Pediatric Obesity

WILEY | WORLD OBESITY

REVIEW ARTICLE

Adherence to the Mediterranean Diet Is Associated With a Lower Risk of Obesity in Children Under 18 Years: A Comprehensive Systematic Review and Meta-Analysis

Maryam Gholami Shahrbabak[1] | Azam Gholami Shahrbabak[2] | Artin Ebrahimi Meymand[3] | Karen Tahmasebi Abdar[4] | Maryam Mobasheri-Shiri[5]

[1]Department of Pediatrics, School of Medicine, Afzalipour Hospital, Kerman University of Medical Sciences, Kerman, Iran | [2]Department of Pediatrics, Afzalipour Hospital, Afzalipour Faculty of Medicine, Kerman University of Medical Sciences, Kerman, Iran | [3]Clinical Research Development Unit, Afzalipour Hospital, Kerman University of Medical Sciences, Kerman, Iran | [4]Kerman University of Medical Sciences, Kerman, Iran | [5]Noncommunicable Diseases Research Center, Fasa University of Medical Sciences, Fasa, Iran

Correspondence: Maryam Mobasheri-Shiri (mrymmbashry6@gmail.com)

Received: 12 November 2025 | **Revised:** 8 August 2026 | **Accepted:** 16 September 2026

Keywords: adolescent | children | Mediterranean diet | obesity

ABSTRACT

Objective: The Mediterranean Diet (MedDiet) is a plant-rich dietary pattern associated with favourable adiposity profiles, making it a relevant model for studying obesity risk in children and adolescents. This study aims to investigate the association between adherence to the MedDiet and risk of obesity in children and adolescents.

Methods: An extensive search in databases PubMed/Medline, Scopus, Web of Science Core Collection, the Cochrane Library and Google Scholar up to October 2025 was conducted. Cohort studies which reported means and standard deviations for the body mass index (BMI) levels and MedDiet adherence scores, and crude and adjusted odds ratios (OR) for overweight or obesity among the children with high and low adherence to the MedDiet were eligible for inclusion.

Results: Twenty three articles (26 studies) met the inclusion criteria. Results demonstrated that the mean BMI levels in children adhering to the MedDiet were significantly lower than those who did not adhere to it (weighted mean difference [WMD] = −0.42 kg/m^2, 95% CI: −0.61, −0.23, $I^2 = 65.15\%$, $p < 0.001$). Additionally, results indicated that children with overweight had a lower mean adherence score compared to children with normal weight (WMD = −0.44 scores, 95% CI: −0.76, −0.12, $I^2 = 85.95\%$, $p < 0.001$).

Conclusion: This meta-analysis highlights that greater adherence to the MedDiet was associated with lower odds of obesity among children and adolescents. However, these findings should be interpreted cautiously because the evidence was entirely cross-sectional, heterogeneity was substantial across several pooled analyses and some estimates were sensitive to exclusion of individual studies.

1 | Introduction

Obesity is one of the greatest health challenges in the world that has a high prevalence in developed and developing countries [1]. The prevalence of obesity among children also follows a similar pattern and has increased substantially over the past decades, from approximately 4% in 1975 to about 18% in 2016 [2]. Current estimates indicate that 11% of children aged 5–9 years and 7%

© 2026 World Obesity Federation.

All rights reserved, including rights for text and data mining and training of artificial intelligence technologies or similar technologies.

of those aged 10–19 years have obesity worldwide, with estimations suggesting these rates could rise to 15% and 11%, respectively, by 2030 [3].

The negative effects of childhood obesity are profound and lead to severe and long-lasting health effects. The risk of obesity persisting into adulthood among children with obesity is approximately five times more than others, which results in an increased risk of non-communicable diseases, including Type 2 diabetes mellitus, cardiovascular diseases (CVDs) and cancers [4–7]. Excess adiposity in childhood has also been associated with metabolic dysfunctions such as hypertension, dyslipidaemia, insulin resistance and non-alcoholic fatty liver disease [7, 8].

Healthy dietary habits are considered important factors associated with healthy weight status and obesity prevention [9]. Among various dietary patterns, the Mediterranean diet (MedDiet) has been extensively recognised as one of the most beneficial and sustainable nutritional models for improving health [10, 11]. Based on the traditional eating behaviours of populations living around the Mediterranean basin, the MedDiet reflects a balanced and culturally rooted lifestyle that emphasises both nutritional adequacy and environmental sustainability [12].

The MedDiet is characterised by a high amount of plant-based foods such as vegetables, fruits, nuts, seeds and olive oil. It also includes moderate intake of fish, sea foods, poultry and eggs, while red and processed meat, refined grains and sugary foods are limited [13, 14]. This dietary composition provides a rich supply of monounsaturated and polyunsaturated fatty acids, fibre, antioxidants, vitamins and minerals, which have been associated with improved lipid and glucose profiles and reduced systemic inflammation [15, 16].

Extensive research has documented that the potential health benefits associated with the MedDiet extend to younger populations. The adherence to the MedDiet during childhood has been associated with healthier body weight and supports normal growth and development [17]. Studies such as the IDEFICS project have shown that high adherence to the MedDiet is associated with lower odds of overweight and obesity in children [18].

Previous paediatric studies have reported inconsistent findings regarding the relationship between MedDiet adherence and obesity-related outcomes, and a quantitative synthesis focused specifically on individuals under 18 years is still needed. Given the global rise in childhood obesity, promoting healthier dietary habits from early life is urgently needed. A systematic review and meta-analysis can provide an objective summary of current studies and identify the association between adherence to the MedDiet and obesity among children and adolescents.

The present systematic review and meta-analysis aims to evaluate the association between adherence to the MedDiet and obesity related parameters in children and adolescents, including body mass index (BMI), adherence score differences and odds of overweight/obesity and guide public health recommendations for enhancing healthy dietary habits and reducing the burden of obesity from an early age.

2 | Method

The present study was conducted following the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). According to recommendations from the Cochrane handbook, we registered our systematic review on the PROSPERO platform with registration number CRD420251182858.

2.1 | Search Strategy

A thorough search was performed across various electronic databases including PubMed/Medline, Scopus, Web of Science (ISI) and the Cochrane Library, spanning from the inception up until October 2025. In addition, Google Scholar was searched as a supplementary source to identify potentially eligible studies and grey literature that might not have been indexed in the primary databases. The same combination of search terms was used as far as permitted by the platform. To enhance reproducibility and ensure a manageable screening process, the first 200 results sorted by relevance were screened for potentially eligible studies. The reference lists of all included articles and relevant review papers were also manually searched to identify additional eligible studies. Our search strategy involved a combination of medical subject headings (MeSH) terms and keywords: ('Diet, Mediterranean' OR 'Mediterranean Die' OR 'Mediterranean Diets') AND ('Child' OR 'Children' OR 'Childhood' OR 'Adolescents' OR 'Adolescence' OR 'Adolescent' OR 'Teenager' OR 'Youth' OR 'Teen' OR 'Paediatric' OR 'Preschool' OR 'Primary School' OR 'Secondary School') AND ('Obesity' OR 'Overweight' OR 'Body Mass Index'OR 'BMI' OR 'Body Mass' OR 'Body Weight' OR 'Body Weights' OR 'Body Measures' OR 'Anthropometric Measurements' OR 'Body Fat' OR 'Fat Mass'). The search strategy used for PubMed search is detailed in Table S1. All searches were conducted by a librarian and managed using the EndNote software.

2.2 | Inclusion Criteria

We included observational studies that fulfilled specific eligibility criteria as follows: (a) observational studies of cross-sectional, case–control or cohort design that examined the relationship between adherence to the MedDiet and studied outcomes in children under 18 years old were eligible; however, only cross-sectional estimates were meta analysed and for longitudinal studies, data were included only when a single cross-sectional phase was reported separately; (b) results reported in a format that displays the association between adherence to the MedDiet and risk of obesity in children and adolescents using numerical values; (c) studies with outcomes specifically related to the occurrence of obesity outcomes. The outcomes of interest encompassed quantitative measures such as mean (±SD) BMI levels and MedDiet adherence scores, as well as qualitative measures like crude and adjusted OR for obesity/overweight among the children with high and low adherence to the MedDiet.

However, certain criteria were used to exclude articles. These criteria included as follows: (a) articles falling under case series, letters to editorials, commentaries, in vivo and in vitro studies, (b) studies with insufficient information, even after multiple attempts to reach out to the authors, (c) study participants who were older than 18 years old, (d) studies with languages other than English.

