dietary recommendations were examined using logistic regression models developed separately by country, dietary score, and food group. For these analyses, both the dietary scores and guideline-compliance outcomes referred to the follow-up assessment, and each participant contributed one observation. Compliance with each recommendation was included as the dichotomous dependent variable, whereas the KIDMED or Y-HEI score was included as the continuous independent variable in separate models and standardised according

to its respective standard deviation to facilitate comparison across models. Accordingly, a one-unit increase in the standardized predictor represented a one-standard-deviation increase in the original dietary score. The results were reported as odds ratios (ORs) and 95% confidence intervals (95% CIs). Each OR represented the association between a one-standard-deviation increase in the KIDMED or Y-HEI score and the odds of meeting a specific dietary recommendation, controlling for age and sex. Given the number of country- and food-specific comparisons, these analyses were considered exploratory. No formal adjustment for multiple testing was applied; therefore, *p*-values should be interpreted as nominal and considered together with the magnitude and precision of the corresponding estimates. All statistical tests were two-sided, and statistical significance was set at p-value < 0.05. Statistical analyses were performed using IBM SPSS Statistics, version 28.0 (SPSS Inc., Chicago, IL, USA).

3. Results

A total of 667 participants included in the follow-up analyses were distributed as follows: 207 from Portugal, 174 from Spain, 197 from Italy, and 89 from Egypt. Changes in KIDMED and Y-HEI scores before and after the DELICIOUS program are presented in Table 1. In the overall study sample (n = 667), adherence to the Mediterranean diet significantly improved following the program, with the mean KIDMED score increasing from 5.3 (SD 1.9) to 6.7 (SD 2.0) ($p < 0.001$) (Table 1). This improvement was consistently observed in all participating countries, with Italy having the lowest level of adherence at baseline but achieving a comparable magnitude to all other countries with the exception of Egypt, which showed the largest increase. In contrast, changes in diet quality, as assessed by the Y-HEI, were substantially more nuanced (53.7 [SD 8.5] vs. 54.3 [SD 8.2], $p = 0.180$), with analyses at the single-school level by country showing significant improvement only in Egypt (Table 1).

Total and at the single-school level by country changes in the frequency of consumption of the main food groups before and after the DELICIOUS program are shown in Table 2 and Figure 1; respectively. Significant pre–post differences were observed for all food groups (all $p < 0.001$) in the whole sample (Table 2). Overall; the program was followed by a shift toward a healthier dietary profile; characterized by more frequent consumption of fruit; vegetables; legumes; fish; nuts; and dairy products and lower meat consumption (Table 2). Particularly marked changes were observed for fruit; with the proportion consuming ≥3 portions/day increasing from 29.8% to 51.7%, and for nuts; for which the proportion of non-consumers approximately halved (Table 2). Conversely; sweet consumption increased and whole-grain consumption decreased; while changes in cereal consumption showed a more heterogeneous pattern (Table 2).

Table 1. Mean KIDMED and Y-HEI scores (and standard deviations) before and after the DELICIOUS program, in the total study sample and at single-school level by country.

	KIDMED			***p-Value***	**Y-HEI**			***p-Value***
	Pre	**Post**			**Pre**	**Post**		
	Mean (SD)		**MD (95% CI)**		***Mean (SD)***		**MD (95% CI)**	
Total (n = 667)	5.3 (1.9)	6.7 (2.0)	1.35 (1.14, 1.57)	<0.001	53.7 (8.5)	54.3 (8.2)	0.61 (−0.25, 1.47)	0.180
Portugal (n = 207)	5.5 (1.7)	6.6 (2.1)	1.14 (0.74, 1.53)	<0.001	55.5 (8.6)	56.6 (8.6)	1.11 (−0.56, 2.78)	0.187
Spain (n = 174)	5.6 (2.0)	6.7 (1.9)	1.09 (0.68, 1.50)	<0.001	53.8 (8.9)	53.8 (8.1)	−0.01 (−1.72, 1.69)	0.987
Italy (n = 197)	4.9 (1.9)	6.0 (1.9)	1.07 (0.67, 1.48)	<0.001	53.0 (8.5)	52.5 (8.5)	−0.48 (−2.11, 1.14)	0.573
Egypt (n = 89)	5.3 (2.1)	8.3 (1.0)	3.00 (2.49, 3.51)	<0.001	50.5 (6.2)	53.7 (5.4)	3.12 (1.52, 4.73)	<0.001

Abbreviations: n, number; KIDMED, Mediterranean Diet Quality Index for Children and Adolescents; Y-HEI, Youth Healthy Eating Index; SD, standard deviation.

Table 2. Frequency of major food group consumption before and after the DELICIOUS program in the total study sample (n = 667).

	Pre	Post	*p-Value*
Vegetables, n (%)			<0.001
Never	28 (4.2)	18 (2.7)	
1–2 portion/d	449 (67.3)	383 (57.4)	
≥3 portion/d	190 (28.5)	266 (39.9)	
Fruit, n (%)			<0.001
Never	26 (3.9)	10 (1.5)	
1–2 portion/d	442 (66.3)	312 (46.8)	
≥3 portion/d	199 (29.8)	345 (51.7)	
Cereals, n (%)			<0.001
Never	6 (0.9)	57 (8.5)	
1–2 portion/d	513 (76.9)	405 (60.7)	
≥3 portion/d	148 (22.2)	205 (30.7)	
Meat, n (%)			<0.001
Never	15 (2.2)	69 (10.3)	
1–2 portion/w	190 (28.5)	177 (26.5)	
≥3 portion/w	462 (69.3)	421 (63.1)	
Legumes, n (%)			<0.001
Never	62 (9.3)	39 (5.8)	
1–2 portion/w	395 (59.2)	333 (49.9)	
≥3 portion/w	210 (31.5)	295 (44.2)	
Fish, n (%)			<0.001
Never	72 (10.8)	25 (3.7)	
1–2 portion/w	460 (69.0)	426 (63.9)	
≥3 portion/w	135 (20.2)	216 (32.4)	
Sweets, n (%)			<0.001
Never	210 (31.5)	106 (15.9)	
1–2 portion/w	249 (37.3)	292 (43.8)	
≥3 portion/w	208 (31.2)	269 (40.3)	
Nuts, n (%)			<0.001
Never	327 (49.0)	166 (24.9)	
1–2 portion/w	295 (44.2)	399 (59.8)	
≥3 portion/w	45 (6.7)	102 (15.3)	
Whole grains, n (%)			<0.001
Never	74 (11.1)	113 (16.9)	
1–2 portion/w	243 (36.4)	319 (47.8)	
≥3 portion/w	350 (52.5)	235 (35.2)	
Dairy products, n (%)			<0.001
Never	371 (55.6)	291 (43.6)	
1–2 portion/d	261 (39.1)	337 (50.5)	
≥3 portion/d	35 (5.2)	39 (5.8)	

