Narrative Review

Determinants of Adherence to the Mediterranean Diet and Weight in Italian Adolescents: A Comprehensive Analysis

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Adolescence, particularly early adolescence (10–14 years), is a crucial period for nutrition due to rapid growth, hormonal changes, and evolving independence in food choices influenced by peers, body image, and family. With regard to Italy, no synthesis of current evidence is available on adherence to a Mediterranean diet (MD) and determinants in this population. This narrative review aims to provide an overview of studies evaluating MD adherence among early adolescents in Italy. We identified 15 studies: 1 at the national level, 3 from northern Italy, 1 from central Italy, and 10 from southern regions. Regional differences emerged: in northern Italy, high adherence ranges from 15.8% to 28.0% and low adherence from 12.0% to 37.3%; in central Italy, 27.7% show low adherence, 47.8% moderate adherence, and 24.5% high adherence; while in southern Italy, low adherence spans from 18.4% to as high as 71.2%, particularly in Apulia. Weight status was the most frequently studied correlation of adherence, with higher adherence among normal-weight individuals. Positive associations were also seen with physical activity, socioeconomic status, parental educational level and occupation, and rural residence. Less consistently studied factors included gender, sleep, academic performance, screen time, smoking, and psychosocial health. This review highlights the lack of nationally representative data on MD adherence in Italian adolescents aged 10–14 years, with most studies conducted in southern Italy. Regional disparities were evident, suggesting that dietary habits are shaped by a combination of individual, familial, and environmental factors. Targeted, age-specific public health strategies to improve MD adherence among Italian early adolescents are required, particularly to increase physical activity and education on nutrition for both children and parents. Additional research, especially in northern and central Italy, is essential to guide effective interventions in this vulnerable population.

Key words: Mediterranean diet, adolescents, public health nutrition, weight status.

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INTRODUCTION

Adolescence: Key Health and Behavioral Issues

Adolescence marks the critical transition from childhood to adulthood. The World Health Organization (WHO) defines adolescence as the period between 10 and 19 years of age.[1] From a developmental perspective, it can be further divided into early adolescence (~10–14 years) and late adolescence (~15–19 years).[2] It is a phase of rapid physical modifications: the body undergoes accelerated growth in height and weight, driven by hormonal changes that lead to body variations. In girls, the appearance of pubic and underarm hair, breast development, and the onset of menstruation are manifested, together with an increase in body fat. Boys undergo a later pubertal growth spurt, usually occurring between the ages of 12 and 17, with manifestations as testicular growth and voice deepening,[3] and a more pronounced and prolonged gain in lean body mass.[5] These sex-specific patterns carry important implications for nutritional requirements, body image, and overall health trajectories throughout adolescence. At the same time, adolescence is marked by substantial cognitive, emotional, and social evolution, occurring alongside crucial brain development.[6] These changes support the formation of personal identity, the development of new and complex relationships, and growing autonomy in decision-making. Peer groups, social media, and marketing strategies increasingly influence, both in a negative or positive way, adolescents' health behaviors and beliefs, overcoming the previously central role of parents and family.[2] Risk factors, such as tobacco and alcohol use, physical inactivity, and unhealthy dietary patterns, often emerge during this time.[2] These behaviors increase the likelihood of developing overweight or obesity and subsequently raise the risk of noncommunicable diseases later in life. Additionally, eating disorders (EDs), including anorexia, bulimia, and binge eating, are increasingly prevalent in this age group, largely driven by body image dissatisfaction influenced by cultural and media ideals, which can result in an unhealthy and unbalanced diet.[4] The lifestyle habits and values adopted during this period often persist as individuals transition into adulthood. **Figure 1** provides a summary of these interconnected factors.

Adolescence and Nutrition

From a nutritional point of view, adolescence is a highly vulnerable phase, making this population particularly susceptible to various forms of malnutrition. An inadequate diet can occur in many ways.[7] Deficiencies in energy, protein, or micronutrients that do not meet the increased requirements for proper growth and development can lead to stunting, delayed puberty, but also to long-term health impacts such as reduced cognitive capacity. Conversely, poor dietary habits typical of this age (eg, high intakes of processed, sugary, and calorie-dense foods), combined with sedentary lifestyles, make overweight and obesity a growing concern among adolescents.

According to the WHO, adolescent obesity has quadrupled since 1990. By 2022, over 390 million children and adolescents aged 5–19 years were classified as overweight, with the prevalence of excess malnutrition increasing from 8% in 1990 to 20% in 2022.[8]

Data from the 2022 Italian Health Behaviour in School-aged Children (HBSC) survey, involving 89 321 adolescents, highlights concerning trends. Among 11-year-olds, 61.6% reported eating breakfast at least 5 days a week, but this percentage dropped to 53.4% by age 13. Similarly, vegetable consumption was low, with only 19.1% of 11-year-olds consuming more than 1 portion of fruit daily and 12.6% consuming more than 1 portion of vegetables. By age 13, these percentages declined further to 15.3% for fruit and 12.1% for vegetables.[9] In this specific age group (11–13 years), the prevalence of overweight is close to 20%, while obesity affects 4% to 5% of adolescents. In general, unhealthy dietary habits and worsened weight status are more common among adolescents from lower socioeconomic backgrounds and residents in southern Italy. The Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study assesses the behaviors of adolescents aged 12.5 to 17.5 years living in 10 European cities including Rome, Italy. The consumption of processed foods and sugary beverages and breakfast skipping were observed, although it is not possible to stratify data by country.[10,11]

Both conditions of improper dietary quality (deficiency and excess) reflect the "double burden of malnutrition."[12] This means that a lack of essential nutrients or energy, along with a surplus of calories, can coexist simultaneously, leading to both chronic and acute malnutrition.