2.3 | Outcome Definition

The primary outcome was the difference in BMI levels between children adhering to the MedDiet versus non-adherent children. Secondary outcomes included as follows: (1) the difference in adherence scores between children with overweight or obesity and children with normal weight; (2) crude and adjusted OR for overweight among adherent versus non-adherent participants; and (3) adjusted OR per one-unit increase in adherence scores.

2.4 | Data Extraction

Two individual authors (M.M.-S. and M.GH) extracted relevant information using a standardised Excel sheet. The information collected included the first author's name, publication year, study location, population characteristics (mean age and gender), study design, sample size, baseline BMI, method of measuring adherence to the Med diet and key data for both quantitative and qualitative outcomes of interest. Any discrepancies were resolved through discussion or consultation with a third author.

2.5 | Quality Assessment

The methodological quality of the included studies was evaluated using the adapted version of the Newcastle-Ottawa Scale for cross-sectional studies. This adapted tool assesses studies across three main domains: selection (representativeness of the sample, justified sample size, response rate and ascertainment of exposure), comparability (control for confounders through subgroup or multivariable analysis) and outcome (assessment of outcome and appropriateness of statistical analysis). The maximum possible scores were 5 stars for selection, 2 stars for comparability and 3 stars for outcome. Each study was classified into categories based on overall score: good quality (score ≥ 7), satisfactory quality (score 5–6) and unsatisfactory quality (score ≤ 4).

2.6 | Statistical Analysis

To estimate the effect size (ES) of quantitative outcomes, we calculated the Mean (±SD) difference in BMI levels between adherents vs. non adherent to Med diet, as well as the mean change in adherence scores between children with OWB and those with NW. The ORs, along with their corresponding 95% confidence intervals (CIs), were considered the effect size for qualitative outcomes if reported or calculated by the studies. A random-effects model was employed to estimate the pooled ESs. We assessed within-study heterogeneity using the Cochrane's Q-test and I^2 statistics. A p value from the Q-test of less than 0.1 and an I^2 exceeding 50% indicated considerable heterogeneity among studies. Furthermore, subgroup analyses were conducted based on major moderator variables such as Med diet index (KIDMED vs. other), adherence category (high/moderate-low [H/MH] vs. high-moderate/low [HM/L]), publication year (<2020 vs. ≥ 2020), sample size (<1000 vs. ≥ 1000) and age groups (<10 years vs. ≥ 10 years) to detect the sources of significant heterogeneity. Sensitivity analysis was performed using leave-one-out meta-analysis after excluding one by one study to evaluate the robustness of the pooled ESs. Potential small study effects were examined using funnel plots and Egger's test, employing both methods as complementary evaluations. All statistical analyses were conducted using Stata software (Stata Corp., College Station, TX, United States).

3 | Results

3.1 | Study Selection and Characteristics

A comprehensive search of the database yielded a total of 2470 studies. After removing 741 duplicate records, 1658 additional records were excluded during the screening of titles and abstracts. This process left 71 publications for further consideration, of which 48 were subsequently ruled out. Ultimately, 23 articles (26 studies) [11, 19–40] were found to meet the eligibility criteria after a thorough review of the full texts. A PRISMA flow diagram illustrating the step-by-step process of study identification and selection is provided in Figure 1.

Overall, this meta-analysis included 210 191 participants, comprising 107 021 boys (50.9%) and 103 170 girls (49.1%). Twenty-one of the 23 included articles used the International Obesity Task Force age and sex specific BMI cut-offs, while two used the World Health Organization growth references. Twelve of the 23 included articles were conducted in Greece [22, 23, 26, 27, 30–34, 36, 37, 40], while four were in Italy [21, 25, 38, 39], three in Turkey [19, 20, 35], two in Spain [11, 28] and the remaining articles were performed in Cyprus [29] and Lithuania and Serbia [24]. All articles included participants of both sexes, with one article reporting Med diet adherence separately by sex using various types of indexes [11]. The articles were published between 2008 [31] and 2025 [11]. All included studies were cross-sectional in design. Although Voltas et al. [28] was described as a longitudinal study, only cross sectional data from phase three were used in our analysis. Therefore, all studies shared a comparable study design. The definition of overweight and obesity across studies, 21 out of 23 articles (approximately) used the International Obesity Task Force (IOTF) age- and sex-specific BMI cut-off criteria proposed by Cole et al. [41]. Only two studies [20, 35] used the World Health Organization (WHO) growth references. Twenty of the articles utilised the MedDiet Quality Index (KIDMED) to assess adherence to the MedDiet, while the others collected data using the Mediterranean Lifestyle Index (MediLIFE-index), the Krece Plus Food Questionnaire, the MED4CHILD Questionnaire and the COME-Kids Food and

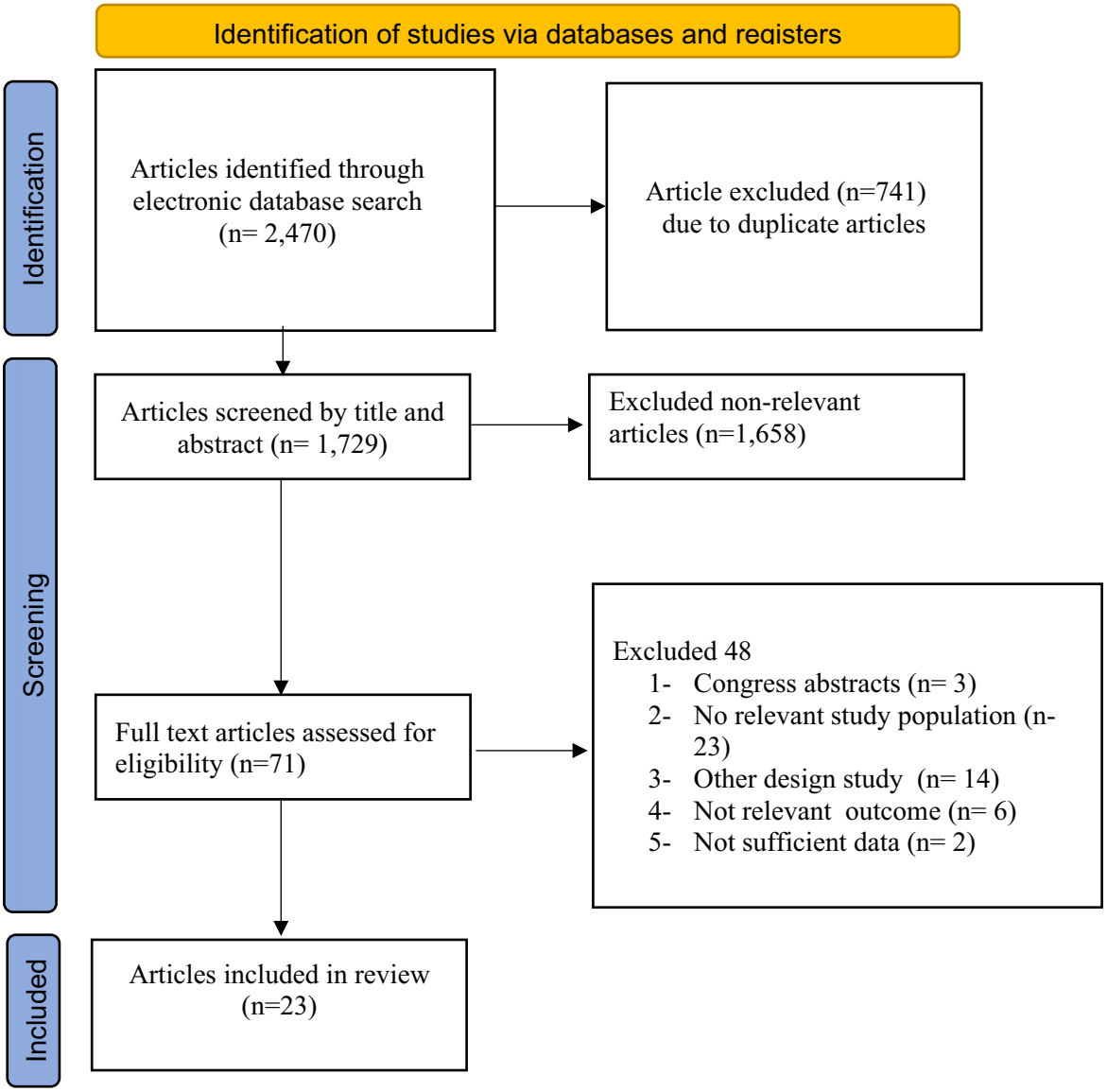


FIGURE 1 | The PRISMA flow chart for study selection process.