Concerning findings across the four school settings, fruit and nut consumption showed the most consistent shifts toward a healthier profile, with favorable changes in fruit consumption observed in most participating schools (except the Spanish one) and favorable changes in nut consumption observed in schools in all four countries (Figure 1). Improvements were also observed for vegetables, legumes and fish, although these changes were less consistent and varied by country (i.e., more favorable vegetable intake in Egypt, legume intake in Italy and Egypt, and fish intake in Spain, Italy and Egypt) (Figure 1). Meat consumption tended to shift toward lower intake in Portugal, Italy and Egypt, in accordance with recommendations of moderate meat consumption within a Mediterranean dietary pattern (Figure 1). Conversely, changes in cereal and whole-grain consumption were heterogeneous in various countries. Cereal consumption shifted toward higher-frequency

categories in schools in Portugal and Egypt, toward lower-frequency categories in Italy, and showed no significant change in Spain. Whole-grain consumption shifted toward lower-frequency categories in Portugal, Spain, and Italy, whereas a shift toward higher-frequency consumption was observed in Egypt (Figure 1). Dairy consumption showed comparatively limited changes, whereas sweet consumption did not demonstrate a consistent reduction and showed unfavorable changes in schools in Portugal and Spain (Figure 1).

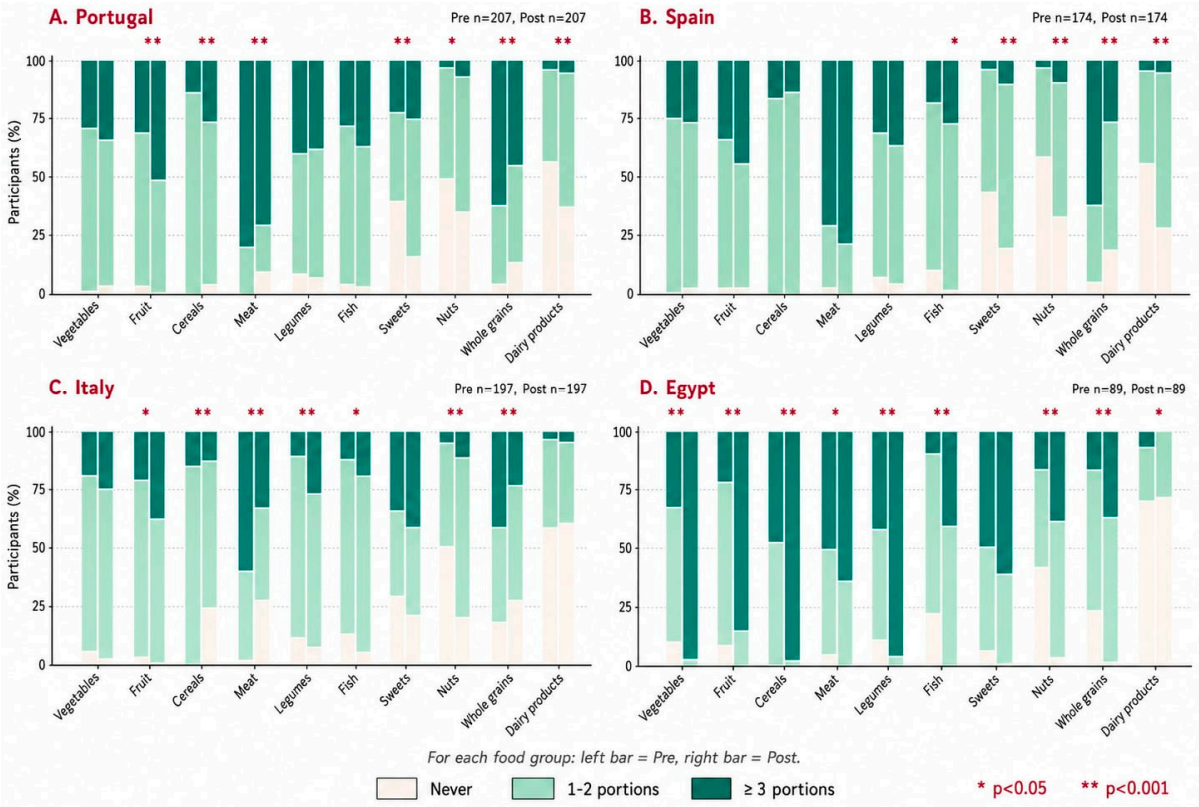

Figure 1. Food group consumption frequency before and after the DELICIOUS program, at single-school level by country.

The changes in food group consumption were partially reflected in improved adequacy to country-specific dietary recommendations, as shown in Figure 2. Overall, compliance with national dietary recommendations improved after the program, although patterns varied by country and food groups. Improvements in fruit and vegetable recommendations were the most consistently observed, while favorable changes were also identified for fish, legumes, cereals, nuts, dairy products, and recommended sources of dietary fat, depending on the country (Figure 2). Portugal and Spain showed improvements in several dietary recommendations, while changes in school in Italy were more selective and Egypt showed particularly marked improvements in fruit, vegetables, legumes, and fish (Figure 2). Few unfavorable changes were observed, the most notable being reduced compliance with egg recommendations in Spain (Figure 2).

Associations between KIDMED and Y-HEI scores and compliance with country-specific dietary recommendations, adjusted for age and sex, are shown in Figure 3. Higher KIDMED scores were positively associated with compliance with fruit and vegetable recommendations across countries, with ORs ranging from 1.65 to 3.46, although not all associations were statistically significant. Significant associations were observed for vegetables by schools in Portugal (OR 3.46; 95% CI: 2.26–5.31) and Italy (OR 2.91; 95% CI: 1.27–6.66), fruit in Portugal (OR 2.28; 95% CI: 1.62–3.21) and Italy (OR 2.33; 95% CI: 1.10–4.94), and the combined vegetable and fruit recommendation in Spain (OR 1.65; 95% CI: 1.12–2.44). In Egypt, the

corresponding associations for vegetables (OR 2.89; 95% CI: 0.93–8.96) and fruit (OR 3.12; 95% CI: 0.97–10.00) did not reach statistical significance. Higher KIDMED scores were also significantly associated with legume compliance in Portugal, Spain, and Italy (ORs 2.17–5.15), and with fish recommendations in Spain, Italy, and Egypt (ORs 1.92–22.52). Additional significant country-specific associations were observed for nuts (OR 3.06; 95% CI: 1.48–6.31) and dairy products (OR 1.76; 95% CI: 1.19–2.60) in Spain, red meat (OR 2.34; 95% CI: 1.52–3.62) and white meat (OR 1.77; 95% CI: 1.17–2.68) in Italy, and dairy products in Egypt (OR 12.44; 95% CI: 1.76–88.11). A positive association was also observed for olive oil in Spain (OR 2.34; 95% CI: 1.27–4.31). The association with cereals in Egypt (OR 3.46; 95% CI: 0.98–12.19) and the inverse association with other fats in Italy (OR 0.89; 95% CI: 0.57–1.40) were not statistically significant. The KIDMED association with fats and oils in Portugal could not be reliably estimated. Estimates for Egypt were generally less precise, as indicated by the wider confidence intervals.