Another important nutritional concern is the rising prevalence of EDs. Recent data indicate that more than 1 in 5 children and adolescents are affected by this issue. Specifically, the prevalence of EDs among individuals aged 11 to 19 years ranges from 1.2% in boys to 5.7% in girls, with incidence rates steadily increasing over recent decades.[13]

The Mediterranean Diet

The term "Mediterranean diet" (MD) encompasses not only a specific dietary pattern but also a broader concept

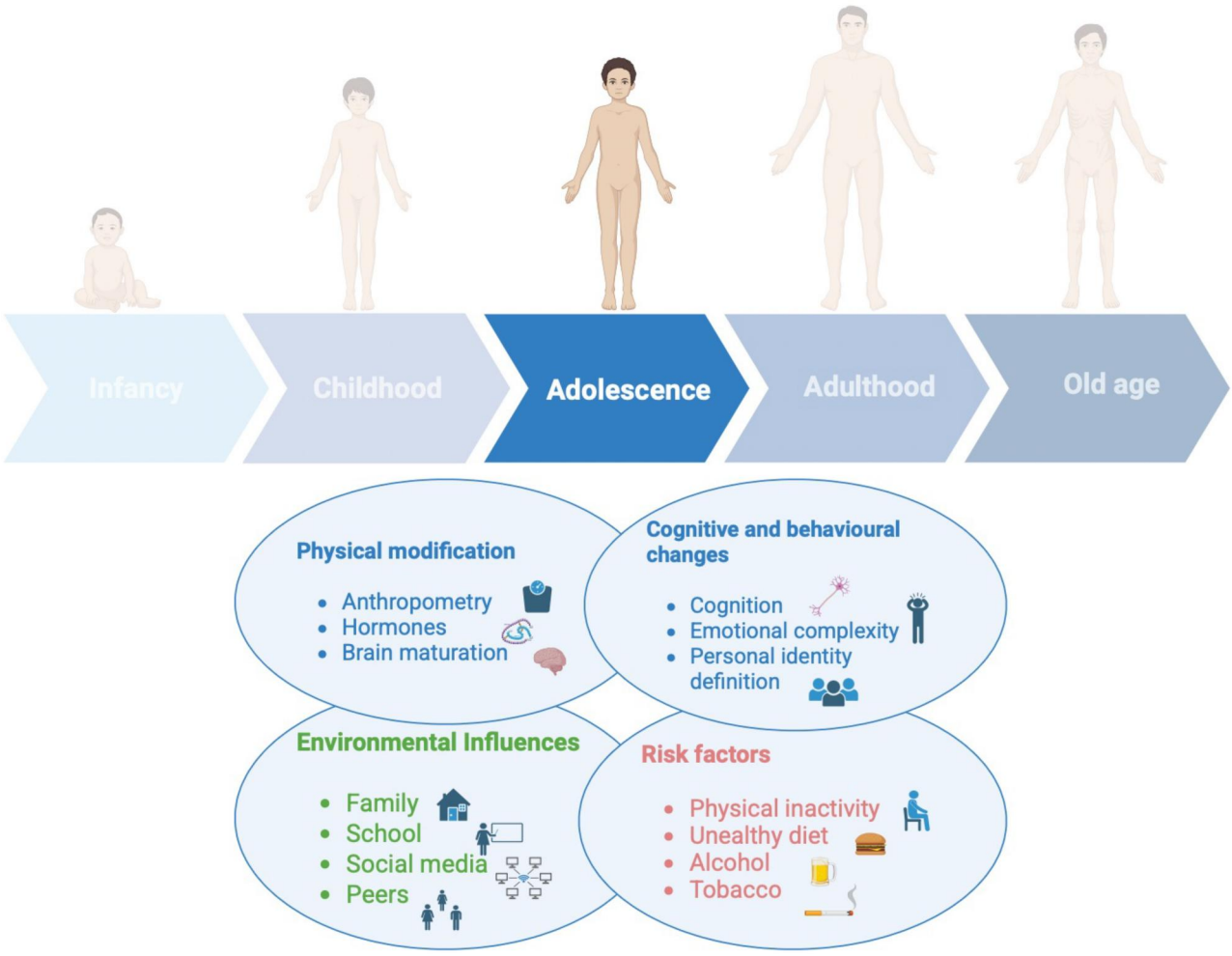

Figure 1. Overview of the Complex Interplay Between Physical, Cognitive, and Social Changes, Along With Emerging Risk Factors During Adolescence, and Their Impact on Health Behaviors and Nutritional Needs

reflecting an entire lifestyle. From a nutritional perspective, the MD offers clear recommendations regarding frequency and portion sizes of different food groups to support and maintain overall health. These guidelines are effectively illustrated through the iconic structure of the Mediterranean Pyramid, whose most recent representation was published by the Italian Society of Human Nutrition (SINU).[14] This updated version was developed based on 2 key references for the Italian population: the Dietary Guidelines for Healthy Eating issued by CREA (Council for Agricultural Research and Economics) and the Reference Intake Levels of Nutrients for the Italian Population[15] (SINU, LARN—5th revision). Additionally, international documents such as the FAO–WHO guidelines on healthy and sustainable diets and the EAT–Lancet Commission report on sustainable food systems were also considered.

The revised model promotes a dietary pattern that is both health-promoting and environmentally sustainable. It places strong emphasis on the consumption of plant-based foods, particularly fruits, vegetables, extra-virgin olive oil, whole grains, legumes, and nuts, as the foundation of nutrition. In contrast, animal-derived foods are to be consumed in moderation, with specific limitations on hard and aged cheeses, large predatory fish, and occasional consumption of red and processed meats.