Beverage Frequency Questionnaire (COME-Kids F&B-FQ). Additional characteristics of each study are summarised in Table 1.

3.2 | Meta-Analysis

The results are presented separately for quantitative outcomes (primary: BMI levels; secondary: adherence scores) and qualitative outcomes (secondary: crude and adjusted ORs), as defined in the methods section.

3.3 | Quantitative Outcomes

The results of the meta-analysis, which was based on 11 studies using a random-effects model [11, 23, 26, 31–33, 35, 36, 38], showed that the mean BMI levels in children adhering to the MedDiet were significantly lower than those in children who did not adhere to it (weighted mean difference [WMD] = −0.42 kg/m^2, 95% CI: −0.61, −0.23, $I^2 = 65.15\%$, p for heterogeneity < 0.001). Additionally, there were nine studies that assessed the mean adherence scores to MedDiet among children with overweight or obesity and children with normal weight [19–21, 25, 27, 30, 33, 37, 39]. The pooled results indicated that children with OWB had a significantly lower mean adherence score compared to children with normal weight (WMD = −0.44 scores, 95% CI: −0.76, −0.12, $I^2 = 85.95\%$, p for heterogeneity < 0.001) (See Figure 2A,B for forest plots).

We observed significant heterogeneity across studies, leading us to conduct additional analyses, including subgroup and sensitivity analysis. As shown in Table 2, subgroup analyses revealed that the heterogeneity was partly explained by the type of MedDiet index, adherence category, publication year, sample size and age group. Notably, studies using 'other' indexes (e.g., MED4CHILD and MediLIFE-index) showed lower heterogeneity ($I^2 = 0.00\%$, $p = 0.61$) and more consistent results compared to those using the KIDMED index. Additionally, studies published in or after 2020 ($I^2 = 23.66\%$, $p = 0.249$) and

TABLE 1 | Characteristics of included studies.

Author	Country	Study	Gender	MedDiet adherence questionnaire	Total sample size	Mean age	Baseline BMI	Quality NOS scores
Larruy-García et al. #1 [11]	Spain	Cross-sectional	603 M	MED4CHILD	603	4.92 ± 1.04	16.21 ± 1.99	8
Larruy-García et al. #2 [11]	Spain	Cross-sectional	615 F	MED4CHILD	615	5.00 ± 1.07	16.45 ± 2.24	8
Larruy-García et al., #3 [11]	Spain	Cross-sectional	603 M	MED-COME-Kids F&B-FQ	603	4.92 ± 1.04	16.21 ± 1.99	8
Larruy-García et al. #4 [11]	Spain	Cross-sectional	615 F	MED-COME-Kids F&B-FQ	615	5.00 ± 1.07	16.45 ± 2.24	8
Antonogeorgos et al. [40]	Greece	Cross-sectional	529 M/596 F	KIDMED	1125	10–12 years	—	8
Archero et al. [39]	Italy	Cross-sectional	324 M/345 F	KIDMED	669	11.2 ± 2.2	18.5 ± 3.5	7
Corte et al. [38]	Italy	Cross-sectional	168 M/75 F	KIDMED	243	12.57 ± 2.77	28.16 ± 6.34	7
V. Diamantis et al. [37]	Greece	Cross-sectional	1614 M/1539 F	KIDMED	3153	7.8 ± 2.6	—	7
George et al. [36]	Greece	Cross-sectional	990 M/982 F	KIDMED	1972	11.1 ± 0.6	20.3 ± 3.8	8
Bakırhan et al. [35]	Turkey	Cross-sectional	1042 M/949 F	KIDMED	1991	5–18 years	19.40 ± 5.55	8
Jacovides et al. [34]	Greece	Cross-sectional	1930 M/1945 F	KIDMED	3875	7.4 ± 1.6	—	8
Kanellopoulou et al. [33]	Greece	Cross-sectional	496 M/646 F	KIDMED	1142	11.17 ± 0.8	—	8
Katsagoni et al. [32]	Greece	Cross-sectional	89 174 M/85 035 F	MediLIFE-index	174 209	11.22 ± 1.64	19.2 ± 3.66	7
Kontogianni et al. [31]	Greece	Cross-sectional	626 M/679 F	KIDMED	1305	10.96 ± 4.61	19.30 ± 3.98	9
Kosti et al. [30]	Greece	Cross-sectional	353 M/522 F	KIDMED	875	11.21 ± 0.79	—	8
Lazarou et a. [29]	Cyprus	Cross-sectional	524 M/299 F	KIDMED	823	10.7 ± 0.98	—	8
Voltas et al. [28]	Spain	Longitudinal study (only Phase 3 Cross sectional)	94 M/147 F	Krece plus food questionnaire	241	13.5 ± 0.9		7
Lydakis et al. [27]	Greece	Cross-sectional	132 M/145 F	KIDMED	277	12 ± 8	22.36 ± 3.26	7
Mazaraki et al. [26]	Greece	Cross-sectional	152 M/213 F	KIDMED	365	13.85 ± 1.6	21.71 ± 3.49	6
Mistretta et al. [25]	Italy	Cross-sectional	885 M/758 F	KIDMED	1643	12.4 ± 0.7	21.7 ± 4.5	9

(Continues)

TABLE 1 | (Continued)

Author	Country	Study	Gender	MedDiet adherence questionnaire	Total sample size	Mean age	Baseline BMI	Quality NOS scores
Novak et al. [24]	Lithuania and Serbia	Cross-sectional	1449 M/1622 F	KIDMED	3071	14–18 years	—	9
Farajian et al. [23]	Greece	Cross-sectional	2359 M/2427 F	KIDMED	4786	10.9 ± 0.75	20.3 ± 3.8	8
Pavlidou et al. [22]	Greece	Cross-sectional	2546 M/2642 F	KIDMED	5188	4.1 ± 1.5	—	8
Rosi et al. [21]	Italy	Cross-sectional	222 M/187 F	KIDMED	409	12.5 ± 0.6	18.4 ± 2.7	6
Bozkurt et al. [20]	Turkey	Cross-sectional	161 M/157 F	KIDMED	318	10.0 ± 0.73	—	8
Cakir et al. [19]	Turkey	Cross-sectional	45 M/30 F	KIDMED	75	11.3 ± 2.6	19.56 ± 4.39	7

Note: #1–#4: Data from the same study by Larruy-García et al. [11], presented separately by sex and dietary adherence assessment tool.
Abbreviations: BMI, body mass index; KIDMED, the Mediterranean Diet Quality Index; MediLIFE-index, the Mediterranean Lifestyle index for Children and Adolescents.

those with larger sample size (≥ 1000) ($I^2 = 64.92\%$, $p = 0.022$) demonstrated lower heterogeneity. For the mean adherence scores, heterogeneity remained high across most subgroups, though studies with larger sample size showed attenuated effect sizes.

Sensitivity analyses findings remained consistent after excluding each study, as indicated by the pooled WMDs (see Figure S1A,B).

3.4 | Qualitative Outcomes

The forest plots illustrating the associations between adherence to the MedDiet and OWB in children are shown in Figure 3A–C. In total, seventeen studies [11, 19–22, 24, 25, 28, 29, 32–34, 36, 39] were included to analyse the crude OR (Figure 3A), fourteen studies [11, 22, 24, 25, 28, 29, 32, 34, 36, 39, 40] evaluated the adjusted OR (Figure 3B) and three studies [25, 30, 33] assessed the adjusted OR per unit increase (Figure 3C) in relation to the association between adherence to MedDiet and the odds of OWB in children within the current meta-analysis.

The pooled results for the crude OR showed that greater adherence to the MedDiet was significantly associated with lower odds of OWB (crude OR = 0.72, 95% CI: 0.45, 0.98, $I^2 = 98.7\%$, p for heterogeneity < 0.001). Similarly, the meta-analysis results for the adjusted OR indicated a decrease in the odds of OWB among adherent versus non-adherent participants (adj OR = 0.78, 95% CI: 0.50, 0.97, $I^2 = 96.8\%$, p for heterogeneity < 0.001). The pooled analysis per one unit increase in adherence scores indicated a significant decrease in the odds of OWB among participants (adj OR per unit increase = 0.91, 95% CI: 0.86, 0.97, $I^2 = 47.16\%$, p for heterogeneity = 0.15).