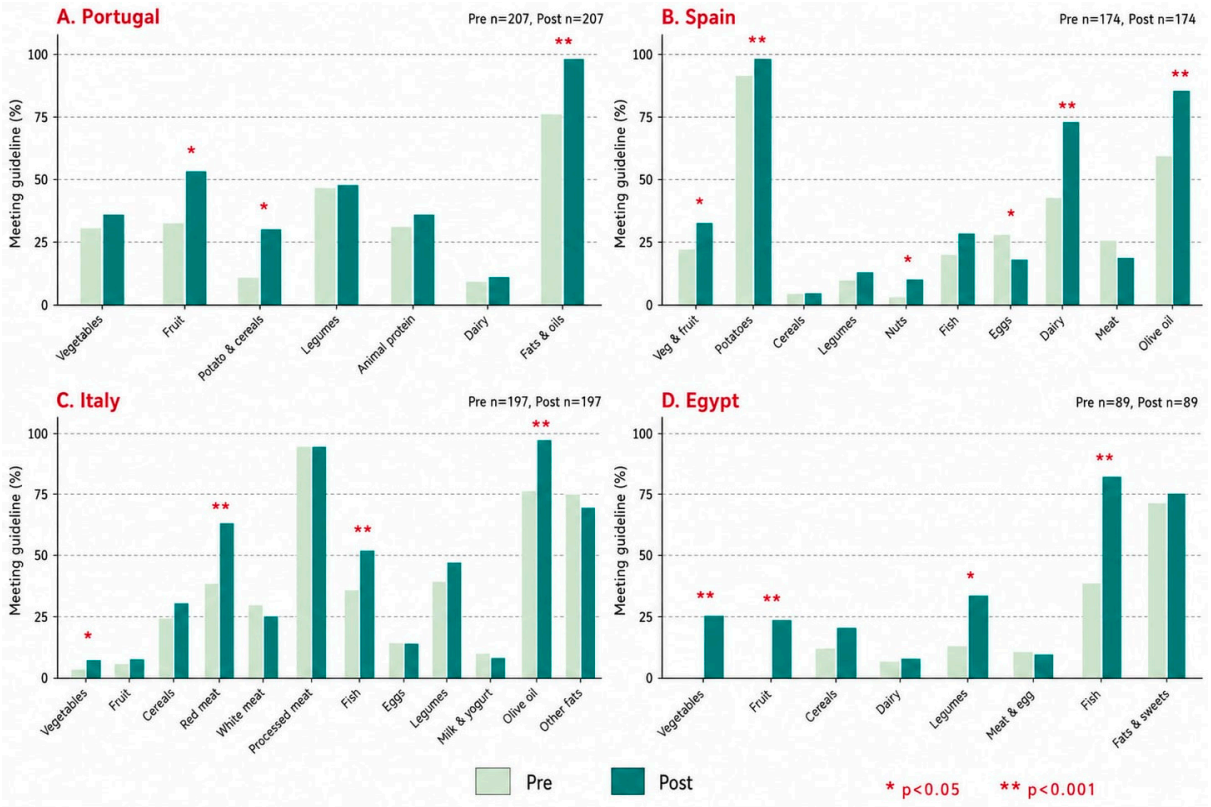

Figure 2. Adequacy to country-specific dietary recommendations before and after the DELICIOUS program, at single-school level by country.

In contrast, associations between Y-HEI scores and country-specific dietary recommendations were less consistent and varied across countries (Figure 3). In Portugal, higher Y-HEI scores were significantly associated with compliance with vegetable (OR 1.56; 95% CI: 1.14–2.13), fruit (OR 1.35; 95% CI: 1.02–1.79), and legume recommendations (OR 1.52; 95% CI: 1.12–2.04). In Spain, a significant positive association was observed only for dairy products (OR 2.94; 95% CI: 1.86–4.65). In Italy, higher Y-HEI scores were positively associated with compliance with recommendations for milk and yogurt (OR 1.79; 95% CI: 1.02–3.16) and other fats (OR 3.39; 95% CI: 2.10–5.48), and inversely associated with red meat compliance (OR 0.61; 95% CI: 0.41–0.90). The inverse associations with fish (OR 0.76; 95% CI: 0.55–1.05) and eggs (OR 0.78; 95% CI: 0.50–1.22) were not statistically significant. In Egypt, the only significant association was an inverse relationship with compliance with the recommendation for fats and sweets (OR 0.10; 95% CI: 0.03–0.32).