Furthermore, the pyramid advocates an active lifestyle and encourages values such as conviviality and the mindful selection of foods that respect biodiversity and sustainability. At the same time, it discourages behaviors characterized by excessive intake of alcohol, salt, and added sugars.[14]

A vast body of literature highlights the numerous benefits of the MD, examining the role of individual nutrients, specific foods, and their synergistic combinations in promoting both physical and mental health. In particular, the MD has been associated with protective effects against cardiovascular, metabolic, and neurodegenerative diseases, as well as a significant reduction in

overall mortality.[16–22] Moreover, when adopted from early childhood, MD contributes to better physical, biological, and cognitive development, and promotes an overall higher quality of life. Despite this, the majority of the population, including adolescents, do not consistently follow the principles of the MD in their daily lives.[23]

The main causes contributing to the gradual abandonment of traditional foods are the so-called processes of modernization, westernization, and globalization, which particularly affect younger population groups. These dynamics lead to easier access, both in terms of availability and affordability, to unhealthy foods, and to the adoption of habits that diverge significantly from the principles of the MD, such as frequent fast-food consumption and eating out.[24] Adolescents, in particular, tend to spend more time, including mealtimes, with peers, and frequently lack the financial resources, time, and nutritional knowledge needed to make informed and health-promoting dietary choices. The persistence of this dietary transition across generations may ultimately result in the progressive loss of adherence to MD, an important cultural and health-related heritage.[24]

Aim of the Work

This article provides a comprehensive analysis of studies conducted across various regions of Italy, one of the native areas of the MD due to its unique geographical and cultural context, focusing on the level of adherence to this dietary pattern among adolescents. Particular attention is given to individuals in early adolescence, a critical and vulnerable developmental stage widely recognized as a strategic window for health promotion and nutritional education. A recent cross-sectional analysis conducted within the European Union–funded DELICIOUS project by Rosi et al[25] reported a significant negative association between high MD adherence and specific factors, especially among individuals aged 12 to 14 years with obesity and with older parents. Conversely, positive determinants of greater adherence included healthy eating habits (eg, regular breakfast consumption and eating with family), higher levels of physical activity, adequate sleep duration, and having younger, more educated parents.

Building on these findings, the article reviews the literature on studies conducted in Italy, focusing on the key factors investigated, such as nutritional status, socioeconomic and cultural background, and lifestyle behaviors, that influence adherence to the MD, either positively or negatively. The overarching goal is to address future research aimed at identifying actionable targets for strategies to improve the appeal, accessibility, and adoption of the MD among younger populations.

METHODS

Search Strategy

The search strategy was conducted using the PubMed, Scopus, and Embase databases on September 19, 2025, and included the following key words: "Mediterranean diet", "MD", "Mediterranean pattern", combined with "adolescent", "young", "teen", and "student". The search was limited to articles published in English between 2010 and 2025. Studies were eligible for inclusion if they had an observational study design, were conducted in Italy, or involved Italian populations, focused on individuals in early adolescence (10–14 years) or provided stratified data for this age group, and assessed adherence to the MD using a quantitative index. Articles were further required to investigate potential determinants of MD adherence, such as nutritional status, socioeconomic and family background, or lifestyle behaviors, and to provide sufficient methodological detail and statistical analysis. Studies were excluded if they focused exclusively on younger children or older adolescents without specific data for the 10–14-year age range, were not conducted in the Italian context, lacked a measure of MD adherence, or were limited to case reports, editorials, narrative reviews, conference abstracts, or studies with incomplete outcome reporting.

RESULTS

Overview of the Available Studies

Fifteen studies met the inclusion criteria, focusing on or including, adolescents in our age range of interest attending schools in different regions of Italy.[26–40] Studies were mostly conducted in the southern region of Italy,[28,30,36,38] and in Sicily in particular,[26,29,31,33–35] compared with north[27,32,37] and central[39] Italy (**Table 1**). One study was conducted using a web-based platform, with no indication of the regions of interest.[40]

MD Adherence Score

Adherence to a dietary pattern is usually assessed using simple and rapid metrics derived from individually administered multiple-choice questionnaires, which are then quantified into a final score. Although these tools were originally developed and validated for the adult population, today multiple scores are available for the pediatric population.[23] **Table 2** provides an overview of the food groups and diet-related items included in each index used in the reviewed studies.

In surveys involving middle school students, the KIDMED (Mediterranean Diet Quality Index for

Table 1. Overview of Studies

Study, year	Region	No. of participants	Age	Grade level
Northern Italy				
Noale et al, 2014[27]	Veneto	209	11-13	Middle school
Archero et al, 2018[32]	Piedmont	379	11-16	Primary and middle school
Rosi et al, 2020[37]	Emilia-Romagna	409	11-14	Middle school
Central Italy				
Intorre et al, 2025[39]	Lazio	159	11-14	Middle school
Southern Italy				
Grosso et al, 2013[26]	Sicily	1135	13-16	Middle and high school
Saulle et al, 2016[28]	Campania	1117	11-19	Middle and high school
Ferranti et al, 2016[29]	Sicily	1586	11-14	Middle school
Martino et al, 2016[30]	Calabria	1657	6-14	Primary and middle school
Mistretta et al, 2017[31]	Sicily	1643	11-16	Middle and high school
Metro et al, 2018[33]	Sicily	241	11-13	Middle school
Buscemi et al, 2018[34]	Sicily	1643	11-16	Middle and high school
De Santi et al, 2020[35]	Sicily	239	11-13	Middle school
Bonaccorsi et al, 2020[36]	Apulia	314	6-14	Primary and middle school
Rutigliano et al, 2024[38]	Apulia	132	2-18	Primary, middle, and high school
Nationwide				
Mastorci et al, 2020[40]	—	1707	10-14	Middle school