Subgroup analyses for qualitative outcomes (detailed in Table 2) revealed that type of MedDiet index and age group were important sources of heterogeneity. For crude OR, studies using KIDMED showed no heterogeneity ($I^2 = 0.0\%$), while studies using other indexes showed substantial heterogeneity. For adjusted OR, studies using other indexes showed no heterogeneity ($I^2 = 0.0\%$) and studies with children < 10 years of age also showed no heterogeneity ($I^2 = 0.0\%$), indicating more consistent results in younger children and with non-KIDMED indexes. The adherence category also influenced the results, with HM/L classification showing a significant protective association (adj OR = 0.78, 95% CI: 0.59, 0.97). A detailed summary of the subgroup analyses is provided in Table 2.

Sensitivity analyses revealed that the pooled results for the associations between adherence to the MedDiet and the odds of OWB significantly differed between the pre- and post-sensitivity analyses. After removing data from Jacovides et al. [34], (crude OR = 0.76, 95% CI: 0.48, 1.05) and Cakir et al. [19], (crude OR = 0.76; 0.49, 1.04) for the crude OR and after omitting data from Palvidou et al. [22], (adj OR = 0.76, 95% CI: 0.48, 1.05) and Jacovides et al. [34], (crude OR = 0.82, 95% CI: 0.63, 1.02). These findings indicated that the statistical significance of the pooled estimates was not entirely robust and was influenced by specific studies (see Figure S2A,B).

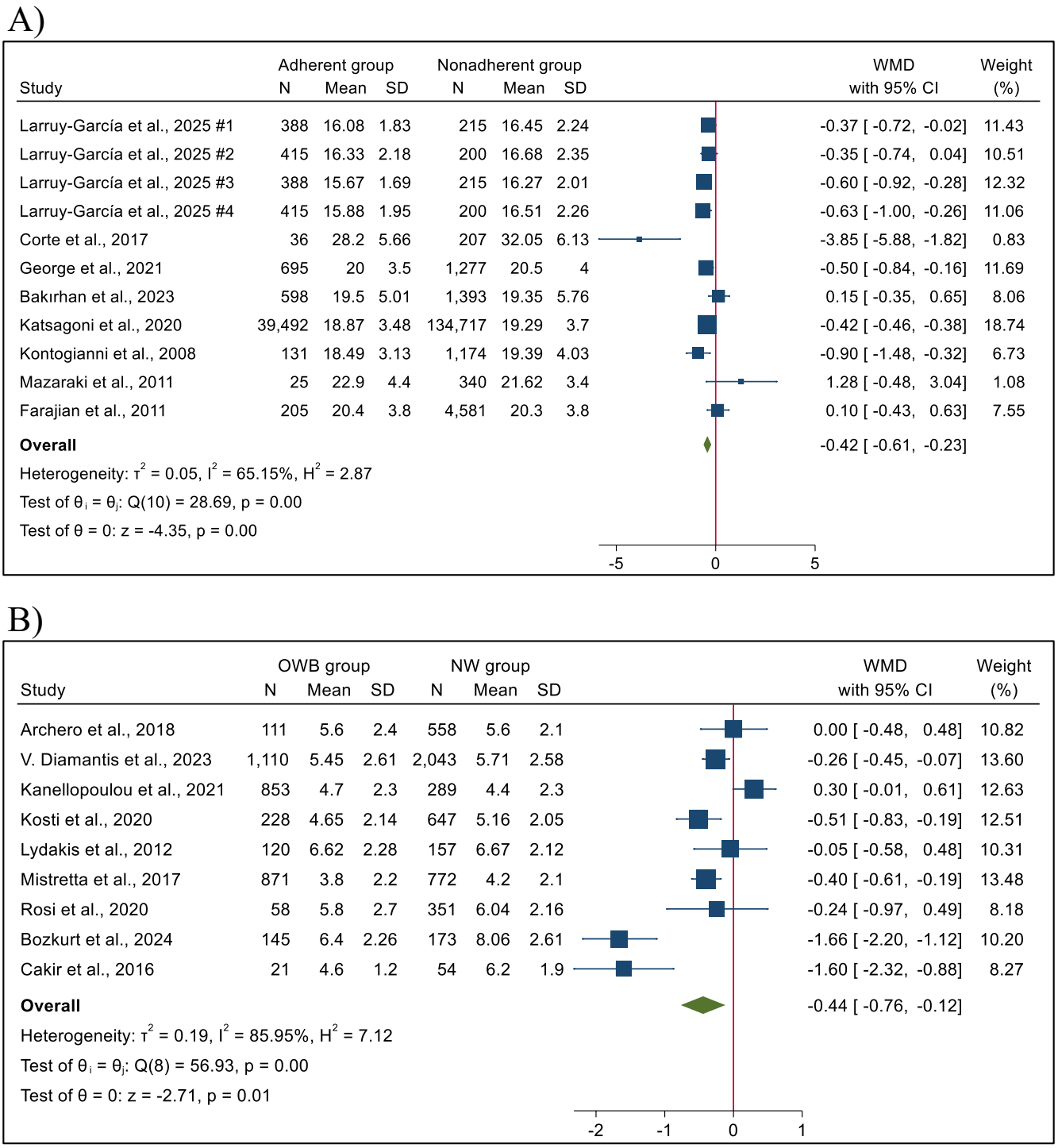


FIGURE 2 | (A) Forest plots from meta-analyses showing the mean BMI levels in adherent versus non-adherent children. (B) Forest plots from meta-analyses showing adherence scores to MedDiet in children with overweight and obese (OWB) versus children with normal weight (NW).

3.5 | Publication Bias and Quality Assessment

Egger's test and funnel plots indicated no significant evidence of publication bias across included studies (See Figure S3A–D). The quality assessment results based on the NOS tool showed that approximately 91.3% of the studies included in the meta-analysis had a quality rating of 'Good', with only two studies being rated as 'satisfactory'. A detailed summary of the quality assessment for each study is presented in Table S2.

4 | Discussion

To our knowledge, this is the first meta-analysis focused specifically on the relationship between adherence to MedDiet

TABLE 2 | Subgroup findings.

Quantitative outcomes		None. studies	Effect size (95% CI) WMD (95% CI)	I^2 (%), $P_{heterogeneity}$
BMI levels (kg/m^2)			MedDiet index	
	KIDMED	6	−0.39 (−0.99, 0.21)	80.32%, < 0.001
	Other	5	−0.42 (−0.46, −0.36)	0.0%, 0.61
			Adherence category	
	H/ML	10	−0.41 (−0.62, −0.19)	68.40%, < 0.01
	HM/L	1	−0.50 (−0.84, −0.16)	——
Adherence score			MedDiet index	
	KIDMED	9	−0.44 (−0.76, −0.12)	85.95%, < 0.001
	Other	—	—	—
			Adherence category	
	H/ML	8	−0.46 (−0.86, −0.06)	87.54%, < 0.001
	HM/L	1	−0.40 (−0.61, −0.19)	—
Qualitative outcomes			**OR (95% CI)**	
[a] OR of OWB			MedDiet index	
	KIDMED	6	0.96 (0.94, 0.99)	0.0%, 0.62
	Other	11	0.56 (0.39, 0.73)	92.9%, < 0.001
			Adherence category	
	H/ML	17	0.72 (0.45, 0.98)	98.7%, < 0.001
	HM/L	—	—	—
[b] OR of OWB			MedDiet index	
	KIDMED	8	0.66 (0.53, 0.80)	84.9%, < 0.001
	Other	6	0.90 (0.89, 0.92)	0.00%, 0.77
			Adherence category	
	H/ML	6	0.84 (0.53, 1.15)	0.0%, 0.90
	HM/L	8	0.78 (0.59, 0.97)	98.3%, < 0.001