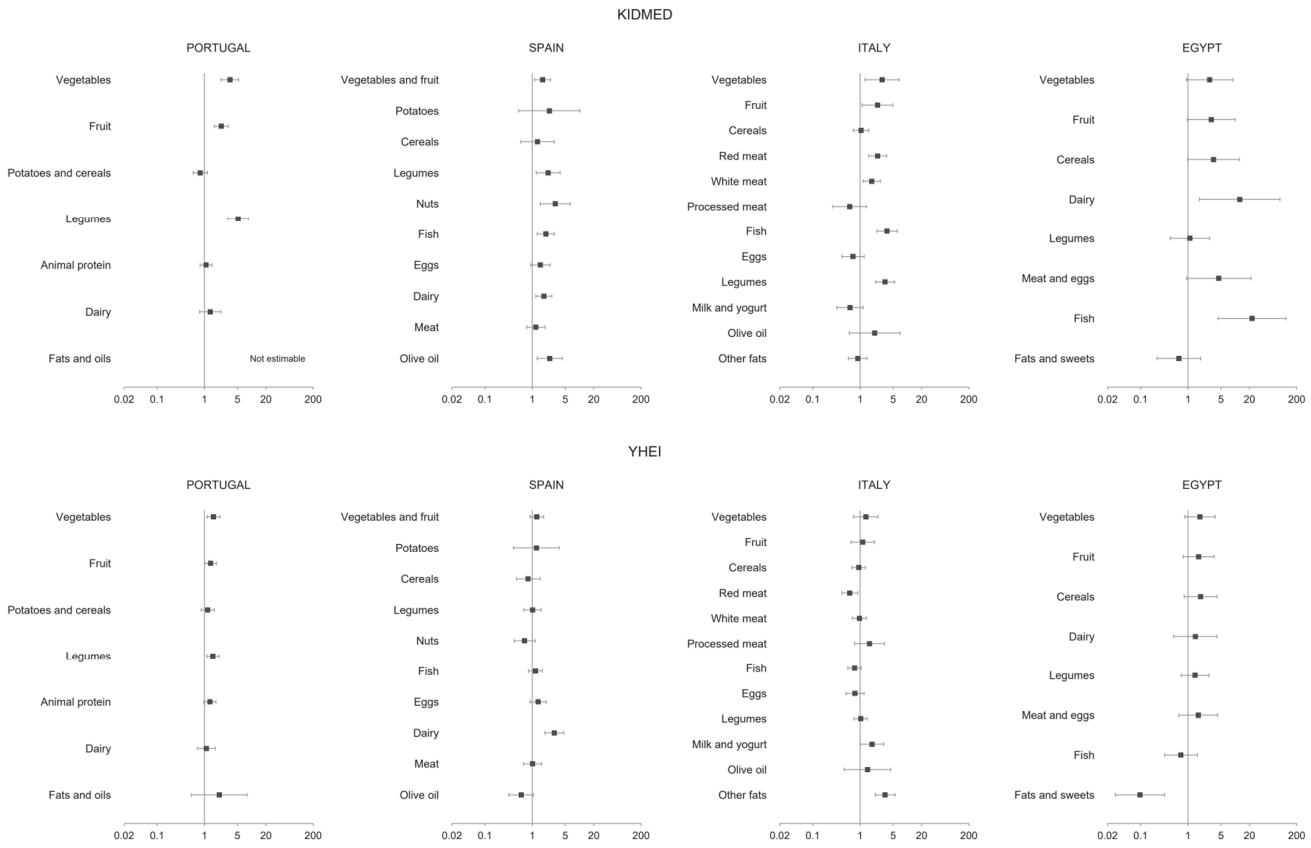

Figure 3. Association between 1-standard deviation increase in KIDMED and Y-HEI scores and adequacy to country-specific dietary recommendations, adjusted for age and sex. Squares represent odds ratios (ORs), and horizontal gray lines indicate the corresponding 95% confidence intervals (CIs).

4. Discussion

The present study evaluated the results of a multicomponent school-based program aiming to improve adherence to the Mediterranean diet among children and adolescents. The findings indicate that, following exposure to educational materials, interactive games, workshops, cooking classes, snack preparation activities, and other school-based initiatives, significant changes were observed in adherence to the Mediterranean diet but not diet quality (except for the school located in Egypt). Moreover, after the program, there was an improvement in adequacy to some country-specific dietary recommendations. In separate analyses conducted at follow-up, KIDMED and Y-HEI scores were associated, to varying degrees, with the likelihood of meeting specific recommendations. Notably, compliance with dietary recommendations was assessed according to country-specific guidelines, which differ in food groups and reference thresholds; hence, the results were not intended for direct comparison across countries, but rather interpreted within the context of each national guideline. These results support the hypothesis that approaches addressing multiple determinants of dietary and lifestyle behaviors may be effective in promoting healthier eating more in line with traditional patterns in young populations.

The results presented in this study are consistent with previous reports showing that school-based nutrition programs, including involvement of school canteen, can positively influence children's dietary behaviors [25,26,42]. Previous studies showed that early educational initiatives may contribute to healthier eating patterns and prevention of obesity and other chronic diseases later in life [43]. A study evaluating strategies to improve Mediterranean diet adherence among preschool children reported significant improvements in diet quality following a structured program targeting dietary behaviors and lifestyle factors [44].

Similarly, an educational program aimed at improving Mediterranean diet adherence among parents and their young children demonstrated measurable improvements in diet quality scores, including increases in Mediterranean diet indices such as the KIDMED score after several months of activities [45]. These findings highlight the potential effectiveness of structured educational strategies in promoting healthier dietary habits in children and that school-based educational initiatives can improve adolescents' adherence to the Mediterranean diet [45]. In such a context, nutrition education initiatives implemented in school settings have been associated with improvements in Mediterranean diet adherence scores and dietary knowledge among adolescents.

Schools represent an ideal setting for promoting healthy eating behaviors, as they provide a structured environment in which children can be repeatedly exposed to health-promoting messages and activities [46]. Integrating nutrition education with practical food-related experiences within the school curriculum may therefore represent an effective strategy for fostering healthier dietary habits during critical developmental stages [47]. The school environment represents an important setting for the implementation of dietary strategies targeting children and adolescents [48]. Schools provide opportunities to reach large populations during a developmental period when lifelong dietary habits are being formed [48]. Moreover, children spend a significant portion of their day in school environments, where repeated exposure to nutrition education and food-related activities may reinforce healthy behaviors [48]. Previous research has emphasized the importance of school-based strategies for improving dietary behaviors and maintaining adherence to healthy dietary patterns such as the Mediterranean diet [49]. Formal nutrition education, including structured lessons and age-appropriate educational materials such as books, can provide children with a coherent framework for understanding food groups, nutritional properties, and the principles underlying healthy dietary choices [50]. Evidence from an umbrella review of school-based nutrition interventions in children aged 4–12 years showed that curriculum-based components were particularly effective in improving nutrition knowledge, supporting the role of structured educational content in developing children's understanding of healthy eating [51]. Their integration within the regular school curriculum also enables repeated exposure to consistent nutritional messages and their progressive reinforcement across different learning activities. Indeed, previous systematic evidence suggests that incorporation of nutrition education into regular school activities and curricula represents a characteristic of more effective school-based interventions [52], while a broader umbrella review has confirmed that school-based nutrition education can positively influence selected dietary outcomes in children and adolescents [53]. Formal educational materials may therefore contribute primarily to the cognitive component of dietary behavior by improving nutrition knowledge and food literacy and providing children with the conceptual tools required to recognize and evaluate healthier food choices [54]. In this regard, systematic evidence on food and nutrition literacy interventions in primary-school children indicates that interventions integrated within existing curricula and tailored to children's needs can improve functional and, to some extent, interactive and critical food and nutrition literacy skills [55]. Furthermore, the use of interactive games and workshops as non-formal education may have enhanced students' engagement and facilitated the acquisition of nutrition knowledge in an accessible and motivating way. Serious games have increasingly been used in health promotion because they combine educational objectives with interactive and engaging activities and may facilitate learning and health-related behavior change among children and adolescents [56,57]. Non-formal and interactive educational approaches, including games, digital tools and experiential activities, may therefore complement traditional educational materials by transforming nutritional information into a more active learning experience. In particular, serious games can integrate established behavior-

change techniques, including goal setting, problem solving, decision making, behavioral modeling, immediate feedback, rewards, personalization and opportunities to rehearse food-related skills and choices within a virtual environment [58]. Such characteristics may be particularly relevant for children and adolescents by promoting active participation and sustained engagement with educational content. Evidence from a systematic review and meta-analysis of 23 randomized controlled trials found that gamification interventions increased nutrition knowledge and fruit and vegetable consumption, although no significant effect was observed for BMI z-score [59]. Similarly, systematic reviews focusing on serious games and eating behaviors suggest beneficial effects on nutrition knowledge and selected dietary behaviors, while emphasizing considerable heterogeneity between interventions and less consistent evidence for changes in actual dietary intake or anthropometric outcomes [60,61]. More recent meta-analytic evidence likewise indicates that serious games may support dietary and physical activity behavior change in children and adolescents, although the magnitude and consistency of effects vary according to intervention characteristics and outcomes considered [62]. Thus, interactive and game-based approaches may be particularly valuable as complementary components of multicomponent nutrition interventions, providing opportunities not only to transmit information but also to reinforce motivation, practice food-related decision making and repeatedly engage with healthy-eating concepts.