Table 2. Food Groups and Food-Related Items in Each Mediterranean Diet Adherence Index

	KIDMED[26,29–32,34–40]	Mediterranean Diet Score[27,28]	MAI[33]
Bread and cereals	X	X	X
Potatoes			X
Milk and dairy products	X	X	X
Meat and equivalents	X	X	X
Fish	X	X	X
Eggs			X
Legumes	X	X	X
Monosaturated and polyunsaturated/saturated fat ratio		X (only for reference 28)	
Animal fat and margarine			X
Olive oil	X		X
Nuts	X	X	X
Fruit	X	X	X
Vegetables	X	X	X
Fast food and snacks	X		
Sweets/desserts	X		X
Sweetened beverages			X
Alcohol		X	X
Breakfast consumption	X		

Abbreviations: KIDMED, Mediterranean Diet Quality Index for children and adolescents; MAI, Mediterranean Adequacy Index. "X" indicates that the food item or food category is included in the corresponding dietary index.

children and adolescents) score was most commonly adopted.[26,29–32,34–40] The KIDMED test is a widely used tool developed by Serra-Majem et al in 2004,[41] that quantifies adherence to MD of children through a scale derived from scores on answers to 16 questions regarding the frequency of consumption of various food groups and dietary habits. For each answer, a −1 score is assigned if the habit conflicts with the adherence to MD, and a +1 score is assigned for answers that reflect a high adherence to MD. A total grade of 0–3 mirrors an overall poor adherence to MD, a 4–7 grade average adherence, and a grade of 8–12 reflects good adherence.

Another widely used method is the Mediterranean Diet Score (MDS) first created by Trichopoulou et al[42] in 1995 considering the mean intake of 8 food groups, and then modified to include fish consumption, resulting in a 9-point scale (low adherence is considered to reflect a 0–3 grade on the test, medium adherence is represented by a 4–5 score, and high adherence is defined by a 6–9 score).[43] This version was adopted in 1 study,[27] whereas Saulle et al[28] used the 10-point MDS score including monosaturated and polyunsaturated/saturated fat ratio.[44]

Last, 1 other study[33] assessed the adherence using the Mediterranean Adequacy Index (MAI) elaborated by Alberti-Fidanza et al[45] in 2004, consisting of dividing the sum of the percentage of total energy intake from typical MD food (bread, cereals, legumes, potatoes,

vegetables, fresh fruits, nuts, fish, wine, and vegetable oils) from the sum of the total energy percentages of groups of less-typical elements of the Mediterranean diet (milk, dairy products, meat, eggs, animal fat and margarine, sweet drinks, desserts, and sugar); the higher the MAI score (when >1), the higher the adherence.

Adherence to the MD

The level of adherence to the MD among Italian adolescents appears to be heterogeneous across different regions (**Table 3**). Considering studies that classify MD adherence as low, medium, and high (2 studies are excluded[30,33]), the average adherence to MD expressed as a mean percentage is 30.8% for low, 53.1% for medium, and 16.1% for high adherence. When considering each index, the mean percentage is 30.6% for low, 51.5% for medium and 16.7% for high adherence to MD for the KIDMED index[26,29–32,34–40] compared with 25.9%, 61%, and 13.1%, respectively, for the MDS.[27,28]

In northern Italy, high adherence scores range from 15.8% to 28.0%, while low adherence scores range from 12.0% to 37.3%.[27,32,37] In central Italy, Intorre et al[39] worked with a cohort of 682 students aged 10 to 24 years from Rome stratifying results by age groups, with 159 middle-school kids aged 10–14 years old. In southern Italy, low adherence rates vary widely, from 18.4%[30] to alarmingly high levels of 71.2% observed in the

Table 3. Percentages of Adherence for Each Cohort of the Included Studies

Study, year	Region	No. of subjects	Index	Adherence, %
Northern Italy				
Noale et al, 2014[27]	Veneto	209	Revised MDS	Low: 37.3% Medium: 46.9% High: 15.8%
Archero et al, 2018[32]	Piedmont	379	KIDMED	Low: 13.7% Medium: 66.2% High: 20.1%
Rosi et al, 2020[37]	Emilia-Romagna	409	KIDMED	Low: 12.0% Medium: 60.0% High: 28.0%
Central Italy				
Intorre et al,[39] 2025	Lazio	159	KIDMED	Low: 27.7% Medium: 47.8% High: 24.5%
Southern Italy				
Grosso et al, 2013[26]	Sicily	1135	KIDMED	Low: 25.6% Medium: 65.1% High: 9.3%
Saulle et al, 2017[28]	Campania	1025	MDS-2 (low: 1-6; high: 7-10)	Low: 63.8% High: 36.2%
Ferranti et al, 2016[29]	Sicily	1586	KIDMED	Low: 44.8% Medium: 47.0% High: 8.2%
Martino et al, 2016[30]	Calabria	1657	KIDMED	Low: 18.4% Medium + high: 81.6%
Mistretta et al, 2017[31]; Buscemi et al, 2018[34],a	Sicily	1643	KIDMED	Low: 29.9% Medium: 61.0% High: 9.1%
Metro et al, 2018[33]	Sicily	241	MAI score	Not available
De Santi et al, 2020[35]	Sicily	239	KIDMED	Low: 59.6% Medium: 27.1% High: 13.3%
Bonaccorsi et al, 2020[36]	Apulia	314	KIDMED	Low: 18.8% Medium: 56.4% High: 24.8%
Rutigliano et al, 2024[38]	Apulia	132	KIDMED	Low: 71.2% Medium: 26.5% High: 2.3%
Whole nation				
Mastorci et al, 2020[40]	—	1707	KIDMED	Low: 15% Medium: 58% High: 27%

[a]Both studies are part of a cross-sectional investigation with the same cohort. Only data on adolescents and Mediterranean diet adherence are reported.