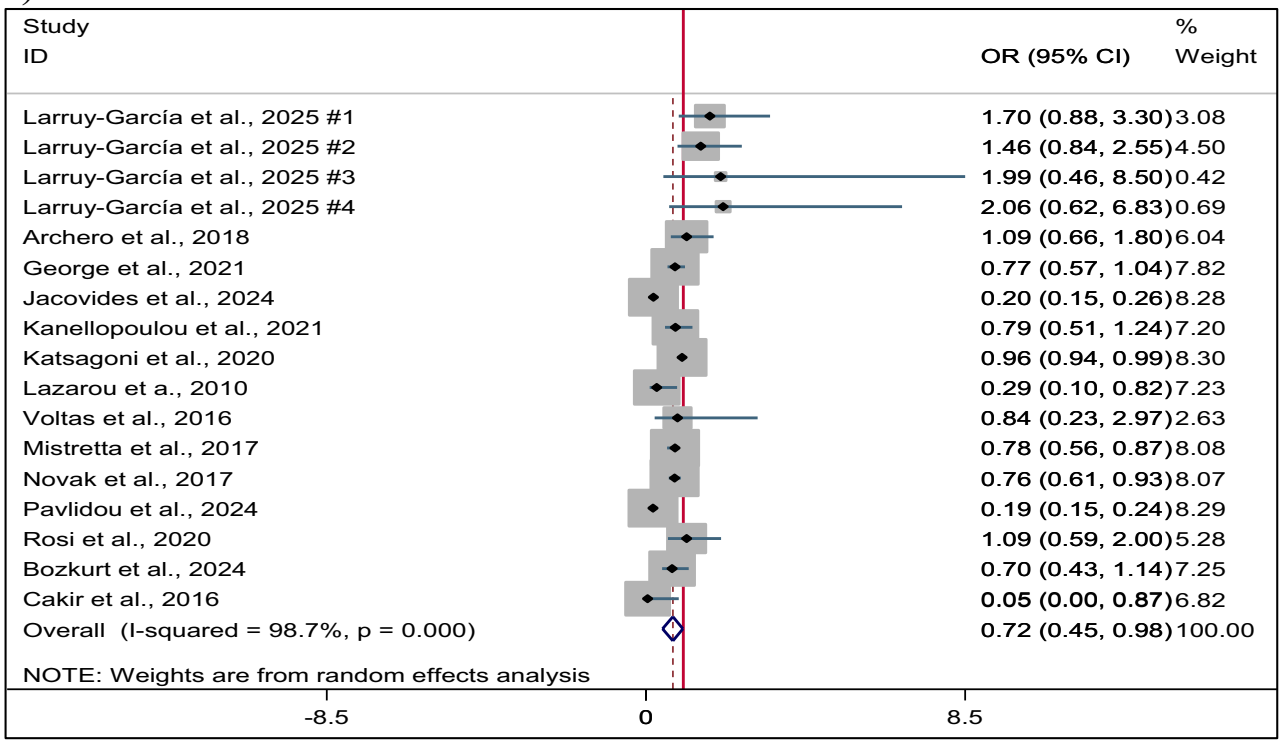
Abbreviations: MedDiet, Mediterranean Diet; KIDMED, the Mediterranean Diet Quality Index; WMD, Weighted Mean Difference; H/ML, High Adherence/Moderate-Low; HM/L, High-Moderate Adherence/Low; OR, Odds Ratio; OWB, Overweight-Obesity.
[a]Crude odds for OWB among adherent participants compared to non-adherent participants.
[b]Adjusted odds for OWB among adherent participants compared to non-adherent participants.

and obesity-related outcomes in individuals under 18 years, integrating BMI differences, adherence scores differences, crude and adjusted odds ratios and subgroup analyses by diet index, age group, publication year and sample size. The present meta-analysis found that higher adherence to the MedDiet was associated with lower BMI, lower odds of overweight/obesity and higher adherence scores among children with normal weight than among those with overweight/obesity. These associations were directionally consistent across outcomes, but their strength should be interpreted cautiously because heterogeneity was substantial in most analyses and some pooled estimates lost statistical significance in sensitivity analyses.

The prevalence of childhood obesity has rapidly increased and become one of the most important issues across the globe [1, 42]. In the United States, the rate of obesity among children has reached 45% [43] and in Europe childhood obesity rate is about 31% [44]. These alarming figures underscore the importance of identifying modifiable factors contributing to this issue, among which dietary patterns play a crucial role. Poor diet and reduced physical activity have been recognised as key preventable factors to childhood obesity [45, 46].

Greater adherence to the MedDiet has been associated with lower BMI and lower odds of obesity. The MedDiet is defined as a diet rich in fruits, nuts, vegetables, fish, culturally rooted and minimal environmental effects that can improve children's development in both physical and cognitive aspects [47, 48]. Despite its well-known benefits, adherence to the MedDiet among children in Mediterranean regions has demonstrated a declining

A)



B)

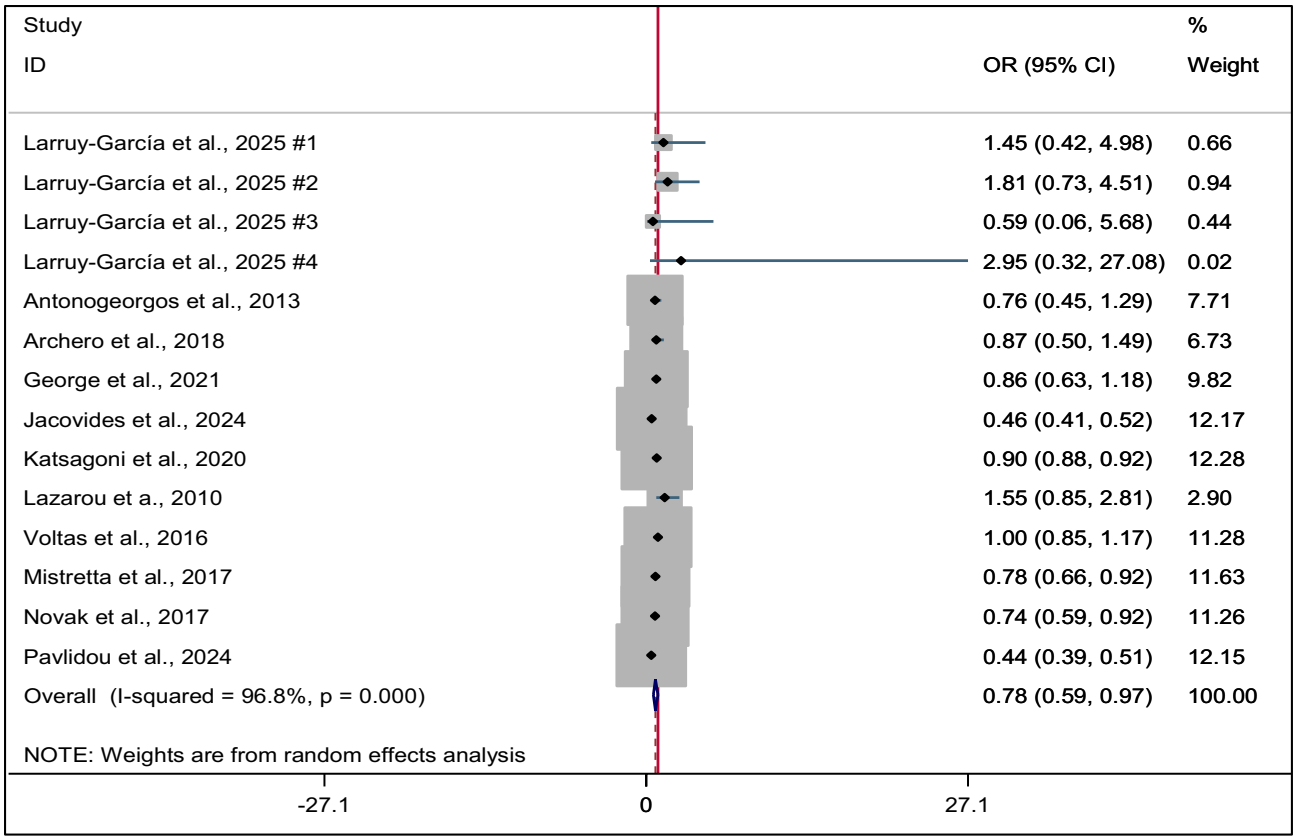


FIGURE 3 | (A) Forest plots illustrating the associations between adherence to the MedDiet and overweight and obesity (OWB) compared to normal weight (NW) in children based on the crude OR. (B) Forest plots illustrating the associations between adherence to the MedDiet and overweight and obesity (OWB) compared to normal weight (NW) in children based on the adjusted OR. (C) Forest plots illustrating the associations between adherence to the MedDiet and overweight and obesity (OWB) compared to normal weight (NW) in children based on the adjusted OR per unit increase in adherence to the MedDiet.