The positive outcomes observed in the present study may be partly explained by the multifaceted nature of the program. Dietary behaviors are influenced by a wide range of factors besides knowledge, such as food preferences, skills, and environmental exposure [63]. Therefore, studies targeting only one component (such as theoretical nutrition education) may have limited impact on behavior change. Interactive and experiential learning strategies, such as cooking classes and food preparation activities, may enhance engagement and facilitate the translation of knowledge into practical skills [64]. Initiatives that incorporate experiential and interactive components (such as cooking activities or food preparation) have been associated with greater improvements in food preferences, nutrition knowledge, and willingness to consume healthy foods [65]. Previous studies have shown that experiential activities such as cooking classes and snack preparation likely contributed to the development of practical food skills and increased familiarity with Mediterranean foods and higher adherence to the Mediterranean diet [66,67]. Experiential nutrition programs that involve hands-on cooking activities have previously been shown to increase cooking self-efficacy and vegetable consumption among school-aged children [68]. In addition, culinary skills have been associated with improved diet quality and greater adherence to the Mediterranean diet [69]. The improvements observed in the present study support the growing evidence that hands-on and engaging approaches may enhance the effectiveness of dietary habits among children and adolescents enhancing nutritional knowledge and self-regulation [70]. Importantly, the dietary changes observed in the present study were not uniformly favourable. Although KIDMED increased significantly, sweets consumption increased and whole-grain consumption decreased, indicating that improvements were selective rather than consistent across all dietary components. These findings suggest that changes were more evident for some dietary behaviours than others. This apparent discrepancy may partly reflect the composite nature of the KIDMED score, whereby favourable changes in some components may offset unfavourable changes in others. Contextual factors not specifically assessed in the present study, including food availability, individual preferences, family eating practices, and the school food environment, may also have contributed to these patterns. In addition, the exclusion of two components from the original Y-HEI should be considered when interpreting the results, as the adapted score may not be directly comparable with the complete index used in previous studies. This modification may also

have influenced the ability of the score to detect changes in diet quality and should therefore be considered when interpreting the absence of a statistically significant overall change in Y-HEI.

This study has the strength to evaluate changes in diet quality and adherence to the Mediterranean diet following a multicomponent school-based program implemented simultaneously in four Mediterranean countries. Notably, one school per country was involved; hence, the participants shall not be intended as representative for the whole country and a selection bias should be considered. Moreover, because only one school was included per country, school- and country-level effects could not be separated, and differences between settings should not be interpreted as country-level effects. However, these findings should be interpreted in light of several methodological limitations. First, this study is based on a real-world experience with no experimental intervention design; hence, the results should be considered observational in nature. The exclusion of participants due to missing classes and the absence of a control group in the pre–post study design limits the possibility of establishing a causal relationship between the program activities and the observed changes, as external factors, temporal trends, and seasonal variation may have influenced the findings. In particular, the different timing of baseline and follow-up assessments may have affected the consumption of seasonally variable foods, particularly fruits and vegetables. Furthermore, the multicomponent design of the program does not allow the independent contribution of each intervention component to be determined. Nutritional education and physical activity were implemented concurrently, and it is not possible to determine whether one component would have a stronger impact than another. Second, dietary intake, including the consumption of major food groups, was assessed through structured questionnaires, which are subject to recall bias and social desirability bias, potentially affecting data accuracy. These sources of bias may have contributed to over- or under-reporting of dietary intake and, consequently, to an over- or underestimation of the magnitude of the observed dietary changes. Similarly, diet quality and adherence to the Mediterranean diet, measured using the Y-HEI and the KIDMED scores, may be influenced by reporting errors, leading to possible misclassification. In addition, repeated measurements over time may introduce response bias, as participants could modify their answers at follow-up due to familiarity with the instruments or increased awareness. The large number of country- and food-specific analyses also increases the potential for chance findings due to multiple testing. As no formal multiplicity adjustment was applied, these analyses should be considered exploratory and individual *p*-values interpreted cautiously. This consideration is particularly relevant for estimates with limited precision, including several country-specific associations in Egypt that were characterized by wide confidence intervals. Finally, several guideline-compliance outcomes correspond to food groups that are also components of the KIDMED and/or Y-HEI. The observed associations are therefore not fully independent and may partly reflect shared item content between the dietary-score predictors and the compliance outcomes. These associations should consequently be interpreted as indicating concordance between dietary scores and country-specific recommendations at follow-up, rather than as independent validation of the dietary scores.

5. Conclusions

In conclusion, the results of this study suggest that multicomponent school-based initiatives integrating educational, interactive, and experiential approaches can be associated with improvements in adherence to the Mediterranean diet among children and adolescents. However, the magnitude and pattern of the observed changes varied across the four school settings located in various Mediterranean countries. Therefore, future school-based interventions should be adapted to the specific characteristics and needs of each

setting rather than being uniformly applied across Mediterranean countries. Considering the documented decline in adherence to the Mediterranean dietary pattern among younger generations, such initiatives may represent a promising strategy for promoting healthier dietary habits and preventing diet-related chronic diseases later in life.

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Abbreviations

The following abbreviations are used in this manuscript:

CI	Confidence Interval
OR	Odds Ratio
SD	Standard Deviation
Y-HEI	Youth Healthy Eating Index

References

1. Parajuli, J.; Prangthip, P. Adolescent nutrition and health: A critical period for nutritional intervention to prevent long term health consequences. *Curr. Nutr. Rep.* **2025**, *14*, 116. [CrossRef] [PubMed]
2. Carducci, B.; Chen, Z.H.; Campisi, S.C.; Miliku, K. Adolescence as a key developmental window for nutrition promotion and cardiometabolic disease prevention. *npj Metab. Health Dis.* **2025**, *3*, 40. [CrossRef] [PubMed]
3. Popkin, B.M.; Adair, L.S.; Ng, S.W. Global nutrition transition and the pandemic of obesity in developing countries. *Nutr. Rev.* **2012**, *70*, 3–21. [CrossRef] [PubMed]
4. Rajeev, A.M.; Malisetty, H.; Baidya, O.P.; Vamshy J, K.; Siddhanta, S.; Dharan, B.G. Pediatric Nutrition and Its Role in Preventing Non-communicable Diseases: A Review. *Cureus* **2025**, *17*, e87431. [CrossRef] [PubMed]
5. Beckerman, J.P.; Alike, Q.; Lovin, E.; Tamez, M.; Mattei, J. The development and public health implications of food preferences in children. *Front. Nutr.* **2017**, *4*, 66. [CrossRef] [PubMed]
6. Gianfredi, V.; Nucci, D.; Pennisi, F.; Maggi, S.; Veronese, N.; Soysal, P. Aging, longevity, and healthy aging: The public health approach. *Aging Clin. Exp. Res.* **2025**, *37*, 125. [CrossRef] [PubMed]
7. Donini, L.M.; Poli, A.; Rosano, A.; Muzzioli, L.; Minnetti, M.; Piciocchi, C.; Di Vincenzo, O.; Frigerio, F.; Pintavalle, M.; Marangoni, F.; et al. Eating behaviours, prevalence of obesity & health policies. *Int. J. Food Sci. Nutr.* **2026**, *77*, 484–497. [CrossRef] [PubMed]