Abbreviations: KIDMED, Mediterranean Diet Quality Index for children and adolescents; MAI, Mediterranean Adequacy Index; MDS-2, Mediterranean Diet Score 2.

Apulia region.[38] In the study conducted by Mastorci et al[40] on 1707 Italian adolescents aged 10–14 years old, without further specification of the region of residence, low, medium, and high adherence was recorded in 15%, 58%, and 27% of individuals, respectively.

Factors Associated With the MD

Table 4 reports multiple factors associated with adherence to the MD that were investigated in the included studies, such as weight status,[26,27,29–38,40] gender,[26,27,30–32,34–40] physical activity level,[26,27,34,35,37,40] family structure and parental socioeconomic and cultural background,[26,34,36,39] urbanization level of residence area,[26] and other factors.[27–29,34,37]

Weight Status

In the context of evolving food systems, lifestyles, and social influences, assessing weight status in adolescence is not merely a matter of tracking BMI, but rather of interpreting a dynamic indicator of health risk, future disease burden, and potential strategies to address it. All the included studies (except for 1 study[28]) evaluated anthropometric measures in relation to diet.

To classify weight status, different reference standards were adopted across studies: the International Obesity Task Force (IOTF) cutoffs,[46] which provide international age- and sex-specific thresholds corresponding to adult BMI categories[26,28–34,36,37]; the WHO growth reference,[47] which defines overweight and obesity according to BMI-for-age z-scores ($> +1$ SD and $> +2$ SDs, respectively)[38–40]; and the Italian growth charts developed by Cacciari et al,[48] which establish national age- and sex-specific percentiles.[27,35] Table 5 summarizes methodological details on the anthropometric measurements of the included articles. Most of the data were collected for the southern Italian regions.

In 2013, Grosso et al[26] enrolled 1135 adolescents aged 13–16 years from 13 secondary schools in Sicily; 36.1% were overweight and 9.8% were obese. Obese and overweight individuals were more likely to have a medium KIDMED score (60.6% of the overweight group and 64.3% of the obese group), However, the score was generally lower in overweight and obese individuals (32.8% and 31.1%, respectively) than in those who were underweight or normal-weight (19.6%). Higher MD adherence was found to be protective against overweight (odds ratio [OR], 0.52; 95% CI, 0.39–0.70) and obesity (OR, 0.59; 95% CI, 0.37–0.94) ($P < .001$).

In 2016, Ferranti et al[29] investigated the weight status of 1586 adolescents aged 11 to 14 years; 27% were overweight and 14.5% were obese. Adherence to the MD was statistically significant among all the BMI groups ($P = .003$), showing that most of the overweight and obese groups reported a low score of adherence (48% of the overweight group and 51.4% of the obese group) compared with normal-weight or underweight participants.

In another study conducted in Sicily in 2017 by Mistretta et al,[31] adherence to MD was evaluated in 1643 adolescents aged 11 to 16 years, together with cardiometabolic parameters including BMI and body composition. On average, the KIDMED score was lower in obese and overweight students compared with normal-weight participants and a high score was found to be protective against obesity and overweight (OR, 0.7; 95% CI, 0.56–0.87; $P = .002$) By evaluating the parameters that best describe body composition, a linear regression analysis showed that a higher KIDMED score was inversely correlated with waist circumference (β = -0.012

Table 4. Participant Numbers of Each Investigated Group and Factors Associated With the Mediterranean Diet

Ref	Year	No. of participants	Weight status	Gender	Physical activity	Family and socioeconomic status	Urban setting	Others
27	2013	1135	X	X	X	X	X	
27	2014	565	X	X	X			X
28	2016	1117						X
30	2016	1586	X					X
30	2016	1657	X	X				
31	2017	1643	X	X				
32	2018	379	X	X				
33	2017	241	X					
34	2018	1643	X	X	X	X		X
35	2020	239	X	X	X			
36	2020	314	X	X		X		
37	2020	409	X	X	X			X
38	2024	132	X	X				
39	2025	159		X		X		
40	2020	1707	X	X	X			

Table 5. Measurements Evaluated Within Each Study, Including BMI Cutoff Values

Study, year	Measures	Derived measures	Measurement/reference of anthropometric measurements	BMI cutoff values
Grosso et al, 2013[26]	BW, HT	BMI	Self-reported	IOTF
Noale et al, 2014[27]	BW, HT	BMI	Self-reported	Cacciari et al.[48]
Ferranti et al, 2016[29]	BW, HT, WC, body impedance	BMI, FM%, FFM%	Measurement according to standard procedures	IOTF
Martino et al, 2016[30]	BW, HT, WC	BMI	Measurement according to standard procedures	IOTF
Mistretta et al, 2017[31]	BW, HT, body impedance	BMI, BF%, FM, FFM, TBW	Measurement according to standard procedures	IOTF
Archero et al, 2018[32]	BW, HT	BMI	Measurement according to standard procedures	IOTF
Metro et al, 2018[33]	BW, HT	BMI	Measurement according to standard procedures	IOTF
Buscemi et al, 2018[34]	BW, HT, body impedance	BMI, FM, FFM, TBW	Measurement according to standard procedures	IOTF
De Santi et al, 2020[35]	BW, HT	BMI	Measurement according to standard procedures	Cacciari et al[48]
Bonaccorsi et al, 2020[36]	BW, HT	BMI	Self-reported	IOTF
Rosi et al, 2020[37]	BW, HT	BMI	Self-reported	IOTF
Rutigliano et al, 2024[38]	BW, HT, WC	BMI, WHtR	Measurement according to standard procedures	WHO
Intorre et al, 2025[39]	BW, HT	BMI	Self-reported	WHO
Mastorci et al, 2020[40]	BW, HT	BMI	Measurement according to standard procedures	WHO