C)

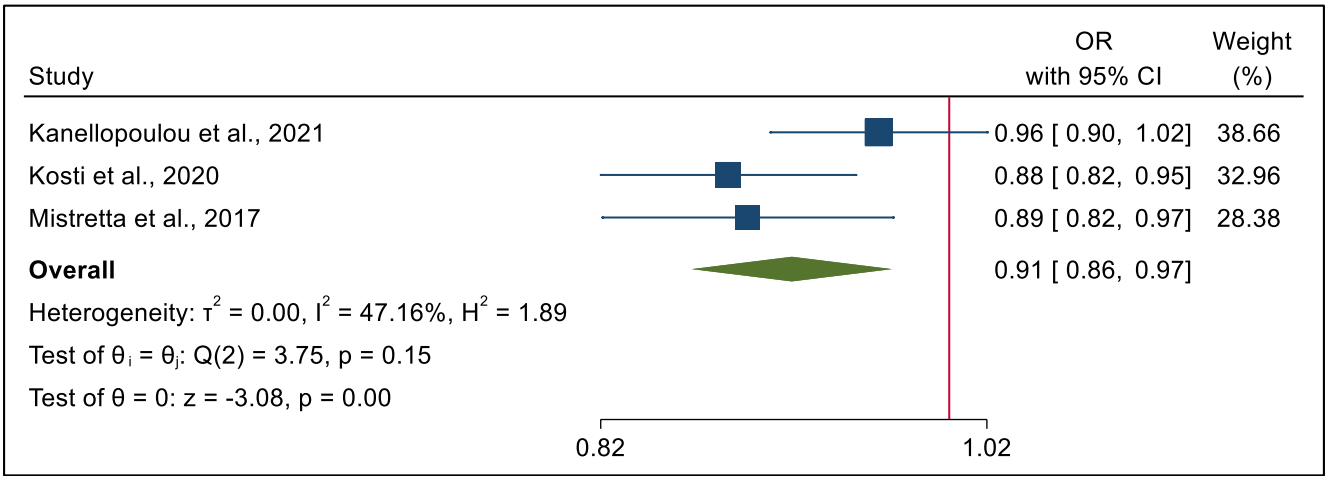


FIGURE 3 | (Continued).

trend. For instance, in Spain, 28.4% of children showed optimal adherence to the MedDiet, while 55.9% required improvement and 15.7% had low adherence [49]. Similarly, in Turkish children, only 34.1% had exhibited acceptable adherence to the MedDiet, while 57% needed improvement and 8.9% had very low adherence [50]. According to the WHO, the gradual reduction of adherence to the MedDiet in the Mediterranean countries has contributed to higher obesity rates and poorer health outcomes among children, even in comparison to non-Mediterranean regions [51].

Evidence from numerous cross-sectional and longitudinal studies consistently demonstrates an inverse relationship between adherence to the MedDiet and risk of obesity among children [22, 33, 52–55], as children with higher adherence to the MedDiet had lower BMI, waist circumference (WC) and waist to height ratio (WHtR) [53, 54, 56].

Several biological mechanisms have been proposed that may explain the observed associations. The MedDiet emphasises nutrient dense, minimally processed food with high fibre, antioxidants and healthy fats [57, 58]. High fibre intake leads to satiety, regulates appetite and reduces energy consumption. The consumption of fruits, vegetable, and grain through low energy density affects satiety signals, which results in controlled caloric intake. The mono and polyunsaturated fats are essential components of dietary fat that play a crucial role in influencing body weight regulation [59, 60]. Monounsaturated fats, mainly derived from olive oil, nuts and avocados, and polyunsaturated fats, found in fish, flaxseed and vegetable oils have been associated with reduced obesity risk and improved cardiometabolic outcomes [61, 62].

Further mechanisms of obesity and metabolic disorders are oxidative stress and low-grade chronic inflammation, which the MedDiet reduces through anti-oxidants and anti-inflammatory properties [63].

Beyond its nutritional and metabolic benefits, the MedDiet helps learning mindful and sustainable eating habits. Mindful eating leads to enhanced self-regulation and awareness of hunger and satiety conditions, may contribute to reduced overeating and promotes choosing healthier food [64–66].

The current meta-analysis had various strengths and limitations. This study represents the first meta-analysis to assess the association between adherence to MedDiet and childhood obesity, given the increasing prevalence of obesity among children and adolescents and its critical role in the development of CVDs and metabolic disorders. Additionally, the sample sizes of included studies are considerable, which lead to better evaluation of the relationship between adherence to the MedDiet and childhood obesity. Moreover, we used subgroup analysis to further examine the potential impact of more covariates on pooled estimates. A limitation of this study is the substantial heterogeneity observed across included studies ($I^2 > 85\%$ in most analyses), which limits the confidence in our pooled estimates. Although we explored potential sources of heterogeneity through subgroup analyses (based on the type of MedDiet index, adherence category, publication year, sample size and age groups), residual heterogeneity remained in some subgroups, suggesting unmeasured sources of variation. Therefore, our findings should be interpreted with caution. Furthermore, the sensitivity analysis revealed that the statistical significance of some pooled estimates was lost after the exclusion of individual studies, indicating limited robustness of the finding. These findings indicate that the available evidence remains relatively limited and that the observed associations may not be entirely stable across different study populations and methodological approaches. An additional limitation relates to the reliance on BMI as the primary measure of obesity across the included studies. Although BMI is widely used in epidemiological research and paediatric screening because of its simplicity and practicality, it is an indirect indicator of adiposity and has recognised limitations in children and adolescents. BMI does not distinguish between fat mass and lean mass, nor does it adequately reflect body fat distribution, visceral adiposity or cardiometabolic risk. Therefore, our findings should be interpreted with caution, as the observed associations may primarily reflect differences in BMI rather than true differences in adiposity or metabolic health. An additional concern is that one large study contributed disproportionately to the pooled sample, which may have amplified

the influence of its population and measurement framework on the summary estimates. This should be acknowledged alongside the high I^2 values and the sensitivity analyses. Furthermore, this study lacked geographical and participant demographic diversity. More specifically, the study lacked information regarding the physical activities of the children who participated in these studies, making it difficult to find the pure association. Furthermore, there was a lack of detailed data regarding the economic condition of participants.

5 | Conclusions

Our systematic review and meta-analysis showed that greater adherence to the MedDiet is associated with lower BMI and lower odds of overweight and obesity among children and adolescents. Children with overweight or obesity also showed lower MedDiet adherence scores than those with normal weight. However, these findings should be interpreted cautiously because most included studies were cross-sectional and substantial heterogeneity was observed across several analyses. More trials evaluating the effects of MedDiet on clinical and biochemical outcomes are needed to further support our findings.

Author Contributions

All authors contributed substantially to the study design, data analysis and manuscript drafting. M.G.S., A.G.S., A.E.M. and M.M.-S. contributed to writing or revising the article K.T.A., A.G.S., A.E.M. and M.M.-S. approved the final revised version for submission. All authors have reviewed and accepted the manuscript.

Acknowledgements

The authors have nothing to report.

Funding

The authors have nothing to report.

Ethics Statement

This study is a secondary research study based exclusively on previously published data and does not involve the recruitment of human participants or the collection of identifiable personal information. Therefore, ethics committee approval and informed consent were not required.

Consent

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

1. L. Abarca-Gómez, Z. A. Abdeen, Z. A. Hamid, et al., "Worldwide Trends in Body-Mass Index, Underweight, Overweight, and Obesity From 1975 to 2016: A Pooled Analysis of 2416 Population-Based Measurement Studies in 128· 9 Million Children, Adolescents, and Adults," *Lancet* 390, no. 10113 (2017): 2627–2642.

2. WHO, "Obesity, Overweight," (2023), https://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight.

3. T. Lobstein, H. Tim, and N. Margot, *World Obesity Atlas* (World Obesity Federation, 2023).

4. S. T. Chung, A. Krenek, and S. N. Magge, "Childhood Obesity and Cardiovascular Disease Risk," *Current Atherosclerosis Reports* 25, no. 7 (2023): 405–415.

5. Y. Zhang, Y. Yin, X. Zhang, J. Ye, and J. Zhang, "Association of Adverse Childhood Experiences With Diabetes: A Systematic Review and Meta-Analysis," *Journal of Diabetes and Its Complications* 36, no. 10 (2022): 108289.

6. E. N. Suspitsin and E. N. Imyanitov, "Hereditary Conditions Associated With Elevated Cancer Risk in Childhood," *Biochemistry (Moscow)* 88, no. 7 (2023): 880–891.

7. V. A. Kovacs, "Mapping the Health System Response to Childhood Obesity in the WHO European Region: An Overview and Country Perspectives," (2019).

8. J. D. Smith, E. Fu, and M. A. Kobayashi, "Prevention and Management of Childhood Obesity and Its Psychological and Health Comorbidities," *Annual Review of Clinical Psychology* 16, no. 1 (2020): 351–378.