8. Sari, D.N.; Hilmanto, D.; Sunjaya, D.K.; Sari, P. Community-based interventions to improve adolescent nutrition: A scoping review. *BMC Public Health* **2025**, *25*, 4394. [CrossRef] [PubMed]
9. Chaudhary, A.; Sudzina, F.; Mikkelsen, B.E. Promoting Healthy Eating among Young People-A Review of the Evidence of the Impact of School-Based Interventions. *Nutrients* **2020**, *12*, 2894. [CrossRef] [PubMed]
10. Devine, L.D.; Hill, A.J.; Gallagher, A.M. Improving adolescents' dietary behaviours in the school-setting: Challenges and opportunities. *Proc. Nutr. Soc.* **2023**, *82*, 172–185. [CrossRef] [PubMed]
11. Fernqvist, F.; Spendrup, S.; Tellström, R. Understanding food choice: A systematic review of reviews. *Heliyon* **2024**, *10*, e32492. [CrossRef] [PubMed]
12. Capper, T.E.; Brennan, S.F.; Woodside, J.V.; McKinley, M.C. What makes interventions aimed at improving dietary behaviours successful in the secondary school environment? A systematic review of systematic reviews. *Public Health Nutr.* **2022**, *25*, 2448–2464. [CrossRef] [PubMed]
13. Varman, S.D.; Cliff, D.P.; Jones, R.A.; Hammersley, M.L.; Zhang, Z.; Charlton, K.; Kelly, B. Experiential learning interventions and healthy eating outcomes in children: A systematic literature review. *Int. J. Environ. Res. Public Health* **2021**, *18*, 10824. [CrossRef] [PubMed]
14. Guasch-Ferré, M.; Willett, W.C. The Mediterranean diet and health: A comprehensive overview. *J. Intern. Med.* **2021**, *290*, 549–566. [CrossRef] [PubMed]
15. Godos, J.; Scazzina, F.; Paternò Castello, C.; Giampieri, F.; Quiles, J.L.; Briones Urbano, M.; Battino, M.; Galvano, F.; Iacoviello, L.; de Gaetano, G.; et al. Underrated aspects of a true Mediterranean diet: Understanding traditional features for worldwide application of a "Planeterranean" diet. *J. Transl. Med.* **2024**, *22*, 294. [CrossRef] [PubMed]
16. Angelino, D.; Bonaccio, M.; Ruggiero, E.; Formisano, A.; Dello Russo, M.; Lauria, F.; Lisciani, S.; Martini, D. From global to local: Comparing the EAT-Lancet planetary health diets with the traditional Mediterranean Diet across Mediterranean countries. *Int. J. Food Sci. Nutr.* **2026**, *77*, 314–325. [CrossRef] [PubMed]
17. Hareer, L.W.; Lau, Y.Y.; Mole, F.; Reidlinger, D.P.; O'Neill, H.M.; Mayr, H.L.; Greenwood, H.; Albarqouni, L. The effectiveness of the Mediterranean Diet for primary and secondary prevention of cardiovascular disease: An umbrella review. *Nutr. Diet.* **2025**, *82*, 8–41. [CrossRef] [PubMed]
18. Molani-Gol, R.; Rafraf, M. Effects of the Mediterranean diet on the secondary prevention of cardiovascular diseases: A systematic review of randomised controlled trials. *Int. J. Food Sci. Nutr.* **2025**, *76*, 226–238. [CrossRef] [PubMed]
19. Dominguez, L.J.; Veronese, N.; Ragusa, F.S.; Petralia, V.; Ciriminna, S.; Di Bella, G.; Schirò, P.; Sabico, S.; Al-Daghri, N.M.; Barbagallo, M. Mediterranean diet and spirituality/religion: Eating with meaning. *Aging Clin. Exp. Res.* **2024**, *36*, 223. [CrossRef] [PubMed]
20. Di Nucci, A.; Silano, M.; Cardamone, E. Adherence to mediterranean diet and health outcomes in adolescents: An umbrella review. *Nutr. Rev.* **2025**, *83*, e1329–e1342. [CrossRef] [PubMed]
21. García-Pérez-de-Sevilla, G.; Zapata-Lamana, R. Adherence to the Mediterranean Diet and Its Association with Cognitive Function in Children and Adolescents: A Systematic Review of Observational Studies. *Children* **2025**, *12*, 789. [CrossRef] [PubMed]
22. Camprodon-Boadas, P.; Gil-Dominguez, A.; De la Serna, E.; Sugranyes, G.; Lázaro, I.; Baeza, I. Mediterranean diet and mental health in children and adolescents: A systematic review. *Nutr. Rev.* **2025**, *83*, e343–e355. [CrossRef] [PubMed]
23. Silva, N.; Gomes, N.; Teixeira, B. Systematic review: Mediterranean diet adherence and health outcomes in children and adolescents with ADHD and OCTD. *Med. J. Nutr. Metab.* **2026**, *19*, 141–152. [CrossRef]
24. Rosi, A.; Scazzina, F.; Giampieri, F.; Abdelkarim, O.; Aly, M.; Pons, J.; Vázquez-Araújo, L.; Frias-Toral, E.; Cano, S.S.; Elío, I.; et al. Adherence to the Mediterranean diet in 5 Mediterranean countries: A descriptive analysis of the DELICIOUS project. *Med. J. Nutr. Metab.* **2024**, *17*, 323–334. [CrossRef]
25. Silva, S.S.; Rocha, A.; Viegas, C. Strategies for increased adherence to the Mediterranean or healthy diet in university food services: A systematic review. *Int. J. Food Sci. Nutr.* **2025**, *76*, 239–264. [CrossRef] [PubMed]
26. Gambescia, S.; Aboul-Enein, B.H.; Keller, T.; Almoayad, F.; Benajiba, N. Effectiveness of School-Based Nutrition Interventions in Italy: A Scoping Review. *Food Sci. Nutr.* **2025**, *13*, e70266. [CrossRef] [PubMed]
27. Grosso, G.; Buso, P.; Mata, A.; Abdelkarim, O.; Aly, M.; Pinilla, J.; Fernandez, A.; Mendez, R.; Alvarez, A.; Valdes, N.; et al. Understanding consumer food choices & promotion of healthy and sustainable Mediterranean diet and lifestyle in children and adolescents through behavioural change actions: The DELICIOUS project. *Int. J. Food Sci. Nutr.* **2024**, *75*, 527–535. [CrossRef] [PubMed]
28. Rosi, A.; Bragazzi, N.L.; Bertolotti, E.; Biasini, B.; Grosso, G.; Del Rio, D.; Mena, P.; Scazzina, F. Dietary Interventions Based on the Mediterranean Diet to Treat Obesity in Children and Adolescents: A Systematic Review with Meta-analysis and Meta-regressions. *Nutr. Rev.* **2026**, *84*, 1566–1589. [CrossRef] [PubMed]
29. López-Gil, J.F.; García-Hermoso, A.; Sotos-Prieto, M.; Cavero-Redondo, I.; Martínez-Vizcaíno, V.; Kales, S.N. Mediterranean Diet-Based Interventions to Improve Anthropometric and Obesity Indicators in Children and Adolescents: A Systematic Review with Meta-Analysis of Randomized Controlled Trials. *Adv. Nutr.* **2023**, *14*, 858–869. [CrossRef] [PubMed]