Abbreviations: BF%, body fat percentage; BMI, body mass index; BW, body weight; FFM%, fat-free mass percentage; FM%, fat mass percentage; HT, body height; IOTF, International Obesity Task Force; TBW, total body water; WC, waist circumference; WHO, World Health Organization; WHtR, waist-to-height ratio.

and β = -0.011 for boys and girls, respectively) and fat mass (β = -0.036 and β = -0.028 for boys and girls, respectively).[31]

The study conducted by Metro et al[33] in 2018 assessed the weight status of 241 children from different cities in Sicily attending middle school (11–13 years old). A total of 41.1% of the participants were found to be overweight and obese, with a mean MAI score higher in normal-weight participants (MAI = 2.67) compared with overweight participants (MAI = 1.25). However, the authors did not report data on statistical analysis that support the significance of the results.

De Santi et al[35] conducted a study in 2020 involving a group of 239 students from Sicily aged 11 to 13 years. Low MD adherence was recorded in 59.6% of the children, with a significant difference between obese and overweight individuals (85.7% and 62.5%, respectively) compared with those with normal weight (53.1%) ($P = .018$). Results were confirmed by assessing the KIDMED score and weight status using 1-way analysis of variance (ANOVA) ($P < .001$ by comparing normal-weight and obese individuals; $P < .05$ if girls and boys are evaluated separately). However, by considering the Spearman correlation coefficient, a negative trend was observed among KIDMED score and weight (r = -0.189; $P = .003$), BMI (r = -0.206; $P = .001$), and weight status (r = -0.207; $P = .001$), although this was not significant.

Considering other southern regions, Bonaccorsi et al[36] showed. in 2020. that among a cohort of 314 students from Taranto (6–14 years old), poor and medium adherence to the MD was statistically significant and associated with increased BMI, indicating an increased likelihood of being overweight or obese, respectively, compared with those with high adherence (medium adherence: OR, 2.314; $P = .047$; poor adherence: OR, 2.776; $P = .029$).[36]

More recently, Rutigliano et al[38] investigated 132 kids aged 2 to 18 years from Apulia. A total of 71.2% of the population exhibited poor adherence to MD, with a higher prevalence among obese children compared to those with normal weight (75% vs 57.1% in underweight and 72.5% in normal-weight children). The reported data referred to the whole cohort, including participants exceeding the age range considered. Notably, the KIDMED score has been divided into 4 quartiles of age, indicating an inverse correlation between MD adherence and age (2.4 ± 2.7 mean KIDMED score for 11.3- to 13.8-year-olds).[38]

Although the association between poor adherence to MD and increased weight is supported by multiple studies, the association is not statistically significant in studies conducted in the northern regions of Italy.[27,32,37] A non–statistically significant relation was also found in a nationwide study on 1707 adolescents.[40]

Gender

By examining Italian adolescents, the relation between the dietary pattern and gender was not statistically significant in most studies,[26,27,32,34,35,37,39,40] although in a few studies the adherence to MD tended to be higher in girls compared with boys[30,31,36] and weight status tended to be worse in males.[29,34,37]

Physical Activity

Physical activity is related to health. Adopting a physically active lifestyle may result in healthier and more nutritious choices concerning food behavior. Although several studies highlighted a positive association between physical activity and adherence to the MD in adolescents, results in the Italian territory remain heterogeneous. Higher adherence to MD was observed in physically active Italian adolescents compared with sedentary ones living in Sicily,[26,35] but no significant associations were found between adherence to the MD and physical activity in 2 studies focusing on northern regions.[27,37]

In the study conducted by Martino and colleagues,[30] lifestyle was assessed as a dichotomous variable (categorized as "best" or "worst") based on 2 components: adherence to the MD (measured with KIDMED and subsequently classified as low or high) and extracurricular physical activity (categorized as low or high). As expected, higher adherence to the MD was significantly associated with a better lifestyle (KIDMED score of 5.6 ± 1.3 for "best" lifestyle; KIDMED score of 2.6 ± 0.6 for "worst" lifestyle; $P = .001$).[30] Mastorci et al[40] also examined lifestyle as a combination of MD adherence and physical activity, showing a greater predisposition to obesity among males with low scores in either variable.

Family Structure and Parental Socioeconomic and Cultural Background

Social factors such as family structure and the educational level and occupation of parents are intertwined with the eating habits and behaviors of adolescents. It is globally recognized that negative influences in this regard could potentially result in unhealthy diets and insufficient nutrition at a young age. Considering the Italian setting, results are heterogeneous. Grosso et al[26] showed a positive correlation between a higher socioeconomic status and a high adherence to the MD (OR for low vs medium–high adherence, 1.53; 95% CI, 1.03–2.26). No significant correlation was found between MD adherence and parents' educational level in the study by Bonaccorsi et al.[36] In the study conducted by Intorre et al,[39] children with foreign parents showed an increased likelihood of having a higher adherence to MD (adjusted OR [aOR] of low adherence to MD, 0.58; 95% CI, 0.42–0.82; $P = .002$).