9. P. M. Emmett and L. R. Jones, "Diet, Growth, and Obesity Development Throughout Childhood in the Avon Longitudinal Study of Parents and Children," *Nutrition Reviews* 73, no. suppl_3 (2015): 175–206.

10. L. Velázquez-López, G. Santiago-Díaz, J. Nava-Hernández, A. V. Muñoz-Torres, P. Medina-Bravo, and M. Torres-Tamayo, "Mediterranean-Style Diet Reduces Metabolic Syndrome Components in Obese Children and Adolescents With Obesity," *BMC Pediatrics* 14, no. 1 (2014): 175.

11. A. Larruy-García, M. L. Miguel-Berges, I. R. D. Torre, et al., "Cross-Sectional Associations Between Mediterranean Diet and Body Composition in Preschool Children. CORAL Study," *Pediatric Obesity* 20, no. 7 (2025): e70014.

12. R. Altomare, F. Cacciabaudo, G. Damiano, et al., "The Mediterranean Diet: A History of Health," *Iranian Journal of Public Health* 42, no. 5 (2013): 449–457.

13. X. Wang, Y. Ouyang, J. Liu, et al., "Fruit and Vegetable Consumption and Mortality From All Causes, Cardiovascular Disease, and Cancer: Systematic Review and Dose-Response Meta-Analysis of Prospective Cohort Studies," *BMJ* 349 (2014): 349.

14. L. Schwingshackl and G. Hoffmann, "Monounsaturated Fatty Acids, Olive Oil and Health Status: A Systematic Review and Meta-Analysis of Cohort Studies," *Lipids in Health and Disease* 13, no. 1 (2014): 154.

15. R. Farias-Pereira, J. B. Zuk, and H. Khavaran, "Plant Bioactive Compounds From Mediterranean Diet Improve Risk Factors for Metabolic Syndrome," *International Journal of Food Sciences and Nutrition* 74, no. 4 (2023): 403–423.

16. A. Masini, L. Dallolio, F. Sanmarchi, et al., "Adherence to the Mediterranean Diet in Children and Adolescents and Association With Multiple Outcomes: An Umbrella Review," in *Healthcare* (MDPI, 2024).

17. P. Henríquez-Sánchez, J. Doreste-Alonso, C. Ruano, L. Serra-Majem, M. Á. Martínez-González, and A. Sánchez-Villegas, "Mediterranean Diet and Quality of Life," in *The Mediterranean Diet* (Elsevier, 2015), 61–68.

18. G. Tognon, A. Hebestreit, A. Lanfer, et al., "Mediterranean Diet, Overweight and Body Composition in Children From Eight European Countries: Cross-Sectional and Prospective Results From the IDEFICS

Study," *Nutrition, Metabolism, and Cardiovascular Diseases* 24, no. 2 (2014): 205–213.

19. M. Cakir, U. E. Akbulut, and A. Okten, "Association Between Adherence to the Mediterranean Diet and Presence of Nonalcoholic Fatty Liver Disease in Children," *Childhood Obesity* 12, no. 4 (2016): 279–285.

20. O. Bozkurt, B. Kocaadam-Bozkurt, and E. Koçyiğit, "Evaluation of the Relationships Among Mindful Eating, Environmental Beliefs, Adherence to the Mediterranean Diet, and Obesity in Children," *Turkish Archives of Pediatrics* 59, no. 1 (2024): 98.

21. A. Rosi, F. Giopp, G. Milioli, et al., "Weight Status, Adherence to the Mediterranean Diet, Physical Activity Level, and Sleep Behavior of Italian Junior High School Adolescents," *Nutrients* 12, no. 2 (2020): 478.

22. E. Pavlidou, S. K. Papadopoulou, O. Alexatou, et al., "Childhood Mediterranean Diet Adherence Is Associated With Lower Prevalence of Childhood Obesity, Specific Sociodemographic, and Lifestyle Factors: A Cross-Sectional Study in Pre-School Children," *Epidemiologia* 5, no. 1 (2023): 11–28.

23. P. Farajian, G. Risvas, K. Karasouli, et al., "Very High Childhood Obesity Prevalence and Low Adherence Rates to the Mediterranean Diet in Greek Children: The GRECO Study," *Atherosclerosis* 217, no. 2 (2011): 525–530.

24. D. Novak, L. Štefan, R. Prosoli, et al., "Mediterranean Diet and Its Correlates Among Adolescents in Non-Mediterranean European Countries: A Population-Based Study," *Nutrients* 9, no. 2 (2017): 177.

25. A. Mistretta, S. Marventano, M. Antoci, et al., "Mediterranean Diet Adherence and Body Composition Among Southern Italian Adolescents," *Obesity Research & Clinical Practice* 11, no. 2 (2017): 215–226.

26. A. Mazaraki, C. Tsioufis, K. Dimitriadis, et al., "Adherence to the Mediterranean Diet and Albuminuria Levels in Greek Adolescents: Data From the Leontio Lyceum ALbuminuria (3L Study)," *European Journal of Clinical Nutrition* 65, no. 2 (2011): 219–225.

27. C. Lydakis, E. Stefanaki, S. Stefanaki, E. Thalassinos, M. Kavousanaki, and D. Lydaki, "Correlation of Blood Pressure, Obesity, and Adherence to the Mediterranean Diet With Indices of Arterial Stiffness in Children," *European Journal of Pediatrics* 171, no. 9 (2012): 1373–1382.

28. N. Voltas, V. Arija, E. Aparicio, and J. Canals, "Longitudinal Study of Psychopathological, Anthropometric and Sociodemographic Factors Related to the Level of Mediterranean Diet Adherence in a Community Sample of Spanish Adolescents," *Public Health Nutrition* 19, no. 10 (2016): 1812–1822.

29. C. Lazarou, D. B. Panagiotakos, and A.-L. Matalas, "Physical Activity Mediates the Protective Effect of the Mediterranean Diet on Children's Obesity Status: The CYKIDS Study," *Nutrition* 26, no. 1 (2010): 61–67.

30. R. I. Kosti, A. Kanellopoulou, E. Fragkedaki, et al., "The Influence of Adherence to the Mediterranean Diet Among Children and Their Parents in Relation to Childhood Overweight/Obesity: A Cross-Sectional Study in Greece," *Childhood Obesity* 16, no. 8 (2020): 571–578.

31. M. D. Kontogianni, N. Vidra, A. E. Farmaki, et al., "Adherence Rates to the Mediterranean Diet Are Low in a Representative Sample of Greek Children and Adolescents," *Journal of Nutrition* 138, no. 10 (2008): 1951–1956.

32. C. N. Katsagoni, G. Psarra, M. Georgoulis, et al., "High and Moderate Adherence to Mediterranean Lifestyle Is Inversely Associated With Overweight, General and Abdominal Obesity in Children and Adolescents: The MediLIFE-Index," *Nutrition Research* 73 (2020): 38–47.

33. A. Kanellopoulou, S. P. Giannakopoulou, V. Notara, et al., "The Association Between Adherence to the Mediterranean Diet and Childhood Obesity; the Role of Family Structure: Results From an Epidemiological Study in 1728 Greek Students," *Nutrition and Health* 27, no. 1 (2021): 39–47.

34. C. Jacovides, A. Pritsa, M. Chrysafi, et al., "Childhood Mediterranean Diet Compliance Is Associated With Lower Incidence of Childhood Obesity, Specific Sociodemographic, and Lifestyle Factors: A Cross-Sectional Study in Children Aged 6–9 Years," *Pediatric Reports* 16, no. 4 (2024): 1207–1222.

35. H. Bakırhan, V. Özkaya, and M. Pehlivan, "Mediterranean Diet Is Associated With Better Gastrointestinal Health and Quality of Life, and Less Nutrient Deficiency in Children/Adolescents With Disabilities," *Frontiers in Public Health* 11 (2023): 1243513.

36. E. S. George, S. Gavrili, C. Itsiopoulos, Y. Manios, and G. Moschonis, "Poor Adherence to the Mediterranean Diet Is Associated With Increased Likelihood of Metabolic Syndrome Components in Children: The Healthy Growth Study," *Public Health Nutrition* 24, no. 10 (2021): 2823–2833.

37. D. V. Diamantis, K. Katsas, D. Kalogiannis, M. Kouvari, and A. Linos, "Health-Related Quality of Life in Childhood and Adolescence: The Interrelation With Level of Adherence to Mediterranean Diet and Dietary Trajectories: Highlights From the DIATROFI Program (2021–2022)," *Nutrients* 15, no. 8 (2023): 1829.