30. Urkiaga, O.; Mora, M.; Romeo-Arroyo, E.; Pistolese, S.; Béaino, A.; Grosso, G.; Busó, P.; Pons, J.; Vázquez-Araújo, L. A Sorting Task with Emojis to Understand Children's Recipe Acceptance. *Foods* **2025**, *14*, 1839. [CrossRef] [PubMed]
31. Romeo-Arroyo, E.; Mora, M.; Urkiaga, O.; Pazos, N.; El-Gyar, N.; Gaspar, R.; Pistolese, S.; Beaino, A.; Grosso, G.; Busó, P.; et al. Co-Creating Snacks: A Cross-Cultural Study with Mediterranean Children Within the DELICIOUS Project. *Foods* **2025**, *14*, 159. [CrossRef] [PubMed]
32. Ammar, A.; Aly, M.; Trabelsi, K.; Abril-Mera, T.; Masmoudi, L.; El-Gyar, N.; Shalaby, A.M.; Jahrami, H.; Husain, W.; Zmijewski, P.; et al. The need for tailoring school-based physical activity interventions: Preliminary insights into body weight and cross-country differences from the DELICIOUS project. *Front. Public Health* **2025**, *13*, 1675893. [CrossRef] [PubMed]
33. Aly, M.; Ammar, A.; Trabelsi, K.; Masmoudi, L.; El-Gyar, N.; Shalaby, A.M.; Abdelkarim, O. School-based physical activity and health-related fitness in Mediterranean students: Findings from the DELICIOUS project. *Front. Public Health* **2025**, *13*, 1603043. [CrossRef] [PubMed]
34. Feskanich, D.; Rockett, H.R.H.; Colditz, G.A. Modifying the Healthy Eating Index to assess diet quality in children and adolescents. *J. Am. Diet. Assoc.* **2004**, *104*, 1375–1383. [CrossRef] [PubMed]
35. Serra-Majem, L.; Ribas, L.; Ngo, J.; Ortega, R.M.; García, A.; Pérez-Rodrigo, C.; Aranceta, J. Food, youth and the Mediterranean diet in Spain. Development of KIDMED, Mediterranean Diet Quality Index in children and adolescents. *Public Health Nutr.* **2004**, *7*, 931–935. [CrossRef] [PubMed]
36. CREA Alimenti e Nutrizione. *Linee Guida per una Sana Alimentazione–Revisione 2018*; CREA Alimenti e Nutrizione: Roma, Italy, 2019.
37. Rodrigues, S.S.P.; Franchini, B.; Graça, P.; de Almeida, M.D.V. A new food guide for the Portuguese population: Development and technical considerations. *J. Nutr. Educ. Behav.* **2006**, *38*, 189–195. [CrossRef] [PubMed]
38. Portuguese Ministry of Health. *A Nova Roda dos Alimentos ... um Guia para a Escolha Alimentar Diária!* Portuguese Ministry of Health: Lisboa, Portugal, 2003.
39. García, E.L.; Lesmes, I.B.; Perales, A.D.; Arribas, V.M.; del Puy Portillo Baquedano, M.; Velasco, A.M.R.; Salvo, U.F.; Romero, L.T.; Porcel, F.B.O.; Laín, S.A.; et al. Report of the Scientific Committee of the Spanish Agency for Food Safety and Nutrition (AESAN) on sustainable dietary and physical activity recommendations for the Spanish population. *EFS4* **2023**, *1*, 0005E. [CrossRef]
40. Agencia Española de Seguridad Alimentaria y Nutrición. *Recomendaciones Dietéticas Sostenibles y de Actividad fíSica*; Agencia Española de Seguridad Alimentaria y Nutrición: Madrid, Spain, 2022.
41. World Health Organization; Regional Office for the Eastern Mediterranean. *Promoting a Healthy Diet for the WHO Eastern Mediterranean Region: User-Friendly Guide*; WHO Regional Office for the Eastern Mediterranean: Cairo, Egypt, 2012.
42. Van Cauwenberghe, E.; Maes, L.; Spittaels, H.; van Lenthe, F.J.; Brug, J.; Oppert, J.-M.; De Bourdeaudhuij, I. Effectiveness of school-based interventions in Europe to promote healthy nutrition in children and adolescents: Systematic review of published and "grey" literature. *Br. J. Nutr.* **2010**, *103*, 781–797. [CrossRef] [PubMed]
43. Haire-Joshu, D.; Tabak, R. Preventing obesity across generations: Evidence for early life intervention. *Annu. Rev. Public Health* **2016**, *37*, 253–271. [CrossRef] [PubMed]
44. Porri, D.; La Rosa, E.; Pepe, G.; Morabito, L.A.; Arena, V.; Luppino, G.; Fazio, C.; Li Pomi, A.; Corica, D.; Alibrandi, A.; et al. Promoting Healthy Lifestyles in Early Childhood at School with the 0-6 EpPOI Project: Efficacy on Motor Skills and Mediterranean Diet Adherence. *Nutrients* **2025**, *17*, 2181. [CrossRef] [PubMed]
45. Roset-Salla, M.; Ramon-Cabot, J.; Salabarnada-Torras, J.; Pera, G.; Dalmau, A. Educational intervention to improve adherence to the Mediterranean diet among parents and their children aged 1-2 years. EniM clinical trial. *Public Health Nutr.* **2016**, *19*, 1131–1144. [CrossRef] [PubMed]
46. Pulimeno, M.; Piscitelli, P.; Colazzo, S.; Colao, A.; Miani, A. School as ideal setting to promote health and wellbeing among young people. *Health Promot. Perspect.* **2020**, *10*, 316–324. [CrossRef] [PubMed]
47. Barnes, C.; McCrabb, S.; Stacey, F.; Nathan, N.; Yoong, S.L.; Grady, A.; Sutherland, R.; Hodder, R.; Innes-Hughes, C.; Davies, M.; et al. Improving implementation of school-based healthy eating and physical activity policies, practices, and programs: A systematic review. *Transl. Behav. Med.* **2021**, *11*, 1365–1410. [CrossRef] [PubMed]
48. Pérez-Rodrigo, C.; Aranceta, J. Nutrition education in schools: Experiences and challenges. *Eur. J. Clin. Nutr.* **2003**, *57*, S82–S85. [CrossRef] [PubMed]
49. Michael, K.; Talias, M.A. Evaluation of a school intervention to improve adherence to the Mediterranean Diet. *Health Educ. J.* **2024**, *83*, 215–227. [CrossRef]
50. Silva, P.; Araújo, R.; Lopes, F.; Ray, S. Nutrition and food literacy: Framing the challenges to health communication. *Nutrients* **2023**, *15*, 4708. [CrossRef] [PubMed]
51. Verdonschot, A.; Follong, B.M.; Collins, C.E.; de Vet, E.; Haveman-Nies, A.; Bucher, T. Effectiveness of school-based nutrition intervention components on fruit and vegetable intake and nutrition knowledge in children aged 4-12 years old: An umbrella review. *Nutr. Rev.* **2023**, *81*, 304–321. [CrossRef] [PubMed]