Urban Setting

Growing up in urban environments can help alleviate family poverty and provide better access to education and healthcare. However, an urban upbringing also increases the risks of mental health issues, substance use, obesity, and physical inactivity. With regard to Italy, access to green spaces and urbanization levels seem to be correlated with weight status among adolescents.[26] The findings highlighted the influence of geographical location on weight status and indicated potential environmental factors that contribute to the prevalence of obesity. Grosso et al[26] showed that living in an urban area was associated with a lower KIDMED score compared with a rural setting (OR, 0.65; 95% CI, 0.44–0.97). More specifically, individuals living in an urban area consumed lower intakes of fruit, sweets, and snacks but higher intakes of meat, cheese, fast food, and sugary drinks than those living in the rural areas.[26]

Other Factors

Several studies have explored a range of behavioral, psychological, and lifestyle factors potentially associated with adherence to MD among adolescents. These factors include sleep patterns, body image perception, academic performance, screen time, smoking, and overall physical and mental well-being.

In the study conducted by Ferranti et al,[29] no significant association was found between MD adherence and sleep timing behavior. Rosi et al[37] also investigated sleep duration during weekdays and weekends in association with adherence to MD, showing no significant relation. However, a significant positive association was found with sleep time adequacy defined by the National Sleep Foundation[49] ($P = .025$), sleep quality ($P = .010$), and daytime sleepiness ($P = .005$).[37]

Buscemi et al[34] investigated the role of self-perception and weight estimation among the Italian teenagers of the cohort described by Mistretta et al.[31] Adolescents with normal weight who overestimate their body weight show lower odds of high adherence to MD, both among males (OR, 0.80; 95% CI, 0.71–0.91) and females (OR, 0.76; 95% CI, 0.64–0.90). Among those who underestimate their body weight, a negative association between high adherence to MD and weight status (normal weight or overweight/obesity) was observed in both sexes. Specifically, in males, the odds of high vs low adherence were reduced in those with normal

weight (OR, 0.68; 95% CI, 0.47–0.98) and in those with overweight/obesity (OR, 0.84; 95% CI, 0.71–0.99). A similar pattern was found in females with normal weight (OR, 0.51; 95% CI, 0.36–0.71) and with overweight/obesity (OR, 0.81; 95% CI, 0.69–0.96). However, these associations were not significant when the odds of medium vs low adherence were considered across all groups.

In 1 study, school performance in terms of average school grade was found to be significantly associated with adherence to MD ($P = .018$ with 1-way ANOVA).[37] However, when the analysis was conducted considering school performance defined as excellent, good, or poor, the association was not significant ($P = .083$).

Noale et al[27] reported no significant correlation between screen time and adherence to MD. Saulle et al[28] identified smoking as a significant factor associated with poor adherence to MD (aOR of nonadherence to MD, 1.93; 95% CI, 1.44–2.57). In the same study, better physical and mental status measured with the Physical Component Summary 12 (PCS12) and Mental Component Summary 12 (MCS12) was associated with higher adherence to MD (aOR of nonadherence to MD, 0.98; 95% CI, 0.96–0.99).[28]

DISCUSSION

This literature review provides a comprehensive overview of adherence to the MD among Italian adolescents, mostly in early adolescence, and examines the key factors influencing their dietary habits. Considering the target age group of our research, the number of included studies is limited. In Italy, other surveys have been conducted on eating habits with a focus on the MD in childhood, but they have often involved school-aged children,[50] older adolescents,[51,52] or young adults.[53,54] For instance, the HELENA project aims to assess nutritional behaviors in a cohort of young adolescents.[10,11] Nevertheless, due to its broad and multicenter design, the Italian data cannot be considered independently. Furthermore, the sample representing Italy includes only participants from a single urban area (Rome), which limits the generalizability of the data to the national context. The data we collected from the included studies exhibit an average of 32.3% low adherence, 52.6% medium adherence, and 15.1% high adherence. When studies that consider only early adolescence are considered, low, medium, and high adherence are shown in 29.9%, 52.9%, and 17.2% of individuals, respectively.[25,27–29,32,35,39] A comparison between geographical areas shows a higher prevalence of low adherence in the south (41.7% low, 11.2% high) than in the north (21% low, 21.3% high). However, these findings should be interpreted with caution given the limited number of studies available for some regions, particularly in the north and central regions, and the heterogeneity in study designs and assessment tools. The overrepresentation of studies from southern Italy, especially Sicily being the region with the greatest number of included studies,[26,29,31,33–35] may have influenced the observed pattern, with reported low adherence reaching 40% compared with 32.3% for the entire country. While these data raise the possibility of regional differences in adherence, further research using standardized methodologies across all Italian regions would be helpful to design targeted interventions.

The assessment of MD adherence was mostly performed with the KIDMED index.[26,29–32,34–39] However, other indexes were also used, with minor differences among the items. The MAI,[33] for example, is the only index that evaluates the consumption of potatoes, which can often be wrongly classified as a vegetable side dish and are frequently eaten by adolescents alongside other carbohydrate-rich foods. The same can be said for fast food, whose consumption is only investigated in the KIDMED index. As a result, the average percentages of the levels of adherence may vary depending on which index is used: the studies in which the MDS is used show a mean low adherence of 25.9%,[27,28] lower than the 30.6% low adherence calculated on average within the KIDMED studies.[26,29,31,33–35] Furthermore, all of the indexes implemented to assess adherence were developed more than 20 years ago, suggesting that their assessment of the Mediterranean Diet may not be as applicable to current dietary practices as when they were originally developed. Recent shifts in how the MD is perceived and composed may alter the results of the scores in terms of which food is considered as typical, or not, of MD.

Intorre et al[39] found that individuals aged 11–14 years showed significantly higher adherence compared with older adolescents (15–19 years; $P = .001$). This suggests that middle-school–aged adolescents may be more receptive to structured eating habits, potentially due to greater parental control and school-based nutrition programs. This finding supports the importance of reinforcing MD-related health education in early adolescence, before the decline in adherence typically seen during later teenage years.