38. C. Della Corte, A. Mosca, A. Vania, A. Alterio, S. Iasevoli, and V. Nobili, "Good Adherence to the Mediterranean Diet Reduces the Risk for NASH and Diabetes in Pediatric Patients With Obesity: The Results of an Italian Study," *Nutrition* 39 (2017): 8–14.

39. F. Archero, R. Ricotti, A. Solito, et al., "Adherence to the Mediterranean Diet Among School Children and Adolescents Living in Northern Italy and Unhealthy Food Behaviors Associated to Overweight," *Nutrients* 10, no. 9 (2018): 1322.

40. G. Antonogeorgos, D. B. Panagiotakos, D. Grigoropoulou, et al., "The Mediating Effect of Parents' Educational Status on the Association Between Adherence to the Mediterranean Diet and Childhood Obesity: The PANACEA Study," *International Journal of Public Health* 58, no. 3 (2013): 401–408.

41. T. J. Cole, M. C. Bellizzi, K. M. Flegal, and W. H. Dietz, "Establishing a Standard Definition for Child Overweight and Obesity Worldwide: International Survey," *BMJ* 320, no. 7244 (2000): 1240–1243.

42. H. Salman, T. Gursoy Koca, S. Dereci, and M. Akcam, "Comparison of Body Composition and Body Mass Index in the Determination of Obesity in Schoolchildren," *Turkish Archives of Pediatrics* 57, no. 5 (2022): 506–510.

43. S. A. Cunningham, M. R. Kramer, and K. V. Narayan, "Incidence of Childhood Obesity in the United States," *New England Journal of Medicine* 370, no. 5 (2014): 403–411.

44. World Health Organization. *WHO European Regional Obesity Report 2022* (WHO Regional Office for Europe, 2022).

45. R. A. Mahumud, B. W. Sahle, E. Owusu-Addo, W. Chen, R. L. Morton, and A. M. N. Renzaho, "Association of Dietary Intake, Physical Activity, and Sedentary Behaviours With Overweight and Obesity Among 282,213 Adolescents in 89 Low and Middle Income to High-Income Countries," *International Journal of Obesity* 45, no. 11 (2021): 2404–2418.

46. H. Jebeile, A. S. Kelly, G. O'Malley, and L. A. Baur, "Obesity in Children and Adolescents: Epidemiology, Causes, Assessment, and Management," *Lancet Diabetes & Endocrinology* 10, no. 5 (2022): 351–365.

47. Organization, W.H, *Sustainable Healthy Diets: Guiding Principles* (Food & Agriculture Org, 2019).

48. M. Guasch-Ferré and W. C. Willett, "The Mediterranean Diet and Health: A Comprehensive Overview," *Journal of Internal Medicine* 290, no. 3 (2021): 549–566.

49. M. del Mar Bibiloni, A. Pons, and J. A. Tur, "Compliance With the Mediterranean Diet Quality Index (KIDMED) Among Balearic Islands' Adolescents and Its Association With Socioeconomic, Anthropometric

and Lifestyle Factors," *Annals of Nutrition and Metabolism* 68, no. 1 (2016): 42–50.

50. N. Sanlier, H. G. Ulusoy, S. Kocabaş, B. Çelik, P. Göbel, and S. Yilmaz, "Mediterranean Diet Adherence Among Preschoolers and Its Association With Parents' Beliefs, Attitudes, and Practices," *Ecology of Food and Nutrition* 60, no. 2 (2021): 225–243.

51. X. Ramos Salas, M. Buoncristiano, J. Williams, et al., "Parental Perceptions of Children's Weight Status in 22 Countries: The WHO European Childhood Obesity Surveillance Initiative: COSI 2015/2017," *Obesity Facts* 14, no. 6 (2021): 658–674.

52. H. D. McCarthy and M. Ashwell, "A Study of Central Fatness Using Waist-To-Height Ratios in UK Children and Adolescents Over Two Decades Supports the Simple Message–'Keep Your Waist Circumference to Less Than Half Your Height'," *International Journal of Obesity* 30, no. 6 (2006): 988–992.

53. H. Schröder, M. A. Mendez, L. Ribas-Barba, M. I. Covas, and L. Serra-Majem, "Mediterranean Diet and Waist Circumference in a Representative National Sample of Young Spaniards," *International Journal of Pediatric Obesity* 5, no. 6 (2010): 516–519.

54. F. Bacopoulou, G. Landis, A. Rentoumis, A. Tsitsika, and V. Efthymiou, "Mediterranean Diet Decreases Adolescent Waist Circumference," *European Journal of Clinical Investigation* 47, no. 6 (2017): 447–455.

55. X. Zheng, H. Wang, and H. Wu, "Association Between Diet Quality Scores and Risk of Overweight and Obesity in Children and Adolescents," *BMC Pediatrics* 23, no. 1 (2023): 169.

56. P. Daly, T. Pace, J. Berg, U. Menon, and L. A. Szalacha, "A Mindful Eating Intervention: A Theory-Guided Randomized Anti-Obesity Feasibility Study With Adolescent Latino Females," *Complementary Therapies in Medicine* 28 (2016): 22–28.

57. M. Dinu, G. Pagliai, D. Angelino, et al., "Effects of Popular Diets on Anthropometric and Cardiometabolic Parameters: An Umbrella Review of Meta-Analyses of Randomized Controlled Trials," *Advances in Nutrition* 11, no. 4 (2020): 815–833.

58. M. Dinu, G. Pagliai, S. Lotti, I. Giangrandi, B. Colombini, and F. Sofi, "Adherence to Mediterranean Diet Measured Through Medi-Lite Score and Obesity: A Retrospective Study," *Nutrients* 13, no. 6 (2021): 2007.

59. B. J. Ganjeh, A. Mirrafiei, A. Jayedi, et al., "The Relationship Between Adherence to the Mediterranean Dietary Pattern During Early Pregnancy and Behavioral, Mood and Cognitive Development in Children Under 1 Year of Age: A Prospective Cohort Study," *Nutritional Neuroscience* 27, no. 7 (2024): 726–733.

60. H. Peña-Jorquera, R. Martínez-Flores, J. P. Espinoza-Puelles, et al., "Adolescents With a Favorable Mediterranean-Style-Based Pattern Show Higher Cognitive and Academic Achievement: A Cluster Analysis—The Cogni-Action Project," *Nutrients* 16, no. 5 (2024): 608.

61. J. Kharazmi-Khorassani, R. Ghafarian Zirak, H. Ghazizadeh, et al., "The Role of Serum Monounsaturated Fatty Acids (MUFAs) and Polyunsaturated Fatty Acids (PUFAs) in Cardiovascular Disease Risk," *Acta Bio Medica: Atenei Parmensis* 92, no. 2 (2021): e2021049.

62. J. Pedersen, B. Hedegaard, E. Schmidt, et al., "Monounsaturated Fatty Acids in Cardiovascular Disease: Intake, Individual Types, and Content in Adipose Tissue as a Biomarker of Endogenous Exposure," *Nutrients* 17, no. 15 (2025): 2509.

63. C. Itsiopoulos, H. L. Mayr, and C. J. Thomas, "The Anti-Inflammatory Effects of a Mediterranean Diet: A Review," *Current Opinion in Clinical Nutrition & Metabolic Care* 25, no. 6 (2022): 415–422.

64. C. Brantley, L. L. Knol, and J. W. Douglas, "Parental Mindful Eating Practices and Mindful Eating Interventions Are Associated With Child Emotional Eating," *Nutrition Research* 111 (2023): 34–43.

65. P. Y. Hong, M. D. Hanson, D. A. Lishner, S. L. Kelso, and S. W. Steinert, "A Field Experiment Examining Mindfulness on Eating Enjoyment and Behavior in Children," *Mindfulness* 9, no. 6 (2018): 1748–1756.

66. J. B. Nelson, "Mindful Eating: The Art of Presence While You Eat," *Diabetes Spectrum: A Publication of the American Diabetes Association* 30, no. 3 (2017): 171–174.

Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Table S1:** Search strategy for PubMed database. **Table S2:** Newcastle-Ottawa quality assessment scale for cross-sectional study. **Figure S1: A-B** Sensitivity findings for BMI levels and adherence scores. **Figure S1: A** BMI levels. **Figure S1: B** Adherence scores. **Figure S2: A-B** Sensitivity findings for crude OR and adjusted OR. **Figure S1: A** Crude OR. **Figure S1: B** Adjusted OR. **Figure S3: A–D** Funnel plots for (A) BMI levels, (B) adherence scores, (C) crude OR and (D) adjusted OR.