52. Silveira, J.A.C.; Taddei, J.A.A.C.; Guerra, P.H.; Nobre, M.R.C. Effectiveness of school-based nutrition education interventions to prevent and reduce excessive weight gain in children and adolescents: A systematic review. *J. Pediatr.* **2011**, *87*, 382–392. [CrossRef] [PubMed]
53. O'Brien, K.M.; Barnes, C.; Yoong, S.; Campbell, E.; Wyse, R.; Delaney, T.; Brown, A.; Stacey, F.; Davies, L.; Lorien, S.; et al. School-Based Nutrition Interventions in Children Aged 6 to 18 Years: An Umbrella Review of Systematic Reviews. *Nutrients* **2021**, *13*, 4113. [CrossRef] [PubMed]
54. Silva, P. Enhancing adolescent food literacy through mediterranean diet principles: From evidence to practice. *Nutrients* **2025**, *17*, 1371. [CrossRef] [PubMed]
55. Omidvar, N.; Doustmohammadian, A.; Shakibazadeh, E.; Clark, C.C.T.; Kasaii, M.S.; Hajigholam-Saryazdi, M. Effects of school-based interventions on Food and Nutrition Literacy (FNLIT) in primary-school-age children: A systematic review. *Br. J. Nutr.* **2023**, *129*, 2102–2121. [CrossRef] [PubMed]
56. Andrew, L.; Barwood, D.; Boston, J.; Masek, M.; Bloomfield, L.; Devine, A. Serious games for health promotion in adolescents—A systematic scoping review. *Educ. Inf. Technol.* **2023**, *28*, 5519–5550. [CrossRef] [PubMed]
57. Ancona, A.; Corea, F.; Lombardo, C.; Gentili, D.; Mistretta, A. Serious games in child and adolescent health education campaigns: A systematic review. *Ann. Ist. Super. Sanita* **2024**, *60*, 274–282. [CrossRef] [PubMed]
58. Baranowski, T.; Thompson, D.; Buday, R.; Lu, A.S.; Baranowski, J. Design of Video Games for Children's Diet and Physical Activity Behavior Change. *Int. J. Comput. Sci. Sport* **2010**, *9*, 3–17. [PubMed]
59. Suleiman-Martos, N.; García-Lara, R.A.; Martos-Cabrera, M.B.; Albendín-García, L.; Romero-Béjar, J.L.; Cañadas-De la Fuente, G.A.; Gómez-Urquiza, J.L. Gamification for the Improvement of Diet, Nutritional Habits, and Body Composition in Children and Adolescents: A Systematic Review and Meta-Analysis. *Nutrients* **2021**, *13*, 2478. [CrossRef] [PubMed]
60. Limone, P.; Messina, G.; Toto, G.A. Serious games and eating behaviors: A systematic review of the last 5 years (2018–2022). *Front. Nutr.* **2022**, *9*, 978793. [CrossRef] [PubMed]
61. Lamas, S.; Rebelo, S.; da Costa, S.; Sousa, H.; Zagalo, N.; Pinto, E. The influence of serious games in the promotion of healthy diet and physical activity health: A systematic review. *Nutrients* **2023**, *15*, 1399. [CrossRef] [PubMed]
62. Liu, M.; Guan, X.; Guo, X.; He, Y.; Liu, Z.; Ni, S.; Wu, Y. Impact of Serious Games on Body Composition, Physical Activity, and Dietary Change in Children and Adolescents: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Nutrients* **2024**, *16*, 1290. [CrossRef] [PubMed]
63. Monterrosa, E.C.; Frongillo, E.A.; Drewnowski, A.; de Pee, S.; Vandevijvere, S. Sociocultural influences on food choices and implications for sustainable healthy diets. *Food Nutr. Bull.* **2020**, *41*, 59S–73S. [CrossRef] [PubMed]
64. da Fonseca, P.G.; Siqueira, L.d.C.; Raposo, A.; Alslamah, T.; Albaridi, N.A.; Saraiva, A.; Guimarães, N.S. From kitchen to health: How culinary workshops influence eating habits, autonomy, and wellbeing in adults-A scoping review. *Front. Nutr.* **2025**, *12*, 1653406. [CrossRef] [PubMed]
65. Bessette, G.K.; Tung, A.H.; Lo, C.L.W.; Yang, S.K.Y.; Yang, A.; Gucciardi, E.; Newsham, A.; Omand, J.A. Impact of Immersive Short-Term Cooking Programs outside of the School Curriculum on the Cooking Skills and Cooking Self-Efficacy of Children and Adolescents: A Systematic Review. *Nutr. Rev.* **2026**. [CrossRef] [PubMed]
66. Razavi, A.C.; Sapin, A.; Monlezun, D.J.; McCormack, I.G.; Latoff, A.; Pedroza, K.; McCullough, C.; Sarris, L.; Schlag, E.; Dyer, A.; et al. Effect of culinary education curriculum on Mediterranean diet adherence and food cost savings in families: A randomised controlled trial. *Public Health Nutr.* **2021**, *24*, 2297–2303. [CrossRef] [PubMed]
67. Gonçalves, C.; Padrão, P.; Pinho, O.; Silva-Santos, T.; Moreira, P. Cooking Skills and Mediterranean Diet Adherence: Societal Insights from the iMC SALT Trial. *Societies* **2025**, *15*, 164. [CrossRef]
68. Jarpe-Ratner, E.; Folkens, S.; Sharma, S.; Daro, D.; Edens, N.K. An Experiential Cooking and Nutrition Education Program Increases Cooking Self-Efficacy and Vegetable Consumption in Children in Grades 3-8. *J. Nutr. Educ. Behav.* **2016**, *48*, 697–705.e1. [CrossRef] [PubMed]
69. Marconi, S.; Nucci, D.; Montani, G.; Gilberti, G.; Marullo, M.; Facciano, L.; Passeri, C.; Zanini, B. Improvement in Adherence to Mediterranean Diet, Cooking and Food Skills Among University Students Attending a "Teaching Kitchen" Project: Results from the S.A.P.O.R.E. Initiative. *Foods* **2026**, *15*, 302. [CrossRef] [PubMed]
70. Mancone, S.; Corrado, S.; Tosti, B.; Spica, G.; Di Siena, F.; Misiti, F.; Diotaiuti, P. Enhancing nutritional knowledge and self-regulation among adolescents: Efficacy of a multifaceted food literacy intervention. *Front. Psychol.* **2024**, *15*, 1405414. [CrossRef] [PubMed]

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