The most investigated factor related to adherence to MD was weight status. The average percentage of overweight or obese individuals was approximately 29.7% across all studies. Within this subgroup, poor adherence to MD was observed in an average of 39.4% of cases. Overall, an inverse relationship was found between BMI and MD adherence, particularly in the southern regions. This result was not confirmed in the

northern regions, possibly due to the fewer studies conducted or differences in sample characteristics or regional dietary patterns. Furthermore, the use of different methods of weight classification across an some studies limits the clustering of data. The IOTF cutoffs are based on adult data, resulting in a possible underestimation of overweight in younger ages. The WHO guidelines are standardized but often yield higher prevalence rates and may result in overestimation. The growth charts developed by Cacciari et al[39] were less frequently adopted and, although they provide national specificity, they lack international generalizability. This heterogeneity should be considered when interpreting prevalence estimates and associations with MD adherence. In the HBSC study conducted by Nardone and colleagues[55] on 15 035 Italian adolescents across the years 2002, 2006, 2010, and 2014, the prevalence of overweight and obesity remained stable at an average of 17%, with no significant changes across the sampling years. The discrepancy between these percentages and those reported in the reviewed studies may be attributed to differences in study design. The HBSC study follows a more standardized methodology, whereas the studies included in this analysis were conducted independently, varied in sample size, and carried out in different years over the past decade. Therefore, a more extensive and unified research project would be beneficial in providing an updated and comprehensive overview of the weight status of Italian adolescents.

Notably, some dietary habits correlate with weight status and overall health independently of MD adherence. For instance, in the study by Archero et al,[32] overweight and obesity were associated with unhealthy behaviors, such as skipping breakfast, low intake of fruits and vegetables, and high consumption of sugary beverages. These findings highlight the multifactorial nature of adolescent nutrition and the importance of evaluating specific food behaviors alongside overall dietary patterns. In this regard, 2 other studies assessed the correlation between adherence to MD evaluated with the KIDMED index and the MDS, respectively,[26,27] and the intake of various nutrients evaluated with a food-frequency questionnaire. The results show a direct correlation between adherence and the consumption of carbohydrates, fiber, fruit and vegetables,[26,27] and vitamins[27] and an inverse correlation with fast foods, snacks, and sugary drinks.[26]

Global research highlights gender differences in adolescent dietary habits that arise from physiological changes and sociocultural influences. Adolescent females often prioritize nutrient-rich foods due to health consciousness and body image concerns, while males tend to favor calorie-dense options driven by energy demands, peer influence, and marketing.[56,57] Considering sex differences in Italian early adolescents, no statistically significant difference was shown in males and females concerning adherence to MD, highlighting the need for further studies that critically compare the 2 groups.

Physical activity is another key factor closely linked to adolescents' health status. Most studies in this review provide strong evidence of lower adherence associated with insufficient physical activity. This is further supported on an international scale by another article from the HBSC study.[58] Here it is highlighted that the percentage of Italian adolescents engaging in moderate-to-vigorous physical activity is among the lowest in Europe (<15% for boys and <10% for girls). Additionally, Italian girls have one of the highest rates of physical inactivity. As Martino and colleagues report,[30] two-thirds of the participants in their study spent 5 or more hours per day engaging in sedentary activities, while 57.1% spent at least 3 hours daily watching television. Aligned with the findings of the HBSC study, girls are the most affected, exhibiting a higher prevalence of metabolic syndrome when less physically active.[30]

Sociodemographic and family contexts play another crucial role in shaping the nutritional status of adolescents in Italy. Factors such as socioeconomic status, family eating habits, and life setting significantly influence dietary choices and overall health. Grosso et al[26] highlight that rural areas tend to have a population with a lower socioeconomic status; however, adolescents in these areas exhibit a higher rate of normal weight and greater engagement in moderate-to-vigorous physical activity compared with those living in urban settings. The HBSC study further explores some of these factors, and reports similar findings. Moreover, it reveals that most participants do not consume fruit or vegetables daily, and a significant decline in breakfast consumption has been observed.[55] This is likely due to the limited availability of fast food and greater reliance on self-grown produce. In urban environments, increased access to facilities that promote sedentary behavior is counterbalanced by greater educational opportunities, which are often associated with improved nutritional knowledge. Therefore, conducting research across diverse settings is essential for developing effective educational interventions aimed at primary prevention.

Last, nutritional knowledge is another key factor influencing dietary habits, overall health, and quality of life. Although, to our knowledge, there are no studies associating nutrition knowledge with adherence to MD in the population of interest, Grosso and colleagues[59] evaluated this in adolescents living in rural areas of Sicily. Participants with a nutrition knowledge score in the lowest quartile had a lower fruit and vegetable consumption, along with a higher intake of sweets, fried

foods, and sugary drinks. Students exhibited higher nutrition knowledge scores when classified as underweight or normal weight, suggesting how unhealthy dietary habits may negatively contribute to weight status. Therefore, improving nutritional knowledge as part of educational programs could improve nutritional status in this population, positively contributing to their health status also in adult life.

CONCLUSION

This review highlights that adherence to the MD among Italian adolescents is shaped by a complex interplay of behavioral, familial, and environmental factors. Key influences include low levels of physical activity, weight status, family eating habits, socioeconomic background, and geographic location. Conversely, the variations based on gender and psychological well-being could assist in elucidating this trend. Further age-specific research is needed to gather more detailed data, particularly to investigate key factors such as family context, nutrition knowledge, and geographic area. The findings highlight the importance of region-specific and school-based programs that strengthen nutrition education, encourage regular physical activity, and foster supportive family and community environments to counteract the decreasing adherence to the MD diet in this age group.

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Conflicts of Interest

None declared.

Data Availability

This review did not produce new datasets. All data extracted and analyzed are derived from published articles, which are fully referenced in the manuscript.

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